

# CRS Report for Congress

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

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Andrew Feickert  
Specialist in National Defense  
Foreign Affairs, Defense, and Trade Division



Prepared for Members and  
Committees of Congress

# 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 to be the Army's major research, development, and acquisition program consisting of 18 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 with advanced, networked combat systems. 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 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 18 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 budgetary constraints are reportedly causing the Army to consider cancelling or deferring FCS systems in order to protect the overall program. The possibility that the Army may increase in size to help ease the strain of the wars in Iraq and Afghanistan might also impact on the funds available for modernization programs such as the FCS.

The FCS is experiencing a number of program development issues - with some technologies advancing quicker than anticipated, others progressing along predicted lines, while still others have experienced significant delays, often impacting other FCS-related programs. The 110<sup>th</sup> Congress, in its appropriation, authorization, and oversight roles may wish to review the FCS program in terms of its 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 which is at the heart of the Army's transformation efforts. It is to be the Army's major research, development, and acquisition program for the foreseeable future and is to consist of 18 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 with advanced networked combat systems. 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 so that FCS-equipped units can function as intended. 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:

- The FCS and the "Long War" against global terror;
- The operational impact of a scaled-back FCS program; and
- How a larger Army could affect the FCS program.

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, program systems and subsystems, as well as current program developmental progress, issues, 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.<sup>2</sup> 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>3</sup> in four days, a division in five days, and five divisions in 30 days.<sup>4</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>5</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>6</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. These seven brigade sized units,<sup>7</sup> known as both Interim Brigade Combat Teams (IBCTs) or

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<sup>2</sup> Many experts consider the Army's 1999 controversial Task Force (TF) Hawk deployment to Kosovo and Albania as the event that triggered the Army's transformation. Reportedly, the Army deployed a unit consisting of units from different divisions that had never trained together commanded by a command and control organization that was unable to conduct joint operations. The most often cited criticism was that it took more than 30 days to deploy TF Hawk, centered on 28 Apache attack helicopters, from bases in Germany to Albania; and, when they finally arrived, they were unable to conduct combat operations due to training and equipment deficiencies. The task force also consisted of mechanized maneuver and support elements competing for limited air lift insertion capabilities.

<sup>3</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>4</sup> Frank Tiboni, "Army's Future Combat Systems at the Heart of Transformation," *Federal Computer Week*, Feb. 9, 2004.

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

<sup>6</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>7</sup> The Army currently plans to field six active and one National Guard Stryker Brigade Combat Teams.



Stryker Brigade Combat Teams<sup>8</sup> (SBCTs), are currently being fielded and some have served in Iraq — with the last brigade due to be fielded in 2007.<sup>9</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>10</sup> In order to initiate the FCS program, General Shinseki turned to the Defense Advanced Research Projects Agency (DARPA), not only because of their 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' 18 systems. On May 14, 2003, the Defense Acquisition Board<sup>11</sup> (DAB) approved the FCS' 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>12</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.

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<sup>8</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>9</sup> Annex A (modular Conversion) to Army Campaign Plan, Change 2, September 30, 2005, p. A-1.

<sup>10</sup> The following description of the early stages of the FCS program is taken from Frank Tiboni's *Army's Future Combat Systems at the Heart of Transformation*.

<sup>11</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>12</sup> Information in this section is taken from the Army's official FCS website [<http://www.army.mil/fcs/factfiles/overview.html>].

FCS would include the following:

- Unattended ground sensors (UGS);
- Non-Line-of-Sight Launch System (NLOS-LS) and Intelligent Munitions System (IMS);
- Four classes of unmanned aerial vehicles (UAVs), which will be organic to platoon, company, battalion,<sup>13</sup> and other echelons;
- Three classes of unmanned ground vehicles (UGVs): the Armed Robotic Vehicle (ARV), the Small Unmanned Ground Vehicle (SUGV), and the Multifunctional Utility/Logistics and Equipment Vehicle (MULE);
- Eight types of manned ground vehicles;
- The network; and
- 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-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**.

## FCS Program Timeline

FCS is currently moving towards the System of Systems Preliminary Design Review (PDR) in 2008.<sup>14</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>15</sup> FCS program leadership maintains that the program is out of the conceptual phase and is focusing on designing, building, integrating, and testing FCS

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<sup>13</sup> According to Army Pamphlet 10-1, *Organization of the United States Army*, 1994, a battalion/squadron (an equivalent sized cavalry organization) consists of from 300 to 1,000 soldiers and is commanded by a lieutenant colonel, a company, battery (an equivalent sized artillery organization), or troop (an equivalent sized cavalry organization) consists of from 62 to 190 soldiers and is commanded by a captain, and a platoon consists of 16 to 44 soldiers and is led by a lieutenant.

