Congressional Research Service
Informing the legislative debate since 1914

The Joint Tactical Radio System (JTRS) and the Army's Future Combat System (FCS): Issues for Congress

November 17, 2005

Congressional Research Service
https://crsreports.congress.gov
RL33161

CRS REPORT
Prepared for Members and
Committees of Congress

Summary

The Joint Tactical Radio System (JTRS) is a Department of Defense (DOD) program that would play a significant role in the U.S Army's proposed Future Combat System (FCS) program. (For a more detailed description of the FCS program see CRS Report RL32888, *The Army's Future Combat System(FCS): Background and Issues for Congress*, by Andrew Feickert.) JTRS, envisioned as a family of software programmable radios, has been described as the "backbone" of the FCS and is intended to link the 18 manned and unmanned systems that would constitute FCS. Two JTRS sub-programs managed by the Army—Cluster One and Cluster Five—have experienced developmental difficulties, delays, and cost overruns which calls into question their viability. This report will be updated on a periodic basis.he Joint Tactical Radio System (JTRS) is a Department of Defense (DOD) program that would play a significant role in the U.S Army's proposed Future Combat System (FCS) program. (For a more detailed description of the FCS program see CRS Report RL32888, *The Army's Future Combat System(FCS): Background and Issues for Congress*, by Andrew Feickert.) JTRS, envisioned as a family of software programmable radios, has been described as the "backbone" of the FCS and is intended to link the 18 manned and unmanned systems that would constitute FCS. Two JTRS sub-programs managed by the Army—Cluster One and Cluster Five—have experienced developmental difficulties, delays, and cost overruns which calls into question their viability. This report will be updated on a periodic basis.

Contents

Background 1
Current Issues 2
Developmental 2
Experimentation and Spin Out One 6
Experimentation 6
Spin Out One 7
Program Restructuring 8
Program Budget Issues 8
Recent Congressional Actions 9
Issues for Congress 10
The Viability of the Cluster One Program 10
Security 11
JTRS Alternatives 12

Tables

Table 1. JTRS Clusters 1
Table 2. Army JTRS Senate-Recommended Adjustments—FY2006 Defense Appropriations 9
Table 3. Army JTRS House-Recommended Adjustments—FY2006 Defense Appropriations 10

Contacts

Author Information 12

Background

The JTRS program originated in the mid-1990s and was intended to replace the 25 to 30 families of radio systems used by the military—many of which could not communicate with each other—with software-based radios that could operate across the entire radio frequency spectrum.[1] JTRS is intended to permit the Services to operate together in a "seamless" manner via wireless voice, video, and data communications through all levels of command, including direct access to near real-time information from airborne and battlefield sensors.[2] Described as a "software-defined radio" JTRS is envisioned to function more like a computer than a conventional radio and is to be upgraded and modified to operate with other communications systems by the addition of software as opposed to redesigning hardware - a more costly and time-consuming process. DOD also asserts that in "many cases, a single JTRS radio with multiple waveforms[3] can replace many separate radios, simplifying maintenance" and that because JTRS is "software programmable, they will also provide a longer functional life"[4] with both features offering potential long-term cost savings. It is also planned that JTRS will be interoperable with current DOD radio systems, the Pentagon's Global Information Grid,[5] and the communications systems of selected allied nations.[6]

JTRS has been characterized by the Army as a key complementary enabler of the FCS network that would enable FCS sensors and combat systems to acquire and engage targets at a distance as well as preventing them from being engaged by enemy systems.[7] To a significant extent, the Army has linked progress in the development of a number FCS subsystems to progress in the JTRS program.

The JTRS program was originally broken into five "clusters' with each cluster having a particular Service "lead."

Table 1. JTRS Clusters

Cluster	One	Two	Three	Four	Five
Description	Ground Vehicle and Helicopter Radios	Hand-Held Radios	Fixed Site and Maritime Radios	High Performance Aircraft (Fixed Wing) Radios	Handheld, Dismounted, and Small Form Factor[a] Radios
Service Lead	U.S. Army	U.S. Special Operations	U.S. Navy	U.S. Air Force	U.S. Army

[1] Peter A. Buxbaum, "Jitters Over JTRS," Armed Forces Journal, July 2005, p. 31.

[2] United States Government Accountability Office (GAO), Report to the Chairman, Committee on Appropriations, House of Representatives, "Defense Acquisitions: Resolving Developmental Risks in the Army's Networked Communications Capabilities is Key to Fielding Future Force," GAO-05-669, June 2005, p. 9.

[3] Waveforms are defined as software applications that determine the total functionality of the radio from the user's perspective.

[4] DOD Pamphlet on JTRS published by the JTRS Joint Program Office, undated.

