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Report to the Chairman, Subcommittee on Defense, Committee on Appropriations, House of Representatives

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The Personnel Concept III System Is Not Ready for Deployment

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Information Management and
Technology Division

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February 27, 1990

The Honorable John P. Murtha
Chairman, Subcommittee on Defense
Committee on Appropriations
House of Representatives

Dear Mr. Chairman:

In September 1989, your office requested that we review the Air Force's development of the Personnel Concept III (PC-III) system. PC-III is an automated system that is intended to allow users at the unit-commander level automated access to an existing personnel system at Air Force bases. The Air Force plans to begin deployment at the first of 125 bases in the spring of 1990.

Our objectives were to determine if (1) PC-III will be fully developed and adequately tested before being deployed, (2) the hardware chosen for PC-III is the best and most cost-effective option, and (3) projected personnel reductions, used to justify PC-III, are valid. Appendix I provides detailed information on our objectives, scope, and methodology.

Results in Brief

To reduce the risk of fielding systems that do not work as intended or cost more than necessary, the Department of Defense requires full development and testing and a complete analysis of alternatives before a system is deployed. The Air Force, however, plans to deploy PC-III, estimated to cost $550 million, to 125 bases even though the system (1) is only partially developed and tested, (2) has not yet passed significant elements of these tests, (3) is based on a hardware design selected without fully analyzing requirements or alternatives, and (4) was justified on the basis of unsupported claims of personnel savings. While the Air Force expects PC-III to improve personnel management functions by automating access to the existing base-level personnel system, these improvements do not justify taking shortcuts and unnecessary risks in deploying the system.

Air Force officials acknowledged that they plan to deploy a partially developed system, but believe their development approach has reduced the risk of system failure. However, if the Air Force deploys PC-III without sufficiently testing whether the complete system will operate as intended, and without knowing that its hardware is the best choice to

meet performance requirements, it could be deploying a system that will not work.

Air Force officials further stated that they do not have the time to reconsider hardware alternatives because personnel reductions attributed to PC-III have begun, and the new system is needed to offset these reductions. However, this claim is unfounded because an Air Force study—done independent of PC-III—found personnel offices to be overstaffed and personnel reductions for the next few years will affect only this overstaffing. Therefore, the Air Force can delay system deployment without adversely affecting personnel services.

The Air Force has the opportunity at this stage in PC-III's development to reassess the system and ensure that it procures the automated system that best meets its needs. Therefore, this report includes recommendations to the Secretary of Defense to delay PC-III deployment until the system is fully developed and tested, and the hardware selected is shown to be the best to meet requirements.

Background

The Air Force Military Personnel Center, headquartered at Randolph Air Force Base in San Antonio, Texas, manages personnel programs for the Air Force. Although its primary responsibility is to ensure that jobs are filled with qualified people, the Center also develops, implements, and manages personnel services programs such as the officer and enlisted personnel evaluation system, awards and decorations program, and physical fitness programs. Information on these programs, as well as other personnel data, is contained in an automated personnel system at each air base.

Currently, changes to the data in the base-level personnel system as well as reports containing information from the system are done only through the centralized personnel office at each base. Changes are made by the personnel office staff on the basis of information sent to them in hard copy from the unit level. Requests for information are filled by the personnel office staff who print the requested information from the system and send it to the requester.

PC-III, which is being developed by Center personnel, will cost about $550 million to develop, operate, and maintain over its 8-year economic life. Of the $550 million, $200 million will be spent to develop and deploy the system. The Air Force began developing PC-III in 1986 and plans to begin installation, one base at a time, in the spring of 1990 and finish in 1992.

The system will be deployed in increments and the first increment will include most of the active duty personnel functions. Future increments will include civilian, reserve, and guard personnel functions.

PC-III will not provide new personnel services; it is intended to automate the access to and updating of information in the base-level personnel system, and reduce the number of people needed to run this system. The Center believes PC-III will allow unit commanders quicker access to information from the base-level personnel system that pertains to their own unit. In addition, instead of typing and submitting hard-copy changes to the centralized personnel staff, units will enter these changes into PC-III. PC-III will collect and batch the entered changes and electronically send them to the centralized personnel computer system where the changes will be screened before the personnel data base is updated.

