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Report to the Chairman, Subcommittee on National Security, International Affairs, and Criminal Justice, House Committee on Government Reform and Oversight

April 1996

TELECOMMUNICATIONS NETWORK

NASA Could Better Manage Its Planned Consolidation

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Management Division

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April 9, 1996

The Honorable William H. Zeliff, Jr.
Chairman, Subcommittee on National
Security, International Affairs,
and Criminal Justice
Committee on Government Reform
and Oversight
House of Representatives

Dear Mr. Chairman:

In September 1995, you asked us to assess the National Aeronautics and Space Administration's (NASA) plans to consolidate the management and operations of its wide area telecommunications networks. Specifically, you requested that we assess whether the consolidation would result in savings and whether NASA had considered a full range of approaches to the consolidation to ensure that savings are maximized. The network consolidation effort is part of NASA's overall strategy to reduce agencywide spending by $5 billion by the end of the decade.

To assess NASA's plans to consolidate its networks, we reviewed reports prepared by NASA teams responsible for evaluating the agency's activities and recommending ways to save money. We interviewed selected members of the teams, officials from the Office of Space Communications at NASA headquarters, and officials from NASA's five networks at three NASA centers. We discussed alternative network consolidation proposals with NASA officials but, because of time and resource constraints, did not independently verify the cost savings estimates presented in these proposals or their technical feasibility. We requested comments on a draft of this report from the Administrator of NASA or his designee. The Acting Deputy Administrator of NASA provided us with written comments, which are discussed in the "Agency Comments and Our Evaluation" section and are reprinted in appendix II.

Results in Brief

While NASA has not yet finalized its strategy for consolidating networks, it has made some important decisions. NASA plans to begin consolidating its networks immediately at the Marshall Space Flight Center and procuring services from commercial providers in fiscal year 1998. NASA's decision to consolidate its networks offers the potential for savings. Nevertheless, in adopting its current strategy, NASA neither considered alternatives

suggested by officials at centers other than Marshall nor attempted to conduct a complete review of its networking needs and how best to satisfy them independent of its ongoing networking activities.

Background

NASA currently has five wide area networks in operation or under development. Three different NASA centers manage these networks, which provide a variety of communications services among headquarters, the field centers, major contractors, affiliated academic institutions, and international partners. NASA's budget for the networks during fiscal year 1995 was $147 million.

The agency uses its NASA Communications (NASCOM) Network for all high-priority, mission-critical communications, such as controlling and communicating with the space shuttle and other spacecraft. When NASCOM was introduced in 1964, network technology was just developing, and few services were available commercially. NASA developed the technology for NASCOM to meet its specific needs, including unique requirements for reliability and security to safeguard against the loss of a spacecraft or harm to astronauts.

When a more routine administrative support network was needed, NASA first considered extending NASCOM. However, NASA decided that a separate network was needed because NASCOM's operational mission communications were considered too critical to dilute with administrative support, which could be accomplished more cheaply outside of the high-performance NASCOM regime. Thus, the Program Support Communications Network (PSCN) was implemented as a separate network in 1986. Since then, three other networks have also been set up to address specialized needs and clienteles. Appendix I describes NASA's five wide area telecommunications networks in more detail.

NASA's approach to wide area networking has been to lease telecommunications lines from commercial providers but to operate its own control centers to retain control over the services provided. NASA and its support contractors independently design, operate, and maintain the five networks providing telecommunications services over commercially leased lines.

Consolidation Is Expected to Achieve Significant Savings

In recent years, communications technology has greatly advanced, reducing the need to operate separate networks. It is now therefore feasible for NASA to consolidate its networks.

Currently, several NASA centers are providing similar network services. For example, multiple transmission lines connecting NASA's centers are being procured separately by both Goddard Space Flight Center in Greenbelt, Maryland, and Marshall Space Flight Center in Huntsville, Alabama. In addition, Goddard, Marshall, and Ames Research Center at Moffett Field, California, all operate network control centers staffed for continuous operations. Multiple contractors perform similar network functions at each of these centers. A variety of NASA review teams have independently reported that significant savings could be achieved by consolidating these resources and functions.[1] We did not, however, verify their findings.