[5] The National Security Agency defines the Global Information Grid as "a net-centric system operating in a global context to provide processing, storage, management, and transport of information to support all DOD, national security, and related Intelligence Community missions and functions (strategic, operational, tactical, and business) in war, in crisis, and in peace."

[6] Buxbaum, pp. 31-33.

[7] Ibid.

Cluster	One	Two	Three	Four	Five
		Command (USSOCOM)			

a. Form factor radios are essentially miniaturized radios that soldiers would carry, as well as radios for weight and power-constrained platforms—such as FCS Unattended Ground Sensors and Intelligent Munitions.

In early 2004, DOD merged Clusters Three and Four into a single program—the Airborne, Maritime, and Fixed Station Program (AMF JTRS)—jointly managed by the Navy and the Air Force—because studies suggested that developing the clusters together would result in a more efficient procurement process and a better overall product.[8] All JTRS Clusters are being developed concurrently and there is no requirement that one cluster is completed before another cluster can be developed. Because the FCS program is heavily dependent on Clusters One and Five, this report will address only issues involving these two clusters being developed by the Army.[9]

Current Issues

Developmental

JTRS has experienced a number of developmental difficulties to date. Some of the more notable difficulties are discussed in the following sections.

Size and Weight Constraints and Limited Range

According to a Government Accountability Office (GAO) report:

> To realize the full capabilities of the Wideband Networking Waveform,[10] including transmission range, the Cluster One radio requires significant amounts of memory and processing power, which add to the size, weight, and power consumption of the radio. The added size and weight are the results of efforts to ensure the electronic parts in the radio are not overheated by the electricity needed to power the additional memory and processing. Thus far, the program has not been able to develop radios that meet size, weight, and power requirements, and the current projected transmission range is only three kilometers—well short of the 10-kilometer range required for the Wideband Networking Waveform ... The Cluster One radio's size, weight, and peak power consumption exceeds helicopter platform requirements by as much as 80 percent.[11]

[8] Henry S. Kenyon, "Communications Systems Meld for Greater Synergy," SIGNAL Magazine, February 2004.

[9] Boeing (Anaheim, California) is the prime contractor for JTRS Cluster One. Other team members include Northrop Grumman Mission Systems (Carson, California); Rockwell Collins (Cedar Rapids, Iowa); BAE Systems (Wayne, New Jersey); and Harris Communications (Rochester, New York). General Dynamics (Scottsdale, Arizona) is the prime contractor for JTRS Cluster Five. Other team members include Rockwell Collins (Cedar Rapids, Iowa); BAE Systems (Wayne, New Jersey); and Thales Communication (Clarksburg, Maryland).

[10] The Wideband Networking Waveform is described as the core of the JTRS networking capability and is intended to operate across a wide range of the radio frequency spectrum - from 2 megahertz (MHZ) to 2 gigahertz (GHz) and would provide increased routing and networking capability - as much as a hundred times more than existing communications systems.

[11] United States Government Accountability Office (GAO), Report to the Chairman, Committee on Appropriations, House of Representatives, "Defense Acquisitions: Resolving Developmental Risks in the Army's Networked Communications Capabilities is Key to Fielding Future Force," GAO-05-669, June 2005, p. 15.

The inability to meet these fundamental design and performance standards has raised concerns that Cluster One may not be able to accommodate additional waveforms (current plan is for Cluster One to have four to eight stored waveforms) as intended and that it may be too bulky or heavy to fit into the stringently weight and size-constrained FCS Manned Ground Vehicles (MGVs)[12] as well as the Army's helicopter fleet. Some are concerned that to meet these physical requirements, the Army may significantly "dumb down" Cluster One performance specifications.[13] According to the Army, however, it continues to make progress in terms of reducing Cluster One's weight and size and in increasing its transmission range, however incorporating all of the desired waveforms into Cluster One is proving to be difficult.[14]Cluster Five radios were also reportedly experiencing similar size, weight, and power difficulties - difficulties more pronounced as some Cluster Five versions are supposed to weigh no more than one pound. [15] Current reports on Cluster Five progress appear to be more optimistic than Cluster One. General Dynamics reports that they have been able to achieve systems compatibility between Cluster Five units and three other key FCS components, the Non-Line of Sight Launch System, the Unattended Ground Sensor, and the Intelligent Munitions System.[16]

DOD convened a mini-Defense Acquisition Board[17] (DAB) for the Cluster One program on October 11, 2005 and, according to one report, plans to hold another review on November 21, 2005.[18] Information concerning the October 11 review was not publically released and there is some renewed concern that the Cluster One program is in trouble. Another report suggests that the airborne version of Cluster One, despite significant re-engineering, still exceeds weight limitations.[19] The issue appears to be that Boeing has had difficulty reducing the radio's weight below 66 kilograms - with 52 kilograms being the maximum allowable weight for the airborne version of Cluster One.[20] According to Boeing officials, it would be possible to achieve the 52 kilogram weight limit but it would require significant design changes to a design that is already well established and not easily changed.[21] Despite this difficulty, certain aspects of the Cluster One program have shown improvement - according to Boeing officials - with the first version of the Wideband Networking Waveform apparently operational on some versions of Cluster One.[22]

---

[12] FCS Manned Ground Vehicles (MGV) are envisioned as a family of eight different combat vehicles - with some having more than one variation - that are based on a common platform and would be designed to be transported by U.S. Air Force transport aircraft and deployed straight into combat with little or no post-flight reconfiguration. They would 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.

