September 2006

DEFENSE ACQUISITIONS

Restructured JTRS Program Reduces Risk, but Significant Challenges Remain

GAO
Accountability · Integrity · Reliability
Highlights

Highlights of GAO-06-955, a report to congressional committees

Why GAO Did This Study

In 1997, the Department of Defense (DOD) initiated the Joint Tactical Radio System (JTRS) program, a key element of its effort to transform military operations to be network centric. Using emerging software-defined radio technology, the JTRS program plans to develop and procure hundreds of thousands of radios that give warfighters the capability to access maps and other visual data, communicate via voice and video, and obtain information directly from battlefield sensors.

The JTRS program has encountered a number of problems, resulting in significant delays and cost increases. The program is currently estimated to total about $37 billion. Given the criticality of JTRS to DOD's force transformation, Congress directed GAO to continue its ongoing review of the JTRS program. This report (1) assesses whether a recent restructuring puts the program in a better position to succeed and (2) identifies any risks that challenge the successful fielding of JTRS.

What GAO Recommends

GAO is making recommendations aimed at ensuring that the activities required for completing the JTRS restructuring reflect stable requirements, knowledge-based acquisition strategies, realistic costs, and comprehensive test plans, as well as to develop plans for fielding JTRS radios. In commenting on a draft of this report, DOD agreed with these recommendations.

www.gao.gov/cgi-bin/getrpt?GAO-06-955.

To view the full product, including the scope and methodology, click on the link above. For more information, contact Paul L. Francis at (202) 512-4841 or francisp@gao.gov.

What GAO Found

The proposed JTRS restructuring—a plan DOD approved in March 2006—appears to address and reduce program risks that GAO and others have documented in recent years. While still meeting key requirements, including those related to DOD's network centric transformation effort, the revised approach is expected to develop and field capabilities in increments rather than attempting to develop and field the capabilities all at once. Costly and non-transformational requirements will be deferred to later increments. Deferring these requirements will allow more time to mature critical technologies, integrate components, and test the radio system before committing to production. JTRS program management has also been strengthened through the establishment of a Joint Program Executive Office (JPEO). The more centralized management structure should help the program improve oversight and coordination of standards, system engineering, and development of the radios.

The real test will be in execution, and, for that, several management and technical challenges remain. First, JPEO must finalize the details of the restructuring, including formal acquisition strategies, independent cost estimates, and test and evaluation plans. DOD also needs to develop migration and fielding plans for how JTRS networking capabilities will be used. Completing and obtaining DOD's approval of these activities is needed to ensure the JTRS program is executable. There are also a number of longer-term technical challenges that the JTRS program must address. For example, the proposed interim solutions for enabling network interoperability among different JTRS variants have yet to be developed. In addition, integrating the radio's hardware onto diverse platforms and meeting respective size, weight, and power limitations has also been a long-standing challenge that must be overcome. Furthermore, operating in a networked environment open to a large number of potential users has generated an unprecedented need for information assurance. This need has resulted in a lengthy, technically challenging, and still evolving certification process from the National Security Agency. At the same time, the program must address the need to obtain and sustain commitments and support from the military services and other stakeholders—a challenge that has often hampered joint development efforts in the past. The extent to which DOD overcomes these challenges will determine the extent to which the program manages cost, schedule, and performance risks and supports JTRS-dependent military operations.

Contents

Abbreviations

DOD	Department of Defense
GAO	Government Accountability Office
JTRS	Joint Tactical Radio System
JPEO	Joint Program Executive Office

GAO
Accountability * Integrity * Reliability

United States Government Accountability Office
Washington, DC 20548

September 11, 2006

The Honorable Thad Cochran
Chairman
The Honorable Robert C. Byrd
Ranking Member
Committee on Appropriations
United States Senate

The Honorable Jerry Lewis
Chairman
The Honorable David Obey
Ranking Member
Committee on Appropriations
House of Representatives

Over the past decade, the Department of Defense (DOD) has undertaken a major transformation of its military operations—one that will rely on network centric communications to improve force information sharing, collaboration, and situational awareness and, thereby, enable more rapid and effective decision-making and speed of execution on the battlefield. The Joint Tactical Radio System (JTRS) program, initiated in 1997, is a key effort in this transformation. By capitalizing on emerging software-defined radio technology, the program plans to develop and procure hundreds of thousands of JTRS radios, which are expected to interoperate with existing radio systems and provide the warfighter with additional communications capability to access maps and other visual data, communicate via voice and video with other units and levels of command, and obtain information directly from battlefield sensors.

Although JTRS offers the potential to address key communications shortfalls and significantly improve military capabilities, the program has encountered a number of problems, including unstable requirements, immature technologies, and aggressive schedules, which have resulted in significant cost increases and delays. In August 2003, we reported that the lack of a strong, joint-management structure presented significant challenges to the program's ability to control costs[1]—currently estimated

[1]GAO, *Challenges and Risks Associated with the Joint Tactical Radio System Program*, GAO-03-879R (Washington, D.C.: Aug. 11, 2003).

to total about $37 billion. In response, Congress directed DOD to strengthen program management, and in February 2005, DOD established a Joint Program Executive Office (JPEO) to manage the JTRS program and its various components. Following JPEO's assessment of the program, the Defense Acquisition Board directed JPEO to come up with a plan to restructure the JTRS development effort—a plan that DOD approved in March 2006.

Given the criticality of JTRS to DOD's force transformation, Congress directed GAO to continue its ongoing review of the JTRS program.[2] This report (1) assesses whether the recent restructuring puts the program in a better position to succeed and (2) identifies any risks that challenge the successful fielding of JTRS.

We conducted our review from August 2005 to August 2006 in accordance with generally accepted government auditing standards. To assess program progress and risks, we reviewed program restructuring data from the JTRS JPEO, including cost, schedule, and performance data. We also reviewed the fiscal year 2007 budget request and projected future year budget requests. We interviewed agency officials from various DOD and service organizations and reviewed reports produced by Defense organizations. More details about our scope and methodology are in appendix I.

Results in Brief

The recent restructuring of the JTRS program appears to put the program in a better position to succeed, by emphasizing an incremental, more moderate risk approach to developing and fielding capabilities. The incremental approach reflects the military services' most urgent priorities for a mobile, flexible communications and networking capability and defers the development of some of the more challenging requirements to later increments. Deferring these requirements will allow more time to mature critical technologies, integrate components, and test the radio system before committing to production. DOD expects that JTRS program management through the JPEO and other structural changes will improve oversight and coordination of standards and development of the radios. The centralized management structure is also empowered to manage

[2]Conference Report, *Making Appropriations for the Department of Defense for the Fiscal Year Ending September 30, 2006, And For Other Purposes*, House of Representatives Report 109-359, December 18, 2005

development costs, which are expected to total $2.1 billion more than originally projected between fiscal years 2006 and 2011. In addition, the restructuring attempts to facilitate information-sharing and competition by ensuring government purpose rights[3] to contractor-developed products.

While the restructuring appears to address many of the problems that affected JTRS in the past, several management and technical challenges still remain. JPEO must finalize the details of the restructuring, including test and evaluation plans and formal acquisition strategies. Estimated program costs also require independent review and validation and the services need to work out migration and fielding plans for the radios. Completing these activities and obtaining DOD's approval of the completed JTRS program restructuring are essential to ensuring the JTRS program is executable. Over the longer term, the program faces several key management and technical challenges. For example, although the new joint management structure for JTRS is a significant improvement over the previous fragmented program management structure, joint development efforts in DOD have often been hampered by an inability to sustain requirements commitments and funding support from the military services and other department stakeholders. Regarding technical challenges, integrating the radio's hardware onto diverse platforms and meeting respective size, weight, and power limitations has been a long-standing challenge and remains so. Operating in a networked environment—open to a large number of potential users—has also resulted in a lengthy, technically challenging, and still evolving information assurance certification process from the National Security Agency. Furthermore, the proposed interim technical solutions for enabling network interoperability among different JTRS variants have yet to be designed and developed.