<sup>14</sup> Ann Roosevelt, "FCS Program Leaves PowerPoint Behind, Moves Toward PDR," *Defense Daily*, Aug. 16, 2006.

<sup>15</sup> "Glossary of Defense Acquisition Acronyms and Terms," Defense Acquisition University, Fort Belvoir, Virginia, 12<sup>th</sup> ed., July 2005, p. B-121.



subsystems.<sup>16</sup> According to the Army, FY2007 program activities will focus on a variety of platform-level design reviews, which are intended to support the System of Systems PDR in FY2008.<sup>17</sup>

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

### FCS Program Schedule

Event	Date (FY)	Event description
Preliminary Design Review	2008	A technical review to evaluate the progress and technical adequacy of each major program item. It also examines compatibility with performance and engineering requirements. (Part of SDD Phase)
Critical Design Review	2010	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. (Part of SDD Phase).
Design Readiness Review	2011	Evaluates design maturity, based on the number of successfully completed system and subsystem design reviews. (Part of SDD Phase).
Milestone C	2012	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, Virginia, 12<sup>th</sup> ed., July 2005.

<sup>16</sup> Ann Roosevelt.

<sup>17</sup> Ibid.

**Program Schedule Concerns.** The Government Accountability Office (GAO) has been a significant participant in the FCS program since its inception. One of GAO's continuing concerns is that under the current program schedule, the actual performance of the completely integrated FCS will be demonstrated very late in the program and could result a significant cost increase. According to GAO, the Critical Design Review ideally should occur in the FCS program in 2008 in order to "confirm that the design is stable enough to build production representative prototypes for testing."<sup>18</sup> GAO notes that the FCS Critical Design Review instead occurs in 2010 which is only two years before the Army decides on whether or not to enter into production and that the Army does not expect to conduct a preliminary demonstration of all the elements of FCS until sometime in 2013 — one year after the production decision.<sup>19</sup> GAO maintains that the Army's current program schedule makes FCS susceptible to "late cycle churn" whereby problems discovered through testing late in a product's development cycle result in significant investments in additional time, effort, and funds to overcome the problem — a phenomenon that GAO notes "is a fairly common occurrence" in DOD programs.<sup>20</sup>

**The Army's View.** The Army does not share GAO's concerns about the program's schedule. FCS program officials maintain that "every single one of our critical technologies is on track to its maturation plan," and that "most of them have already reached and exceeded their targeted maturity level and the remaining are all on track to be complete prior to our system of systems PDR."<sup>21</sup> The Army also contends that the FCS program is on schedule and about one percent under budget.<sup>22</sup> While these claims may be accurate, some observe that they have little bearing on GAO's concerns about the potential for "late cycle churn."

## 2006 FCS Program Developments<sup>23</sup>

FCS program officials assert that the program faced and passed a number of significant program milestones in 2006. Some of these developments are examined in the following sections:

**FCS Evaluation Brigade Combat Team.** In 2006 the Army announced that the FCS Evaluation Brigade Combat Team (EBCT) would begin to form at Ft.

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<sup>18</sup> Government Accountability Office, *Future Combat Systems Challenges and Prospects for Success*, GAO-05-442T, Mar. 16, 2005, p. 2.

<sup>19</sup> Ibid.

<sup>20</sup> Ibid.

<sup>21</sup> Ann Roosevelt.

<sup>22</sup> Jefferson Morris, "FCS Performing on Time, Slightly Under Budget, Officials Say," *Aerospace Daily & Defense Report*, June 20, 2006 and Chris Roberts, "Army Modernization Program on Schedule, Officials Say," *El Paso Times*, Aug. 16, 2006.

<sup>23</sup> Unless otherwise noted, information in this section is taken from Scott R. Gourley, "Programmed for Success: FCS Advances Towards Historic Milestones in 2006," *Jane's International Defence Review*, October 2006, pp. 73-81.