Center officials believe that since units will be entering their own changes, staffing levels at the base personnel offices can be reduced. The Center does not expect staffing levels in the units to increase because the staff will not be performing additional work—they will be typing reports on a computer terminal instead of a typewriter.

The level of oversight and approval responsibility for defense system projects depends on several factors, including cost. PC-III, with an estimated acquisition cost of $200 million, was designated as a major system[1] and was, therefore, the responsibility of the Secretary of Defense through the Major Automated Information System Review Committee. The Committee reviews systems at major milestones and must approve the next stage before development can proceed. On June 29, 1989, citing the success of PC-III development to date, the Secretary of Defense delegated PC-III approval authority to the Secretary of the Air Force.

PC-III Is Not Ready to Be Deployed

The purpose of the system development and testing phase is to discover and correct problems, and to determine if the entire system works as intended. The Center's decision to field PC-III when it is only partially developed and tested increases the risk of problems occurring later in the development cycle, when they are more costly and more difficult to correct. The Air Force does not know if PC-III will operate as intended because it has not tested the complete system. Further, PC-III has not

[1]Defense Directive 7920.1 defines major systems as those with estimated acquisition costs over $100 million, those with estimated costs in any 1 year exceeding $25 million, or those designated as special interest.

passed some of these tests. Additionally, the decision to deploy this system was made without knowing if it is the best alternative to meet system requirements.

Tests Have Been Conducted on an Incomplete System

PC-III plans originally called for deployment of a completely developed and tested system. The system was not to be deployed until all increments were completed and tested, and the entire system had passed all tests. These included development testing and evaluation—which is performed at various points during system development to show that each increment works as intended, and operational testing and evaluation—which is performed on the completed system to demonstrate the operational effectiveness and suitability of the system.

Air Force regulations for system development, test, and evaluation reinforce the importance of testing a completed system. These regulations state that approving a system for deployment should be supported by fully developed and tested computer programs, and the successful completion of both the development test and evaluation and the operational test and evaluation.

Although the Air Force reports it has successfully completed these two major tests on PC-III, neither test was performed on a fully developed system as required. PC-III will consist of four functional areas—active duty, civilian, reserve, and guard—but only segments of the active duty functions were tested. While most guard and reserve functions were developed, they were not included in the tests because the program manager felt these functions were very similar to the active duty functions. In addition, the civilian functions were not tested because only 2 percent of these applications were developed at the time the tests were performed.

The program manager acknowledged that all functions were not tested, but believes that 2 years of testing during development demonstrates the full system's operational characteristics and performance. The remaining functions will be developed as time and resources permit. The program manager further stated that incremental development is a widely accepted strategy for deploying new systems. However, it was not until schedules began to slip that the Center decided to deploy PC-III in increments. The original plans for PC-III called for full development and testing before deployment. Because tests were performed on an incomplete system, the Center has not demonstrated that the complete

system will function as required, and could be deploying increments of a system that will not work.

PC-III Has Not Passed System Tests

The development test and evaluation of PC-III was only partially completed and, according to test documentation, several major functional requirements were not met. These requirements included acceptable response times when performing updates, multiple record update and inquiry capability, integration of office automation software, and uploading and downloading of user data. In October 1989, the program manager said that these missing functions were "only sophisticated enhancements" to the system. However, performance characteristics such as acceptable response times, and system functions such as updates and inquiries are basic system features, not enhancements.

The operational test and evaluation also was not successful and PC-III again failed to meet its response time objectives. In fact, the average time needed to respond to user queries for information took hours, not 20 minutes as required in the test. If responses take hours, the system's intended purpose of providing timely information to unit commanders is not being realized.