We are recommending the Secretary of Defense ensure that the activities required for completing the JTRS restructuring reflect stable requirements, knowledge-based acquisition strategies, and comprehensive test plans, as well as to develop plans for fielding JTRS radios. In commenting on a draft of this report, DOD agreed with our recommendations.

[3]Government purpose rights means the rights to (1) use, modify, reproduce, release, perform, display, or disclose technical data or computer software (or computer software documentation) within the government without restriction and (2) to release or disclose technical data or computer software (or computer software documentation) outside the government and authorize persons to whom release or disclosure has been made to use, modify, reproduce, release, perform, display, or disclose the work for U.S. government purposes.

Background

The JTRS program was initiated to exploit advancements in software-defined radio technology and provide battlefield commanders with superior information capabilities. Since its initiation in 1997, the program has experienced cost and schedule overruns and performance shortfalls, due primarily to immature technologies, unstable requirements, and aggressive schedules. In an effort to address these problems, the program was restructured in March of this year. However, due to JTRS' lengthy development path, DOD has had to continue buying other tactical radios—currently estimated to cost $11 billion—to support its communication needs.

JTRS Was Initiated to Address Long-Term Military Communications Needs

Survivability and lethality in warfare are increasingly dependent on smaller, highly mobile, joint forces that rely on superior information and communication capabilities. The single function hardware design of DOD's existing radio systems lack the functionality and flexibility necessary to achieve and maintain information superiority or to support the rapid mobility and interoperability required by today's armed forces. To support new operational or mission requirements, DOD determined that the large number and diversity of legacy radios in use would require wholesale replacement or expensive modifications.

Software-defined radios such as JTRS primarily use software rather than hardware to control how the radio works and, because they are programmable, JTRS offers significant flexibility to meet a wide variety of needs. Rather than developing radios that are built to different standards and operate on different fixed frequencies, as was the case in the past, JTRS is to be a single, interoperable family of radios based on a common set of standards and applications. The radios are expected to not only satisfy the requirements common to the military's three operational domains—air, sea, and ground—but be able to communicate directly with many of DOD's existing tactical radios. To facilitate interoperability, JTRS will develop a set of waveforms (software radio applications) designed with the same operating characteristics as many of DOD's existing radios.[4]

[4]A waveform is the representation of a signal that includes the frequency, modulation type, message format, and/or transmission system. In general usage, the term waveform refers to a known set of characteristics, for example, frequency bands (VHF, HF, and UHF), modulation techniques (FM, AM), message standards, and transmission systems. In JTRS usage, the term waveform is used to describe the entire set of radio functions that occur from the user input to the RF output and vice versa. A JTRS waveform is implemented as a reusable, portable, executable software application that is independent of the JTRS operating system, middleware, and hardware.

Depending on operational needs, different waveforms could be loaded onto a JTRS radio and used to communicate with a variety of other radios.

In addition to supporting interoperability, JTRS is to contribute to DOD's goal of network centric warfare operations by introducing new wideband networking waveforms that dramatically increase the amount of data and speed at which the data can be transmitted. As such, the waveforms would facilitate the use of maps, imagery, and video to support the decision-making of tactical commanders at all echelons. Table 1 compares the frequency band, nominal channel bandwidth, and data rates of selected legacy waveforms and new wideband waveforms.

Table 1: Comparison of Frequency Band, Nominal Channel Bandwidth, and Data Rates for Selected Legacy Waveforms and New Wideband Waveforms

Waveform	Frequency band (millions of Hertz (MHz))	Nominal channel bandwidth (thousands of Hertz (KHz))	Data rate (thousands of bits per second (Kbps))
Legacy			
Single Channel Ground and Airborne Radio System (SINCGARS)	30 - 88	25	Voice: 16 Data: .075 - 16
Enhanced Position Location Reporting System (EPLRS)	420 - 450	3,000	Data: 57 or 228
High Frequency	2 - 30	3/6/12	Voice and Data: 11 distinct data rates between .075 – 9.6
Have Quick	225 - 400	25	Voice: 16 Data: .075 - 16
Tactical Data Information Link-Joint (TADIL-J)	960 - 1,215	3,000	Voice: 2.4 and 16 Data: 28.8 – 1,137
Ultra High Frequency Satellite Communications Demand Assigned Multiple Access (UHF SATCOM DAMA)	225 – 400	5 and 25	Voice and Data: .075 – 56, or 64
New			
Wideband Networking[a]	2 - 2,000	25 – 30,000	Data: up to 5,000
Soldier Radio[a]	2 - 2,000	13,000	Data: up to 1,000
Joint Airborne Network – Tactical Edge	2 - 2,000	To be determined	To be determined

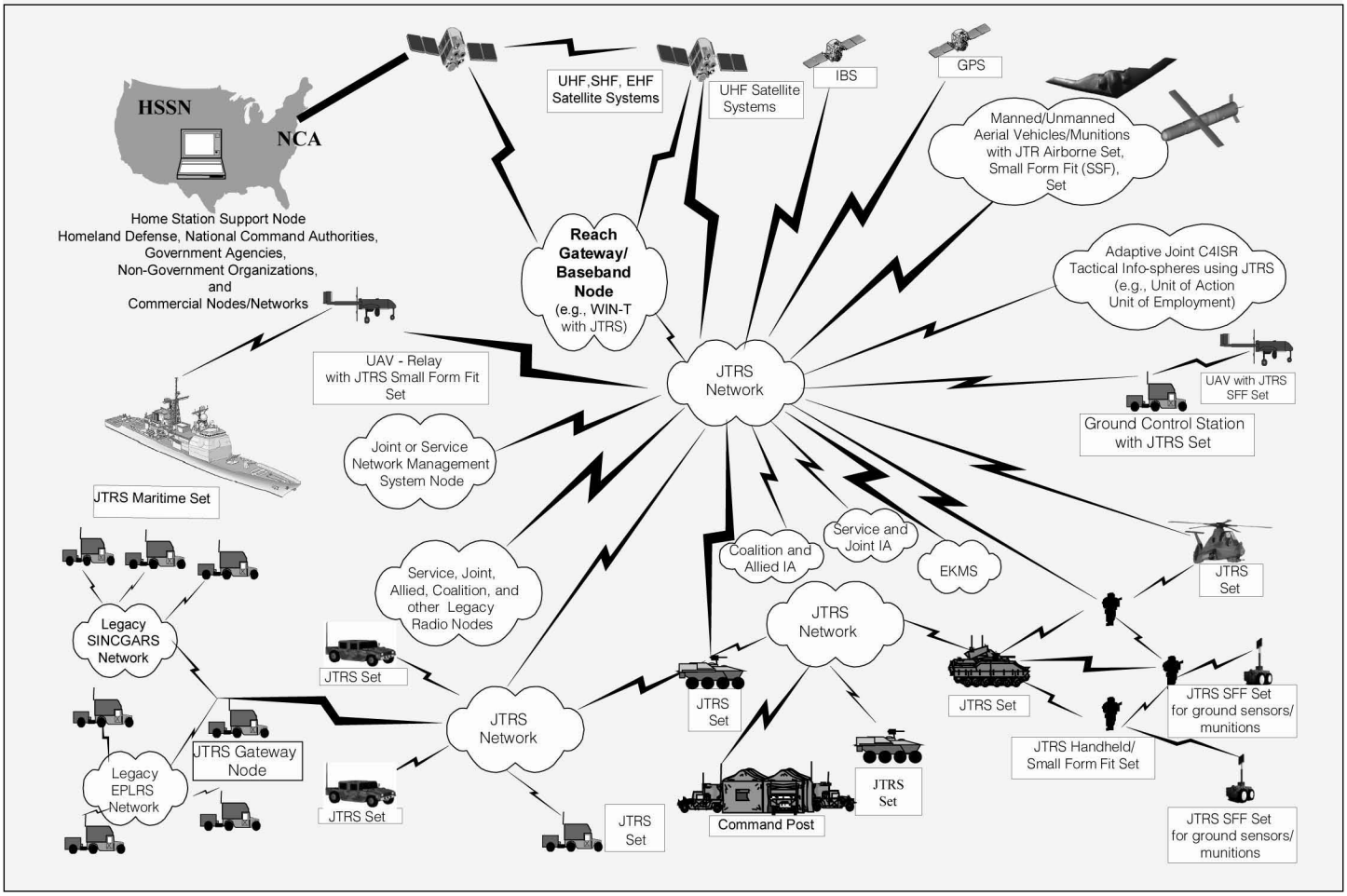
Source: GAO analysis of April 2003 JTRS Operational Requirements Document, Annex E.