NASA evaluations indicate that consolidating network infrastructure will achieve significant savings. As a result of consolidation, NASA expects to be able to consolidate its transmission requirements, buying in larger units of bandwidth, which would result in significant economies of scale. NASA also expects to dramatically reduce the numbers of both NASA and contractor personnel required to support operational and administrative services and to eliminate the overhead associated with multiple facilities and support contracts.

Potential Cost-Saving Alternatives Not Considered

In August 1995, NASA's Associate Administrator for Space Communications made a decision to begin network consolidation by following a plan proposed by Marshall. Under Marshall's plan, NASA would consolidate the management, engineering, and operations of its networks under an existing support contractor at Marshall starting in 1996 and begin using commercial providers for network services in 1998. The Administrator estimated that this strategy would save $236 million over the next 6 years.

We are concerned that in deciding to consolidate at Marshall, NASA did not consider other existing proposals that could result in potentially greater savings. Moreover, NASA has embarked on its present course of action in an ad hoc manner, without taking a comprehensive and objective look at its

[1]Reviews recommending consolidation include (1) the Information Systems Cross-Cutting Team review to assess ways to decrease the human factor costs of providing information technology services, (2) the Zero-Base Review to assess streamlining functions across NASA centers, and (3) the Space Operations Streamlining Team Review to study possible privatization and commercialization of space operations across NASA.

overall communications requirements independent of the approaches championed by officials who are currently managing NASA's networks.

Rather than taking the extra time to analyze a full range of alternatives and possibly delaying the start of consolidation, NASA's Associate Administrator for Space Communications decided to act quickly so that some budget savings could be realized in 1997. However, the adopted plan does not seek cost savings in the near term as aggressively as other existing proposals. For example, network officials at Goddard have proposed a more accelerated approach, with potentially greater savings. The Goddard approach would immediately procure services from AT&T under the agency's FTS 2000 contract rather than waiting until 1998. Goddard estimates that outsourcing immediately could save an additional $94.5 million over the next 6 years. We did not verify their estimated savings, but we believe these potential savings warrant further analysis.

Other existing proposals support the notion that NASA's strategy could be modified and that more savings may be possible. Examples include the following:

- The Zero-Base Review Team recommended that NASA first run a competition to determine which center could consolidate the networks most cost effectively, after which services would be procured from commercial providers. This alternative would ensure that the choice of the lead center is based on the approach that offered the greatest cost savings.
- Ames proposed that savings could be increased by using a broader range of management and technical approaches, including not only consolidation and the use of advanced communications technology, but also methods that provide new incentives for validating user requirements and more accountability in service delivery. Ames could not perform a detailed analysis of cost savings under this approach because it was unable to acquire detailed budget information for network operations not under its control.

These proposals offer specific examples of alternatives that may result in greater overall savings. However, we believe that NASA should not limit itself to considering proposals made by officials who may be biased by a vested interest in preserving ongoing telecommunications programs. An objective assessment of NASA's telecommunications needs and how best to satisfy them, made by a team independent of any of the NASA organizations currently providing telecommunications services, might identify opportunities for even greater savings.

Conclusions

NASA's goal in consolidating its networks was to achieve cost savings as part of its effort to cut overall spending by $5 billion by the end of the decade. Network consolidation is a step in the right direction and should result in significant cost savings. We believe, however, that NASA's quick decision to adopt Marshall's approach to network consolidation may not result in the greatest possible savings. Proposals made by Goddard, Ames, and the Zero Base Review team offer specific alternatives that have the potential to realize greater savings. However, none of these proposals can take the place of an objective and independent review in ensuring that consolidation savings are being maximized.

Recommendation

We recommend that the NASA Administrator direct a team of agency officials, which includes team members not affiliated with any of the competing centers, to conduct an objective review of NASA's telecommunications needs and how best to satisfy them. This review should examine a broad range of alternatives, including but not limited to the existing proposals from the different centers and review team studies. Following this review, the most cost-effective approach should be implemented.