[13] Sandra I. Erwin, "Military Sets Less Ambitious Goals for New Tactical Radio," *National Defense*, National Defense Industrial Association (NDIA), Washington, DC, August 2005.

[14] Meeting between CRS and the Army Staff's G-8 (Force Development) Section's Directorate of Integration FCS Office, September 15, 2005.

[15] United States Government Accountability Office (GAO), Report to the Chairman, Committee on Appropriations, House of Representatives, "Defense Acquisitions: Resolving Developmental Risks in the Army's Networked Communications Capabilities is Key to Fielding Future Force," GAO-05-669, June 2005, p. 19.

[16] Rebecca Christie, "Troubled DOD Radio Program Shows Progress Despite Delays," *Wall Street Journal*, October 3, 2005.

[17] The Defense Acquisition Board is the Department of Defense's senior level forum for advising the Under Secretary of Defense for Acquisition, Technology, and Logistics on critical decisions concerning major acquisition programs.

[18] Rebecca Christie, "Pentagon Plans Another Review for Troubled Radio Program," *Wall Street Journal*, October 12, 2005.

[19] Joshua Kucera, "Weight Issues Bear Down on JTRS," Jane's Defence Weekly, October 12, 2005, p. 8.

[20] Ibid.

[21] Ibid.

[22] Rebecca Christie, "Troubled DOD Radio Program Shows Progress Despite Delays," *Wall Street Journal*, October 3,

Security

Security for JTRS has emerged as a significant developmental difficulty. According to one expert, one of the program's biggest problems is security, "namely encryption, as JTRS encryption is software-based and is, therefore, vulnerable to hacking."[23] Computer security experts generally agree that software used for any purpose is vulnerable, as no current form of computer security offers absolute security or information assurance. According to GAO, JTRS will be required to operate applications at multiple levels of security and in order to meet this requirement, developers will have to not only account for traditional radio security measures but also computer and network security measures.[24] In addition, National Security Agency (NSA)[25] security concerns about JTRS interface with radio systems of U.S. allies, and the requirement for JTRS to be interoperable with DOD's Global Information Grid (GIG), are also expected to pose developmental challenges.[26] One such security-related challenge is that DOD's Global Information Grid will also interface with the Internet, which brings with it a whole additional set of security concerns for JTRS.[27]

Interoperability with Legacy Radio Systems

Some have expressed concerns that the goal of making JTRS "backward compatible" with legacy radios may be technologically infeasible.[28] Reportedly, early program attempts at cross-banding[29] to synchronize incompatible legacy radio signals proved to be too complex and current Army efforts are focusing on using the Wideband Networking Waveform to link with legacy radio frequencies.[30] One report suggests that while the Wideband Networking Waveform can receive signals from legacy radios, legacy radios cannot receive signals from JTRS and to rectify this situation, the Army is looking at using 19 different waveforms to facilitate JTRS transmissions to legacy systems.[31] Incorporating up to 19 different waveforms into a JTRS radio has the potential to significantly increase memory and processing power requirements which, in turn, could drive up JTRS size, weight, and power requirements. Recently, the Joint Staff asked the Services to prioritize JTRS waveforms and the Army reportedly identified four waveforms as initial priorities for FCS and other complementary programs.[32]

2005.

[23] Buxbaum, p. 32.

[24] Ibid.

[25] The National Security Agency is the U.S. government's cryptologic organization. It coordinates, directs, and performs highly specialized activities to protect U.S. government information systems and produce foreign signals intelligence information.

[26] Buxbaum, p. 32.

[27] Jeff Child, "Cyber Security, JTRS, and the GIG," COTS Journal, June 2005.

[28] Sandra I. Erwin, "Military Sets Less Ambitious Goals for New Tactical Radio," *National Defense*, National Defense Industrial Association (NDIA), Washington, DC, August 2005.

[29] Cross-banding is a technique of receiving a number of incompatible frequencies and then re-transmitting them on previously designated channels, thereby allowing communications systems operating on different bands to communicate with one another.

[30] Ibid.