[a]The Wideband Networking Waveform and Soldier Radio Waveform are actually families of waveforms. The Wideband Networking Waveform family consists of four different waveforms and the Soldier Radio Waveform family consists of three different waveforms.

In addition to providing new wideband waveforms, individual JTRS radios would have the capability to support multiple services (e.g., voice, data, and video) and operate on multiple channels simultaneously. For example, a four-channel JTRS radio set intended for a ground vehicle could be programmed to have channels dedicated to SINCGARS, Have Quick, the Wideband Networking Waveform, and the Soldier Radio Waveform. All four channels could be operating simultaneously. Data could also be transferred from one channel (or network) to another through a "gateway" device implemented with hardware and software.

Figure 1 depicts the JTRS operational overview.

Figure 1: JTRS Operational Overview



Source: JTRS Operational Requirements Document, April 2003.

Notes:

IBS: Integrated Broadcast Service

GPS: Global Positioning System

UAV: Unmanned Aerial Vehicle

EKMS: Electronic Key Management System

IA: Information Assurance

C4ISR: Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance

Developing JTRS is a significant challenge. Because JTRS is intended to operate on the battlefield where there is no fixed infrastructure of cell towers, fiber optic lines, and other network components such as routers and switches, the radios must be powerful enough to transmit and relay information wirelessly over long distances, maintain network linkages and quality of service while on the move, and ensure that communications and the network itself are secure. Development of the individual waveforms and their ability to function effectively on different JTRS sets is critical to the success of JTRS. The Wideband Networking Waveform, for example, will require complex software development and include over 1.6 million lines of software code. To ensure the waveforms perform as intended, they will go through a rigorous certification process—one that involves testing the functionality, portability,[5] interoperability, and security aspects of the waveforms when operating on production representative JTRS radios.

To manage JTRS' development, DOD established a Joint Program Office and service-led program/product offices in the late 1990s. Table 2 summarizes the general management structure of JTRS until 2005, at which time it was changed.

[5]Porting the waveform involves the transfer of the software from one operational environment (hardware, operating system, etc.) to another.

Table 2: Responsibilities of JTRS Program/Product Offices until 2005

Program/Product Office (lead service)	Responsibilities	Major milestones
Joint Program Office	• JTRS Software Communications Architecture • Waveform applications and associated cryptographic algorithms • Certifying compliance of hardware and software with the architecture • Ensuring overall joint interoperability	• Development of Software Communications Architecture started in 2000 • Development of waveform applications and associated cryptographic algorithms started in 2002
Cluster 1 (Army)	• Radios for ground vehicles and helicopters	• System development started in 2002
Cluster 5 (Army)	• Handheld and manpack radios • Radios for use in weight- and power-constrained platforms, such as sensors and weapons systems	• System development started in 2004
Airborne, Maritime, Fixed-Site (Air Force/Navy) Cluster	• Radios for aircraft • Radios for maritime platforms • Radios for fixed-site locations	• Pre-system development started in 2004
Multifunctional Information Distribution System-JTRS (Navy)	• Radios for selected airborne platforms equipped with Multifunctional Information Distribution System terminals	• System development started in 2004
Special Operations Command	• Handheld radios for Special Operations Forces	• System development started in 2002

Source: GAO analysis of JTRS documents.

Note: A JTRS cluster was the term used to describe a grouping of platforms with similar requirements.

JTRS Program Restructured to Address Cost, Schedule, and Performance Problems

Achieving JTRS' technical requirements has proven to be a significant challenge. In 2001, an independent assessment of the program identified numerous concerns, including the program's aggressive acquisition approach and schedule, unstable requirements, and an ambiguous management decision chain.[6]

In our reviews, we have found similar problems. For example, the JTRS Cluster 1 program—which includes development of the Wideband Networking Waveform, the waveform intended to serve as the main

[6]The independent assessment was requested through the Office of the Under Secretary of Defense, Acquisition, Technology, and Logistics' Tri-Service Assessment Initiative. The Tri-Service Assessment Initiative was founded by the Office of the Secretary of Defense in 1998 to address software acquisition issues. Subsequently, Independent Expert Program Reviews, which serve as the basis for the Defense Acquisition Program Support, were incorporated into the DOD acquisition regulation and became part of the Defense Acquisition Guidebook.

conduit of information among Army tactical units—began development with an aggressive schedule, immature technologies, and a lack of clearly defined and stable requirements. As a result, the program struggled to mature and integrate key technologies and was forced to make major design changes. These factors contributed to significant cost and schedule problems that led DOD to stop key development work and propose restructuring the program. Meeting requirements for JTRS Cluster 5 radios proved even more challenging, given the radios' smaller size, weight, and power needs.[7] Several programmatic changes and a contract award bid protest also slowed progress of the Cluster 5 program.

Subsequent to our reporting that the JTRS program lacked a strong, joint-management structure for resolving requirements and funding differences among the services,[8] Congress directed DOD to develop a plan for managing JTRS's development under a single joint program office. Under DOD's plan, all JTRS programs were realigned under the authority of a single JTRS Joint Program Executive Officer, established within the Navy's Space and Naval Warfare Systems Command. The JPEO's assessment of the JTRS program revealed that

- the program evolved from a legacy radio replacement program to a network centric radio program without a re-baselining of program impacts;
- requirements significantly changed and never stabilized;
- the complexity of information assurance/security problems were not anticipated; and
- the program was executing at high technical, schedule, and cost risk.

To get the program on track, JPEO was directed by DOD to come up with a proposal for JTRS that addressed the services' priority requirements, was technically doable, and could be executed within a reasonable budget. In November 2005, JPEO presented three program options reflecting different sets of capabilities and development costs (see table 3). Each

[7]The smallest Cluster 5 radio weighs only about 1 pound, compared with 84 pounds for Cluster 1.

[8]GAO, *Challenges and Risks Associated with the Joint Tactical Radio System Program*, GAO-03-879R (Washington, D.C.: Aug. 11, 2003).

option included a specific mix of form factors[9] and waveforms for each of the services. For example, under option 3, the Marine Corps would use 4-channel vehicle radios, capable of operating two or three legacy waveforms and up to three new waveforms, as well as 2-channel manpack radios operating one or two legacy waveforms and one or two new waveforms. The Army would also use 4-channel vehicle radios, but with the capability to operate three or four legacy waveforms and two or three new waveforms, as well as 1-channel and 2-channel radios operating the Soldier Radio Waveform for its sensors and weapons systems. The Air Force would use a 4-channel Multifunctional Information Distribution System terminal form factor operating two legacy waveforms and one new waveform. The Navy would use the same form factor, operating one legacy and one new waveform, as well as a ship form factor operating one new waveform.

[9]Form factors is a term used to describe the various types of radios used by the services. For example, there are radios that will be customized for ground vehicles, manpacks, aircraft, ships, and embedded in sensors and weapons systems.

Table 3: Three JTRS Development Options Presented in November 2005

Waveform	Option 1: Execute program within existing budget profile	Option 2: Transformational capability only	Option 3: Transformational plus some legacy capabilities
Legacy			
SINCGARS	✓		✓
EPLRS			✓
High Frequency			✓
Have Quick			✓
TADIL-J (Link 16)	✓	✓	✓
New			
Wideband Networking		✓	✓
Solider Radio	✓	✓	✓
Joint Airborne Network-Tactical Edge[a]		✓	✓
Mobile User Objective System[b] (or UHF SATCOM DAMA)		✓	✓
Additional fiscal year 2006–2011 development cost, in billions	NA	$1.8	$2.1
Total fiscal year 2006–2011 development cost, in billions	$1.9	$3.7	$4.0
Prior development cost (through fiscal year 2005), in billions	$1.5	$1.5	$1.5
Total development cost, in billions	**$3.4**	**$5.2**	**$5.5**

Source: GAO analysis of data provided by JPEO.