Bliss, TX in March 2007. This 3,5000-soldier brigade was to have been built from the 1<sup>st</sup> Armored Division, but in early 2007, because of additional requirements for troops in Iraq, the Army decided instead to build the evaluation brigade on an ad-hoc basis.<sup>24</sup>

In the spring of 2007, the Army expects to begin fielding radios that will be installed in Abrams tanks, Bradley fighting vehicles, and Humvees, and unattended ground sensors. The Army plans to use the EBCT until 2016 to evaluate FCS technologies prior to those technologies being fielded to the operational force.<sup>25</sup>

**Joint Expeditionary Force Experiment (JEFX) 06.** In April 2006, the U.S. Air Force sponsored JEFX 06 at Nellis Air Force Base, Nevada which was designed to test network-centric communications and targeting technologies. JEFX 06 employed FCS Unattended Ground Sensor prototypes and a number of Humvee surrogates replicating FCS command and control vehicles.<sup>26</sup> The sensors and FCS surrogate vehicles were used to relay targeting information to Air Force aircraft. FCS program officials maintain that JEFX 06 demonstrated the improved situation awareness of the FCS network and the ability to more effectively engage time-critical ground targets.

**Engineering Reviews.**<sup>27</sup> In May 2006, the FCS program underwent a Defense Acquisition Board review in which, reportedly, all program objectives were met, although few details about the review have been made public. A number of platform-level System Functional Reviews<sup>28</sup> (SFRs) were completed in 2006 for the following platforms:

- Manned Ground Vehicles (MGVs);
- Class I and IV Unmanned Aerial vehicles (UAVs);
- Small Unmanned Ground Vehicle (SUGV);
- Multifunctional Utility/Logistics and Equipment Vehicle (MULE);
- Unattended Ground Sensors (UGS); and

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<sup>24</sup> From discussions with the Army Staff G-8 Office, January 12, 2007.

<sup>25</sup> Chris Roberts, "Bliss Brigade Will Test New Equipment for Future Use," *El Paso Times*, Aug. 16, 2006.

<sup>26</sup> Scott R. Gourley, "US Holds Landmark FCS Field Experiment," *Jane's International Defense Review*, July 2006.

<sup>27</sup> Unless otherwise noted, information in this section is taken from Scott R. Gourley, "Programmed for Success: FCS Advances Towards Historic Milestones in 2006," *Jane's International Defence Review*, October 2006, pp. 73-81.

<sup>28</sup> According to the Defense Acquisition Acronyms and Terms Glossary published by the Defense Acquisition University, a System Function Review (SFR) is conducted to demonstrate the achievability of system requirements and readiness to initiate preliminary design.

- Non-Line-of-Sight Launch System (NLOS-LS) and Intelligent Munitions System (IMS).

Program officials note that these aforementioned platforms, having completed their respective SFRs are now in the preliminary design phase of their development. In August 2006, the FCS program conducted an Initial Preliminary Design Review, which incorporated information from the earlier platform-level System Functional Reviews.

## Program Developmental Issues

The FCS program is comprised of a myriad of core and associated programs, each progressing in its own unique manner. Some programs are exceeding or meeting expectation, while others are experiencing difficulties. Some of the more notable ongoing programs are examined in the following sections.

**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 designed so that it can 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 it never the less is 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>29</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>30</sup>

On January 5, 2006, the JTRS Cluster Two hand-held radio reportedly received Software Communications Architecture (SCA) approval from the U.S. National Security Agency (NSA) which clears the way to begin full-rate production of the radio, which was originally expected to have begun in the first quarter of 2005.<sup>31</sup> In September 2006, the Airborne and Maritime/Fixed Station JTRS began a series of preliminary design reviews between Boeing and Lockheed Martin, with the

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<sup>29</sup> Government Accountability Office, Defense Acquisitions: Restructured JTRS Program Reduces Risk, but Significant Challenges Remain, GAO-09-955, September 2006, p. 4.

<sup>30</sup> Ibid., p. 1.

<sup>31</sup> Jane's International Defense Review, "U.S. Government Certifies Cluster 2 JTRS," February 2006, p. 17.

expectation of a contract award for the radio in the March 2007 timeframe.<sup>32</sup> The JTRS Program Executive Office (PEO) is scheduled to renegotiate its contract for the JTRS Ground Mobile Radio (GMR) - formally known as JTRS Cluster One - by early 2007.<sup>33</sup> The JTRS GMR is considered a key component of the FCS program as it is intended to be used in the FCS Manned Ground Vehicles (MGVs). The JTRS GMR program has experienced numerous developmental problems and delays in the past, resulting in a stop-work order from the U.S. government to Boeing - the radio's developer.<sup>34</sup> This order was later rescinded and work has continued on a scaled-back version of the radio.

