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Report to the Secretary of Defense

February 1988

COMMAND AND CONTROL

Upgrades Allow Deferral of $500 Million Computer Acquisition

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United States
General Accounting Office
Washington, D.C. 20548

Information Management and
Technology Division

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The Honorable Frank Carlucci
Secretary of Defense

Dear Mr. Secretary:

The World Wide Military Command and Control System Information System is approaching a critical acquisition milestone. This report focuses on a key decision you will make at that milestone: when to replace the existing joint mission computer systems at a base year estimated investment cost of $500 million. This report also discusses steps you can take to ensure the investment is made wisely.

The report contains recommendations to you in chapter 5. As you know, 31 U.S.C. 720 requires the head of a federal agency to submit a written statement on actions taken on our recommendations to the House Committee on Government Operations and the Senate Committee on Governmental Affairs not later than 60 days after the date of the report. A written statement must also be submitted to the House and Senate Committees on Appropriations with an agency's first request for appropriations made more than 60 days after the date of the report.

We are sending copies of this report to the Chairmen of the above Committees; the Director, Office of Management and Budget; and the Chairmen of the House and Senate Committees on Armed Services.

Sincerely yours,

Ralph V. Carlone

Ralph V. Carlone
Director

Executive Summary

Purpose

The World Wide Military Command and Control System includes personnel, facilities, and equipment that directly support the President and military commanders in the joint mission planning and control of conventional United States military forces. The Department of Defense has been upgrading and replacing the computer hardware and software that supports the system, through a $2.3 billion modernization program. In March 1988, Defense will decide whether to procure new computer systems, estimated to cost about $500 million, to replace existing ones at 35 sites from 1989 through 1991.

GAO reviewed this modernization program to assess the adequacy of the justification for the estimated $500 million acquisition of new computer systems in view of improvements made or planned through upgrades to the existing computer systems.

Background

The computer hardware used for the system originally was acquired during the 1970's. Defense recognized in 1982 that the computer hardware and software needed to be improved significantly. At that time, Defense began its modernization program, which had as a basic premise that the existing computer systems had to be replaced with new state-of-the-art computer systems.

Recognizing that this replacement would not occur for several years, Defense began in 1983 to upgrade its existing computer hardware and software. Through December 1986 Defense spent about $105 million on these upgrades and plans to spend about $50 million more through fiscal year 1989.

Results in Brief

GAO believes that the planned $500 million acquisition of new computer systems is not justified because the upgrades Defense has made and plans to make will correct six of seven deficiencies identified. The seventh deficiency will not be corrected by upgrades and cannot be corrected through the planned replacement. Further, postponing this acquisition would permit Defense to make the analyses and evaluations federal guidelines require before new computer systems are acquired.

Principal Findings

Underlying Defense's 1982 decision, reaffirmed in 1985, to replace the existing computer systems with state-of-the-art systems were seven deficiencies Defense identified. GAO found, however, that six of these deficiencies, ranging from problems of aging computer hardware to inadequate expansion capability, will be corrected by the completed or planned upgrades. In fact, because the upgrades involve both computer hardware and software, the upgraded computer systems will be very

similar to current computer technology. Further, although Defense has identified a need for important new joint mission capabilities that may warrant replacing the upgraded computer systems, the system requirements for these capabilities have not been defined. The upgraded systems should meet all defined requirements to at least 1996 and have significant expansion capabilities for undefined requirements. If the new joint mission capabilities justify the acquisition of new computer systems, the planned acquisition could be deferred from fiscal year 1989 to at least fiscal year 1992.

The remaining deficiency, not corrected by the upgrades, relates to system security. Personnel with no clearance or clearances other than top secret are prohibited from using computer resources that are processing top-secret information, because doing so would risk compromising sensitive information. In GAO's view, however, the security deficiency does not justify purchasing new computer systems because: (1) the security capability of any new computer system now available commercially will not correct the deficiency; (2) a limited capability, proposed by Defense to provide secure access by a second level of cleared personnel, would not be commercially available until the 1990's; and (3) the expenditures to develop this limited capability have not been justified. Furthermore, Defense does not have a basis to assess whether new computer systems would improve system security, because it has neither determined how security shortfalls of the current systems will be corrected by new systems, nor established a security policy and requirements for new systems.

If Defense were to postpone acquiring the new computer systems, it could use the time to (1) define computer system requirements for supporting important new joint mission planning and execution capabilities; (2) establish a security policy, define security requirements, and explore alternative approaches for meeting these requirements; and (3) establish a computer performance measurement and capacity planning program to help guide future computer system upgrades or replacement decisions.

Recommendations

GAO recommends that the Secretary of Defense defer the planned $500 million acquisition of new computer systems until:

- Requirements for the new joint mission planning and execution capabilities are defined and approved.
- A security policy is established, security requirements are defined, alternatives for implementing the requirements are evaluated, and the most cost-effective means of meeting security requirements are selected.

- A computer performance evaluation and capacity planning program is established to (1) measure system performance against Defense standards, (2) identify future needs for computer system resources, and (3) project when the current computer systems can no longer provide cost-effective support.

GAO makes other recommendations concerning requirements and computer performance. (See ch. 5.)

Agency Comments

The Department of Defense concurred with all of the recommendations and generally agreed with GAO's findings. The report contains an evaluation of the Department of Defense comments. (See ch. 5.)

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Abbreviations

DOD	Department of Defense
GAO	General Accounting Office
IMTEC	Information Management and Technology Division
JOPES	Joint Operation Planning and Execution System
WIS	World Wide Military Command and Control System Information System
WWMCCS	World Wide Military Command and Control System

Introduction

The World Wide Military Command and Control System (WWMCCS) consists of personnel, equipment, communications, facilities, and procedures used to plan, direct, coordinate, and control operational activities of United States military forces. It includes the command and control systems and related management information systems used by the headquarters of military departments, service commands, Department of Defense (DOD) agencies, and unified and specified commands.

WWMCCS is intended to provide the National Command Authorities (the President and the Secretary of Defense or their successors) a capability to (1) receive warning and intelligence information, (2) apply the resources of the military departments, (3) assign military missions, and (4) provide direction to unified and specified commands. It is also intended to support the Joint Chiefs of Staff and other key military commanders in carrying out their responsibilities. WWMCCS is used by the National Command Authorities and key military commanders for operations ranging from day-to-day activities to crises.

A major component of WWMCCS consists of 58 Honeywell computer systems that support force status and readiness monitoring, plan development, and command activities for United States conventional (nonnuclear) military forces (Air Force, Army, and Navy). Computer systems at 27 sites are included in a worldwide network directly accessible to National Command Authorities that supports information processing requirements for DOD's joint mission, as well as those for service- and command-unique applications. These WWMCCS joint mission computer systems originally were acquired during the 1970's and have since undergone numerous upgrades.

WWMCCS Information System Modernization Program

DOD analyses of WWMCCS computer systems during 1976 through 1980 indicated that the computer hardware and software needed to be improved significantly. DOD considered various approaches to accomplish this improvement and, in July 1982, decided to acquire new computer systems and to modernize application software.

The WWMCCS Information System (WIS) modernization program objectives include (1) replacing WWMCCS computers with state-of-the-art computers at 35 sites, (2) developing application software to support operational requirements established by the Joint Chiefs of Staff, and (3) making maximum use of commercially available computer hardware and software to minimize development costs and technical risks. The new WIS computer systems were also expected to be easier to use than the existing systems, and to improve security controls to allow users with secret clearances to use the computer systems without compromising top-secret data and applications.

The Chief of Staff, United States Air Force, was designated the executive agent for the WIS modernization. A WIS joint program manager was made the focal point for coordination and control of all WIS modernization activities. The Joint Chiefs of Staff were to provide the joint program manager with policy guidance and validated joint operational requirements. Development and acquisition management was to be carried out under the joint program manager's direction by a system program office established at the Air Force Systems Command's Electronic Systems Division.

In May 1984, the Defense Systems Acquisition Review Council evaluated the WIS modernization program strategy. The council agreed that WIS should be developed in clearly defined and costed phases, designated as blocks A, B, and C, and that each block would require council review and approval to proceed into full-scale development. This council was replaced earlier this year by the Defense Acquisition Board.

In September 1985, the Secretary of Defense granted approval for the Air Force to proceed with system design for all WIS blocks, and into full-scale development of block A capabilities. Capabilities now being developed and acquired in this block include (1) an automated message handling system to improve controls over message receipt, preparation, and dissemination; (2) computer workstations to provide data processing in user work areas; and (3) a local area network to connect computer systems, automated message handling systems, and workstations.

The DOD decision-coordinating paper that accompanied the Secretary of Defense's 1985 decision identified deficiencies of the then existing joint mission computer systems and reaffirmed DOD's intent to replace them in block B. DOD's plans for block B include (1) competitive procurement of new computer systems to replace the existing computer systems that are now being upgraded, (2) development of new application software to consolidate three existing applications, (3) procurement of a data base management system, and (4) development of improved security controls over access to information.

The WIS block B review to approve full-scale development, to be made by the Defense Acquisition Board, is scheduled for March 1988. The major decision to be made is whether the WIS program should proceed with a procurement to replace the upgraded computer systems. In 1985 DOD estimated this procurement would cost over $500 million in fiscal year 1982 dollars (and over $750 million in the dollars for the years in which the expenditures would be made). If the acquisition of new WIS computer systems is approved as planned, contract award will occur in the third

quarter of fiscal year 1989[1] and the new systems will be installed over a 2-year period beginning in the fourth quarter of fiscal year 1989 and ending in the fourth quarter of fiscal year 1991.

Block C will focus on enhanced joint mission planning and execution functions and improved interfaces to non-DOD agencies and North Atlantic Treaty Organization systems. DOD has not set a date for the Defense Acquisition Board to review WIS block C and determine whether to proceed.

In December 1986, DOD estimated the total WIS modernization program would cost about $2.3 billion ($0.7 billion for block A and about $1.6 billion for blocks B and C) through fiscal year 1993. A schedule to complete the program has not been established, and is contingent on DOD decisions on WIS blocks B and C.

Joint Operation Planning and Execution System

The primary application software developed in WIS blocks B and C will be the Joint Operation Planning and Execution System (JOPES). This system is intended to improve all aspects of conventional joint operation planning and execution. WIS is the modernization of the WWMCCS computer systems, which will support the data processing requirements of JOPES.

JOPES will integrate conventional planning, execution, resource, and unit monitoring information management in order to plan for and execute the mobilization, deployment, employment, and sustainment of military forces and resources. JOPES will be developed and implemented in increments. Increment I will modernize and integrate several data processing applications now being supported by WWMCCS computer systems. The main focus now is the integration of the Joint Deployment System, the Joint Operation Planning System, and portions of the Unit Status and Identity Report System.

JOPES Increment I, being developed now, is to be supported, beginning in the first quarter of fiscal year 1991, by the upgraded WWMCCS computer systems. JOPES Increment II will provide additional automated support for joint command and control, and is critical to DOD's goal to improve the command and control of military forces.

[1]The most recent Selected Acquisition Report, dated December 31, 1986, establishes the contract award milestone as June 1988. The joint program manager has since deferred this milestone to the third quarter of fiscal year 1989.

Interim Upgrades to WWMCCS Computer Systems

Because the WIS modernization was expected to be a long-term effort, DOD began making upgrades to the existing computer systems in fiscal year 1983. These upgrades, for which DOD currently expects to spend about $155 million, were seen as providing immediate solutions for the computer systems' information processing shortfalls. DOD believed these upgrades could not satisfy long-term needs for users. Through December 1986, DOD had spent over $105 million for new computer hardware. DOD anticipates spending an additional $26 million for new operating system software to control the computer hardware, and $24 million for computer hardware, through fiscal year 1989 as part of this upgrade program.