[a]A wideband waveform for airborne platforms.

[b]A waveform for a new satellite communication system that will provide low data rate voice and data communications capable of penetrating most weather, foliage, and manmade structures.

Note: NA = Not applicable.

DOD selected option 3, which establishes a priority for developing a networking capability mainly through the introduction of transformational wideband waveforms. Since future JTRS capabilities are still planned, option 3 also reflects an incremental approach to developing full JTRS capabilities. The initial option 3 increment is referred to as JTRS Increment 1.[10]

[10]Subsequent to the selection of option 3, DOD determined that the Have Quick waveform was not a priority and thus would not be included in the Increment 1 development effort.

To implement JTRS Increment 1, JPEO established a new organizational structure for JTRS that includes three domains and a program for "special radios." Table 4 summarizes the general management structure of JTRS after the program restructuring.

Table 4: Responsibilities of JPEO JTRS Domains

Domain	Responsibilities
Ground	Communications and networking capabilities for vehicles, dismounted soldiers, sensors, and weapons systems
Airborne, Maritime, Fixed Site	Communications and networking capabilities for aircraft, ships, and ground fixed site platforms
	A JTRS radio to replace the Multifunctional Information Distribution System terminals on selected platforms, including the F/A-18 aircraft
Network Enterprise	Waveforms, gateways, and common networking services solutions
Special Radios	JTRS Enhanced Multi-Band Intra-Team Radio used by Special Operations Forces

Source: GAO analysis of data provided by JPEO.

It is likely that the first users of operational JTRS radios will be Navy F/A-18 aircraft equipped with Multifunctional Information Distribution System-JTRS radios and Special Operations Forces using the JTRS Enhanced Multi-Band Intra-Team Radio. Initially, the radios will operate legacy waveforms only.

Delay in JTRS Development Has Required Investments in Other Radio Systems

From the start of JTRS development through the end of this year, DOD estimates that $11 billion has been required to buy other radio systems.[11] Of this total amount, $1.3 billion has been used in fiscal years 2005 and 2006 to procure SINCGARS radios to meet urgent operational needs in Iraq and Afghanistan. In addition, because of delays in the development of JTRS, several users depending on JTRS have had to make adjustments and procure interim radios to meet operational needs. For example, the Army

[11]In August 1998, shortly after the establishment of the JTRS program, the Office of the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence identified a need to stem the continuing efforts by the services to acquire unique radios and communications terminals. All component efforts to initiate any contracting activity related to the development and acquisition of any radio system were to be held in abeyance. However, service, command, or agency acquisition executives were allowed to submit requests for exceptions to the policy through the JTRS Joint Program Office. Eventually, the waiver process was suspended. As of May 2005, the services no longer had to request a JTRS waiver; they only had to notify the Assistant Secretary of Defense for Networks and Information Integration of plans to acquire non-JTRS radios to meet current operational needs.

is in the process of procuring radios for several of its existing helicopter platforms and a new development effort to outfit and equip individual ground soldiers. Since JTRS development will require at least several more years, it is likely that the estimated $11 billion investment in legacy radios will continue to grow. Table 5 shows the annual procurement amounts for radio systems other than JTRS from 1998 through 2006.

Table 5: Estimated Procurement Amounts Required for Other Radio Systems from 1998 through 2006 by Procuring Organization

Dollars in millions

Year	Army	Air Force	Marine Corps	Navy	Combatant commands and agencies	Total
1998	0	$7.74	0	0	0	$7.74
1999	$91.55	$19.25	$1.30	$1.28	$24.87	$138.25
2000	220.89	65.68	25.63	63.74	0.60	376.54
2001	142.72	4.00	0	72.79	1.52	221.03
2002	54.02	1.62	2.38	60.56	71.17	189.75
2003	199.99	78.66	51.07	49.94	0.30	379.96
2004	668.18	104.10	42.58	326.32	3.29	1,144.47
2005	1,564.52	2,289.17	314.43	368.79	0.75	4,537.66
2006	[a]	[a]	[a]	[a]	[a]	4,170.00
Total	**$2,941.87**	**$2,570.22**	**$437.39**	**$943.42**	**$102.50**	**$11,165.40**

Source: GAO analysis of data provided by DOD.

[a]DOD provided only a total estimate for 2006.

Program Restructuring Appears to Address Many Concerns with JTRS

The proposed JTRS restructuring approach appears to address past concerns with the program that GAO and others have documented in recent years. While still meeting the needs of key users such as Future Combat Systems, the revised approach is expected to develop and field capabilities in increments rather than attempting to develop and field the capabilities all at once. Costly and non-transformational requirements will be deferred to later increments. In addition, through the establishment of the JPEO and other structural changes, JTRS program management has been strengthened and has become more centralized. The centralized management structure should help the program control development costs and improve oversight through the coordination of standards, system engineering, and development of the radios and waveforms. A new governance structure is also expected to help ensure appropriate oversight and establish clear lines of accountability while, according to JPEO officials, the establishment of an information repository is expected to

help facilitate the delivery of waveform and operating system software to the radios' hardware developers. These efforts, if carried out, should help the restructured JTRS program address previous cost, schedule and performance problems. Table 6 summarizes the significant changes to the JTRS program as a result of the restructuring.

Table 6: Summary of JPEO-Initiated Changes to JTRS Program

Parameter	Pre-JPEO	JPEO
Management Structure	Decentralized	Centralized/Enterprise
Requirements Approach	Unconstrained (Big Bang)	Constrained (Incremental)
Program Milestones	Compressed	Expanded
Waveform Deliveries	Expansive	Reduced
JPEO Assessment of Program Risk	High	Moderate

Source: GAO analysis.

New Approach Emphasizes Developing Capabilities in Increments and Deferring Some Requirements

A central feature of the JTRS program restructuring is its evolutionary acquisition approach. The program plans to develop capabilities in increments rather than attempt to field a complete capability all at once, which was the previous approach. Specifically, the program plans to defer or reduce costly and non-transformational requirements to later increments. At the same time, the approach prioritizes the development of networking capabilities, primarily through the development of three networking waveforms, and the ability to interoperate with key legacy radios. These capabilities are critical to key dependent users such as the Army's Future Combat Systems and the implementation of DOD's vision of network centric operations warfare. Program officials noted several requirements that were reduced or deferred from the previous program to later increments:

- *Reduced number of waveforms:* The number of waveforms to be delivered for the first increment has been reduced from 32 to 11. The waveforms deferred to later increments are all non-networking legacy waveforms. Reducing the number of waveforms allows the program to focus the initial JTRS increment on developing and testing the critical networking waveforms as well as some of the more commonly-used legacy waveforms. In addition, the smaller number of waveforms reduces porting efforts.

- *Reduced number of radio variants:* The number of variants to be delivered for the first increment has been reduced from 26 to 13. For

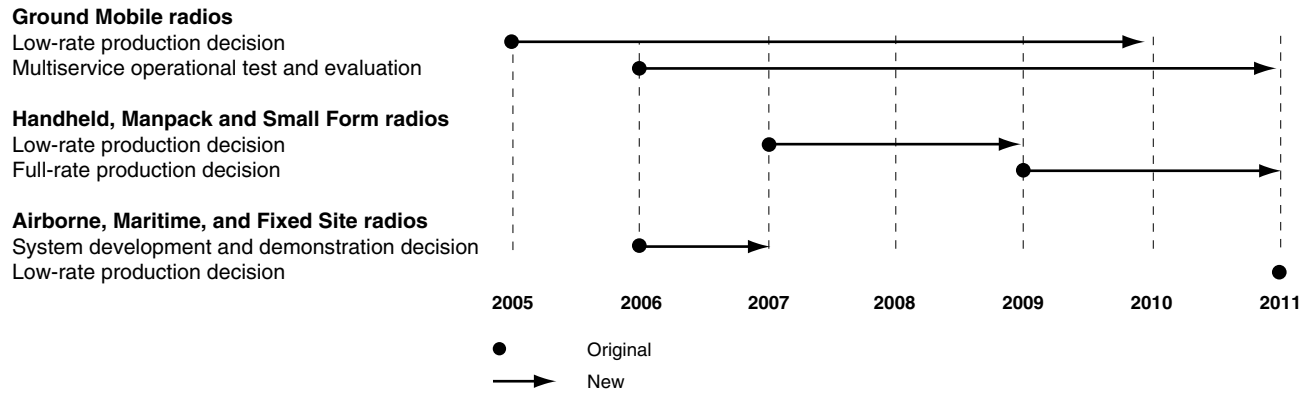
example, only 9 of the 15 small form radios will be developed for the first increment. Reducing the number of variants provides relief in the hardware design and platform integration work, allowing the program to focus the initial JTRS increment on developing the variants most critical to key dependent users such as the Future Combat Systems.