**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>35</sup> WIN-T, reportedly expected to cost approximately \$14.2 billion, is intended to permit the Army to communicate and transfer large amounts of data on the move.<sup>36</sup> The Army has restructured the WIN-T program, due in part to delays in associated programs such as JTRS-GMR, the changing needs of the FCS program, and funding issues.<sup>37</sup> Given this restructuring, the WIN-T program is described as being "on a strategic pause" largely due to delays in other programs.

Because of this program delay, some suggest that industry may press ahead and develop and field some of WIN-T's more mature technologies instead of waiting from four to six years for the JTRS-GMR program to "catch up." As an example, some industry officials believe that a high band-width, on-the-move, networking system will be ready for deployment in the near future. While this could have near-term benefits for the operational Army, some are concerned that deploying WIN-T technologies "piecemeal" could endanger the overall WIN-T program. Past program delays to the 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.

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<sup>32</sup> Ann Roosevelt, "Boeing AMF JTRS Program Begins Series of PDRs," *Defense Daily*, Vol. 231, No. 58, Sept. 27, 2006.

<sup>33</sup> Jen DiMascio, "Government, Boeing in Process of Renegotiating Key Joint Tactical Radio System Contract," *Defense Daily*, Vol. 231, No. 79, Oct. 26, 2006.

<sup>34</sup> *Ibid.*

<sup>35</sup> Scott Nance, "Analyst: Advanced Networks to be Rumsfeld Legacy," *Defense Today*, Volume 26, Number 233, p. 3.

<sup>36</sup> "Army Restructures WIN-T to Meet Future Combat System Requirements," *Inside the Army*, July 3, 2006.

<sup>37</sup> Information in this section is taken from "Army Restructures WIN-T to Meet Future Combat System Requirements," *Inside the Army*, July 3, 2006 and Stephen Trimble, "WIN-T Faces Being Usurped by Spin-Offs," *Jane's Defence Weekly*, Nov. 1, 2006.



**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. 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.<sup>38</sup> The report further contends that the Army is 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 are suffering casualties because of this decision.<sup>39</sup>

The Army contends that it is not favoring Raytheon - whom the Army calls part of their "Best of Industry Team"<sup>40</sup> - over the Trophy system.<sup>41</sup> The Army maintains 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. 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 is now knocking down live warheads during testing.

#### **Systems of Systems Common Operating Environment (SOSCOE).**<sup>42</sup>

The first major software build for SOSCOE - the software "middleware toolkit" that will enable all FCS platforms to talk and interact - completed a major qualification test on December 15, 2006 and Build 1.0.8.0 was released for FCS program use. The next release, Build 2.0.0.0, is scheduled for release in December 2007.

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<sup>38</sup> Adam Ciralsky and Lisa Meyers, "Army Shuns System to Combat RPGs," MSNBC.com, Sept. 5, 2006.

<sup>39</sup> Ibid.

<sup>40</sup> Army FCS 2006 Briefing, September 7, 2006.

<sup>41</sup> Information in this section is taken from Michael Fabey, "Anti-RPG Systems for Vehicles Still Undeployable, Army Says," *Aerospace Daily & Defense Report*, Sept. 11, 2006; Jen DiMascio, "Army Defends Decision to Bypass Trophy Active Protection System," *Defense Daily*, Vol. 231, No. 46, Sept. 11, 2006; Nathan Hodge, "Army Touts Progress on APS," *Jane's Defence Weekly*, Sept. 20, 2006, p. 10; and Nathan Hodge, "The Future of Heavy Armour - Weight Watching," *Jane's Defence Weekly*, Oct. 4, 2006.

<sup>42</sup> Information in this section is taken from Ann Roosevelt, "FCS Team Completes Software Test, Delivery," *Defense Daily*, Vol. 231, No. 116, Dec. 22, 2006.



**Non-Line-of-Sight Cannon (NLOS-C).**<sup>43</sup> The Army and BAE Systems reported that the Non-Line-of-Sight Cannon (NLOS-C) platform has completed its prototype development and its first firing trials were conducted in October 2006, supposedly one month ahead of schedule. The NLOS-C is one of eight planned FCS manned ground vehicles (MGVs) and is intended to provide long-range automated artillery support to FCS brigade combat teams. BAE Systems is expected to deliver eight pre-production NLOS-C systems to the Army by 2008.

## **FCS Program Budget**

The FCS program budget has risen steadily since 1999 as the program has evolved. DOD asked for \$3.745 billion in FY2007 for FCS Research, Development, Testing and Evaluation (RDT&E) and anticipates \$22.4 billion RDT&E from FY2007-FY2011 (Future Years Defense Plan - FYDP).<sup>44</sup>

**FY2007 National Defense Authorization Act (PL 109-364).** The FY2007 Defense Authorization Act (PL 109-364) authorizes \$3.495 billion for FCS RDT&E - approximately \$ 250 million less than the budget request.<sup>45</sup> WIN-T funding was also decreased by \$ 30 million from the FY2007 budget request of \$ 158 million.<sup>46</sup> The FY2007 Defense Authorization Act calls for a number of FCS-related provisions.