Objective, Scope, and Methodology

We reviewed the WIS modernization program to assess the adequacy of the justification for the $500 million acquisition of new computer systems in view of the improvements made or planned through the upgrades to WWMCCS computer systems. To accomplish our objective, we evaluated recent improvements made or planned to WWMCCS computer systems to determine whether the upgraded systems could meet defined user requirements. We also evaluated DOD's rationale and analyses for the $500 million acquisition. We examined the scope of WIS block B to determine whether the achievement of block B capabilities is dependent on new computer systems. A limited review of block A progress and problems has been separately reported.[2]

In reviewing DOD's decisions and plans, we used, in part, DOD Directive 5000.1, "Major System Acquisitions." This directive states that the acquisition of a new system may result from (1) an identified deficiency in an existing capability, (2) a decision to establish new capabilities in response to a technologically feasible opportunity, (3) a significant opportunity to reduce the system life cycle cost, or (4) a response to a change in national defense policy. The directive further states that the development of a new system may be undertaken only after assessment of alternative system concepts, including the feasibility of upgrading the existing system.

Our audit was conducted between December 1985 and August 1987. We analyzed reports, records, and studies on the performance and capabilities of the current WWMCCS computer systems; WIS modernization program planning documents; and WIS development contracts. We interviewed DOD officials in the Office of the Joint Chiefs of Staff,

[2]DOD Acquisition Programs: Status of Selected Systems (GAO/NSIAD-87-128, April 1987).

Washington, D.C.; the WIS Joint Program Management Office, McLean, Virginia; the Defense Communications Agency in Washington, D.C.; the Joint and Air Force WIS system program offices in Bedford, Massachusetts; the Army WIS project management office, Fort Belvoir, Virginia; and the Joint Deployment Agency, Tampa, Florida. We obtained information from and interviewed officials at the National Security Agency, Baltimore, Maryland, and at the headquarters locations of the following WWMCCS joint mission computer system users: United States Army Forces Command, Fort McPherson, Georgia; Strategic Air Command, Omaha, Nebraska; Tactical Air Command, Hampton, Virginia; United States Atlantic Command and Atlantic Fleet in Norfolk, Virginia; United States European Command, Stuttgart-Vaihingen, Germany; United States Air Force, Europe, Ramstein Air Force Base, Germany; and United States Army, Europe, Heidelberg, Germany. We also interviewed Honeywell Federal Systems Division contractor personnel responsible for maintaining and providing products to upgrade the current WWMCCS computer systems.

Our review was performed in accordance with generally accepted government auditing standards.

Upgrades Have Corrected Nearly All System Deficiencies

A basic premise of the WIS modernization program, since its inception in 1982, has been that WWMCCS computer systems needed to be replaced with state-of-the-art systems. Underlying this premise have been seven deficiencies in the computer systems, identified by DOD in 1982 and 1985, which DOD planned to correct through a $500 million acquisition of new computer systems. Those deficiencies are:

- difficulty in maintaining aging computer hardware;
- difficulty in maintaining customized operating system software;
- lack of a data management capability;
- inadequate computer system availability;
- inadequate computer system response time;
- inability to expand to support defined application requirements; and
- inability to meet multilevel security requirements.

Our analyses show, however, that the upgrades DOD has made since 1983, or plans to make soon, will resolve all of these deficiencies except for the inability of the computer systems to meet multilevel security requirements. Problems associated with security requirements are discussed in chapter 3. We found that the upgraded computer systems can meet defined application requirements to at least 1996. Moreover, we found that even if Increment II of JOPES requires a computer system replacement, the earliest that DOD could award a contract based on well-defined requirements would be late fiscal year 1992. Therefore, DOD can defer its currently planned fiscal year 1989 acquisition of new computer systems without jeopardizing mission support.

Upgraded Computer Hardware Is Maintainable

In 1982, DOD believed it had a choice of continuing to operate and maintain obsolete computer systems that would not be supported by the manufacturer, or acquiring upgraded capabilities that would be fully supported by the vendor. DOD analyzed the alternatives available to meet users' operational needs until the computer systems could be replaced under the WIS modernization program. On the basis of this analysis, DOD decided to upgrade WWMCCS computer systems.

DOD spent about $105 million between 1983 and 1986 to upgrade WWMCCS computer systems. With these upgrades, and an ongoing $26 million acquisition of Honeywell's most current operating system software, DOD will have computer systems that can continue to be maintained by the vendor and are very similar to Honeywell's current computer systems. DOD plans to spend an additional $24 million for hardware upgrades through 1989.

Although DOD's contract with Honeywell for maintenance of the upgraded computer systems will expire in 1991, Honeywell has contracts with other federal agencies for similar systems that extend into 1993 and beyond. Honeywell's WWMCCS contracting manager told us that Honeywell would be willing to negotiate a contract to support the upgraded computer systems through the year 2000. Therefore, we believe DOD can obtain maintenance support several years beyond the current contract's expiration date.

Upgraded Operating System Software Can Be Maintained

By 1982, Honeywell had announced its intention to phase out maintenance and support for the operating system software used by WWMCCS computer systems. This support was expected to be discontinued by January 1986, at which time DOD would be faced with full maintenance and future costs for enhancements to the operating system software. DOD anticipated that development, maintenance, and documentation of WWMCCS-unique operating system software could become increasingly more expensive, time consuming, and difficult to continue.

Because of this concern, DOD completed an economic analysis of WWMCCS operating system software in 1984. It compared the trade-off between continuing to enhance and maintain the existing operating system software and obtaining new software. This analysis concluded that obtaining new operating system software was warranted.

In February 1987, the Honeywell computer system contract was amended, at a cost of about $19 million, to acquire the new operating system software for use on the upgraded WWMCCS computer systems. DOD expects to begin the conversion to the new operating system software during fiscal year 1988. The life cycle for this new software has been projected by DOD to extend through 1996 and beyond. The contract to support this software extends through September 1991. However, Honeywell's WWMCCS contracting manager told us that Honeywell would be willing to negotiate another contract to support the new operating system through the year 2000.

The commercial version of the new operating system software that has been acquired by DOD has incorporated some security controls and other features that were formerly unique to WWMCCS. Operating system software that supports the interchange of information for WWMCCS computer network systems will become a standard commercial offering to DOD customers. A larger number of users and the vendor will now be responsible for identifying and correcting any problems with the software. Thus, WWMCCS users will no longer bear the entire cost of maintaining features that were previously unique to WWMCCS.

In June 1986, a $7 million contract was awarded to Honeywell to incorporate the remaining WWMCCS-unique features needed in the new operating system. Under this contract Honeywell will incorporate these features in future versions of the operating system at no cost to the government. The current operating system contract has no such provision. Consequently, the difficulty and cost of maintaining a customized operating system should be less with the new operating system software than if DOD had continued with the old operating system software.

Upgraded Computer Systems Will Support a Commercially Available Data Management Capability

Another shortfall of WWMCCS computer systems was the lack of an effective data management capability to enable users to easily search for, retrieve, and summarize desired information. This shortfall was particularly acute in regard to the ability to quickly develop operational plans requiring rapid access to data bases.

One of DOD's objectives for the computer systems it plans to acquire is the support of a commercially available data base management system. This system would include a relational capability that supports a user-query language.[1] DOD expects that this data base management capability would be able to support identified requirements.

We found, however, that it is not necessary for DOD to procure new computer systems to achieve this capability. DOD plans to acquire a Honeywell relational data base management system for the upgraded computer systems. According to Honeywell, this data base management system will support a user-query language. On the basis of a WIS Joint Program Management Office analysis, this data base management system will satisfy the requirements of JOPES Increment I.

Upgraded Computer System Availability Is Adequate

In 1985, DOD expected computer system availability to decline and make system support unacceptable for either periods of crisis or day-to-day operations. However, our analysis of computer system availability from April 1985 to March 1987 shows that WWMCCS computer system availability rates during simulated crisis and day-to-day operations have been generally meeting or exceeding the standards established by the Joint Chiefs of Staff. The details of our analysis are classified, so the actual availability standards and percentages are not discussed in this report.

[1] A relational data base management system allows users to retrieve information from a data base by specifying in discrete queries the attributes of the information sought (for example, units ready for deployment to a specific location).

Availability standards are expressed as the percentage of time a site's computer system should be usable during day-to-day or crisis operations. The standards do not specify the period of time over which usability is to be measured. Our analyses used system availability percentages for the shortest period that complete data were obtainable—either one quarter of a fiscal year or one Joint Chiefs of Staff exercise (from 10 to 14 days). These exercises periodically test the computer systems under simulated crises. During exercises, the computer systems simultaneously support both exercise and day-to-day work loads.

We compared computer system availability during the four exercises since April 1985 with the availability standard for crisis operations established by the Joint Chiefs of Staff. In all four exercises, each of the National Command Authorities' sites (two at the National Military Command Center, one at the Alternate National Military Command Center, and one at the Operational Support Facility) met the Joint Chiefs of Staff standard. Further, in each exercise no more than four other sites in the network[2] fell short of the availability standard for crises.

Joint Chiefs of Staff officials, who manage the WWMCCS computer network for the National Command Authorities, compare computer system availability from one exercise to the next on a network-wide basis to assess computer system availability. Network availability in each of the four most recent exercises exceeded the Joint Chiefs of Staff computer system availability standard for crises.

To determine availability during day-to-day operations, we compared computer system availability for the eight quarters ending in March 1987 with the Joint Chiefs of Staff standard. We found that on a quarterly basis, all of the National Command Authorities' sites met the Joint Chiefs of Staff standard. Further, no more than three of the other network sites measured below this standard in any one quarter. We also found that for the WWMCCS computer network as a whole, the average quarterly availability of network sites always exceeded the Joint Chiefs of Staff standard.

On the basis of our analysis and information provided by DOD management officials, in those cases where crisis or day-to-day availability standards were not met, operational and environmental factors—and not the upgraded computer systems—were the cause. Both Joint Chiefs of Staff and Defense Communications Agency officials responsible for managing the WWMCCS computer network believe that computer system availability is currently adequate. A Joint Chiefs of Staff official

[2]During the first two exercises the network contained 25 sites. There were 27 sites in the network for the two most recent exercises that we reviewed.

responsible for defining user requirements told us that the current WWMCCS need is for a more user-friendly system, not increased computer system availability.

Upgraded Computer Systems Correct Response Time Deficiencies

During the 1970's and early 1980's, the WWMCCS computer systems were criticized because they did not provide timely support for user information requests. In March 1985, DOD recognized that its ongoing program to upgrade WWMCCS computer systems would have the effect of improving system availability and response time. Response time is defined as the time required for a computer system to provide an answer to a user's information request (query) at the user's terminal. DOD identifies two types of WWMCCS queries: simple and complex. By definition, complex queries can take up to 24 times as long to process as simple queries. In 1985, DOD stated that simple queries were requiring 2 to 3 minutes and complex queries were requiring 15 to 20 minutes. DOD noted, however, that this performance information was complicated by the ongoing upgrade of the systems and the fact that conditions under which the performance data were gathered were less than carefully controlled. The limited actual data available show that the deficiencies in computer system response time reported by DOD in 1985 no longer exist. Further, the upgraded computer systems may already be meeting the future WIS response time goals.

The WIS Joint Program Manager has established response time goals for blocks B and C of the WIS modernization program, with different sets of goals for crisis (or exercise) and day-to-day operations. In blocks B and C, the goals are to complete 95 percent of simple queries within 5 seconds during a crisis and within 10 seconds during day-to-day operations. The goals are to complete 95 percent of complex queries within 3 minutes for crisis operations and 5 minutes for day-to-day operations.

Crisis Response Times

Data from the primary WWMCCS site, the National Military Command Center, for the two most recent exercises show that response times for queries (both complex and simple) on the existing computer system met the complex query goal for crisis operations (3 minutes or under), and over 80 percent of the queries met the simple query goal for crisis operations (5 seconds or under). For two reasons, we believe it is possible that the primary site is meeting the WIS blocks B and C goal that responses to 95 percent of simple queries require less than 5 seconds. First, the computer system response time data provided to us reflect a combination of both the simple and the more time-consuming complex queries, because DOD has not developed a methodology for measuring response time by type of query. If the complex queries were removed from the response

time data so that the simple queries could be measured, we would expect to find that a higher percentage of the simple queries would have actually met the 5-second criterion.

Second, the primary site work load was not limited to crisis simulation during the exercises. Day-to-day applications and exercise applications were performed on the computer system simultaneously. We would expect that the measured computer system response time would improve if the work load were limited to those activities directly related to the exercise, because more of the computer system resources would be available to support the exercise work load. Thus, we believe current response time at the primary site could be meeting the WIS modernization goals for both simple and complex queries under crisis (or exercise) operational conditions. Similar data were not available to determine crisis (or exercise) operation response times for other WWMCCS network sites.