- *Reduced number of waveform combinations per radio variant:* The original intent of JTRS was that most waveforms would operate on most radio variants. However, DOD determined that porting 32 different waveforms onto 26 different variants would have been an immense and costly undertaking. In addition, operating numerous waveforms simultaneously on a JTRS radio would have substantially increased power demands. By reducing the number of waveform combinations per variant, program officials expect to both reduce porting efforts and more easily meet size, weight, and power requirements on some variants. In addition, program officials expect that reducing the number of waveforms operating on each radio will help to mitigate interference.

- *Interim solutions for network interoperability:* To achieve DOD's desired networking capabilities, the waveforms must be able to interoperate reliably and securely with each other. The optimal solution is to have this functionality performed inside JTRS radios as it reduces the overall footprint of the communication network. However, technologies and radio designs are not mature enough at this point to develop an interoperability capability that would function inside individual JTRS radios. Thus, for the initial increment, interoperability between the waveforms may be facilitated by developing gateway devices that reside outside of the JTRS radio. This should help developers mitigate integration challenges.

  While lesser capabilities will be delivered in the first increment, the program could still significantly enhance current communications and networking capabilities through the development of the networking waveforms and the ability to interoperate with the more commonly used legacy radios, such as SINCGARS. The incremental approach should also make the program more achievable by allowing more time to develop and test key technologies. Figure 2 shows the impact of the expanded schedule on Increment 1 product milestones. Despite the lengthened schedule, the program schedules are still intended to address the needs of key users depending on JTRS such as Future Combat Systems.

Figure 2: Impact of Restructuring on Product Schedules



Source: GAO analyses of JTRS doment.

JTRS Program Management Strengthened

With the creation of the JPEO, DOD has established a stronger, more centralized joint management structure. Under the new management structure, all JTRS domains—Ground; Airborne, Maritime, and Fixed Site; Special Radios, and Network Enterprise—report directly to the JPEO while the JPEO reports directly to the Under Secretary of Defense for Acquisition, Technology, and Logistics. As such, the JPEO controls development funding and has full directive authority over standards, systems engineering, and developing radios and waveforms. Such a comprehensive authority did not exist in the previous structure where authority was fragmented and the domains reported to individual service executives. Also, to facilitate more effective management, the JPEO has realigned various components of JTRS. Cluster 1 and Cluster 5 are now combined under the new Ground domain while the waveform development was placed under the newly established Network Enterprise domain. Meanwhile, DOD removed the Army helicopter requirements from the JTRS Cluster 1 program and transferred them to the Airborne, Maritime, and Fixed Site domain. With the new strengthened management structure, the program is in a better position to manage requirements growth and control costs.

A key feature of the new management structure is the new governance model which aims to streamline decision making and empower the oversight capacity of the JPEO. We previously reported that the existing

management structure had been unable to get the services to reach agreement over new and changing requirements expeditiously.[12] Under the prior structure, key decisions were made by consensus, which made it difficult to resolve interservice differences involving requirements and funding. This resulted in a lengthy decision-making process. Under the revised governance structure, stakeholder disagreements are elevated to and decided by a JTRS Executive Council and later by a JTRS Board of Directors, if necessary. The purpose is to make the acquisition process timelier, provide appropriate oversight, and establish clear lines of accountability.

Another key feature of the new management structure, according to JPEO, is ensuring greater information sharing among JTRS components takes place to better facilitate the delivery of waveform and operating system software to the radios' hardware developers. JTRS components depend on several software developers to deliver the required waveforms to their programs for integration onto their particular radios. This involves transfers of complex contractor-owned software code. Because waveforms are such an integral part of the radio's functionality, delaying their integration onto the radio's hardware could have a ripple effect on a radio's overall development. To mitigate this risk, the JPEO has established an information repository where waveform developers would place their waveform software code for the purposes of information sharing.[13] Operating system software code—critical to ensuring the development of a common software architecture—would also be placed in the repository. DOD intends to hold government-purpose rights to all of the software specifications in the repository, so that no single contractor will have complete control over JTRS software development. While the information repository is new and its usefulness is yet to be determined, it remains to be seen whether and to what extent the contractors will be willing to share their software code. If successful, the JPEO expects that information sharing will not only make available software code to hardware developers more timely, but will also contribute to technology innovation as developers attempt to enhance existing software code. In

[12]GAO, *Challenges and Risks Associated with the Joint Tactical Radio System Program*, GAO-03-879R (Washington, D.C.: Aug. 11, 2003).

[13]According to JPEO, while a library of completed waveforms was envisioned under the original JTRS management structure, the JPEO has implemented this concept by permitting incremental builds of software to be placed in the library. The library is now called the information repository.

addition, because the software will be shared with many different vendors, the JPEO expects to enhance competition among hardware developers. Furthermore, it is hoped that by developers reusing the same software code in the information repository, waveforms will be more standardized, cutting down on development and integration costs.

Program Uncertainties and Technical Risks Remain

While the restructuring appears to place JTRS in a better position to succeed, several management and technical challenges remain. The JPEO must first finalize the details of the restructuring, including completing formal acquisition strategies, independent cost estimates, and test and evaluation plans. DOD also needs to revise the Concept of Operations so that it effectively describes how JTRS networking capabilities will be used. Completing and obtaining DOD's approval of these activities is needed to ensure the program is executable. Over the longer term, the program faces key management and technical challenges that must be overcome. For example, although the new joint management structure for JTRS is a significant improvement over the previous fragmented program management structure, joint development efforts in DOD have often been hampered by an inability to obtain and sustain commitments and support from the military services and other stakeholders. Regarding technical challenges, developing waveforms and porting them to radio hardware is a complex and lengthy undertaking. The proposed interim technical solutions enabling network interoperability have also yet to be developed. In addition, operating in a networked environment open to a large number of potential users has generated an unprecedented need for information assurance. This need has resulted in a lengthy, technically challenging, and still evolving certification process from the National Security Agency. Moreover, integrating the radio's hardware onto diverse platforms and meeting respective size, weight, and power limitations has been a long-term challenge and remains so.

Details of the Restructuring yet to Be Finalized

According to program officials, efforts to complete the restructuring have taken time and delays have occurred in gaining approval to go forward. As such, important details of the restructuring have yet to be finalized. This includes completing acquisition strategies, independent cost estimates, test plans, and obtaining final approval of an amended operational requirements document. These activities are currently in the process of being completed. However, until each of these activities is completed and DOD ensures that requirements are firm, acquisition strategies are knowledge-based, cost estimates are realistic, and test plans provide insight into the achievement of the networking capability priorities, there

will be uncertainty as to whether the JTRS program, as restructured, is executable.

- *Operational Requirements Document:* An Operational Requirements Document contains the requirements and operational parameters for a system. The most recent JTRS Operational Requirements Document was approved in April 2003. To reflect the restructured approach of achieving JTRS requirements incrementally, it was necessary to develop an amendment to the April 2003 Operational Requirements Document. The process to develop the amendment has been led by the Joint Staff and involved input from the requirements community, the services, and other stakeholders; the Joint Requirements Oversight Council has provided oversight of the process. Through the process of developing the Operational Requirements Document amendment, some '"gaps" in requirements have been identified by some stakeholders. In particular, the proposed amendment to the Operational Requirements Document includes a requirement for certain JTRS sets to be able to interface with a new satellite system called the Mobile User Objective System. Some stakeholders, however, have identified a need for the manpack and handheld radios to also have this capability. According to agency officials, if the capabilities are deferred to later increments, then the Mobile User Objective System will have to consider options other than JTRS to meet its terminal requirements. Also, according to agency officials, the amendment process is nearly complete. The amendment to the JTRS Operational Requirements Document is awaiting final approval from the Vice Chairman of the Joint Chiefs of Staff.