**FCS Milestone Review.** Section 214 of PL 109-364 requires the Secretary of Defense to conduct an FCS milestone review no later than 120 days after the completion of the FCS preliminary design review (currently scheduled for FY 08). In addition to assessing how FCS will meet Combatant Commander's needs and if the program can be developed and produced within existing resources, the congressionally-mandated milestone review is to recommend whether the program should continue as currently structured; continue as a restructured program; or be terminated. Until this milestone review is submitted to Congress, FY2009 FCS procurement funds may not be obligated, except for those funds needed to insert new technologies into the current force or funds designated for the Non-Line-of-Sight Cannon (NLOS-C).

**Bridge to the Future Networks Program.** Section 114 of PL 109-364 places a limit of no more than 75 percent of the amount authorized to be appropriated for FY2007 for the Army-designated Bridge to Future Networks program. This limit will remain in place until the Secretary of the Army submits a report to congressional

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<sup>43</sup> Information in this section is taken from Nathan Hodge, "Army to Unveil Cannon Platform" Jane's Defence Weekly, Sept. 27, 2006, p. 14 and Christopher F. Foss, "NLOS-C FP Begins Firing Trials," Jane's Defence Weekly, Nov. 8, 2006, p. 8.

<sup>44</sup> FY2007 Department of Defense Budget Briefing, February 6, 2006, p. 6.

<sup>45</sup> House Armed Services Committee Press Release, "House and Senate Conferees Approve the Conference Report for the National Defense Authorization Act for Fiscal Year 2007," September 29, 2006.

<sup>46</sup> Conference Report, John Warner National Defense Authorization Act for FY 2007, Report 109-702, September 29, 2006, p. 572.

defense committees on the analysis of the integration of the Joint Network Node (JNN) and the Warfighter Information Network-Tactical (WIN-T).

***Comptroller General Report on the Contract for the FCS Program.***

Section 115 of PL 109-364 requires the Comptroller General of the United States to submit a report to the congressional defense committees no later than March 15, 2007 on the participation and activities of the FCS program lead systems integrators [Boeing and SAIC]. This report is to assess how Boeing's and SAIC's lead systems integrator roles differ from those of other lead systems integrators involved in DOD programs; how the FCS lead systems integrators meet the Army's goals; and the mechanisms in place to protect U.S. interests and mitigate conflicts of interest with respect to competition for FCS subcontracts.

***Report on Vehicle-Based Active Protection Systems for Certain***

***Battlefield Threats.*** Section 234 of PL 109-364 requires the Secretary of Defense to select a non-U.S. government entity to conduct an assessment of foreign and domestic technological approaches to vehicle-based active protection systems (APS). This report is to be submitted to congressional defense committees no later than April 17, 2007 and is to include a detailed comparative analysis of these technical approaches. This comparative analysis is to include the feasibility, military utility, cost, and potential short-term and long-term development and deployment schedule of these approaches.

**Budget-Driven FCS Program Changes.** Reports suggest that the Army is modifying the FCS program reportedly due to congressional budget cuts, fiscal guidance from the Department of Defense requiring the Army to eliminate \$25 billion from its budget between FY2008 and FY2013, and other anticipated future demands on the Army's budget.<sup>47</sup> According to the Army, two types of unmanned aerial vehicles (UAVs) -Class II and III -were cut from the program and two versions of the Armed Robotic Vehicle (ARV) are being deferred.<sup>48</sup> This change would result in 14 platforms and the FCS network as opposed to the previous 18 platforms. The Army cancelled the Intelligent Munitions System (IMS) program as it pertained to FCS but would continue to produce enough IMS to meet landmine treaty obligations. The Army also terminated its Land Warrior program, scheduled to make its operational debut in the summer of 2007 in Iraq. The Army will also modify some of the FCS system quantities that it intends to buy to fill capability gaps resulting from cancelling or deferring programs. These program changes could supposedly save the Army over \$3.3 billion dollars over fiscal years 2008 to 2013.