[31] Jen DiMascio, "JTRS Cluster One to Play Role, Execs Say: Exercise to Test Mettle of Early FCS Technologies Will Begin this Year," *Inside the Army*, Vol. 17, No. 25, June 27, 2005, p. 7.

[32] Comments from the Army Staff's G-8 (Force Development) Section's Directorate of Integration FCS Office, November 10, 2005.

Cluster One Stop Work Order

On April 25, 2005, DOD issued a "Show Cause" letter to Boeing- the lead contractor for JTRS Cluster One - stating that it was considering cancelling the contract for the first phase of Cluster One due to Boeing's "anticipated failure to meet cost, schedule, and performance requirements." Shortly after this decision, work on Cluster Five was also partially suspended, due in part to developmental problems, changing technical requirements, and a contract award protest, and also because progress in Cluster Five was heavily leveraged against progress on Cluster One.[33] As a result of the work stoppage, DOD lifted its requirement for Services to obtain a DOD waiver before purchasing non-JTRS radios and the Services were authorized to purchase legacy radios, such as the Single Channel Ground and Airborne Radio System (SINCGARS), which has been in service since the 1980s.[34]

JTRS Alternatives

Some analysts suggest that there are alternatives to JTRS that are already commercially available. Companies such as Harris Corporation—a Cluster One team member - produces a software-defined radio (Falcon II AN/PRC-117F(C)) and Thales—a Cluster Five team member and the lead contractor for SOCOM's Cluster Two radio—both produce software-defined radios that are already in use in the field.[35] It should be noted, however, that these software-defined radios currently in use only run a subset of the current force waveforms, and the Wideband Networking Waveform and Soldier Radio Waveform—both FCS program requirements—would not be available on these radios.[36] Another possible solution could be to use existing software-defined radios and to acquire a commercial wideband system such as WiMax[37]—a non-line-of-sight commercial broadband networking technology that could be modified for military use.[38] Experts suggest that a system such as WiMax could provide the military with more bandwidth and enhanced over-the-horizon mobile communications.[39] The Army asserts, however, that if a system such as WiMax was adopted for use, that it would require NSA certification not unlike current certification efforts for JTRS.[40] The greater bandwidth and over-the-horizon mobile features of WiMax could address concerns that FCS might not have sufficient bandwidth and the perceived over-reliance on unmanned aerial vehicles (UAVs) and other airborne platforms - which are

---

[33] United States Government Accountability Office (GAO), Report to the Chairman, Committee on Appropriations, House of Representatives, "Defense Acquisitions: Resolving Developmental Risks in the Army's Networked Communications Capabilities is Key to Fielding Future Force," GAO-05-669, June 2005, p. 3.

[34] Comments from the Army Staff's G-8 (Force Development) Section's Directorate of Integration FCS Office, November 10, 2005 and Buxbaum, p. 32.

[35] Scott Nance, "Analyst Sees Interim, Commercial Solutions if JTRS Canceled," *Defense Today*, Volume 26, Number 81, April 29, 2005, p. 4.

[36] Comments from the Army Staff's G-8 (Force Development) Section's Directorate of Integration FCS Office, November 10, 2005.

[37] WiMax is an acronym that stands for Worldwide Interoperability for Microwave Access. Proponents say that WiMax wireless coverage using WiMax nodes or "base stations" would enable high-speed Internet connectivity for homes and businesses in a radius of up to 50 km (31 miles). These base stations would eventually cover an entire metropolitan area, and allow wireless mobility within it. It should be noted that claims of 50 km (31 miles) range, especially claims that such distances can be achieved without lines of sight, represent a theoretical maximum under ideal conditions.

[38] Scott Nance.

[39] Ibid.

[40] Comments from the Army Staff's G-8 (Force Development) Section's Directorate of Integration FCS Office, November 10, 2005.

subject to hostile fire and weather constraints - to retransmit JTRS signals over extended distances.

Boeing Retains Cluster One Contract

On July 19, 2005, the Army reportedly decided to keep Boeing as the Cluster One lead contractor but would continue to assess the program's progress.[41] No details were publically released as to why the Army decided to keep Boeing as the lead contractor but some suggest that it was not because Boeing demonstrated progress in correcting noted design deficiencies, but instead because Boeing had a strong legal case against the Army if the Army had decided to terminate its contract with Boeing. Work on Cluster Five radios - which, unlike Boeing, was never formally suspended by DOD - has continued in areas that were not dependent on Cluster One technologies and General Dynamics has reportedly made progress in addressing size and power concerns raised by GAO in their report.[42]

Experimentation and Spin Out One

Experimentation

In October 2005, the Army initiated what it calls "Experiment 1.1" to test elements of the FCS network - including JTRS.[43] The experiment, slated to run through early 2006, is to test other network components including the System of Systems Common Operating Environment (SOSCE)[44] and Networked Battle Command Systems.[45] The intent is to test the network inside of formations and down to the soldier level and also to link sensors to soldiers and various FCS items in preliminary stages of development such as unmanned aerial vehicles (UAVs), unmanned ground vehicles (UGVs) and unattended munitions systems. Because manned ground vehicles are not yet developed, network items - including JTRS- are to be placed in surrogate vehicles (modified High Mobility Multi-Wheeled Vehicles—HMMWVs).