Of the 18 operational test objectives, PC-III failed 2 and passed 8; the remaining 8 were not tested. Most of the objectives not tested, including system reliability, were not tested because the Center had not developed testing criteria for them. Although the program manager acknowledged that the tests identified deficiencies that will require extensive changes to the PC-III software, he stated that the Center does not plan to make these corrections before it begins deployment. Until PC-III is fully tested, including testing those changes intended to correct identified deficiencies, deployment could significantly increase the risk that the system may never function as intended.

Computer Hardware Alternatives Have Not Been Evaluated

In addition to being only partially developed and tested, the chosen architecture for PC-III may not be the best one to satisfy the Air Force's needs. PC-III was selected without adequate consideration of alternatives, although Air Force regulations require that all feasible system alternatives be evaluated. Such evaluations are especially critical when the services are under tight budgets.

An important first step in choosing the best system design alternative is identifying the work-load requirements the system must satisfy. An

analysis of projected work loads helps define the capacity, processing, and performance needs of a system. A cost/benefit analysis of each alternative that meets these requirements should then be performed. These steps help ensure that the best alternative is chosen.

Although the Center performed work load analyses, the analyses were not sufficient to help determine the computer capacity, processing, and performance requirements for PC-III. Program officials said they used air base populations to determine these requirements—that is, the greater the number of personnel on a base, the greater the size and/or number of hardware components proposed. While the number of projected users is one factor to be considered in determining work loads, other factors such as frequency of use and types of transactions must also be considered.

Because its work load analysis was flawed, the Center cannot effectively size PC-III. For example, the Center does not know the number of processors, amount of disk space, and memory capacity needed to deploy PC-III. Until the hardware requirement can be better defined, program officials will use a "best guess" sizing approach as a starting point, with an understanding that resizing at a later date may be required. Center officials said they plan to use a computer model that incorporates data compiled during the last 2 years of system development to assist them in determining hardware requirements after PC-III is installed at each air base. While this approach may help determine the needs of each base, it will be too late to help choose the best hardware alternative.

In addition to not sufficiently identifying work load requirements, the Center evaluated only one hardware alternative to the current manual system. In July 1987, the Center had identified four hardware approaches. However, cost and benefit analyses completed in August 1987 and April 1989 included only a comparison of the manual system to a minicomputer-based alternative, which is described in appendix II.

Air Force regulations require that a new automated information system be the most effective and economical alternative to satisfy mission needs. Since the Center did not perform cost/benefit analyses of all hardware alternatives, it does not have assurance that the best and most economical alternative for meeting PC-III requirements was selected. Although we do not advocate any particular hardware architecture, we believe that a system based on microcomputers is a feasible alternative.

A microcomputer-based system, as described in appendix III, may better satisfy mission requirements. According to program documentation, PC-III requirements include (1) a stand-alone operation that enables users to continue processing updates on their workstations when other parts of the system are not operational, (2) the availability to units of basic data on each assigned individual, and (3) the capability of the system to use standard or locally designed programs to produce various reports for the unit commander. Under the Center's selected minicomputer-based hardware configuration, the first requirement would not be met. However, microcomputers would provide the units with the independent processing capabilities that would satisfy this PC-III mission requirement.

According to Air Force officials, they considered the microcomputer-based alternative in 1984 and decided it was beyond state-of-the-art technology and too costly. However, since microcomputer technology and price/performance ratios of commercial microcomputer products have changed substantially since 1984, unless the Center uses current data to analyze and compare feasible alternatives, it cannot be sure that it is deploying the most effective and economical alternative to meet its operational requirements. Additional information comparing estimated costs of the chosen alternative to our suggested alternative is provided in appendix III.

PC-III Projected Personnel Savings Are Questionable

The Center used projected personnel savings to justify the cost of developing PC-III and to instill a sense of urgency in PC-III's deployment. However, the projected personnel savings are based on questionable analysis and many of the savings could have occurred with or without the new system. As a result, the Center does not know how many staff can be reduced when PC-III is implemented and its claim that the new system must be deployed as quickly as possible to avoid degradation in personnel service is unfounded.