Agency Comments and Our Evaluation

In its written comments on a draft of our report, NASA generally agreed with the report and discussed measures it is taking to ensure that its network consolidation achieves what it referred to as "an optimum Agencywide implementation." NASA, however, did not clearly state whether or not it planned to conduct the objective review we recommended. It did state that it would not delay progress on consolidation until an objective review is completed. Our recommendation does not state, nor does it intend to imply, that ongoing consolidation activities must be suspended until the objective review is complete. Our concern with current consolidation activities is not that they may be counterproductive and need to be reversed but rather that they simply may not go far enough in identifying and capturing potential savings. After conducting an independent review, NASA may well be able to make adjustments to its ongoing consolidation program that would realize additional savings.

We conducted our review between September 1995 and December 1995 in accordance with generally accepted government auditing standards.

We are sending copies of this letter to the NASA Administrator and appropriate congressional committees. We will also make copies available to interested parties on request.

Please contact me at (202) 512-6240 or John de Ferrari, Assistant Director, at (202) 512-6335 if you or your staff have any questions concerning this letter. Major contributors are listed in appendix III.

Sincerely yours,

Jack L. Brock, Jr.
Director, Defense Information
and Financial Management Systems

Contents

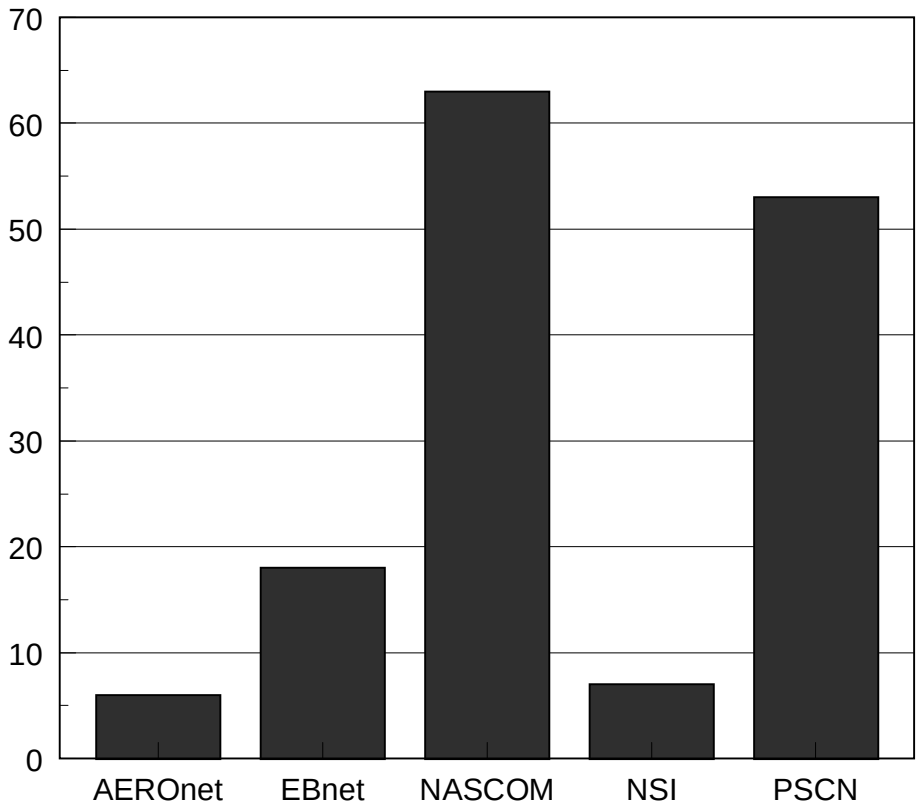
Abbreviations

AEROnet	Aeronautic Network
ATM	Asynchronous Transfer Mode
EBnet	Earth Observing System Backbone Network
EOS	Earth Observing System
NASCOM	NASA Communications
NASA	National Aeronautics and Space Administration
NSI	NASA Science Internet
PSCN	Program Support Communications Network

NASA's Wide Area Networks

The following chart shows the baseline budgets for NASA's wide area networks in fiscal year 1995. The networks are discussed in more detail in this appendix.