Day-To-Day Response Times

We also reviewed the available computer system performance evaluations performed at the WWMCCS computer network sites over the past 2 years. Only 12 WWMCCS sites, other than the primary site, reported measuring computer system response time during this period. The primary site did not provide us with day-to-day response time data. WWMCCS sites are not all staffed to measure computer system response time and there is no central WWMCCS location that collects what response time data are produced. Only 8 of the 12 sites provided response time data for our analysis. Five of these sites reported average computer system response times of about 3 to 7 seconds. The other 3 sites reported that over 85 percent of queries were within 7 seconds. As with the primary site's data, these computer system response times include time to respond to the complex queries. In light of these data, we believe the previously reported deficiencies no longer exist and the response times may be meeting the WIS blocks B and C goal for simple queries under day-to-day operational conditions (10 seconds or under).

Finally, system response times are expected to improve with the continuing upgrade of the current WWMCCS computer systems. A preliminary analysis by the Joint Deployment Agency of upgraded computer system performance, using the new operating system and additional memory, projects a substantial reduction in response times. Further, potential system expansion, as well as implementation of computer system performance management activities discussed in chapter 4, could permit attainment of WIS goals at all sites and improvement of system response times.

Upgraded Computer Systems Will Support Defined Application Requirements and Can Be Further Expanded

One of the stated deficiencies was that WWMCCS computer systems could not be expanded to support defined application requirements. Our review showed that the upgraded WWMCCS computer systems can support all defined computer system requirements to at least 1996. Moreover, these systems can be further expanded, if needed, to support unforeseen requirements. New capabilities to be provided by JOPES Increment II will not likely be ready for deployment until at least fiscal year 1994.

All Defined Requirements Are Supportable on the Upgraded WWMCCS Computer Systems

DOD analysis that preceded the WWMCCS computer system upgrades indicated that the upgraded system would meet operational requirements. DOD projected that the upgraded computer systems would provide a 66 percent increase in processing speed and provide additional residual capacity to better support peak work loads encountered during crises or exercises, without requiring the acquisition of additional system components. In 1986, the WIS Joint Program Manager studied alternatives available for support of JOPES Increment I, and concluded that it could be supported on the upgraded computer systems and then later moved to the new WIS computer systems. Since the life cycle of the upgraded systems extends to at least 1996, and JOPES Increment I can be fully supported on these upgraded systems, all currently defined joint mission requirements are supported to at least 1996.

If new computer systems were procured in 1989, as planned, the current systems would continue to be used until fiscal year 1992 when JOPES Increment I will be installed on the new computer systems. Therefore, any identified or unforeseen requirements between now and fiscal year 1992 would have to be met by the upgraded computer systems, regardless of whether, or when, DOD acquires new computer systems.

At our request, DOD surveyed the 27 sites on the WWMCCS computer network to identify any documented future needs for additional computing resources that would meet anticipated work load growth. This survey was conducted in the context of our determining whether buying new computer system resources in WIS block B was necessary. Some sites' responses indicated that they will require additional memory to accommodate the new operating system software. However, no sites provided analyses that indicated a future need for additional processors, memory, mass storage, or other peripheral devices. Officials at one site told us that they have budgeted for added mass storage devices in fiscal years 1988 and 1990, though they did not provide an analysis of this need.

An analysis of 1985 data by the Defense Communications Agency confirmed the need for additional memory for the new operating system

software and also identified memory shortfalls for supporting the Joint Deployment System—a current WWMCCS software application program to be replaced by JOPES Increment I. DOD plans to have the operating system software ready to be distributed to the sites in 1988. On the basis of our analysis, we estimate that the current computer systems can be upgraded to meet all defined requirements to at least 1996.

New Capabilities for the Primary Application Will Not Likely Be Ready for Deployment Until at Least Fiscal Year 1994

Increment II of JOPES is supposed to provide many additional functions for joint mission command and control and is critical to attaining DOD's goal for overall improvement of the command and control of conventional military forces. DOD has goals to reduce the time required to develop operation plans from 18 through 24 months to 45 days, and to develop operation orders within 3 days. JOPES documents show that automated support of mobilization plans and schedules is necessary to attain these goals. However, JOPES Increment I will not provide such support.

The Joint Chiefs of Staff have a responsibility to advise the National Command Authorities on mobilization, but the only current automated support rests with the stand-alone systems of the military departments. Mobilization requires aggregating data for decisionmakers. However, this capability will not be provided until JOPES Increment II. Therefore, it is unlikely that DOD's goals can be reached without JOPES Increment II.

A determination of requirements for JOPES Increment II and approval by the Joint Chiefs of Staff have not been performed. On the basis of DOD estimates, the approval most likely will not be completed until fiscal year 1991, or later. If development of JOPES Increment II takes the same time estimated by DOD for JOPES Increment I, the earliest that Increment II could be available for deployment would be the first quarter of fiscal year 1994.

If JOPES Increment II requires new computer systems, however, we estimate that the earliest DOD could award a contract for such systems would be late fiscal year 1992. Using DOD's current estimate for the time required to install new computer systems, we believe the earliest that JOPES Increment II could be deployed on new computer systems would be in early fiscal year 1995.

Upgraded Computer Systems Have Substantial Expansion Potential to Meet Unexpected Needs

The upgraded WWMCCS joint mission computer systems have significant capability to expand. We examined the expansion potential in three critical categories: memory, mass storage devices, and processors. Regarding memory, even after the addition of memory for the new operating system, our analysis of DOD data showed that all but one current WWMCCS

computer network site will have the potential to increase configured memory by over 80 percent without the addition of processors. One site will have a 30 percent memory expansion potential.

WWMCCS computer network sites also have significant capability to expand storage capacity of disk drives. For example, these sites could replace their existing Honeywell disk drive units with higher capacity, faster Honeywell models to increase their disk storage by a range of 53 percent to 663 percent. Sites could increase disk storage even further by acquiring Honeywell input-output processors. These processors would allow sites to acquire and install other manufacturers' disk drives that provide even greater capacity and speed than Honeywell models. By replacing all currently configured Honeywell disk drives with greater capacity models of other manufacturers, sites could increase their disk storage by 150 percent to 1,148 percent.

Finally, the new operating system software will allow up to six processors to be configured as a system. The existing operating system software only allows a maximum of four. Therefore, all sites will have the potential for configuring additional processors to support unanticipated work load growth.

Security Requirements Cannot Be Met by Acquiring New Computer Systems

DOD has identified security requirements as another deficiency in WWMCCS computer systems that justifies the acquisition of new systems. DOD's stated requirement is for multilevel security that permits users with varying levels of security clearances, and with no security clearances, to simultaneously share computer resources and to access all levels of classified or unclassified information for which they are authorized. Unlike the other deficiencies, however, this security requirement cannot be met either by the planned new WIS computer systems or by upgrades to the existing systems.

DOD has identified a limited security capability to be achieved through the planned acquisition of new computer systems that allows users with secret clearances to meet their data processing requirements using the same computer hardware, data base management system, and operating system that simultaneously processes top-secret information. According to DOD, upgrades are not available that would permit the existing systems to provide this limited security capability. In our view, this limited capability does not warrant acquiring new computer systems in 1989 because (1) the security capability of new systems will not meet the stated WIS multilevel security requirement, (2) the limited capability has not been economically or operationally justified, and (3) this limited security capability would not be available until the early 1990's. Further, as discussed in chapter 4, DOD has not established a security policy, defined current deficiencies and future requirements, and explored alternatives for WIS security. In the absence of such analyses, any assertion of security as a justification for computer system replacement is suspect. In fact, such a replacement may not improve security because it may not address current security vulnerabilities. DOD policy calls for these activities to precede, and be part of the basis for, the acquisition of new computer systems.

New Computer Systems Will Not Meet WIS Security Requirement

WWMCCS computer systems control access to national security data ranging in classification from unclassified through top secret. Presently, any authorized user of a computer system can access data controlled by the system regardless of the classification. Consequently, the computer system and all users are subjected to top-secret security procedures even when processing unclassified information. DOD believes that these procedures are costly from an administrative and operational standpoint because all users must possess a top-secret security clearance and computer systems must be maintained in a top-secret environment. Moreover, current computer systems cannot adequately control some types of classified data (for example, intelligence, nuclear, and North Atlantic Treaty Organization data) that are needed for mission performance.

To achieve greater mission performance, the Joint Chiefs of Staff decided that the WIS computer systems should provide multilevel security that would allow users to share computer resources while accessing all categories of classified or unclassified data to which they are authorized. DOD has determined, however, that the computer system technology required to achieve multilevel security capabilities will not be available when needed for the WIS modernization program.

As a partial solution, DOD plans that the WIS computer systems would provide a more limited security capability (termed "controlled mode" security). This limited security capability would provide access control for top-secret data and would allow the minimum security clearance required for computer system users to be reduced from top secret to secret. However, this capability would fall short of the WIS requirement for access control over all types of classified as well as unclassified data.

Limited Security Capability Has Not Been Justified

Joint Chiefs of Staff procedures require that before a requirement is approved, an analysis of the cost and operational effectiveness for implementing the required capability be performed. However, DOD has not defined the costs and benefits associated with controlled mode security, has not demonstrated that this limited security capability is justified on the basis of greater economies and improved mission performance, and has not established that it is a required interim step to attain multilevel security.

In our opinion, improvements in mission performance will not be realized until multilevel security is implemented. For example, one problem with the current computer systems is their inability to exchange classified information with intelligence information systems. However, this problem will not be corrected with controlled mode security because the computer systems will not be certified as able to control classified intelligence data until multilevel security is implemented.

Controlled mode security studies developed for the WIS joint program management office assumed that new computer systems were needed, and not justified solely on the basis of security deficiencies. These other deficiencies, however, will be corrected through computer system upgrades. An official from the joint WIS program management office told us that the controlled mode security capability could be dropped as a requirement if achieving that capability became an impediment to achieving other WIS benefits in the block B time frame. A cost/benefit analysis will be required in advance of the block B Defense Acquisition Board's development decision, but it is not clear whether that analysis will quantify the benefits from controlled mode security.

The WIS joint program manager asserted that the attainment of controlled mode security is a technically correct approach and is in the best interest of providing a first increment of the users' need for multilevel security. However, there is no assurance that a computer system designed to the controlled mode level of security could evolve to multilevel security. Officials of the National Security Agency's National Computer Security Center, who are responsible for certifying the security capability of computer systems, told us that achieving controlled mode is not a necessary interim step to achieving a multilevel security capability in computer systems. The officials also stated that, although it is theoretically possible for a computer system certified at one level of security to evolve to a higher level, such an evolution has never been proven or demonstrated. To achieve the higher security level would require that the computer system be originally designed to achieve the higher level of capability.

Limited Security Capability Is Not Commercially Available

Even if a controlled mode security capability for WIS was justified as an interim step, the commercial marketplace presently does not have computer systems capable of providing this capability. Officials of the National Computer Security Center estimate that commercially available computer systems capable of implementing controlled mode security requirements for WIS will not be available until at least the early 1990's.

The National Security Agency official responsible for developing the criteria for certifying data base management systems told us that the certification criteria applicable to controlled mode security have not yet been developed, and will not be available until September 1988. He estimated that once these criteria have been developed, it would be the early 1990's before industry could provide a certified, controlled mode data base management system.

Nevertheless, DOD is preparing to acquire new computer systems in 1989 that do not have the limited WIS controlled mode security capability with the expectation that the successful offeror will later evolve the newly acquired systems to provide this capability. Thus, DOD would procure new computer systems that would provide no improvement over the current computer system security capabilities and operating procedures. This strategy involves the cost and technical risk that controlled mode security may never be achieved on the computer systems acquired if (1) the selected vendor is unsuccessful in developing this controlled mode capability, or (2) the cost of adding this controlled mode capability to the newly acquired computer systems is found to be prohibitive.