According to Air Force documentation, the primary justification for the cost of PC-III is that the system will pay for itself by reducing the number of staff needed to run the existing personnel system. The Center projected that PC-III would enable the base personnel offices to reduce staff by 1,537. The Center arrived at its projection by gathering information at a single base and then extrapolating this information to the entire Air Force, a statistically unreliable approach. The Air Force Audit Agency

reviewed projected PC-III personnel savings and reached the same conclusion.[2] Though it appears that successful implementation of PC-III will reduce the number of personnel office staff, the Center currently does not know how many positions can be eliminated. Further, until the Center develops support for its claims of personnel reductions, it has inadequate justification for PC-III.

In addition, the Center claims that personnel reductions attributed to PC-III have begun and, therefore, the new system must be deployed as soon as possible in order to avoid a degradation in personnel service. However, this claim is unfounded. In fact, a study performed that was unrelated to PC-III concluded that personnel offices were overstaffed and recommended personnel staff reductions. This study, completed in September 1985 by the Air Force Management Engineering Agency, recommended a reduction of 1,214 staff positions in base personnel offices. Because of command concerns, the Air Force Chief of Staff for Personnel Resource Management decreased the recommended reductions to 534. Subsequently, Air Force officials decided to attribute these reductions to PC-III.

In October 1989, the PC-III program manager said that actually only 370 positions were targeted for elimination on the basis of the study and that the rest, or 1,167, are directly attributable to PC-III. Regardless of the exact number of positions, the fact remains that the Air Force study found that, with or without PC-III, the personnel offices were overstaffed. As a result, the reductions in staff scheduled for the first 2 or 3 years should not greatly affect personnel services and, therefore, PC-III deployment is not urgent.

Conclusions

The Air Force currently plans to deploy a system that is only partially developed and tested, and is based on poorly defined requirements and an incomplete analysis of alternatives. Further, the Air Force has not completed software development for PC-III, and deficiencies identified during testing that require extensive software changes have not been corrected. If PC-III is deployed in the spring of 1990 as planned, the Air Force has no assurance that the various components of PC-III will form a complete system that will meet requirements or work in an operational setting.

[2]Validation Test of Personnel Concepts III (PC-III), Air Force Audit Agency (January 11, 1989).

Additionally, the Center has not demonstrated that the current system design is the best alternative to meet system requirements. The Center has not completed a work load analysis to determine system hardware capacity, processing, and performance requirements, nor have they completed a cost and benefit analysis of alternatives. Program officials claim that, since personnel reductions have already begun, a delay in deploying PC-III would degrade personnel services. However, this claim is unfounded because personnel reductions were needed to correct an overstaffing problem and would have occurred regardless of PC-III. Therefore, PC-III deployment is not urgent and the Air Force has time to determine requirements and take another look at possible alternatives. Before the Air Force commits to a system estimated to cost $550 million, it needs to be sure the chosen alternative is the best one.

Recommendations

Since the Air Force has no assurance that PC-III as currently defined will best meet Air Force needs, we recommend that the Secretary of Defense not approve the purchase and installation of computer hardware to deploy PC-III until the Secretary of the Air Force ensures that

- a comprehensive evaluation of projected benefits (i.e., personnel reductions) is completed that justifies the system;
- potential work loads are analyzed to determine the needed capacity, processing, and performance requirements for PC-III;
- hardware alternatives are evaluated and the best and most cost-effective one is selected; and
- an operational test and evaluation of the complete PC-III system is successfully completed to determine its operational effectiveness and suitability.

In addition, to ensure that the Air Force satisfactorily resolves the above issues before further approval is given, we recommend that the Secretary of Defense reinstate Major Automated Information System Review Committee oversight of PC-III.

In accordance with your office's wishes, we did not obtain official agency comments on this report. We did, however, discuss its contents with Air Force and Department of Defense officials and have included their comments where appropriate. We conducted our review between February and November 1989 in accordance with generally accepted government auditing standards.