The Army also plans slow the fielding of its 15 FCS brigades to one FCS-equipped brigade per year for 15 years, starting in 2015. The Army would continue

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<sup>47</sup> Information in this section is taken from Jen DiMascio, "Army Mulls Cutting a Division, FCS," InsideDefense.com, June 13, 2006; Jen DiMascio, "Army May Adjust Future Combat System Program," *Defense Daily*, Vol. 231, No. 103, Dec. 5, 2006; "Army Proposes Major FCS Cut, Land Warrior Kill," InsideDefense.com, Dec. 6, 2006; and Tony Capaccio, "Army's Six-Year Plan May Hit SAIC," *San Diego Union-Tribune*, Dec. 6, 2006.

<sup>48</sup> From discussions with the Army Staff G-8 Office, January 12, 2007.

to “spin out” FCS technologies to the operational force as originally planned although the composition and perhaps timing of these “spin outs” would be modified. Reports maintain that the Army will reduce the number of spin outs from four to three and would provide FCS technologies to six modular BCTs per year.<sup>49</sup>

**Changes to the “Spin Outs.”** According to the Army, the first FCS technology “spin out” is scheduled for FY2010.<sup>50</sup> In addition to providing selected FCS technologies to operational Army units, the Army might also these technologies to Marine Corps regiments and Special Operations Forces (SOF). This first technology spin out is scheduled to include the Non-Line- of- Sight Launcher System (N-LOS), Urban and Tactical Unattended Ground Sensors (UGS), and selected FCS network capabilities. Future spins outs might also include the Active Protective System (APS), Class I UAVs; Small Unmanned Ground Vehicles (SUGVs); and the full FCS network.

**Impact of Increasing the Size of the Army.** It is expected that the Army will be authorized to increase its endstrength after senior Army leadership recently stated that “thousands more” active duty troops are required or the force [Army] “will break.”<sup>51</sup> One proposal is that the temporary 30,000 soldier increase authorized by Congress (P.L. 108-375 and P.L. 109-163) would be made permanent and that 30,000 additional troops would be added over the next five years, resulting in a 542,000-soldier active duty Army by 2012.<sup>52</sup> Recent reports suggest that the Secretary of Defense wants to increase the strength of the active Army by 65,000.<sup>53</sup> The costs of this potential 60,000-plus soldier expansion has been estimated at \$1.2 billion dollars in personnel costs annually for every 10,000 soldiers added and an additional \$2 billion dollars to equip every 10,000-soldier increment.<sup>54</sup>

The Army has resisted past attempts to permanently increase its endstrength suggesting that “it would consider cutting troop strength in order to protect funding for modernization programs such as FCS.”<sup>55</sup> It has long been the Army’s position that modernization funds must not be used to fund personnel increases and Army leadership has implored Congress to fully fund the costs associated with endstrength

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<sup>49</sup> Ann Roosevelt, “Army Directs Cuts, Adjustments to FCS,” *Defense Daily*, Vol. 233, No. 11, January 19, 2007, p. 2.

<sup>50</sup> Information in this section is taken from “Army Transformation” Army G-8 Section, January 8, 2007, p. 14.

<sup>51</sup> Associated Press, “Army Chief Wants More Troops,” MSNBC.com, December 14, 2006.

<sup>52</sup> Damien Cave and Thom Shanker, “With Bigger Army, a Bigger Task for Recruiters,” *New York Times*, Dec. 24, 2006.

<sup>53</sup> Jason Sherman and Ashley Roque, “Gates Announces Plans for 92,000 More Ground Troops,” InsideDefense.com, Jan. 11, 2007.

<sup>54</sup> Damien Cave and Thom Shanker.

<sup>55</sup> Jonathan Karp, Andy Pasztor, and Greg Jaffe, “Pentagon Weighs Personnel Cuts to Pay for Weapons,” *Wall Street Journal*, Dec. 5, 2005; and Megan Scully, “Army Poised to Cut Guard Troops to Protect Core Program,” *National Journal’s CongressDaily AM*, Dec. 6, 2005.

increases. Recent reports suggest that Congress may be supportive of the Army's position of funding troop increases without cutting back on modernization programs.<sup>56</sup> Even if there is support to fully fund personnel increases and Army modernization, given current and projected budgetary constraints facing the Department of Defense and the Army, some might view the FCS program as a source of funding for potential Army endstrength increases.

**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>57</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 over \$300 billion.<sup>58</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>59</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>60</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>61</sup> Some maintain that this wide disparity in FCS cost estimates five years into the program has resulted in a lack of confidence that the FCS program can be conducted in a cost-efficient manner.