These vehicles are to use early developmental models of the Cluster One radio. The program manager for FCS, Brigadier General Charles Cartwright, expects to receive 42 "pre-engineering" development models of Cluster One in December 2005 and also plans on using Cluster Five units in Experiment 1.1—and, possibly, a second "Experiment"—in 2006.[46]

The Army has a number of specific objectives for Experiment 1.1 including:

- FCS risk mitigation;

[41] James Gunsalus, "Boeing Retains Army Radio Deal," *Seattle Post-Intelligencer*, July 20, 2005.

[42] CRS discussion with General Dynamics Program Manager for Cluster Five, September 29, 2005.

[43] Information in this section is taken from Jen DiMascio, "JTRS Cluster One to Play Role, Execs Say: Exercise to Test Mettle of Early FCS Technologies Will Begin this Year," *Inside the Army*, Vol. 17, No. 25, June 27, 2005, pp. 1-9.

[44] SOSCOE is intended to be the network-centric operating system, or middleware, that permits the integration of separate FCS communications software packages. The Army equates SOSCE to Microsoft Windows on a much larger scale - SOSCOE will comprise about 10 percent of the more than 30 million lines of FCS software code.

[45] The Network Battle Command System consists of applications such as mission planning and preparation, situational understanding, battle command and execution, and applications linking soldiers and crews to various FCS systems.

[46] Jen DiMascio, "Army to Receive 42 Model Radios by December: Pentagon to Restructure Joint Tactical Radio System After DAB Review," *Inside the Army*, 17, No. 38, September 26, 2005, pp. 1-9.

- Support the development of the Army's modular force Brigade Combat Teams (BCTs);[47]
- Gain knowledge to support further development of FCS capabilities;
- Provide information that could lead to program improvements and perhaps more rapid development, and
- To show the progress and maturity of the FCS program and the FCS network in an operational environment.[48]

Given these objectives, it is not unreasonable to assume that the early development models of JTRS Cluster one will undergo considerable experimentation and testing. If this is the case, the experiment's results could potentially have significant ramifications for the future of the Cluster One program, particularly if Cluster One's performance fails to meet the Army's expectations.

Spin Out One

The Army's FCS program consists of four "spin outs"—formerly known as spirals—that will introduce FCS technologies and systems to the current force. These fielding spin outs are slated to occur in 2008, 2010, 2012, and 2014 to an experimental brigade and then two years later to the rest of the Army. The first spin out of FCS technology in 2008 is to emphasize improved munitions and sensors connected in an initial version of network capabilities.[49] These network capabilities are thought to include Clusters One and Five, Wideband Networking Waveform, Warfighters Information Network-Tactical (WIN-T),[50] and the System of Systems Common Operating Environment (SOSCOE). In Spin Out One, Clusters One and Five are planned to be used in conjunction with other FCS systems such as Unattended Ground Sensors (UGS), the Intelligent Munitions System (IMS), and the pre-production model of the Non-Line of Sight Cannon (NLOS-C).

GAO asserts that "it is unlikely that Cluster One radios will be available for the first spiral [now referred to as spin out] of the FCS network, slated for FY2008 and that Cluster Five radios might not be available for the first spiral."[51] Some reports suggest that JTRS program progress is being made, particularly in the Cluster Five program where technology workarounds necessitated by the Cluster One stop work order, have helped Cluster Five to "achieve a degree of compatibility" with other FCS components due to be tested in Spin Out One.[52] If, however, Cluster One and Five

[47] For additional information on the Army's modular force initiative see CRS Report RL32476, *U.S. Army's Modular Redesign: Issues for Congress*, by Andrew Feickert.

[48] Comment from the Army Staff's G-8 (Force Development) section's Directorate of Integration FCS Office, November 10, 2005.

[49] Ibid.

[50] The Warfighter Information Network-Tactical (WIN-T) is the Army's tactical telecommunications system consisting of communication infrastructure and network components from the maneuver battalion to the theater rear boundary. The WIN-T network provides command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) support capabilities that are mobile, secure, survivable, seamless, and capable of supporting multimedia tactical information systems.