We are sending copies of this report to the Chairmen, Senate Committees on Appropriations and Government Operations; House Committee on Government Operations; the Director, Office of Management and Budget; and the Secretaries of Defense and the Air Force. We will also make copies available to others on request. This work was performed under the direction of Samuel W. Bowlin, Director, Defense and Security Information Systems, who can be reached at (202) 275-4649. Other major contributors are listed in appendix IV.

Sincerely yours,

Ralph V. Carlone
Assistant Comptroller General

Contents

Abbreviations

ADP	automated data processing
GAO	General Accounting Office
IMTEC	Information Management and Technology Division
PC-III	Personnel Concept III

Objectives, Scope, and Methodology

In September 1989 the office of the Chairman, Subcommittee on Defense, House Committee on Appropriations, asked us to review PC-III. Our objectives were to determine if (1) PC-III will be fully developed and adequately tested before being deployed, (2) the chosen hardware architecture for PC-III is the best and most cost-effective, and (3) projected personnel reductions, used by the Air Force Military Personnel Center to justify PC-III, are valid.

To determine whether the PC-III application software would be sufficiently developed and tested before implementation, we (1) reviewed the program status to evaluate the progress of application development; (2) analyzed design reviews, test reports, and analyses performed by the Air Force Audit Agency; and (3) observed and interviewed Air Force personnel using a PC-III prototype system at Moody Air Force Base, Georgia. We also discussed the completeness of this testing and the system's overall readiness for implementation with officials from the Air Force Communications Command responsible for conducting the system's operational test and evaluation.

To evaluate the computer hardware that the Center has chosen for PC-III, we reviewed system acquisition and architecture plans, and program documentation to identify established hardware capacity, processing, performance requirements, and cost/benefit analyses of alternative configurations. Also, we interviewed officials responsible for computer hardware selection and configuration. To identify a potential hardware alternative, we evaluated performance characteristics of the chosen configuration, and analyzed the Center's hardware contract.

We compared estimated costs for components of both the minicomputer-based and microcomputer-based hardware alternatives to determine which was potentially less costly. In making this comparison, we selected three bases undergoing first-year installation of the system to illustrate potential savings of the microcomputer-based architecture. The three bases selected—Hickam Air Force Base, Andrews Air Force Base, and the Air Force Academy—were chosen because of the number of computers (small, medium, and large as defined by the Air Force) required to implement PC-III at these bases. Cost estimates for computers were taken from the Standard Multi-User Small Computer Requirements Contract. Estimated microcomputer costs were taken from the Center's program documentation supplied at the time of our review.

To determine whether the estimations of personnel reductions were valid, we analyzed studies made by the Air Force Manpower and Personnel Management Engineering Team prior to and during the development test and evaluation conducted by the Center from October 1987 through October 1988. In addition, we evaluated the Air Force Audit Agency's assessment of this validation test and discussed with Audit Agency officials the scope and results of their work.

We conducted our work from February 1989 through November 1989 at the Air Force Military Personnel Center at Randolph Air Force Base, Texas; the Consolidated Base Personnel Office at Moody Air Force Base, Georgia; and the Air Force Communications Command at Wright-Patterson Air Force Base, Ohio. We did not obtain official agency comments on this report. However, we discussed the contents of the report with Air Force officials, and their comments have been incorporated where appropriate.

We did not independently verify cost and status information, or the results of independent assessments made of the PC-III program.