## Issues for Congress

### The Relevancy of FCS in the "Long War"

Congress might decide to examine the relevancy of FCS in the "Long War" against global terrorism. The concept for FCS originated in the late 1990s when the Army was focused on developing a more deployable and lethal Army that could operate in environments ranging from major theater wars (MTW) to small-scale contingencies (SSCs). According to the Army, SSCs include:

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<sup>56</sup> Michael Bruno, "HASC Members Set Stage for More Military Spending," *Aerospace Daily & Defense Report*, Jan. 9, 2007.

<sup>57</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>58</sup> Megan Scully, "Army Sticks to its Guns, Rejects New FCS Cost Estimates," *National Journal's Congress Daily AM*, July 13, 2006.

<sup>59</sup> *Ibid.*

<sup>60</sup> "The Army's Future Combat Systems Program and Alternatives," A CBO Study, August 2006, p. xii.

<sup>61</sup> Ann Roosevelt, "Army Calls CBO's FCS Report Seriously Flawed," *Defense Daily*, Vol. 231, No. 52, Sept. 19, 2006.

- Strikes and other limited intervention;
- Noncombatant evacuation operations (NEOs);
- Counterdrug operations;
- Shows of force;
- Maritime sanction and “no fly” enforcement;
- Peace accord implementation and other forms of peacekeeping; and
- Support for humanitarian operations and disaster relief (e.g., preventative deployments).

Notably absent from this list are counterinsurgency or counterterrorism operations, that have come to characterize the “Long War.” While the FCS program has evolved since the late 1990s, the 18 FCS manned and unmanned systems and the FCS network have been a constant fixture in the program. It appears that there has been little or no change in these platforms or FCS unit organization that might better address the demands of counterinsurgency or counterterrorism, calling into question what roll, if any FCS-equipped units would play in the “Long War.”

The 2006 Quadrennial Defense Review (QDR), which discusses at great length what is needed to “fight the Long War,”<sup>62</sup> makes only a passing reference to FCS, noting that FCS improvements should be incorporated into the modular force.<sup>63</sup> The Army’s most current doctrine related to fighting the “Long War” - Field Manual 3-24, Counterinsurgency, published in December 2006 - makes no mention of the Future Combat System or what role these units could potentially play in operations. Field Manual 3-24 notes that units such as dismounted infantry and civil affairs “have capabilities particularly relevant” to counterinsurgency operations.<sup>64</sup> Some analysts maintain that if FCS embodied capabilities that were relevant to fighting the “Long War” that FCS would have been featured more prominently in these key national security documents.

### **What Are The Impacts of a Scaled-Back FCS Program ?**

With reports suggesting that the Army may eliminate or defer two of its four FCS-related Unmanned Aerial Vehicle (UAV) programs, both versions of the Armed Robotic Vehicle (ARV), and perhaps the Land Warrior program - which originated in 1991 - Congress might explore how these and possibly other program changes will impact the operational capability of FCS brigade combat teams. In the case of UAVs, in addition to the surveillance function, UAVs are intended to provide beyond-line-of-sight targeting information for FCS indirect fire systems and provide aerial retransmission capabilities for the FCS network. The ARVs are intended to conduct direct fire and reconnaissance missions that might be too dangerous for

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<sup>62</sup> Department of Defense, Quadrennial Defense Review Report, February 6, 2006, p. 9.

<sup>63</sup> Ibid., p. 43.

<sup>64</sup> Field Manual (FM) 3-24, Counterinsurgency, Headquarters Department of the Army, December 2006, p. 2-5.



manned FCS MGVs to undertake. The possible cancellation of the Land Warrior program after almost 16 years of development could degrade the linkage between dismounted soldiers and the FCS network. The operational impacts of these and other potential changes should be well understood as well as their impact on the FCS program schedule and funding requirements.

## **How Will a Larger Army Affect the FCS Program?**

Many believe that the Army might eventually grow by 65 thousand soldiers and some believe that it could grow even larger. With this growth will come a requirement for significant additional funding. The Army reportedly believes that this larger force will be fully paid for by means of a significant budget increase.<sup>65</sup> Others suggest, however, that while much of this increase will be funded by means of additional resources, that the Army will not receive all of the funds that they believe they will require and will have to come up with additional funds by other means - such as program cuts.

These potential resourcing scenarios raises issues for congressional consideration. If the Army personnel increases are fully funded and program cuts are not required, the Army could conceivably revise FCS program requirements, reflecting the needs of a larger Army. The Army might request more FCS brigades than the current planned 15 FCS-equipped brigade combat teams. Even if the Army does not ask for additional FCS-equipped brigade combat teams, it is high likely that additional FCS equipment, particularly FCS communications and networking systems, will be required to integrate new combat formations into the existing Army force structure. Both possibilities will likely require fairly significant changes to the FCS program as well as the requirement for additional funds.