Postponement of the Acquisition of New Computer Systems Has Advantages

Because upgrades to WWMCCS computer systems obviated the need for replacement, DOD can postpone the acquisition of new computer systems, and use the period of postponement to (1) define requirements for JOPES Increment II; (2) implement a WIS security policy, define security requirements, and explore alternative approaches for meeting these requirements; and (3) establish a computer system performance measurement and capacity planning program. These activities are needed to ensure that any eventual WWMCCS computer system replacement is based on current and approved functional and security requirements, and can be correctly timed to provide cost-effective support of mission needs.

Time to Define Requirements for JOPES Increment II

Because the upgraded systems will support JOPES Increment I, the driving force for new WIS computer systems should be JOPES Increment II. On the basis of DOD estimates, the earliest that the computer system requirements for JOPES Increment II can be defined and approved is fiscal year 1991. This schedule would allow JOPES Increment II to be deployed on new computer systems, if they are required, in fiscal year 1995. Since the life cycle of the upgraded computer systems extends through 1996, there is time available now to base the acquisition of new computer systems on JOPES Increment II requirements.

The WIS joint program manager told us that sound computer system acquisitions can be based on application requirements that are not fully defined. He believes that accurate, well-defined requirements for an application such as JOPES Increment II are very difficult to fully define in advance of the acquisition of computer systems and that user needs become better defined as a system is used. In his opinion, an evolutionary approach for defining and building supporting computer systems, making extensive use of application prototyping and user feedback, is the most effective means of system development and implementation. WIS would need a contract providing modularly expandable computer systems to support this approach.

However, not basing this computer system acquisition on well-defined, JOPES Increment II requirements would increase unnecessarily the risk that any acquired computer systems would have greater capacity and be more costly than necessary, or would require additional upgrades, or replacement, because they would not be well matched to mission needs.

DOD regulations call for requirements definition—including the development and approval of the functional description document, which includes a description of procedures, and the data requirements document—to precede system development and acquisition. However, DOD has not defined JOPES Increment II requirements and ensured that requirements definition will be included in the WIS computer systems'

acquisition schedule. DOD has not established milestones for the definition of JOPES Increment II requirements, because DOD officials believed that they could not set realistic dates at the time of our review. Without milestones, it will be difficult to ensure that JOPES Increment II requirements are defined in time to provide the basis for a computer system upgrade or replacement.

Further, the development of JOPES Increment I requirements is not formally tracked by the WIS system program office. Because the development of JOPES requirements and the planned computer system acquisition are not being well coordinated, computer systems could be acquired before requirements are well defined, and the systems could fail to meet the users' needs. A similar problem has already occurred in the WIS modernization program. In April 1987, we reported[1] that the automated message handling system—a major product from block A of the WIS modernization program—fell short of the primary user's (National Military Command Center) requirements. These requirements had not been completely defined over a year after the development contract for that system was awarded. This message system was designed to specifications based on other users' requirements and, as a consequence, fell short of the primary user's needs.

To avoid a similar problem in WIS block B, the Joint Chiefs of Staff could establish milestones and monitor the completion of JOPES Increment II requirements. These actions would ensure that a computer system replacement, if needed, can be based on these new requirements and timed to support them.

Time to Establish Security Policy, Define Requirements, and Explore Security Alternatives

Because the acquisition of new computer systems can be delayed until at least late fiscal year 1992, and the upgraded computer systems will meet defined requirements to at least 1996, DOD has time to perform the numerous security-related tasks needed to ensure that critical security needs are met cost effectively. DOD Directive 5200.28, "Security Requirements For Automated Data Processing Systems," states that security is most cost effective and economical if the system is originally designed to provide it. DOD has the opportunity over the next few years to develop an overall security policy, define security requirements, and explore alternatives for meeting these requirements.

Need for Security Policy

Currently, there is no overall security policy for the WIS modernization program to assure that security considerations are a part of the system development process and that critical security needs will be provided by

[1] DOD Acquisition Programs: Status of Selected Systems (GAO/NSIAD-87-128, April 1987).

new WIS computer systems. DOD considers Joint Chiefs of Staff Publication 22 to be the security policy for WWMCCS. However, this document only states how the current system operates. DOD does not use it as the basis to develop new systems. For example, this publication does not define what types of controls would be needed in new computer systems to safeguard different categories of sensitive information. DOD computer system security standards require that computer systems enforce an explicit and well-defined security policy that governs the control of sensitive information.

Security clearances for contractor employees working on a WWMCCS software project illustrate the increased risk resulting from not establishing a security policy before beginning the system development process. Two and one-half years into the development process, WIS program officials found that a DOD regulation was not being followed that requires contractors designing and developing security-relevant software to possess a clearance as high as the classification of the most sensitive information to be processed by the system. WIS program officials decided not to take corrective action as a result of pressure to keep software development on schedule, and their assessment after discussions with other program managers that the security risk was acceptable. We believe DOD could have avoided this choice between security and program delays if an overall security policy had existed. Had such a policy existed, contractor security clearances would have been identified as a long-lead-time item and could have been obtained without requiring a program delay.

Further, an important security requirement, termed close-hold, may not be implemented in block B because the WIS program lacks a security policy. Close-hold establishes the level of protection necessary to (1) limit user access to selected operation plans, and (2) prevent users who have not been granted access to a specified plan from knowing of its existence. Officials of the National Security Agency's computer security center and a WIS contractor official specializing in security were uncertain whether the level of security that DOD planned to acquire for WIS would provide the necessary protection for close-hold information because the policy for protecting this information is not well defined. Without a policy for protecting close-hold information, DOD cannot ensure that a new WIS computer system will adequately protect such information.

Need to Define Security Requirements

To define its security requirements, DOD needs to analyze current system threats, capabilities, and the allocation of security controls among system components.

WIS security requirements analyses have not included an assessment of the actual threats to the current system. Federal information processing standards suggest conducting a threat analysis before attempting to improve the security of a computer system. The Joint Chiefs of Staff require a risk analysis for each WWMCCS computer system site to be conducted every 3 years. However, there is no link between these analyses and the security requirements process. WIS security requirements analyses have either focused on the operational problems of not having multilevel security or have addressed generic threats, not WWMCCS-specific risks. If the requirements process does not cover current threats, information in the new WIS computer systems could be vulnerable to undisclosed threats or security deficiencies.

Some of the required WIS block A security capabilities were not identified when development began. After 3 years of system development, the WIS program still had not determined how to implement some features needed by WWMCCS security officers. An example of such a feature is a "watchteam" capability that allows multiple users to use the same computer system password so that the team size can be rapidly expanded during a crisis. If current security capabilities are not analyzed before beginning block B system development, the WIS program could be delayed or its costs increased should required capabilities be added during system development. Alternatively, DOD could acquire new computer systems that do not provide current security capabilities.

Finally, DOD needs to determine which WIS security functions can best be implemented with a computer system and which should be implemented through other means. Some security controls can be enforced by hardware, software, physical separation, or administrative procedures. For those security functions to be implemented with a computer system, DOD should determine how best to allocate security functions between components of the computer system. Federal information processing standards suggest that the best mix of controls should be selected during the design phase. By making such a selection part of the WIS design process, DOD can ensure implementation of the most cost-effective mix of security controls in the new WIS computer systems.

Need to Explore Alternatives for Implementing Security Requirements

Joint Chiefs of Staff policy requires an examination of alternatives, including those related to system security, before a requirement is approved. DOD needs to explore all alternatives that may meet WIS program needs, to ensure that it selects the most cost-effective one. The WIS joint program manager has stated that highly secure computer systems capable of meeting WIS security requirements may not be commercially

attainable and that other alternatives for providing required security should be considered.

One alternative that has not been considered is an Army security system that could achieve benefits similar to those from WIS controlled mode, and could be available much sooner. The WIS controlled mode approach allows users with secret and top-secret clearances to access the same computer system. The Army is currently developing a security system with a similar capability. The Army's system uses a monitor computer system between two physically separate computer systems to ensure that users with secret clearances do not access top-secret information.

A representative of the Army office responsible for deploying WIS to Army sites told us that this project will meet the need for two levels of access control at Army locations scheduled to receive WIS computer systems. We believe, however, there may be disadvantages in the cost of separate computer systems and the difficulty of keeping their files consistent. The Joint Chiefs of Staff have deferred a survey of the applicability of this alternative to WWMCCS computer network sites because of higher priority staffing needs.

Time to Implement a Program to Manage Computer System Performance and to Project Future Needs

As the upgraded computer systems approach the end of their life cycle in the mid-to-late 1990's, it will become increasingly important for DOD to have in place a computer system performance measurement and capacity planning program. Such a program will be needed to determine whether additional capacity is necessary for new requirements, such as those of JOPES Increment II, and whether this capacity can be achieved most cost effectively through (1) computer system tuning to modify the way computer system resources are used, (2) system upgrade, or (3) system replacement. The establishment of such a program could allow the WIS modernization program to safely delay computer system replacement, to reduce costs, and to provide more time for the definition of JOPES Increment II and security requirements.

Computer system upgrades have provided time for DOD to establish a WWMCCS computer system performance measurement and capacity planning program. Currently, there is no such network-wide program for WWMCCS to project the impact of future work loads on computer system performance or measure response times in a way comparable with DOD standards. Many problems of poor performance can be detected, isolated, and solved with a computer system performance management program, most often with substantial savings. Our discussions with a contractor that simulates computer system performance, staff from the Federal Computer Performance Evaluation and Simulation Center, and

the computer system performance evaluation manager for the primary WWMCCS site indicate that the establishment of a computer system performance measurement and capacity planning program is feasible and desirable.

Because sites do not project the impact of computer work loads, these sites risk not supporting the users' mission when work loads increase. For example, during a 1985 exercise, a capacity problem arose from using new application software at a WWMCCS site that did not project the impact of future work loads. Had it been a crisis and not an exercise, it could have been too late to learn that the new work load could not be supported without computer system modification.

This example also illustrates the importance of lead time in projecting computer system performance. It is not enough to know that a future work load will require either additional resources or computer system tuning to improve performance. That knowledge must come in sufficient time to acquire and install the additional resources or plan and modify the way existing resources are used.

The WIS program lacks the data upon which to base a cost-effective computer system replacement. A WIS contractor that was tasked to develop a specification for the new computer systems found that anticipated work loads, whether in day-to-day operations, exercises, or crises, were not known. Accordingly, the contractor made conservative estimates of future work loads, and over-sized the specification of the computer system to reduce the risk of inadequate performance. Conversely, it is also possible to undersize the computer system because work loads and resulting performance are not projected.

Conclusions, Recommendations, and Agency Comments

Conclusions

The upgraded WWMCCS computer systems are significantly different from the systems that operated in 1982 when DOD initiated its plan to replace these systems. The estimated $155 million that has been, or will be, spent on upgraded computer hardware and software has improved computer systems so that they will be similar in capability to current computer technology. All of the deficiencies DOD had identified as justifying the replacement of computer systems will be corrected, with the exception of security. The upgraded computer systems are capable of supporting all currently defined application requirements to at least 1996, have adequate availability, have corrected response time deficiencies, are maintainable, and will support a commercially available data base management capability.

While DOD has for several years identified security as a current system shortfall, DOD has not set a security policy, defined its security needs, or identified its current system security shortfalls. Therefore, DOD does not have a basis to assess whether new computer systems would better protect sensitive information. In order to define security requirements, a WIS security policy must first be established. This policy should include protection for close-hold information and address the potential trade-off between commercially available technology and security goals. WIS security requirements based on this policy should identify the security functions that can best be implemented within computer systems, and satisfy current system operating procedures and security shortfalls. An analysis of security alternatives is needed to determine how best to meet mission needs. It should include an evaluation of the cost effectiveness of security through physical separation, such as the approach used by the Army, as a potential short-term solution for sites with urgent needs.

In our view, the proposed capability for controlled mode security capability is a partial, risky, and late solution for security that does not justify the acquisition of new computer systems estimated to cost $500 million. Acquiring new computer systems offering this limited security capability would also place DOD in the difficult position of (1) acquiring computer systems that do not meet its stated requirement for multilevel security, (2) assuming the risks that the contractor may not be able to develop the security functions on the computer systems to provide this limited security capability, and (3) obtaining the limited capability several years after DOD's planned acquisition of computer systems in 1989.