[51] United States Government Accountability Office (GAO), Report to the Chairman, Committee on Appropriations, House of Representatives, "Defense Acquisitions: Resolving Developmental Risks in the Army's Networked Communications Capabilities is Key to Fielding Future Force," GAO-05-669, June 2005, p. 3.

[52] Rebecca Christie, "Troubled DOD Radio Program Shows Progress Despite Delay," Dow Jones Newswire, October 4, 2005.

are not available by 2008, reports suggest that the Army is planning to use pre-production models and/or surrogate software defined radios of lesser capabilities in their place.[53]

Program Restructuring

On July 28, 2005 the JTRS program underwent a Defense Acquisition Board (DAB) review and although results have not been publically disclosed, the Secretary of the Army, Francis Harvey, reportedly acknowledged that DOD would restructure the entire JTRS program.[54] In August, the JTRS Joint Program Executive Office (JPEO) submitted a proposal to DOD which details how it would manage all JTRS Cluster efforts (as opposed to the management structure depicted in Table 1) with the intent of achieving near-term success by delivering usable capabilities to the field now, while pursuing the long term goal of fielding a complete interoperable software defined radio over time.[55] Preceding the JTRS program restructuring, Boeing and Science Applications International Corporation (SAIC)—who serve as lead systems integrators for the entire 18 system FCS program—announced in June 2004 that Cluster One and Five programs would be restructured to better meet the needs of the FCS program.[56] While supporters suggest that this restructuring might help to focus JTRS development efforts and provide definitive design guidance to JTRS developers, critics say that this is just another in a series of program "restructurings"—the Army added two years of additional effort and $458 million to Cluster One in December 2004 to address developmental problems[57]—for a program that started in 1999 and "has a long ways to go before it can be used in military operations."[58]

Program Budget Issues

According to GAO,[59] the Cluster One program is expected to cost $15.6 billion to develop and acquire over 100,000 Cluster One radios and $8.5 billion to develop and acquire over 300,000 Cluster Five radios, and the Army has reportedly requested $156.7 million in FY2006 for JTRS.[60] Cost growth for Cluster One has been of significant concern as noted by GAO:

> Since the program entered systems development in 2002, the contractor has overrun cost estimates by $93 million - nearly 28 percent above what was planned. Although the program attempted to stabilize costs by adding approximately $200 million to the contract in January 2004, costs continued to grow steadily thereafter. In addition, the contractor has increasingly fallen behind schedule and has had to devote more resources than originally

[53] Peter A. Buxbaum, "Jitters Over JTRS," Armed Forces Journal, July 2005, p. 31 and David A. Fulghum, "A Case of the Jitters,"Aviation Week & Space Technology, May 2, 2005, p 30 and comments from the Army Staff's G-8 (Force Development) section's Directorate of Integration FCS Office, November 10, 2005.

[54] Jen DiMascio, "Army to Receive 42 Model Radios by December: Pentagon to Restructure Joint Tactical Radio System After DAB Review," *Inside the Army*, 17, No. 38, September 26, 2005, pp. 1-9.

[55] Adam Baddeley, "Going Forward with JTRS," *Military Information Technology*, October 2, 2005.

[56] Scott Nance, "JTRS Restructuring Aimed at Better Supporting FCS, Contractors Say," *Defense Today*, Volume 26, Number 120, June 24, 2005.

[57] Scott Nance, "GAO: FCS Communication Systems, Software are at Risk," *Defense Today*, Volume 26, Number 127, July 6, 2005.

[58] Sandra I. Erwin.

[59] United States Government Accountability Office (GAO), Report to the Chairman, Committee on Appropriations, House of Representatives, "Defense Acquisitions: Resolving Developmental Risks in the Army's Networked Communications Capabilities is Key to Fielding Future Force," GAO-05-669, June 2005, p. 9.

[60] Fiscal Year 2006 Army Budget: An Analysis, Association of the United States Army (AUSA), Washington, DC, September 2005, p. 76.

> planned. In January 2005, the prime contractor estimated that the total costs for the Cluster One radio and waveform development would be $531 million more than what was originally budgeted, reaching $898 million at completion. However, according to program officials, since contract award, the prime contractor has not demonstrated strong cost estimating and cost management techniques, and it is difficult to estimate with any confidence what the overall program is likely to cost.[61]

Given this history of cost overruns and the inability to forecast and manage program costs, some say a strong case could be made to permanently stop work on Cluster One while still in the Product Development and Demonstration Phase of development, and transfer program elements that show promise to another developer already in the JTRS program or a developer not in the program but with demonstrated communications systems proficiency.