Technical Information on Hardware Selected for Personnel Concept III

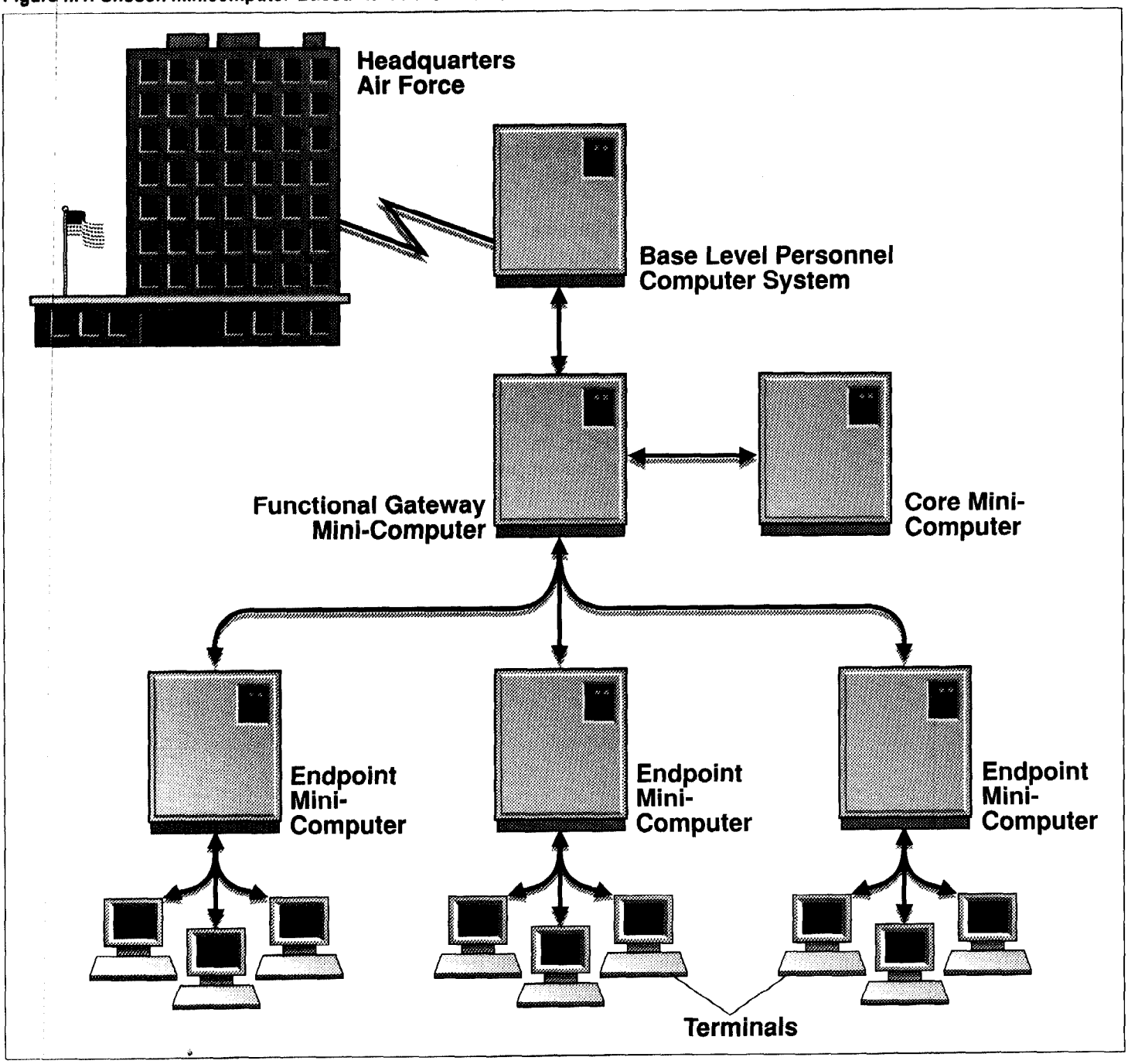
In a June 1989 System Decision Paper presented to the Department of Defense's Major Automated Information System Review Committee, the Air Force Center described the minicomputer-based hardware architecture selected for PC-III. This architecture will be a distributed system with the following attributes:

- A "functional gateway" minicomputer in the base personnel office will serve as a communications processor. It will provide access to the "core" minicomputer containing the base-level personnel system, and through the "core" minicomputer, using the Defense Data Network, will provide access to the Air Force headquarters Military Personnel Center system.
- A "core" minicomputer will contain the PC-III master personnel data base for the installation. It will be one or more large minicomputer systems located in the base personnel office.
- "Endpoint" minicomputers will be located in the offices of units and base tenants. These minicomputers will contain that portion of the centralized applications software and personnel data needed by individual units. Endpoint minicomputers will be connected to the functional gateway and will not have the capability of sharing information directly with each other.
- Terminals, located in unit offices, will be connected to the "endpoint" minicomputers. These terminals will provide access to PC-III capabilities maintained on the endpoint computers. Although terminals provided under the PC-III program will be dumb terminals,[1] microcomputers existing in the units will be used if they can emulate the PC-III terminal.