We believe that DOD should not go forward with the acquisition of new computer systems as currently planned. The existing computer systems will need to be replaced sometime in the future. If replacement were justified by the requirements for JOPES Increment II, we estimate that the acquisition could be deferred from fiscal year 1989 until at least fiscal

year 1992. In order for this replacement to provide cost-effective support for requirements, including important new capabilities to be provided by JOPES Increment II and needed security, these requirements must be defined and approved prior to the acquisition of new computer systems. Because of upgrades to WWMCCS computer systems, DOD has the opportunity to define these requirements before replacement is needed.

Greater management attention is needed to define requirements and coordinate them with the system development and hardware acquisition process. Management must ensure that any acquisition of new computer systems is based on well-defined requirements to meet mission needs cost effectively. Further, network-wide performance measurement and capacity planning is needed to enhance benefits from current computer systems and determine when system upgrade or replacement is warranted.

Consequently, the postponement of this acquisition will provide DOD the opportunity to make the necessary analyses and establish the necessary systems that will guide future decisions on WWMCCS computer systems. Meanwhile, advances in technology increase the likelihood that commercial products will be available to satisfy WWMCCS functional and security requirements.

Recommendations

We recommend that the Secretary of Defense defer the currently planned $500 million WIS joint mission computer system acquisition until:

- Requirements for the acquisition are defined and approved, especially the processing capabilities needed for the Joint Operation Planning and Execution System Increment II.
- A formal security policy is established, security requirements are defined, alternatives for implementing these requirements are evaluated, and the most cost-effective means of meeting security requirements are selected.
- The above processing and security requirements can no longer be met by upgrading the current computer systems.

In addition, in order to ensure a proper and timely acquisition, the Secretary of Defense should:

- Establish milestones and monitor the development and approval of the requirements for the additional mission capabilities needed in JOPES Increment II, incorporate these milestones into the WIS acquisition schedule, and target completion of development and approval for 1992.

- Establish a network-wide performance management and capacity planning program to (1) measure computer system performance against DOD standards, (2) identify future needs for computer system resources, and (3) project when the current computer systems can no longer provide cost-effective mission support.

Agency Comments and Our Evaluation

In the detailed comments attached to its November 1987 letter commenting on this report (see appendix), DOD concurred with all of our recommendations and fully or partially concurred with 19 of the 21 report findings. Specifically, DOD agreed to our recommendation to (1) defer the computer acquisition that has been partially funded for fiscal year 1989, and (2) base any future computer acquisition on approved and defined requirements for JOPES Increment II and information security. DOD also agreed with our recommendation to establish milestones for defining JOPES Increment II requirements and a computer performance evaluation program.

DOD's January 1987 budget submission shows fiscal year 1989 funding (at least $39 million) to begin acquiring new computers for the joint mission. However, DOD does not now plan to use such funds for acquiring joint mission computers (see appendix, p. 51). Another change indicated by DOD's response is its commitment to perform various security-related tasks before acquiring new computer systems. As our report points out, WIS began its earlier system developments without a well-defined security policy or defined security requirements.

Despite DOD's general concurrence with our report, there were a number of areas where it either disagreed or believed our report to be inconclusive. DOD's letter stated that it considers the GAO conclusions on the adequacy of the hardware to meet future requirements to be premature because all the relevant studies have not been completed. We disagree that the conclusions are premature, because they focus on the ability of the current systems to meet currently defined requirements, not undefined future requirements. DOD will not be able to define the future requirements of JOPES Increment II in time to conduct the computer acquisition as scheduled.

DOD's letter stated that our report does not discuss the cost benefits that could accrue to DOD through modernization of the existing hardware architecture. DOD expressed specific concern that the report does not address the savings in operation and maintenance that might be realized if the existing systems were competitively replaced. We did not assess this issue during our audit because there were no DOD studies or evaluations to use as a basis for estimating WWMCCS maintenance costs in the

1992-1996 time frame (the 5-year period beyond the current contractual maintenance agreement). However, an October 1987 contractor proposal indicates that replacing the current systems with new computers of an equivalent capacity from the current vendor's product line would provide maintenance cost savings that would repay the required investment in about 7 years. In oral comments on this report, DOD officials identified this proposal as an indication that maintenance savings might justify replacing the current systems.

We believe the contractor's proposal provides an optimistic projection of savings to the government if it replaced the current systems on a sole-source basis. A replacement based on maintenance cost savings assumes that the computer systems would be retained long enough to fully recover the investment cost. We believe this assumption is ill-founded. Any computer systems acquired in 1989 would probably need replacement in 1992 to meet the needs of JOPES Increment II (see ch. 2) and the security requirements now being defined (see ch. 4), which is before their cost could be recouped through the anticipated maintenance cost savings. Further, if the government replaced the current system competitively, additional costs would have to be considered, such as the costs of (1) the conversion of the current application software so that it can be used with competitively acquired, new computer systems, and (2) the new commercial operating system and software and any modifications required to satisfy unique DOD communications protocols and security needs.

DOD's letter noted that our report does not address DOD's goals for a modular WIS design with an "open systems"[1] architecture and stated that continued and long-term reliance on the Honeywell architecture may not be in the best interests of the government. DOD is correct in stating that our report does not address the benefits of acquiring modularity and an unmodified commercial operating system, or the open systems architecture. We did not include these issues because (1) the current computer systems are modular, (2) the new operating system on the current systems is a modern commercial operating system that is modified only to the extent needed to accommodate unique DOD protocols and security requirements, and (3) the future requirements should be defined and DOD's readiness to choose among alternatives should be established before questions of new system design or architecture are raised. We fully support DOD's commitment to the exploration of all plausible alternatives and to the competitive acquisition of new computer systems or system components once the need is justified.

[1]Systems in which computers and automation functions of different types and manufacture may be interconnected.

In a comment on this report (see appendix, p. 50), DOD infers erroneously that we concluded that the controlled mode security capability would be of limited value. Rather, we concluded (see ch. 4 and ch. 5, p. 31) that because DOD has neither justified nor fully analyzed the controlled mode security requirements, it should not commit to a controlled mode architecture, or use controlled mode operation as justification for an acquisition. We also doubt that the potential savings from controlled mode security, if it were presently feasible and taken with the maintenance savings discussed above, would justify a $500 million computer acquisition in 1989.

Finally, in the detailed attachment (see appendix, p. 53), DOD may have misinterpreted what we meant by security requirements in the report. DOD claimed in its comments on this report (see appendix) that the WIS security requirement was defined in a 1983 document. The only security requirement that was clearly defined in the 1983 document was the need for multilevel security. Multilevel security alone is not a comprehensive statement of security requirements. It does not address such problems as ensuring personnel, procedural, network, and telecommunications security.

On a related issue, DOD stated that the Army security system had been evaluated in August 1987 and it had been determined that it did not meet "the WIS security requirement" (see appendix, p. 54). We reviewed this evaluation and found that DOD only evaluated the ability of a prior version of the security monitor to support controlled mode security, not its potential to address WWMCCS-specific security shortfalls. Furthermore, the system that DOD evaluated was not the system that we identify in our report as the Army Security Monitor, rather it was an earlier design that the Army has since abandoned. We believe that DOD needs to fully define its security requirements and explore all plausible alternatives, including the current version of the Army Security Monitor.

Agency Comments

ASSISTANT SECRETARY OF DEFENSE

WASHINGTON, D C 20301-3040

COMMAND, CONTROL, COMMUNICATIONS AND INTELLIGENCE

6 NOV 1987

Mr. Frank C. Conahan
Assistant Comptroller General
National Security and International
Affairs Division
U.S. General Accounting Office
Washington, DC 20548

Dear Mr. Conahan:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report, "COMMAND AND CONTROL: Upgrades Allow Deferral of $500 Million World-wide Computer Acquisition," dated September 9, 1987, GAO code 510140, OSD case 7403. The DoD concurs with many of the GAO conclusions on current hardware capabilities. However, the DoD considers the GAO conclusions on the adequacy of the hardware to meet future software requirements to be premature, since all the technical and cost analysis studies on this issue have not yet been completed. The GAO report will be referenced during the Defense Acquisition Board (DAB) Milestone II review for WWMCCS Information System Block B, as an independent assessment of the current WWMCCS hardware.

The GAO report focuses entirely on technical issues and does not discuss the cost benefits that could accrue to the DoD through modernization of the existing hardware architecture and through a new contracting strategy acquired in a competitive environment. Operating costs for new hardware and its associated system software could be significantly reduced from those of the current system. There are two reasons for this premise. First, a modern commercially available operating system, that requires no "customizing," is a much cheaper alternative (as the GAO correctly states in its report) than the current operating system. Second, a hardware system designed to be modular, and a contracting vehicle that supports this modularity, allows each site to be sized to its specific needs and allows each site configuration to be readily expanded as the requirements increase. This incremental or modular capability assures optimum and efficient use of computer resources.

Another issue, not specifically addressed in the report, pertains to the recurring software development/tailoring costs and the open systems architecture goals of the WIS program. In traditional development efforts, software design and implementation have necessarily been tailored to a particular vendor's hardware and system software suites. In the WIS program, the objective

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is to achieve substantial, if not complete, software portability through the application of the Ada programming language, standard data manipulation languages, and modern software engineering architectural concepts. This approach supports operation in a heterogeneous, open architecture which simplifies the acquisition process and significantly increases competition for future hardware acquisition. This approach also allows DoD to select the best processing "solution" for the requirement. Therefore, continued and long-term reliance on the Honeywell architecture may not be in the best interests of the government.

For these reasons, as well as the technical uncertainties detailed in the enclosure, the DoD is conducting feasibility studies and cost analyses to determine the savings and technical benefits that would accrue by replacing the existing WWMCCS hardware. The DoD has not yet completed all the analyses necessary to support any specific hardware alternative. When the DAB meets to discuss the alternative methods for achieving the Block B goals, this data will be available for review.

The detailed DoD comments on the GAO findings and recommendations are enclosed. The Department appreciates the opportunity to comment on the report in draft form.

Sincerely,

Thomas P. Quinn
Principal Deputy

Enclosure

GAO DRAFT REPORT - DATED SEPTEMBER 9, 1987
GAO CODE 510140 OSD CASE 7403

"COMMAND AND CONTROL: UPGRADES ALLOW DEFERRAL OF $500 MILLION WORLD-WIDE COMPUTER ACQUISITION"

DEPARTMENT OF DEFENSE COMMENTS

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FINDINGS

o **FINDING A: World Wide Military Command and Control System.** The GAO reported that the World Wide Military Command and Control System (WWMCCS) is intended to provide the National Command Authorities (the President and the Secretary of Defense or their successors) a capability to:

- receive warning and intelligence information;
- apply the resources of the Military Departments;
- assign military missions; and
- provide direction to Unified and Specified Commands.

The GAO further reported that, in addition, WWMCCS is intended to support the Joint Chiefs of Staff (JCS) and other key military commanders. The GAO found that the WWMCCS is used by the National Command Authorities (NCAs) and key military commanders for operational activities ranging from day-to-day to crisis operations. The GAO observed that the WWMCCS joint mission computer systems were originally acquired during the 1970s and have since undergone numerous upgrades. (pp. 10-11/GAO Draft Report)

DoD Response: Concur.

o **FINDING B: WWMCCS Information System Modernization Program.** The GAO noted that during 1976 through 1980, DoD analyses of the WWMCCS computer systems, indicated the computer hardware and software needed to be improved significantly. The GAO reported that the DoD considered various approaches to accomplish this improvement and, in July 1982, decided to acquire new computer systems and to modernize application software. The GAO noted that, in May 1984, the Defense Systems Acquisition Review Council evaluated the WWMCCS Information System (WIS) modernization program strategy and agreed that the WIS should be developed in clearly defined and costed phases (Blocks A, B, and C). According to the GAO, the Council further agreed that each block would

require Council review and approval to proceed into full-scale development. The GAO also reported that, in September 1985, the Secretary of Defense granted approval for the Air Force to proceed with system design for all WIS Blocks and into full-scale development of Block A capabilities. The GAO found that the DoD plans for Block B include the following:

- competitive procurement of new computer systems to replace the existing computer systems now being upgraded;
- development of new application software to consolidate three existing applications;
- procurement of a data base management system; and
- development of improved security controls over access to information.