Recent Congressional Actions

The Senate passed its version of the FY2006 Defense Authorization Bill (S. 1042) on November 15. A conference agreement on the Defense Appropriations Bill (H.R. 2863) has been delayed in part because the House has not formally appointed conferees. Both the Senate and House Reports recommend cuts for the entire JTRS program and the Army's JTRS programs are addressed in the following sections:

- Senate - In its report on the FY2006 Defense Authorization Bill[62] the Senate Appropriations Committee voiced its support for JTRS and the ongoing JTRS review by DOD's Program Executive Office (PEO) but noted "the Army's Cluster 1 program faces significant technical challenges" further noting that "these challenges could impact the program efforts in the Navy and Air Force." The Appropriations Committee also called for a DOD assessment and a revised JTRS program plan to be provided to the defense committees. Committee recommended adjustments for the Army's programs are in **Table 2**.

Table 2. Army JTRS Senate-Recommended Adjustments—FY2006 Defense Appropriations

($ thousands)

	Amount	Budget Request
FY2006 Reductions		**FY2006**
Research, Development, Test, and Evaluation - Army	-178,000	573,000[63]
FY2005 Rescissions		**FY2005**
Research, Development, Test, and Evaluation - Army	-21,600	117,259
Other Procurement, Army	-68,500	109,200

[61] United States Government Accountability Office (GAO), Report to the Chairman, Committee on Appropriations, House of Representatives, "Defense Acquisitions: Resolving Developmental Risks in the Army's Networked Communications Capabilities is Key to Fielding Future Force," GAO-05-669, June 2005, p. 17.

[62] S.Rept. 109-141 to accompany H.R. 2863, Department of Defense Appropriations Bill, 2006, September 29, 2005.

[63] This figure includes JTRS waveform development and Program Management Office activities; Cluster One and Five hardware development; and JTRS aviation hardware development.

- House—The House Appropriations Committee Report on the FY2006 Defense Appropriations bill[64] while critical of the Army's Cluster One and Five programs recommended fully funding waveform development and funding to continue hardware development. The House also calls for a detailed DOD report on JTRS to the House Armed Service Committee. Appropriations Committee recommended adjustments for the Army's programs are in **Table 3**.

Table 3. Army JTRS House-Recommended Adjustments—FY2006 Defense Appropriations

($ thousands)

	Amount	Budget Request
FY2006 Reductions		**FY2006**
Research, Development, Test, and Evaluation - Army	-69,500	549,800[a]
Aircraft Procurement, Army[b]	-12,300	23,500
FY2005 Rescissions		**FY2005**
Other Procurement, Army FY2005	-60,500	109,200
Research, Development, Test, and Evaluation - Army FY2005	-21,600	117,259

a. Includes requested amounts for JTRS waveform development and Program Management Office activities and Cluster One and Five hardware development. JTRS aviation development and integration amounts are not included in JTRS program total.

b. This reduction is for the integration of aircraft (helicopter) versions of JTRS Cluster One units.

With these House and Senate figures, it is unlikely that a conference committee would fully fund the JTRS program; actual recommended program cuts for the FY2006 Defense Appropriations bill are pending the outcome of a conference. It is unclear how these yet-to-be-determined program cuts would impact not only the Cluster One and Five programs, but also how they would impact the overall FCS program. Following a House-Senate conference report, the Army would likely issue an assessment on how the cuts impact both the JTRS and FCS programs.

Issues for Congress

The Viability of the Cluster One Program

While both Clusters One and Five have experienced a number of developmental difficulties, it appears that the Cluster Five program has "divorced" itself from Cluster One through technological workarounds and has achieved a degree of program success reportedly having achieved compatibility with a number of FCS systems. Cluster One, however, seems to be progressing to a lesser extent with its first "test" likely to be in Experiment 1.1 later on in 2005. The performance of Cluster One in this experiment might prove to be a useful metric to help decision-makers determine if the Cluster One program is a viable one or if another course of action should be pursued. Although not believed to be included in Experiment 1.1, the airborne version of Cluster One might warrant further examination. It appears that in order for the airborne version to meet the weight limit of 52 kilograms that significant capability trade offs may be required to this system that is already in the advanced phases of development - likely resulting in additional delays and significantly increased costs.

[64] H.Rept. 109-119 to accompany H.R. 2863, Department of Defense Appropriations Bill, 2006, June 10, 2005.

Given this situation, Congress might review the Army's performance expectations for Cluster One during Experiment 1.1 testing. Will Cluster One's performance impact on the Army's decision to continue with what some call a "troubled program" or will the Army opt to stick with Cluster One's developers no matter what the outcome, and attempt to rectify identified deficiencies through additional funds and further program delays? Another issue that might be considered for congressional review is the state of the airborne version of Cluster One. Some suggest that the program has reached an impasse due to aircraft weight and size constraints, and that the only way to meet these requirements is to redesign the system into a significantly less-capable version—a course of action that could further delay the program and carry with it significant cost implications.