With the exception of the dumb terminals at the unit level, all components are American Telegraph and Telephone 3B2/600G minicomputer systems, purchased from the Air Force Standard Multi-User Small Computer Requirements Contract.

[1]Dumb terminals are terminals that have no processing capability (i.e., intelligence) of their own, but can only send and receive or display data from a computer.

Figure II.1: Chosen Minicomputer-Based Hardware Alternative

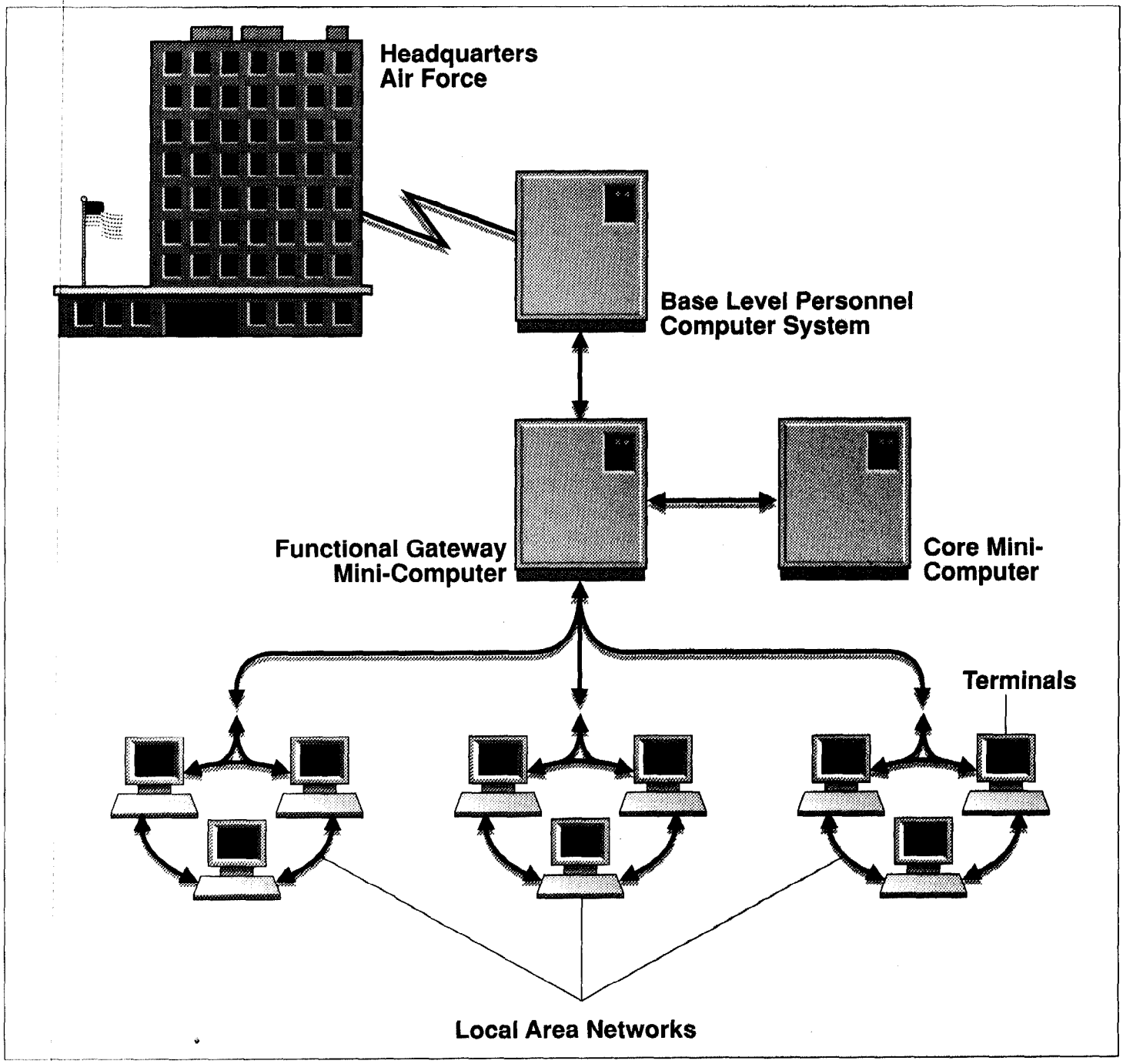


A Potential Hardware Alternative to Personnel Concept III

In a July 1987 System Decision Paper presented to the Department of Defense's Major Automated Information System Review Committee, the Air Force Center described a microcomputer-based hardware architecture for PC-III. Although we do not advocate any particular hardware architecture, we believe that a microcomputer-based configuration has the potential to effectively and economically meet PC-III operational requirements. This distributive system design could consist of the following components:

- A "functional gateway" minicomputer in the base personnel office could serve as a communications processor. It would provide access to the "core" minicomputer containing the base level personnel system, and through the "core" minicomputer, using the Defense Data Network, would provide access to the Air Force headquarters Military Personnel Center system.
- A "core" minicomputer could contain the PC-III master personnel data base for the installation. It would be one or more large minicomputer systems located in the base personnel office.
- "Endpoint" microcomputers could be located at the unit level. These microcomputers would provide the capabilities to accomplish routine personnel actions as well as stand-alone operations. Each unit would be able to use its microcomputer with standard or locally developed applications. Rather than connecting dumb terminals to an "endpoint" minicomputer, these microcomputers could be interconnected to each other and to the "functional gateway" via a local area network. Where possible, PC-III would use existing microcomputers.

Figure III.1: Proposed Microcomputer-Based Hardware Alternative