The GAO noted that the WIS Block B review by the Defense Acquisition Board (DAB) to approve full-scale development is scheduled for March 1988. The GAO observed that the major decision to be made is whether the WIS program should proceed with a procurement to replace the upgraded computer systems, at an estimated cost of over $500 million. The GAO further found that Block C will focus on enhanced joint mission planning and execution functions and improved interfaces to non-DoD agencies and North Atlantic Treaty Organization (NATO) systems. Finally, the GAO found that, in December 1986, the DoD estimated that, through FY 1993, the total WIS modernization program would cost about $2.3 billion ($732 million for Block A and about $1.6 billion for Blocks B and C). According to the GAO, a schedule to complete the program has not been established, and is contingent on DoD decisions on WIS Blocks B and C. (pp. 11-14, p. 17/GAO Draft Report)

DoD Response: Concur. Plans for Block B have been, and continue to be, evolving. The program strategy for Block B is principally based on a software first approach (designed and developed in Ada), with any necessary replacement or addition of hardware to occur at a point in time that is optimum considering economic and mission imperatives. The near term focus of the Block B efforts are improvements to the existing system, both hardware and software, considered essential to satisfy existing operational requirements. The software modernization consists of integrating existing functionality, and enhancing operational user interfaces. There are many hardware alternatives being considered to support the Block B software. Until the DAB approves the strategy for proceeding with full-scale development, the "plans," referred to by the GAO, are merely alternative strategies that are being analyzed and assessed for their

applicability to satisfy the requirements.

- **FINDING C: Joint Operations Planning and Execution System.** The GAO reported that the primary application software for WIS will be the Joint Operation Planning and Execution System (JOPES). The GAO observed that the JOPES--to be developed and implemented in increments--will tie together conventional planning, execution, resource and unit monitoring information management activities, in order to plan for and execute the mobilization, deployment, employment, and sustainment of military forces and resources. The GAO found that Increment I will combine and replace three separate data processing applications now being supported by WWMCCS computer systems--the Joint Deployment System, the Joint Operations Planning System, and portions of the Unit Status and Identity Reporting System. The GAO also found that JOPES Increment I (being developed now) is to be supported, beginning in the first quarter of FY 1991, by the upgraded WWMCCS computer systems. In addition, the GAO found that the JOPES Increment II will provide additional automated support for joint command and control activities. (p. 15/GAO Draft Report)

  DoD Response: Concur. (The DoD has separately provided suggested changes to more accurately describe the relationship between JOPES and WIS.)

- **FINDING D: Interim Upgrades to WWMCCS Computer Systems.** The GAO reported that, because the WIS modernization was expected to be a long-term effort, in FY 1983, the DoD began making upgrades to the existing computer systems. The GAO observed that these upgrades were seen as providing immediate solutions for the computer systems' information processing shortfalls and, according to the DoD, could not satisfy long-term needs of system users. The GAO found that, through December 1986, the DoD spent over $105 million for new computer hardware. In addition, the GAO found that through FY 1989, as part of this upgrade program, the DoD anticipates spending an additional $26 million for new operating system software to control the computer hardware, and $24 million for computer hardware. The GAO observed that the upgraded WWMCCS computer systems are significantly different from the systems that operated in 1982. The GAO concluded that the estimated $155 million that has been, or will be, spent on upgraded computer hardware and software has improved computer systems to such an extent that they will be similar in capability to current computer technology. (p. 16, p. 57/GAO Draft Report)

  DoD Response: Concur. It should be noted that the upgrades to the WWMCCS system did not begin in FY 1983, but rather have continued through the life of the system.

- **FINDING E: Upgraded Computer Hardware Is Maintainable.** The

GAO observed that, since its inception in 1982, a basic premise of the WIS modernization program has been that WWMCCS computer systems needed to be replaced with state-of-the-art systems. The GAO reported that, in 1982, the DoD assumed it was faced with continuing to operate and maintain obsolete computer systems, which would not be supported by the manufacturer. The GAO found that the DoD analyzed the alternatives available to meet user operational needs, until the computer systems could be replaced under the WIS modernization program, and decided to upgrade the WWMCCS computer systems. The GAO reported that the Honeywell WWMCCS contracting manager stated that Honeywell would be willing to negotiate a contract to support the upgraded computer systems through the year 2000. The GAO, therefore, concluded that the DoD can obtain maintenance support several years beyond the current contract expiration date. The GAO also concluded that, with the upgrades undertaken and ongoing (also see Finding D), the DoD will have computer systems that can continue to be maintained by the vendor and are very similar to current Honeywell computer systems. (pp. 20-21/GAO Draft Report)

DoD Response: Concur. Honeywell's willingness to negotiate a support contract for the WWMCCS system until the year 2000 is known to the DoD. While Honeywell asserts that the current computer hardware may be maintainable, the cost penalty of continuing to remain in a sole-source environment is unknown. It is not clear what cost savings might accrue to the DoD if the computer hardware was purchased and maintained through a new competitive process. It is also not clear if the existing Honeywell architecture is the optimum architecture to support the Block B requirements. The appropriate cost and technical data will be gathered and assessed in preparation for the DAB process to determine the need and timing of the hardware acquisition.

o FINDING F: Upgraded Operating System Software Can Be Maintained. The GAO reported that, by 1982, Honeywell had announced its intention to phase out maintenance and support for the operating system software used by WWMCCS computer systems. The GAO found that, because of concern by the DoD that development, maintenance and documentation on existing software would become more expensive, in 1984, the DoD completed an economic analysis of WWMCCS operating system software and concluded that obtaining new operating system software was warranted. The GAO reported that, in February 1987, the Honeywell computer system contract was amended, at a cost of about $19 million, to acquire new operating system software for use on the upgraded WWMCCS computer systems. The GAO found that the life cycle for this new software has been projected by the DoD to extend beyond 1996. The GAO again noted the statement of the Honeywell WWMCCS contracting manager that Honeywell would be willing to negotiate another contract to support the new

operating system through the year 2000. The GAO also observed that the commercial version of the new operating system software, which has been acquired by the DoD has incorporated some security controls and other features that were formerly unique to the WWMCCS. The GAO noted, therefore, that WWMCCS users will no longer bear the entire cost of maintaining features that were previously WWMCCS-unique. The GAO reported that, in June 1986, a $7 million contract was awarded to Honeywell to incorporate the remaining WWMCCS-unique features needed in the new operating system. The GAO further reported that this contract also provides for Honeywell to incorporate these features in future versions of the operating system at no cost to the Government. The GAO concluded that the difficulty and cost of maintaining a customized operating system should be less, with the new operating system software, than if the DoD had continued with the old operating system software. (pp. 22-23/GAO Draft Report)

DoD Response: Concur. Following the GAO logic, acquiring an operating system that requires no customizing is the preferred alternative. The DoD hopes to achieve that objective through a competitive process.

- FINDING G: Upgraded Computer System Will Support A Commercially Available Data Management Capability. The GAO reported that another shortfall of the WWMCCS computer systems was the lack of an effective data management and capability to enable users to easily search for, retrieve, and summarize desired information. The GAO observed that this shortfall was particularly acute with regard to the ability to quickly develop operational plans requiring rapid access to data bases. The GAO noted that the DoD plans to acquire a Honeywell relational data base management system to operate on the upgraded computer system. The GAO observed that, according to Honeywell, this data base management system will satisfy the requirements of the JOPES Increment I. The GAO concluded, therefore, that it is not necessary for the DoD to procure new computer systems to achieve the required relational capability. (pp. 24-25/GAO Draft Report)

  DoD Response: Partially concur. The DoD plans to acquire the Honeywell relational data base management capability to satisfy near term operational requirements and to support Release I of JOPES Increment I. The program manager plans to initiate an Information Engineering project to determine optimum solutions to data management needs for Block B of WIS.

- FINDING H: Upgraded Computer System Availability Is Adequate. The GAO noted that, in 1985, the DoD expected computer system availability to decline and make system support unacceptable for either periods of crisis or

day-to-day operations. The GAO compared site computer system availability from four exercises, since April 1985, with the JCS availability standard for crisis operations. The GAO found that, in all four exercises, each of the National Command Authority sites met the JCS standard. The GAO further found that, in each exercise, no more than four other sites in the network fell short of the availability standard for crisis operations. The GAO also found that network availability in each of the four exercises exceeded the JCS computer system availability standard for crisis operations. To determine availability during day-to-day operations, the GAO compared computer system availability for the eight quarters, ending in March 1987, with the JCS standard. The GAO found that, on a quarterly basis, all of the National Command Authorities sites met the JCS standard and in no quarter were more than three of the network sites available less than required by the standard. For the WWMCCS computer network as a whole, the GAO found that the average availability always exceeded the JCS standard. Furthermore, the GAO reported that, based on its analysis and information provided by DoD management officials, operational and environmental factors were the cause of failures. The GAO noted that both JCS and Defense Communications Agency (DCA) officials responsible for managing the WWMCCS computer network consider the current computer system availability to be adequate. The GAO concluded that its analysis of computer system availability showed that WWMCCS computer system availability rates during simulated crisis and day-to-day operations have been generally meeting or exceeding the standards established by the JCS. (pp. 25-27/GAO Draft Report)

DoD Response: Partially concur. System availability has been better than was anticipated in 1985. However, to maintain this level of availability during exercises, many normal users are not allowed access to the system. During routine operations, training can only be conducted after duty hours due to lack of available processing capability.

- **FINDING I: Upgraded Computer Systems Correct Response Time Deficiencies.** The GAO noted that, during the 1970s and early 1980s, the WWMCCS computer systems were criticized because they did not provide timely support for user information requests. The GAO reported, however, that in March 1985, the DoD recognized that its ongoing program to upgrade WWMCCS computer systems would have the effect of improving system availability and response time. The GAO found that, in 1985, the DoD stated that simple queries were requiring 2 to 3 minutes and complex queries were requiring 15 to 20 minutes, but noted that this performance information was complicated by the ongoing upgrade program and the less than carefully controlled conditions under which the performance data were gathered. According to the GAO, not only does the limited actual data show that the

deficiencies in computer system response time reported by the DoD in 1985 no longer exist, but the upgraded computer systems may already be meeting the future WIS response time goals. The GAO reported that the WIS Joint Program Manager has established response time goals for Blocks B and C to complete 95 percent of simple queries within five seconds and complex queries within 3 minutes, under crisis conditions. The GAO found that data from the primary WWMCCS site, for the two most recent exercises, show that the existing computer system met the complex query goal and, for 80 percent of queries, met the simple query goal. The GAO observed that, if the complex queries were severable from the response time data (so that simple queries only could be measured), it would expect to find a higher percentage of simple queries that had met the five second response time criteria. The GAO also observed that the primary site was handling both day-to-day and exercise applications, and concluded that, if the workload was limited to those activities directly related to the exercise, the computer system response time would improve because more of the computer system records would be available to support the exercise workload. For these reasons, the GAO concluded that it is possible the primary site is meeting the WIS Blocks B and C goals. The GAO further concluded that the limited actual data available shows that the deficiencies in computer system response time reported by the DoD in 1985 no longer exist. Finally, the GAO concluded that the upgraded computer systems may already be meeting the future WIS response time goals. (pp 27-30/GAO Draft Report)

DoD Response: Partially concur. Response times have improved. However, the application software and integrated data base have not yet been developed to provide the query capability required by the user. An extensive software integration effort is scheduled to begin in FY 1988, with a first release delivered to the users in FY 1990. This software will provide the capability to formulate additional queries. In addition, the WIS workstations will provide significantly enhanced user capability to interact with the application software. It is anticipated that the system load will increase dramatically as the workstations are proliferated throughout the system. The program manager will analyze the extent to which the "overhead" of the new software and increased hardware usage impact the current and future operations. This information will be used as part of the DAB process. Any conclusion now on hardware adequacy or future response times based on current data is premature.