Security

Congress may decide to examine the issue of security in greater detail. According to GAO, in addition to a requirement to change JTRS hardware to accommodate processing and memory capacity upgrades for enhanced security, the current design of JTRS has been judged by the National Security Agency as:

> Not sufficient to meet security requirements to operate in an open networked environment. Specifically, particular versions of JTRS radios will be used by allied and coalition forces, requiring the Army to release specific source code of the software architecture to these forces. To address the release, the National Security Agency has required changes to the security architecture.[65]

Although GAO expresses security concerns about JTRS use by allied and coalition forces, it is not readily apparent how pervasive a problem security is for JTRS and other components of the FCS network. Given the stated security challenges of software-defined radios, it is conceivable that even if Cluster One and Five can meet the Army's communications and data transmission requirements, that security deficiencies might preclude the operational employment of Clusters One and Five.

It can be argued that network security would take on an even a more significant role in FCS than compared to the Army's current force. FCS Manned Ground Vehicles—lighter and less heavily armored than the M-1 Abrams and M-2 Bradleys that they are intended to replace—would rely extensively on situational awareness provided through the FCS Network for their survivability. Furthermore, this network-provided situational awareness would have a significant impact on FCS's ability to engage enemy forces beyond line-of-sight. Given this significant reliance on the FCS Network for survivability and for target acquisition and engagement, potential adversaries might seek to identify and exploit security weaknesses in the FCS network—including JTRS—as a means to attack FCS units. One potential adversary—China—has "likely established information warfare units to deploy viruses to attack enemy computer systems and networks" and China's "recent exercises have incorporated offensive [computer] operations, primarily as first strike against enemy networks."[66] A potential scenario for consideration is that if an adversary obtained FCS-related source code, they could engineer a virus that could be introduced into the FCS network and computers. While some may consider this an improbable scenario, the reported

[65] United States Government Accountability Office (GAO), Report to the Chairman, Committee on Appropriations, House of Representatives, "Defense Acquisitions: Resolving Developmental Risks in the Army's Networked Communications Capabilities is Key to Fielding Future Force," GAO-05-669, June 2005, p. 15.

[66] Annual Report to Congress, The Military Power of the People's Republic of China, Unclassified, Office of the Secretary of Defense, 2005, p. 51.

recent discovery by Russian security experts of the first known computer virus spread by cell phone networks suggests otherwise.[67]

The Army is not unaware of these security challenges and notes that network security and information assurance are an "ever growing priority, regardless of FCS development."[68] As part of this recognition, the Army FCS program conducts bi-monthly information assurance architecture development reviews with the Army staff sections responsible for Intelligence (G-2) and Information and Communications (G-6) and the National Security Agency and Office of the Secretary of Defense.[69]

JTRS Alternatives

With its history of developmental difficulties, program delays, and additional costs, some suggest that the JTRS Cluster One program might be a candidate for cancellation. In this view, Congress might opt to explore alternatives to Cluster One with the Army and DOD. A possible starting point for such a review might be an examination of software-defined radios already in service within the U.S. military or commercially available through other manufacturers. Some critics argue that the military should adopt commercially available and emerging telecommunications technology. One example of such a technology is third-generation cellular technologies that encompass streaming video, netted communications, and data and voice communications over Internet provider networks.[70] While proponents maintain that third-generation cellular could exceed JTRS performance capabilities, critics of the commercial approach note that these technologies need to be ruggedized, customized to fit on specific vehicles and systems, and require specialized encryption, and therefore the "off the shelf approach" might be equally as expensive as developing JTRS. After a thorough technical and cost-based evaluation of these and other JTRS alternatives, some project the best course of action may be to continue Cluster One development as currently planned.

Author Information

Andrew Feickert
Specialist in Military Ground Forces

[67] Ryan Naraine, "Cell Phone Virus Ringing," Internetnews.com, June 15, 2004.

[68] Comments from the Army Staff's G-8 (Force Development) section's Directorate of Integration FCS Office, November 10, 2005.

[69] Ibid.

[70] Adam Baddeley, "Military Explores Third-Generation Cellular," Military Information Technology, October 27, 2005.

Disclaimer

This document was prepared by the Congressional Research Service (CRS). CRS serves as nonpartisan shared staff to congressional committees and Members of Congress. It operates solely at the behest of and under the direction of Congress. Information in a CRS Report should not be relied upon for purposes other than public understanding of information that has been provided by CRS to Members of Congress in connection with CRS's institutional role. CRS Reports, as a work of the United States Government, are not subject to copyright protection in the United States. Any CRS Report may be reproduced and distributed in its entirety without permission from CRS. However, as a CRS Report may include copyrighted images or material from a third party, you may need to obtain the permission of the copyright holder if you wish to copy or otherwise use copyrighted material.