Neither the August 1987 nor the April 1989 cost and benefit analyses considered a microcomputer-based alternative. We did not perform an in-depth cost comparison of the alternatives. However, using estimates provided by the Center, we did make a preliminary analysis of the costs of hardware differences in these alternatives.

Table III.1: Cost Comparison of PC-III Hardware Alternatives

	Estimated[a] total costs for hardware components		
Hardware component	**Mini-based**	**Micro-based**	**Difference**
Core	$3,821,610	$3,821,610	$0
Gateway	3,871,548	3,871,548	0
Endpoints			
Minicomputer	18,131,348	0	18,131,348
Microcomputer	0	6,892,500	(6,892,500)
Terminals	3,313,250	2,890,000	423,250
Total	**$29,137,756**	**$17,475,658**	**$11,662,098**

[a]Costs were estimated by extrapolating the average total cost at Hickam Air Force Base, Hawaii; Andrews Air Force Base, Maryland; and the Air Force Academy, Colorado; to all Air Force bases.

This analysis does not include software development costs or software and hardware maintenance costs of either alternative. Also, while the minicomputer-based alternative requires about $49 million in communications equipment, the Center estimated that a local area network for the microcomputer alternative would cost about $40 million. The Air Force is currently developing a requirements contract to install local area networks at all bases. If networks are installed at bases under this standard contract, then networks would be available for PC-III to use. Therefore, the cost of installing a network would not be directly attributable to PC-III.

Additionally, the microcomputer alternative cost estimate may be significantly overstated because, from 1986 through 1988, over 620,000 microcomputers were purchased from an Air Force standard requirements contract. Until an inventory of available microcomputers at air bases is completed, and a decision made on their reallocation, the cost of additional microcomputers cannot be determined with any accuracy.

In addition to costing less than the minicomputer system, a microcomputer system could provide other benefits. For instance, the microcomputers could be put to countless other uses when not being used for PC-III. The dumb terminals proposed for the Center's minicomputer-based system will be used only for PC-III.

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