- FINDING J: Upgraded Computer System Corrected Response Time Deficiencies--Day-To-Day Operations. The GAO noted that, for day-to-day operations, the Block B and C goals are to complete 95 percent of queries within certain time limits (simple queries within two seconds and complex queries within 5 minutes). The GAO reviewed the available computer

system performance evaluations performed at the WWMCCS computer network sites over the past two years. The GAO noted that only eight of the sites provided response time data for its analysis. The GAO reported that five of these sites reported average computer system response times of about three to seven seconds, while the other three sites reported that over 85 percent of queries were within seven seconds (including responses to complex queries). The GAO concluded that the previously reported deficiencies no longer exist and that the current response times may be meeting the WIS Blocks B and C goal for simple queries under day-to-day operational conditions (ten seconds or less). The GAO also noted that system response times are expected to improve with the continuing upgrade of the current WWMCCS computer system. (pp 28-31/GAO Draft Report)

DoD Response: Partially concur. As previously noted, response times have improved. However, major modifications to the application programs are underway. Any conclusion on response times in the future configuration, prior to experience with the initial Block B software initiatives, is premature.

- **FINDING K: All Defined Application Requirements Are Supportable On The Upgraded WWMCCS Computer Systems.** The GAO reported that the DoD analysis, which preceded the WWMCCS computer system upgrades, indicated the upgraded system would meet operational requirements. The GAO found that, in 1986, the WIS Joint Program Manager studied alternatives available for support of the JOPES Increment I and concluded it could be supported on the upgraded computer systems. The GAO observed that, even if new computer systems were procured in 1989, as planned, the current systems would continue to be used until FY 1992, when the JOPES Increment I will be installed on the new computer systems. The GAO observed that, until then, any identified or unforeseen requirements would have to be met by the upgraded system. The GAO reported that, at its request, the DoD surveyed the 27 sites on the WWMCCS computer network to identify any documented future needs for additional computing resources to cope with any anticipated workload growth. The GAO found that, while some sites indicated they would require additional memory to accommodate the new operating system software, no sites provided analyses that indicated future need for additional processors, memory, mass storage or other peripheral devices. Although no analysis was provided, officials at one site told the GAO that they had budgeted for added mass storage devices in FY 1988 and FY 1990. The GAO also noted that the Defense Communications Agency (DCA) analysis of 1985 data confirmed the need for additional memory for the new operating system software and also identified memory shortfalls for supporting the Joint Deployment System--a current WWMCCS software application program to be replaced by the JOPES

Increment I. The GAO concluded that, since the life cycle of the upgraded systems extends to at least 1996, the JOPES Increment I can be fully supported on these upgraded systems until that time. (pp. 32-34/GAO Draft Report)

DoD Response: Concur. However, more recent analysis now indicates that most sites will require additional memory and disk drives to implement Release I of Increment I. As previously mentioned, major changes to the applications programs are underway. Any conclusion on the adequacy of the current system, prior to operational experience with the early Block B software release, is premature.

- **FINDING L: New Capabilities For The Primary Application Will Not Likely Be Ready For Deployment Until At Least FY 1994.** The GAO reported that the JOPES Increment II is supposed to provide many additional functions for joint mission command and control activities and is critical to attaining the DoD goal for overall improvement of the command and control of conventional military forces. The GAO found that the DoD has goals to reduce the time required to develop operation plans from 18-24 months to 45 days, and to develop operation orders within 3 days. The GAO noted that JOPES documents show automated support of mobilization plans and schedules is necessary to attain these time reduction goals; however, the JOPES Increment I will not provide such support. The GAO noted that the JCS has the responsibility to advise on mobilization decisions, but currently the only automated support for such decisions lies in the Military Departments. The GAO found that the required aggregation of data for decisionmakers will not be provided until the JOPES Increment II. The GAO further found that the JOPES Increment II requirements determination and approval by the Joint Chiefs of Staff, based on DoD estimates, will not be completed until FY 1991 or later. The GAO observed that, if the JOPES Increment II requires new computer systems, the earliest the DoD could award a contract for such systems would be late FY 1992. The GAO concluded that, using the current DoD estimate for the time required to install new computer systems, the earliest the JOPES Increment II could be deployed on new computer systems would be early FY 1995. The GAO further concluded that, if the JOPES Increment II takes the same development time estimated by the DoD for the JOPES Increment I, the earliest that Increment II could be available would be the first quarter of FY 1994. (pp 34-36/GAO Draft Report)

DoD Response: Nonconcur. The OJCS is initiating definition of Increment II during FY 1988, with the expectation that Increment II will be defined well before FY 1991. Further hypothesis on the Increment II development and acquisition schedule is speculative until some experience has been gained with the Increment I initiatives.

- **FINDING M: Upgraded Computer Systems Have Substantial Expansion Potential To Meet Unexpected Needs.** The GAO analysis of DoD data showed that all but one current WWMCCS computer network site will have the potential to increase configured memory by over 80 percent, without the addition of processors. (One site will have only a 30 percent memory expansion potential.) The GAO reported that these sites could replace the existing Honeywell disk drive units with higher capacity and faster Honeywell models to increase their disk storage by a range of 53 percent to 663 percent. In addition, the GAO found that sites could increase disk storage even further by acquiring Honeywell input-output processors that would allow them to acquire and install other manufacturers' disk drives, which provide even greater capacity and speed (increasing their disk storage by a range of 150 percent to 1,148 percent). Finally, the GAO observed that the new operating system software will allow up to six processors to be configured as a system, versus four under the existing operating system software. The GAO concluded that all sites have the potential for configuring additional processors to support unanticipated workload growth. The GAO, therefore, further concluded that the upgraded WWMCCS joint mission computer systems have significant expansion capability. (pp. 36-37/GAO Draft Report)

  DoD Response: Concur. The WIS goals include implementing a network architecture that will support several vendors' products and modernizing the software so that the various applications can be "ported" among different vendor hardware systems. These initiatives have been undertaken to facilitate the migration from a sole-source environment. Continual expansion on the WWMCCS hardware suite, as proposed by the GAO, will extend the sole source commitment to the present Honeywell vendor.

- **FINDING N: New Computer Would Not Meet WIS Security Requirement.** The GAO reported that the DoD considers the present requirements for all users of the WWMCCS to have TOP SECRET security clearances and for all computers to be maintained in a top secret environment are costly from an administrative and operational standpoint. The GAO noted, moreover, that current computer systems cannot adequately control some types of classified data needed for mission performance (for example, intelligence, nuclear, and NATO data). The GAO reported that the JCS has determined that the WIS computer system should provide multilevel security (MLS) that permits users with varying levels of security clearances (or no security clearance) to simultaneously share computer resources and to access all levels of classified or unclassified information for which they are authorized. The GAO found, however, that the DoD has determined that the computer system technology required to achieve such capabilities will not be available when needed

for the WIS modernization program. The GAO reported, as a partial solution, the DoD plans that the WIS computer systems would provide a more limited security capability (termed "controlled mode" security), providing access control for top secret data and allowing the minimum security clearance to be reduced from TOP SECRET to SECRET. The GAO observed, however, that this capability would fall short of the WIS requirement for access control over all types of classified data. The GAO concluded that, unlike the other deficiencies, this security requirement cannot be met either by the planned new WIS computer systems or by upgrades to the existing systems. (pp 38-40/GAO Draft Report)

DoD Response: Concur. The technology is not yet widely available to satisfy the MLS requirements of WIS. However, the program manager has initiated a security architecture analysis that will define alternative potential architectures necessary to support secure operations. This analysis will also determine the technical feasibility and costs of these alternatives, and will determine if controlled mode security is a viable interim solution to full MLS capability. As a point of clarification, DoD policy does not prohibit partial solutions for validated requirements. Often partial technical solutions, coupled with new operating parameters, provide a cost effective method to satisfy a large part of a requirement. Implementation of a controlled-mode security capability would provide improved system flexibility.

- **FINDING O: Limited Security Capability Has Not Been Justified**. The GAO reported that the JCS procedures require that, before a requirement is approved, an analysis of the cost and operational effectiveness for implementing the required capability must be performed. The GAO found, however, that the DoD has not defined the costs and benefits associated with controlled mode security, or demonstrated that this limited security capability is justified on the basis of greater economics and improved mission performance. The GAO observed that one problem with the current computer systems is their inability to exchange classified information with intelligence information systems. The GAO found, however, that this problem will not be corrected with controlled mode security, because the computer systems will not be certified as able to control classified intelligence data until MLS is implemented. The GAO also noted that an official from the joint WIS program management office stated that the controlled mode security capability could be dropped as a requirement, if achieving that capability became an impediment to achieving other WIS benefits in the Block B time frame. The GAO observed that, while a cost/benefit analysis will be required in advance of the Block B DAB development decision, it is not clear whether that analysis will quantify the benefits from controlled mode security. The GAO also reported that there is no

assurance a computer system, designed to the controlled mode level of security, could evolve to MLS. The GAO noted that officials of the National Security Agency (NSA) National Computer Security Center (who are responsible for certifying the security capability of computer systems) stated that achieving controlled mode is not a necessary interim step to achieving a MLS capability in computer systems. Conversely, the GAO found that to achieve the higher security level would require the computer system to be originally designed to achieve the higher level of capability. The GAO concluded that improvements in mission performance will not be realized until MLS is implemented. The GAO further concluded that the limited security capability does not warrant acquiring new computer systems in 1989 because (1) the security capability of new systems will not meet the stated WIS MLS requirement and (2) the limited capability has not been economically or operationally justified. (pp. 38-39, p. 42/GAO Draft Report)

DoD Response: Partially concur. The DoD does not agree that "improvements in mission performance will not be realized until MLS is implemented" (also see the DoD response to Finding P). The GAO is correct in stating that the costs and benefits of security have not yet been defined. However, the JOPES Required Operational Capability (ROC) was validated with the agreement that the requirements would be reviewed and further refined when the costs of implementing them became known. The DAB Milestone II process has been the vehicle for the costs of the various capabilities to be clearly delineated and agreed to by the users. Prior to the approval to proceed with full scale development of the various Block B capabilities, the DAB principals and their staffs will make a conscious decision, based on cost and benefits, on the level of security to be implemented within Block B.

- **FINDING P: Limited Security Capability Is Not Commercially Available Nor Does It Justify Purchase Of New Computer Systems.** The GAO reported that officials of the National Computer Security Center estimate that commercially available computer systems, capable of implementing controlled mode security requirements for WIS, will not be available until at least the early 1990s. The GAO reported that the NSA official responsible for developing the criteria for certifying data base management systems stated that the certification criteria applicable to controlled mode security have not yet been developed, and will not be available until September 1988. The GAO noted that the NSA official also estimated it would be the early 1990s before industry could provide a controlled mode certified data base management system. The GAO observed that the DoD is, nevertheless, preparing to acquire new computer systems in 1989 which do not have the limited WIS controlled mode

security capability, with the expectation that the successful offerer will later evolve the newly acquired systems to provide this capability. The GAO concluded that, under this plan, the DoD would procure new computer systems that would provide no improvement over the current computer system security capabilities and operating procedures. The GAO further concluded that the proposed controlled mode security capability is a partial, unsure, and late solution for security, which does not justify the acquisition of new computer systems estimated to cost $500 million. Finally, the GAO concluded that, acquiring new computer systems offering this limited security capability, would also place the DoD in the difficult position of (1) acquiring computer systems that do not meet its stated requirements for MLS (2) assuming the risks that the contractor could later evolve the computer systems to provide this limited security capability, and (3) obtaining the limited capability several years after the DoD planned acquisition of computer systems in 1989. (pp. 43-44/GAO Draft Report)

DoD Response: Nonconcur. The DoD does not agree that achieving the controlled mode would be of rather limited value. Although controlled mode would not satisfy all the system requirements, it would certainly be of value by reducing the number of Top Secret clearances/facilities required and by allowing additional personnel to use the system. Implementation of controlled mode technology, coupled with changes in the operational procedures, could provide significant improvements to the current environment and may provide cost savings to the DoD.