- *Acquisition strategies:* Individual acquisition strategies need to be developed for each JTRS component. An acquisition strategy outlines the business and technical management approach to achieve program objectives within the constraints imposed by resources. A well–developed knowledge-based strategy minimizes the time and cost required to satisfy approved capability needs, and maximizes affordability throughout the program lifecycle.[14] Until the acquisition strategies are complete, there is less assurance that a well-developed and executable approach is in place. This could affect program cost estimates, and fielding plans. Furthermore, an acquisition strategy serves as the basis for other important activities such as testing plans and contract negotiations. As such, any delay in the acquisition strategy could have a ripple effect and delay these activities.

[14]Our past work has shown that systems without sufficient knowledge—stable requirements, mature technologies, and the funding needed to meet requirements—will take longer and cost even more than promised and deliver fewer quantities and other capabilities than planned.

- *Test and evaluation plans:* Plans for the overall structure and objectives of the test and evaluation program are also under development and need to be completed. Given the radio's unprecedented performance capabilities and technical complexity, it is critical that a well-developed test and evaluation plan be developed. Not only is the testing of individual radio components important, but testing the network with sufficient scale is critical to demonstrating transformational capabilities. At this point, it is not clear how DOD plans to test the entire JTRS network including interoperability between all the networking waveforms. The Director of Operational Test and Evaluation recommended that the Army develop a test and evaluation strategy that supports an evaluation of network maturity as part of Future Combat Systems' production.

In addition to the activities that JPEO needs to accomplish to finalize the restructuring, DOD also needs to complete its revisions to the Concept of Operations and determine transition and fielding plans for JTRS. According to JPEO officials, when JTRS development was first initiated, DOD envisioned replacing virtually all legacy radios with JTRS sets. Since then, there has been an evolution of thinking in DOD about networked operations. Although the Concept of Operations for JTRS has gone through several iterations, according to JPEO the current version does not effectively provide a joint vision of how JTRS networking capabilities will be used. How JTRS radios will be used may also be affected by the large increase recently in fielding thousands of newer versions of legacy radios. The recent fielding of so many new legacy radios to the current force may call into question the affordability of replacing them prematurely with JTRS sets. If sufficient detail is not provided by the Concept of Operations, then JTRS development efforts may be inadequate and operational goals may be unfulfilled. Moreover, if migration and fielding plans are not driven by an effective Concept of Operations, the production costs and quantities for JTRS may need to be adjusted.

Untested Management Structure

DOD has historically had difficulty managing joint programs primarily because of inter-service differences involving funding and requirements. To succeed, the new JTRS management structure will have to meet those challenges. According to DOD officials, obtaining the necessary resources to execute JTRS development will be one such challenge. The proposed funding arrangement is for the services to individually request and secure development funding that then gets rolled into a centralized account under JPEO control. As currently proposed, each service will fund equal shares unless there are service-unique development efforts, which would be funded by the proponent services. The services will also be required to

fund the integration of the radio into their respective platforms. Some agency officials expressed concern whether the services would have the budget capacity to fund integration once the radio sets were available for installation. Stakeholders also need to come to agreement on requirements by obtaining final approval of the amended Operational Requirements Document. If requirements are not thoroughly vetted through the various stakeholders and agreed upon, there is greater risk of future requirements growth or decreased stakeholder support for the program.

Regarding JPEO's new governance model, the decision-making model is untested. The JPEO expects the system development decision for the JTRS Airborne, Maritime, and Fixed Site product line to be decided through the new governance structure.

Program Continues to Face Significant Technical Risks

While the program has reported making progress in maturing technologies and stabilizing system designs, several technical challenges must still be overcome to achieve program success.

Waveform Development and Portability

The development of waveforms—particularly the networking waveforms—remains a technically challenging and lengthy effort. This effort involves complex software development and integration work by contractors as well as oversight by the government through a series of rigorous tests and certifications from various authorities, including the JTRS Technology Laboratory, National Security Agency, and the Joint Interoperability Test Command. If waveforms are not available as planned, potential schedule delays or performance impacts could occur to key dependent users, particularly the Future Combat Systems.

The JTRS program began with the assumption that the Wideband Networking Waveform would meet the networking waveform needs for all the services. However, the program underestimated the complexity of meeting the Wideband Networking Waveform requirements and the services' needs within the size, weight, and power constraints of the various user platforms. As a result, DOD began developing two additional networking waveforms to address specialized capabilities. The Soldier Radio Waveform is being designed for radios with severe size, weight, and power constraints such as the handheld, manpack, and small form radios. The Joint Airborne Network-Tactical Edge waveform is being designed to better enable time critical airborne operations. The networking waveforms are the core of the JTRS networking capability and their availability is crucial to the program's success. The three networking waveforms are in various stages of development:

- *Wideband Networking Waveform:* The Wideband Networking Waveform—designed for JTRS ground vehicle radios—is the farthest along in development of the three networking waveforms. Nevertheless, while initial functionality has been demonstrated through a contractor demonstration held in the summer of 2005, some technical challenges remain. The demonstration showed that ground mobile radios operated in a network with the Wideband Networking Waveform and were able to connect to the network as well as reconnected when the network was disrupted. However, the Wideband Networking Waveform also experienced various performance problems including limited data throughput, latency, and start-up time.[15] Program officials believe these performance problems have largely been corrected. Nonetheless, the demonstrated network linked only 4 users, far fewer than the required 250. In addition, program officials noted that meeting the Wideband Networking Waveform requirement for voice communications over a mobile ad hoc network remains challenging.

- *Soldier Radio Waveform:* The Soldier Radio Waveform is a low power, short range networking waveform optimized for radios with severe size, weight, and power constraints such as dismounted soldier radios and small form radios. Currently, the waveform is transitioning from a science and technology program.[16] Program officials expect to award a sole source contract in fiscal year 2007 for further development of the waveform. While the Soldier Radio Waveform has demonstrated some functionality, program officials noted that it will take significant effort to transition the waveform from a science and technology project to meet full operational requirements. In particular, program officials are concerned about the waveform's insufficient security architecture and how this may affect porting it onto a JTRS radio. Given these concerns, the waveform's development schedule may be ambitious. Future Combat Systems is the driver of near-term Soldier Radio Waveform requirements. The success of the first spin-out of Future Combat Systems is dependent on the delivery of the certified waveform ported to selected JTRS small form radios.

- *Joint Airborne Network—Tactical Edge:* The Joint Airborne Network—Tactical Edge is an extremely low latency networking waveform optimized

[15]Latency refers to the amount of time it takes data to travel from source to destination. Together, latency and bandwidth define the speed and capacity of a network.

[16]The Soldier Radio Waveform capability will leverage the Soldier Level Integrated Communications Environment program being developed as a science and technology project under the Army's Communications-Electronics Research, and Development and Engineering Center.

for airborne platforms. Like the Soldier Radio Waveform, the Joint Airborne Network—Tactical Edge is transitioning from a science and technology project and program officials expect to award a sole source contract in fiscal year 2006.[17] For Increment 1, the waveform will initially operate on a Multifunctional Information Distribution System—JTRS radio and will have limited capabilities. Program officials expect that it will be upgraded to full networking functionality in subsequent increments.

After waveforms are developed, they must be ported to radio hardware. According to agency officials, porting waveforms onto JTRS radios has been more technically challenging than originally expected. The intent of JTRS is that waveforms be highly portable meaning that waveforms can be transported and adapted to a variety of radio platforms at a cost lower than the cost of redeveloping the waveform again for a radio set with different hardware components. When waveforms are developed, the software code is designed to operate on a particular radio's hardware architecture. When the same waveform is transported to different hardware, changes to the software code may be necessary to ensure proper integration of the waveform onto the new hardware. The more costly the integration effort is, the less portable the waveform.