In the event that potential Army personnel increases are not fully funded, the Army might be compelled to modify the FCS program in order to free up funds to pay for troop increases. Such program changes could have a detrimental impact on the FCS program - forcing either significant program delays, the termination of FCS programs, or equipping fewer brigade combat teams with FCS technologies. In the event the Army modifies the FCS program, the operational ramifications of any proposed changes should be examined in detail to insure that the FCS program can still meet it's goal of being "as good as or better than" the Army's current force in terms of "lethality, survivability, responsiveness and sustainability."

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<sup>65</sup> Jason Sherman, "Pentagon Expecting Huge Budget Increase to Pay for Larger Army, Marine Corps," *InsideDefense.com*, Jan. 4, 2006.



## **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>66</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-mounted long-range, electro-optical infra-red sensor, sensors for radio

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<sup>66</sup> Information for these descriptions are taken from two Army sources: The Army's *FCS 18+1+1 White Paper*, dated Oct. 15, 2004 and the *FCS 2005 Flipbook*, dated Aug. 26, 2004.

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>67</sup>

Each FCS-equipped brigade is to have almost 200 UAVs ranging from small, platoon-level vehicles to larger, higher endurance aircraft.<sup>68</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>67</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 Oct. 15, 2004 and the *FCS 2005 Flipbook*, dated Aug. 26, 2004.

<sup>68</sup> Sandra I. Erwin, “Army to Field Four Classes of UAVs,” *National Defense*, Apr. 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 II UAVs.** Class II UAVs are intended to provide RSTA at the company level. The Class II UAV is to be vehicle mounted and have a vertical takeoff and landing capability. Its planned distinguishing capability is that it can designate targets both day and night and in adverse weather at a distance of 2 kilometers from the UAV, enabling the company commander to employ line-of-sight, BLOS, and NLOS fires. It can also provide limited communications relays. Class II UAVs are intended to have an endurance of 120 minutes over a 16 kilometer area and an 11,000 foot maximum ceiling.

**Class III UAVs.** Class III UAVs are to be multifunctional systems intended to be employed at the battalion level. A Class III UAV encompasses all capabilities found in the Class I and II UAVs and are planned to also provide an enhanced communications relay capability, mine detection, chemical, biological, radiological, and nuclear detection, and meteorological survey. The Class III UAV is to be able to take off and land without a dedicated airfield and is intended to be able to stay aloft for 6 hours over a 40 kilometer area with a maximum ceiling of 12,000 feet.

**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>69</sup>

**Armed Robotic Vehicle (ARV).** The ARV is intended to come in two variants — the Assault variant and the Reconnaissance, Surveillance, and Target Acquisition (RSTA) variant. The two variants are 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. The RSTA version is to have similar capabilities but is not intended to provide direct support fire to mounted or dismounted troops.

**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

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<sup>69</sup> Unless otherwise noted, information for these descriptions are taken from two Army sources: The Army's *FCS 18+1+1 White Paper*, dated Oct. 15, 2004 and the *FCS 2005 Flipbook*, dated Aug. 26, 2004.

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.

### **Unattended Ground Sensors (UGS)<sup>70</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) and Intelligent Munitions System (IMS).**

**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.

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<sup>70</sup> Ibid.

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.

**IMS.** IMS is intended to be an unattended munitions system, consisting of a variety of lethal and non-lethal munitions and can be used for filling gaps, isolating enemy forces or objectives, and controlling non-combatant movement with nonlethal munitions. IMS is to have an on-off capability and can be recovered and re-employed if not used. It can also self destruct if required and is to have an anti-tamper capability. IMS is eventually intended to replace most current U.S. anti-personnel mines.

## The Network<sup>71</sup>

The FCS network is considered the most crucial system of all 18 systems and, according to the CSA, General Schoomaker, “the toughest part of the program will be assembling the network that ties the system of systems together.”<sup>72</sup> 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.

**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.

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<sup>71</sup> Ibid.

<sup>72</sup> “House Moves to Double Stryker Budget in Effort to Help Reset the Force,” *Inside the Army*, June 21, 2004.



**Situation Understanding.** This consists of 10 different packages that allow the user to better comprehend their 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.

## **The Soldier**

All dismounted soldiers are to wear the Land Warrior combat ensemble, which includes enhanced body protection, an embedded computer/communication system, and a family of new personal weapons.