- **FINDING Q: Defer Computer Acquisition And Define Requirements for JOPES Increment II.** The GAO reported that, based on DoD estimates, the earliest the computer system requirements needed to support the JOPES Increment II can be defined and approved is FY 1991. The GAO noted that, if shown to be required, this would allow it to be deployed in FY 1995. The GAO observed that, since the upgrades to the WWMCCS computer systems obviated the need for replacement, and the life cycle of the upgraded computer systems extends through 1996, the DoD can postpone acquiring the new computer system and make time available to base the acquisition of new computer systems on the JOPES Increment II requirements. The GAO noted that, according to the WIS joint program manager, an evolutionary approach, using prototyping and user feedback, is more effective for developing and implementing computer systems for an application, such as the JOPES Increment II. The GAO concluded that the driving force for the new WIS computer system should be the JOPES Increment II. The GAO observed that, not basing this computer system acquisition on well-defined JOPES Increment II requirements, would increase unnecessarily the risk that any acquired computer systems would have greater capacity and be more costly than

necessary, or would require additional upgrades, or replacements. In addition, the GAO pointed out that, although DoD regulations call for requirements definition to proceed system development, the DoD has neither defined the JOPES Increment II, nor established milestones for the definition of the JOPES Increment II requirements. In addition, the GAO observed that the development of the JOPES Increment I is not formally tracked by the WIS Program Office. The GAO concluded that this as an indication the two systems are not being well coordinated. The GAO noted that it had previously reported[1/] that the WIS automated message handling system--a major product from Block A of the WIS modernization program--fell short of the primary user requirements. (The GAO observed that these requirements still had not been completely defined over a year after the development contract for that system was awarded.) The GAO concluded that, to avoid a similar problem in WIS Block B, the JCS should establish milestones and monitor the completion of the JOPES Increment II requirements. The GAO observed this would ensure that a computer system replacement, if needed, can be based on, and timed to, support these new requirements. The GAO concluded that, otherwise, the computer system could again fail to meet user needs. The GAO also concluded that, although the existing computer systems will need to be replaced some time in the future, the DoD should not go forward with the acquisition of new computer systems as currently planned. (If the replacement were justified on the requirements for the JOPES Increment II, the GAO estimated that the acquisition could be deferred from FY 1989 to at least FY 1992.) (pp. 45-48, p. 59/GAO Draft Report)

DoD Response: Partially concur. The DoD has not ascertained that the upgrades to the WWMCCS computer have obviated the need for replacement. That determination cannot be made without further analysis. The DoD does agree that any computer replacement should be based on clearly defined requirements and supporting cost benefit analysis. In any event, the FY 1989 budget does not contain Block B procurement funds.

- **FINDING R: Time To Establish Security Policy.** The GAO reported that DoD computer system security standards require that computer systems enforce an explicit and well-defined security policy that governs the control of sensitive information. The GAO also reported that, while the DoD considers the JCS Publication 22 to be the security policy for the WWMCCS, this document only states how the current system operates. The GAO found that the DoD does not use it as the basis to develop new systems. The GAO also found that this publication does not define what types of controls would be needed in new computer systems to safeguard

1/"DOD ACQUISITION PROGRAMS: Status of Selected Systems," April 1987 (OSD Case 7253)

different categories of sensitive information. The GAO observed that, currently, there is no overall security policy for the WIS modernization program to assure that security considerations are a part of the system development process and that critical security needs will be provided by new WIS computer systems. In addition, the GAO observed that not establishing a security policy before beginning the system development process entails risk. The GAO cited, as an example, a problem that WIS program officials found with the lack of proper security clearances for personnel developing security-relevant software. The GAO observed that, had a security policy existed, contractor security clearances would have been identified as a long-lead item. The GAO also reported that a close-hold security requirement may not be implemented in Block B, because the WIS program lacks a security policy. The GAO observed that officials of the NSA computer security center and a WIS contractor official, specializing in security, were uncertain whether the level of security the DoD planned to acquire for WIS would provide the necessary protection for close-hold information, because the policy for protecting close-hold information is not well defined. The GAO concluded that, without a policy for protecting close-hold information, the DoD cannot ensure that the WIS computer system acquisition will result in a system that adequately protects such information. The GAO also concluded that, while the DoD has identified security as a current system shortfall, it has not set a security policy, defined security needs, or identified current system security shortfalls. The GAO further concluded that the DoD does not now have a basis to assess whether new computer systems would provide greater protection of sensitive information. The GAO finally concluded that, in order to define security requirements, a WIS security policy must first be established. (pp. 48-51, pp. 57-58/GAO Draft Report)

DoD Response: Concur. Development of a security policy applicable to the WIS Block A and Block B systems has been initiated.

- **FINDING S: Need To Define Security Requirement**. The GAO reported that DoD Directive 5200.28, "Security Requirements For Automated Data Processing Systems," states that security is most cost-effective and economical if the system is originally designed to provide it. The GAO observed that, to define its security requirements, the DoD needs to analyze current system threats, capabilities, and the allocation of security controls among system components. The GAO found, however, that WIS security requirements analyses have not included an assessment of the actual threats to the current system. In addition, the GAO reported that some of the required WIS Block A security capabilities were not identified when development began and, after three years of system development, the WIS program

still has not determined how to implement some features (for example, pass words for multiple users) needed by WWMCCS security officers. Finally, the GAO reported that the DoD needs to determine which WIS security functions can best be implemented with a computer system and which should be implemented through other means. The GAO observed that Federal information processing standards suggest that the best mix of controls should be selected during the design phase. The GAO found that, by making such a selection part of the WIS design process, the DoD can ensure implementation of the most cost-effective mix of security controls in the new WIS computer systems. The GAO concluded that, if the requirements process does not cover current threats, information in the new WIS computer systems could be vulnerable to undisclosed threats or current computer system deficiencies. The GAO also concluded that in order for the replacement computers to provide cost-effective support for requirements, including important new capabilities to be provided by JOPES Increment II and needed security, these requirements must be defined and approved prior to the acquisition of new computer systems. The GAO finally concluded that because of upgrades to WWMCCS computer systems, the DoD has the opportunity to define these requirements before replacement is needed. (pp. 48-52, pp. 58-59/GAO Draft Report)

DoD Response: Partially concur. The WIS security requirement was defined in 1983 in the JOPES ROC while recognizing that the technology needed to support that requirement was still being developed. While the WIS security threat analysis has been conducted and documented in the WIS System Threat Assessment Report, the report has not yet been published pending validation by DIA, currently scheduled for December 1987. The validated threat assessment will be used as the basis for decisions on ways to implement the security requirement defined in the JOPES ROC. Further, the program manager's staff is working with the National Security Agency to provide a detailed WIS security assessment, security environment definition and criteria needed to evaluate the level of security needed for each of the proposed alternative security architectures for WIS.

- FINDING T: Need To Explore Alternatives For Implementing Security Requirements. The GAO reported that JCS policy requires an examination of alternatives, including those related to system security, before a requirement is approved. The GAO noted that the WIS joint program manager believes that highly secure computer systems, capable of meeting WIS security requirements, may not be commercially attainable and that other alternatives for providing required security should be considered. The GAO observed that one alternative not considered is an Army security system, which could achieve benefits similar to those from

the WIS controlled mode and which would certainly be available much sooner. (The Army system uses a monitor computer system, between two physically separate computer systems, to ensure that secret-cleared users do not access top secret information.) The GAO noted that a representative of the Army office, responsible for deploying WIS to Army sites, stated that this project will meet the need for two levels of access control at Army locations scheduled to receive WIS computer systems. The GAO found, however, that the JCS has deferred a survey of the applicability of this alternative to WWMCCS computer network sites because of higher priority staffing needs. The GAO concluded that there may be disadvantages related to the cost of two computer systems and the difficulty of keeping their files consistent. The GAO also concluded, however, that an analysis of security alternatives, which includes an evaluation of the cost effectiveness of security through physical separation, is needed to determine how best to meet mission needs. (pp. 53-54, p. 58/GAO Draft Report)

DoD Response: Concur. Various alternatives are being evaluated. The Army security system has been evaluated but a determination was made in August 1987 that the system is not acceptable to satisfy the WIS security requirement. Other system evaluations will be completed to determine how best to meet the requirement.

- **FINDING U: Time To Implement A Program To Manage Computer System Performance And To Project Future Needs.** The GAO reported that, as the upgraded computer systems approach the end of their lives, it will become increasingly important for the DoD to have a computer system performance measurement and capacity planning program to project the impact of future workloads and measure response times against DoD standards. The GAO observed that this will be needed to determine whether additional capacity is necessary for new requirements and whether this capacity can most cost effectively be achieved through (1) computer system tuning to modify the way computer system resources are used, (2) system upgrade, or (3) system replacement. The GAO also observed that, in this way, many problems can be avoided, often with substantial savings. The GAO noted that its discussions with a contractor (who simulates computer system performance), the staff from the Federal Computer Performance Evaluation and Simulation Center, and the computer system performance evaluation manager for the primary WWMCCS site, indicate that the establishment of such a program is feasible and desirable. The GAO cited a capacity problem that arose at one site during a 1985 exercise to indicate the importance of such a system and of lead time in projecting computer system performance. The GAO also reported that the WIS program lacks the computer system performance data upon which to base a cost-effective

computer system replacement. The GAO noted, for instance, that a WIS contractor, tasked to develop a specification for the new computer systems, found that anticipated workloads, whether in day-to-day operations, exercises, or crises, were not known. The GAO concluded that the establishment of a network-wide computer system performance measurement and capacity planning program would allow the WIS modernization program to safely delay computer system replacement to reduce costs and provide more time for the definition of JOPES Increment II and security requirements. The GAO further concluded that such a program is needed to maximize benefits from current computer systems and determine when system upgrade or replacement is warranted. The GAO also concluded that, consequently, the postponement of this acquisition will provide the DoD the opportunity to make the necessary analyses and establish the necessary systems to guide future decisions on keeping WWMCCS computer systems current and economical. Finally, the GAO concluded that, during the intervening time, technology will advance, increasing the likelihood commercial products will be available to satisfy WWMCCS requirements. (pp. 54-56, pp. 59-60/GAO Draft Report)

DoD Response: Partially concur. The DoD recognizes the value of collecting and analyzing data on computer resource usage as an effective planning tool. It is not clear if the current WWMCCS network can support this type of capability. The OASD(C3I) will request the network manager to assess the feasibility and costs associated with implementing these collection and analytic techniques.

RECOMMENDATIONS

- **RECOMMENDATION 1**: The GAO recommended that the Secretary of Defense defer the currently planned $500 million WIS joint mission computer system acquisition until:

  - requirements for the acquisition are defined and approved, especially the processing capabilities needed for the Joint Operation Planning and Execution System (Increment II);

  - A formal security policy is established, security requirements are defined, alternatives for implementing these requirements are evaluated, and the most cost-effective means of meeting security requirements are selected;

  - the upgraded computer systems cannot be cost effectively upgraded further to meet the above processing and security requirements. (p. 60/GAO Draft Report)

  DoD Response: Concur. It is DoD policy that new acquisitions must be fully justified based on defined requirements and independent cost estimates. Because the impacts of the early Block B software initiatives have not yet been experienced, it is premature to speculate on hardware requirements or replacement schedules at this time. The DAB will review the alternatives presented for the Block B Milestone II decision. This DAB is currently scheduled for the summer of 1988.

- **RECOMMENDATION 2**: The GAO recommended that, in order to ensure a proper and timely WIS acquisition, the Secretary of Defense should:

  - establish milestones and monitor the development and approval of the requirements for the additional mission capabilities needed in the JOPES Increment II;

  - incorporate these milestones into the WIS acquisition schedule; and

  - target completion of development and approval for 1992. (p. 61/GAO Draft Report)

  DoD Response: Concur. The ASD(C3I) will request that the JCS provide these milestones to the WIS JPM. These milestones will be monitored during the various WIS reviews to ensure that the requirements process remains in synch with the development activities.

- **RECOMMENDATION 3**: The GAO recommended that, also in order to ensure a proper and timely WIS acquisition, the Secretary of Defense should establish a network-wide computer system

performance management and capacity planning program to:

- measure computer system performance against DoD standards;

- identify future needs for computer system resources; and

- project when the current computer systems can no longer provide cost-effective mission support. (p. 61/GAO Draft Report)

DoD Response: Concur. The DoD will establish this type of program in the current system, if technically feasible and cost effective. In any event, the ASD(C3I) will request that the JCS require that such a system is implemented in the new WWMCCS Information System.

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