Although the JTRS Software Communications Architecture specifies design rules for waveform software to enhance portability across different hardware, the limited experience of porting waveforms thus far has shown significantly higher costs and longer schedules than anticipated. The JPEO noted that government direction and oversight as well as coordination between waveform, operating environment, and hardware developers needs improvement. Officials are also concerned about the porting of the networking waveforms being developed in science and technology programs to meet the full requirements for the Soldier Radio Waveform and the Joint Airborne Network-Tactical Edge waveform. To make this happen the waveforms will need to become compliant with the JTRS Software Communications Architecture, incorporate network management functions, and develop required security capabilities. Efforts to rework software to effectively transfer the waveforms, therefore, could result in cost and schedule problems.

[17]The Joint Airborne Network—Tactical Edge capability will leverage the Tactical Targeting Network Technology program being developed as a science and technology project under the Defense Advanced Research Projects Agency.

Interoperability of Networking Waveforms

The proposed interim technical solutions enabling network interoperability have yet to be developed. To achieve DOD's desired networking capabilities, waveforms must be able to communicate and interoperate with each other. However, technologies and radio designs are not mature enough at this point to develop an interoperability capability that would function inside individual JTRS radios. As a result, the program plans to meet network interoperability requirements for the initial increment through the use of gateways. A gateway is a separate node within a network equipped to interoperate with another network that uses different protocols. As such, key functions facilitating interoperability between waveforms may be performed outside of the JTRS radio rather than inside.

At this point, the JPEO is assessing different options to achieve the gateway function and anticipates that development will start in 2007. The JPEO expects that the development of the gateway will result in a separate acquisition decision but is uncertain as to whether it will be acquired through the forthcoming Airborne, Maritime, Fixed Site system development contract or through a separate contract. In addition, the JPEO is uncertain as to whether the gateway will be employed as a separate piece of hardware or whether it will leverage an existing radio in the network. According to JPEO officials, employing the gateway as a separate piece of hardware could result in additional size, weight, and power risks for some platforms. JPEO officials also noted that without a fully functioning gateway capability, users operating in separate networks will not be able to communicate directly with one another. For example, a ground soldier operating on a Soldier Radio Waveform with a handheld radio would not be able to call directly for fire support from an aircraft operating on the Joint Airborne Network—Tactical Edge Waveform with a Multifunctional Information Distribution System-JTRS radio.

Hardware Integration/Size, Weight, and Power

Integrating the radio's hardware onto diverse platforms and meeting their respective size, weight and power limitations remains a challenge. To realize full networking capabilities, the radios require 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 result of efforts to ensure electronic parts in the radio are not overheated.

While progress has been made in meeting the size, weight, and power requirements for the ground mobile radios, developers still face some challenges. The JPEO has already delivered 30 partially functioning prototype radios—built on production assembly lines—to the Future Combat Systems program. However, until the ground mobile radios

demonstrate greater Wideband Networking Waveform functionality—a key source of power consumption—using a fully functioning prototype, size, weight, and power concerns remain. The delivery of new power amplifiers that are currently being developed as part of a science and technology program by the Army's Communications—Electronics Research, Development and Engineering Center could help address these concerns. According to center officials, the power amplifiers are approaching maturity and have demonstrated significantly higher power output and improved efficiency over the current amplifier used on the ground mobile radios. The JPEO expects to begin receiving the new power amplifiers this September.

Meeting the requirements of the handheld, manpack, and small form radios continues to be the most challenging of all JTRS components because of their smaller size, weight, and power constraints. Program officials expect that the requirements relief provided through the restructuring should help to address size, weight, and power requirements. For example, the restructuring reduces the number of waveforms required to operate on each radio, which is expected to reduce power demands, thereby reducing the size and weight demands. In addition, like the ground mobile radios, the JTRS small form radios are also expected to benefit from the delivery of new wideband power amplifiers. However, these technologies are still maturing. Moreover, the handheld, manpack, and small form radio designs are not stable.

Security

The JTRS requirement to operate applications at multiple levels of security in a networked environment has resulted in significant information assurance challenges. Developers not only have to be concerned with traditional radio security issues but also must be prepared to implement the features required for computer and network security. One challenge is that military software defined radio technology capable of processing data at multiple security levels is immature. In addition, the requirement to operate in an open networked environment allows greater access to external networks increasing the number of potential users and the likelihood of threats to the network. These challenges will require the development of new technologies, obtaining certification through a rigorous process by the National Security Agency, and accommodating an expected growth in security requirements.

The complexities and uncertainties involved with JTRS security certification were illustrated when the National Security Agency determined that the design for the Cluster 1 radio was not sufficient to meet newly identified operational requirements from the Office of the

Secretary of Defense to operate in a networked environment. This resulted in the need for additional security requirements and significant hardware design changes to the radio's security architecture that ultimately resulted in significant cost increases. National Security Agency officials noted that one of the key lessons learned from the Cluster 1 experience was that security requirements need to be considered early in the development of the radio. As such, the JPEO has taken steps to better coordinate with the National Security Agency to meet security requirements. Specifically, the National Security Agency currently has a representative in each JTRS domain and participates in management reviews, design reviews, vendor technical exchanges, and weekly conference calls. The National Security Agency is also expected to be a member of the JTRS Executive Council and advisory member of the JTRS Board of Directors in the new JTRS governance structure. Both National Security Agency and JPEO officials noted that coordination and cooperation between the agencies has significantly improved since the JPEO was established. In addition, National Security Agency officials do not expect the other JTRS radios will encounter the same design problems experienced by the Cluster 1 radio as contractors now have a greater understanding of security requirements. Further, the restructured schedules for Ground domain radios appear to be sufficiently aligned to receive National Security Agency certification in time to meet the needs of Future Combat Systems. Nevertheless, because of the complex software encryption and networking requirements, security will continue to be a challenge for all JTRS components.

Spectrum Availability

JTRS radios will require considerable radio spectrum for effective operations especially when using the new networking waveforms that could operate within several different bands of radio spectrum. However, obtaining sufficient radio spectrum allocations is problematic because the program must compete with other military and civilian users. Radio spectrum in general is becoming more saturated and demand for spectrum is increasing. Efforts are underway by the JPEO to work through the required DOD spectrum certification processes; however, certification of software defined radios remains a challenge because, according to spectrum management officials, these processes were designed around hardware-based radios and may not fully support the certification of cutting edge technologies such as JTRS. DOD has recognized the shortcomings of the existing processes and has taken initial steps to address them. Most recently, DOD has worked with the National Telecommunications and Information Administration to stand up a permanent software defined radio working group that would study how to proceed.

Conclusions

U.S. military forces' communications and networking systems currently lack the interoperability and capacity DOD believes are needed to access and share real-time information, identify and react quickly to threats, and operate effectively as a joint force. JTRS is critical to providing the capabilities to support DOD's future vision of net-centric warfighting. Yet, since its inception, the JTRS development effort has struggled due to unrealistic cost, schedule, and performance expectations. As a consequence, DOD and the military services have had to make adjustments and acquire interim communications solutions to meet their near-term communications requirements.

The restructuring approach developed by JPEO and approved by DOD holds promise for delivering much needed communications capability to the warfighters. However, given the program's troubled development history, putting the approach into action will be a challenge and require strong and continuous oversight. Key details of the JTRS restructuring—including assurance that there are stable operational requirements, knowledge-based acquisition strategies for each domain's product lines, and effective test plans that reflect the priority of developing networking capabilities—must be finalized and approved by DOD. In addition, significant programmatic and technical risks—including further technology maturation, certification of waveforms and radios, and implementation of the new JTRS governance model—must still be overcome. Furthermore, detailed migration and fielding plans that are consistent with a well-developed concept of operations are needed to ensure an affordable and operationally effective use of JTRS radios in the future. Any manifestations of these risks will likely increase program costs, delay fielding, or reduce planned capabilities. To the extent JTRS delivers less capability than planned, future warfighting concepts may have to be altered as well as the design of weapons systems such as Future Combat Systems that are dependent on JTRS.

Recommendations

To enhance the likelihood of success of the JTRS program, we recommend that the Secretary of Defense:

- before approving the detailed program plans for each JTRS domain, ensure that they reflect stable and well-defined requirements; knowledge-based acquisition strategies; clear and meaningful test plans that address the need to not only test individual JTRS components but the overall networking capabilities of JTRS as well; and, funding commitments necessary to execute the program; and

- develop JTRS migration and fielding plans that are consistent with a well-developed concept of operations for using JTRS networking capabilities and effectively balances recent investments in acquiring legacy radios with future needs.

Agency Comments and Our Evaluation

In its letter commenting on the draft of our report, DOD agreed with our recommendations. DOD's letter is reprinted in appendix II. DOD noted that the report recommendations are consistent with the measures taken by the department to restructure the JTRS program, develop JTRS radios in an incremental manner, and effectively balance recent investments in legacy radios with future needs. While we acknowledge that DOD has taken measures to put the JTRS program in a better position to move forward, we continue to believe that additional measures, as outlined in our recommendations, are needed to ensure that the program will be successfully executed and achieve its intended objectives.

DOD also provided detailed comments, which we incorporated where appropriate.

We are sending copies of this report to the Chairmen and Ranking Minority Members of other Senate and House committees and subcommittees that have jurisdiction and oversight responsibilities for DOD. We will also send copies to the Secretary of Defense; the Secretaries of the Air Force, Army, and Navy; and the Director, Office of Management and Budget. Copies will also be available at no charge on GAO's Web site at http://www.gao.gov. If you or your staff have any questions about this report, please contact me at (202) 512-4841, or Assistant Director John Oppenheim at (202) 512-4841. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Major contributors to this report are listed in appendix III.

Paul L. Francis, Director
Acquisition and Sourcing Management

Appendix I: Scope and Methodology

To assess whether recent actions taken by DOD puts the JTRS program in a better position to succeed, we obtained briefings on restructuring assessments, plans, and decisions, analyzed documents describing Increment 1 requirements, and interviewed program and product officials from the Joint Program Executive Office, San Diego, California. To obtain the perspective of organizations that provide policy guidance, oversight, and technology support for the JTRS program, we interviewed officials from the Office of the Under Secretary of Defense, Acquisition, Technology, and Logistics, Arlington, Virginia; Office of the Under Secretary of Defense, Comptroller, Arlington, Virginia; Assistant Secretary of Defense, Networks and Information Integration, Arlington, Virginia; Office of the Director, Operational Test and Evaluation, Arlington, Virginia; Assistant Secretary of the Army for Acquisition, Logistics, and Technology, Arlington, Virginia; and, the Army's Communications-Electronics Research, Development and Engineering Center, Fort Monmouth, New Jersey.

To identify the risks that might continue to undermine the successful fielding of JTRS, we obtained and analyzed briefings from the JTRS Domain, Program, and Product Managers, as well as the JTRS Technical Director, San Diego, California. We also reviewed Selected Acquisition Reports, budget requests, acquisition decision memorandums, and the JTRS governance structure. We interviewed officials from the National Security Agency, Fort Meade, Maryland; Joint Interoperability Test Command, Fort Huachuca, Arizona; Defense Contract Management Agency, Anaheim, California; Project Manager for Future Combat Systems Network Systems Integration, Fort Monmouth, New Jersey; and, JTRS contractors in Arlington, Virginia and Anaheim, California.

Our review was conducted from August 2005 through August 2006 in accordance with generally accepted government auditing standards.

Appendix II: Comments from the Department of Defense

OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE
6000 DEFENSE PENTAGON
WASHINGTON, DC 20301-6000

NETWORKS AND INFORMATION INTEGRATION

29 August 2006

Mr. Paul L. Francis
Director, Acquisition Sourcing and Management
U. S. Government Accountability Office
441 G Street, N.W.
Washington, D.C. 20548

Dear Mr. Francis,

Thank you for the opportunity to respond to the Government Accountability Office (GAO) draft report, GAO-06-955, "DEFENSE ACQUISITIONS: Restructured JTRS Program Reduces Risk, but Significant Challenges Remain," dated August 1, 2006 (GAO Code 120470). The attached enclosure addresses some specific comments and observations made in the report. Below is our response to the GAO recommendations.

The Department agrees with both of the GAO recommendations. The GAO report and recommendations are consistent with the measures taken by the Department to restructure the JTRS Program, develop JTRS Radios in an incremental manner and effectively balance recent investments in legacy radios with future needs.

Thank you for the opportunity to respond to the GAO draft report. We appreciate the ongoing dialogue between the GAO and the DOD, and look forward to further interaction to ensure JTRS supports the best interests of the warfighter and the nation.

Sincerely,

for Ronald C. Jost
Deputy Assistant Secretary of Defense
(C3, Space and Spectrum)

Enclosure:
As stated

GAO-06-955

"DEFENSE ACQUISITIONS: Restructured JTRS Program Reduces Risk, but Significant Challenges Remain" (U)

DEPARTMENT OF DEFENSE DETAILED COMMENTS (U)

(U) The following is a detailed review of the GAO report on the JTRS Program, with specific explanations of DoD's concerns.

1. (U) What the GAO Found:, 2nd paragraph, lines 1 and 2: "JPEO must finalize the details of the restructuring, including completing an operational requirements document…"

(U) The Operational Requirements document has been completed, staffed and is awaiting VCJS signature of the approval JROCM, which is expected shortly.

2. (U) Results In Brief: Page 3, paragraph 2, line 4: "JPEO must finalize the details of the restructuring, including finalizing operational requirements…"

(U) The JTRS requirements community has come to agreement on Increment 1 requirements and has finalized the operational requirements for JTRS Increment 1. The JTRS JPEO has concluded that it can deliver Increment 1 requirements within its current budget within moderate risk to cost and schedule.

3. (U) JTRS Program Management Strengthened: Page 18, paragraph 1, states: "Under the proposed governance structure…."

(U) The JTRS Governance Process has been approved by USD/AT&L on August 1, 2006.

4. (U) Program Uncertainties and Technical Risks: Page 19, paragraph 1: "The JPEO must first finalize the details of the restructuring, including completing an operational requirements document..."

(U) The operational requirements document is complete and has been staffed through the JROC, attaining the concurrence of the Services. Final JROCM approval is awaiting VCJS signature which is expected in the near future (prior to final publication of the GAO report).

5. (U) Details of the Restructuring Yet To be Finalized, *Operational Requirements Document, states:* Page 20, paragraph 2: "The JPEO has drafted a modified version of the former Operational Requirements Document, which is currently being reviewed by various stakeholders."

(U) Development of Operational Requirements is the joint responsibility of the Requirements Sponsor with oversight from the Joint requirements Oversight Council. The JPEO does not have the responsibility nor authority to change operational requirements. Tasked by the JROC to lead

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the effort to defer/reduce JTRS Increment 1 requirements, the Joint Staff J6, in cooperation with the Army (JTRS Requirements Sponsor), JTRS Stakeholders and the JPEO drafted the amendment to the JTRS Operational Requirements Document. This amendment identifies Increment 1 requirements and defers other requirements to later Increments. As indicated in previous comments above, this ORD amendment is complete and awaiting final approval, which is expected in the very near future.

6. (U) Details of the Restructuring Yet To be Finalized, *Acquisition Strategies:* Page 22, paragraph 2: " Regarding JPEO's proposed governance model, the decision-making model is untested and has not been formally approved."

(U) The JTRS Governance Process has been approved by USD/AT&L on August 1, 2006.

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Appendix III: GAO Contact and Staff Acknowledgments

GAO Contact

John Oppenheim, Assistant Director, (202) 512-4841

Staff Acknowledgment

In addition to the contact above, Katherine Bittinger, Ridge Bowman, Karen Sloan, Amy Sweet, James Tallon, Tristan To, Hai Tran, and Paul Williams made key contributions to this report.

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