Figure 1: NASA Wide Area Network Budgets for Fiscal Year 1995
(Dollars in Millions)



Legend

AEROnet = Aeronautic Network
EBnet = Earth Observing System Backbone Network
NASCOM = NASA Communications Network
NSI = NASA Science Internet
PSCN = Program Support Communications Network

Aeronautic Network (AEROnet)

AERONet is a high-capacity network that enables the nationwide aerospace research and technology community to access NASA's Numerical Aerodynamics Simulation supercomputing facility, located at Ames. This facility allows scientists to address complex aerodynamic problems that,

due to their size, cannot be handled on less than state-of-the-art supercomputer systems. In addition, AERONET provides access to the High Performance Computing and Communications Program testbeds and the Aeronautics Consolidated Supercomputer facility.

Services provided include Internet protocol connection to the supercomputing facility, security protection using network filtering and firewalls, and interconnection with individual sites collaborating on research efforts.

The system's architecture consists of routers located at end-user sites connected to the nearest NASA center. PSCN provides communication lines from these sites to other NASA centers.

AERONET is actively pursuing Asynchronous Transfer Mode (ATM) technology. In the near future, additional bandwidth will be required to accommodate the next generation of supercomputers as well as emerging technologies. These include on-line research collaboration using video links to analyze simulation and wind tunnel data in real time at remote sites.

AERONET's estimated cost in fiscal year 1995 was $6 million, which includes $4.2 million funding currently provided by PSCN for backbone services and $1.2 million provided by the Office of Aeronautics for the cost of tail circuits for user connections. AERONET is currently staffed at 0.5 civil servants and 4.5 Computer Sciences Corporation personnel.

Earth Observing System Backbone Network (EBnet)

EBNET is the project name for the wide area network being developed to support the requirements of the Earth Observing System (EOS). Built on a temporary network that interconnects the existing data systems of the earth science community, EBNET will provide high-capacity connectivity among the program's distributed data processing and archive facilities and its international partners. EBNET will also provide mission support to the Tropical Rainfall Measuring Mission and other joint programs with Europe, Japan, and the National Oceanic and Atmospheric Administration. NASA plans to make the network operational in 1997.

EBNET will transport forward link commands, return link telemetry and payload science data, and operational data between the EOS spacecraft and elements of the EOS Data and Information System, including the EOS Core System, the EOS Data and Operations System, and the EOS Distributed

Active Archive Centers, where the EOS scientists and researchers are connected to the network.

EBnet's estimated budget in fiscal year 1995 was $18 million. Staff levels in 1995 for EBnet include 3 civil servants and 30 contractor personnel.

NASA Communications Network (NASCOM)

NASCOM provides operational communications for deep space missions, earth orbiting satellites, manned missions, and aeronautical activities. NASCOM interconnects NASA's overseas and domestic tracking and telemetry stations, launch areas, mission and project operations control centers, science data processing facilities, and network control centers.

NASCOM provides a range of communications services. These include analog and digital voice transport, low-speed and high-speed message switching, wideband packet switching, video transport, and integrated transmission services.

The Goddard NASCOM Switching Center is the primary switching center and control point. Additional centers are at the Jet Propulsion Laboratory, Marshall Space Flight Center, Kennedy Space Center, Vandenberg Air Force Base, Canberra (Australia), and Madrid (Spain). NASCOM has terminal equipment at all NASA centers.

NASCOM leases 900 circuits from 30 national and international carriers and employs both satellite and terrestrial-based transport services. Most national circuits are provided under a modified FTS 2000 contract.

The NASA Communications Division has been upgrading NASCOM's current systems as well as developing new network systems. NASCOM has been using a NASA-unique, 4800-bit block protocol for data transmission, which the division is replacing with a standard Internet protocol. It plans to eliminate the need to support the 4800-bit block by no later than fiscal year 1997. The division has begun implementing a Common Transmission Infrastructure backbone system with PSCN, employing both dedicated circuits and ATM services provided by common carriers. The backbone will provide common nodes, circuits, management, and service interfaces. Each network will continue to provide connections to its users via routers and ATM switches.

NASCOM's estimated budget in fiscal year 1995 was $63.0 million. Staffing for NASCOM in fiscal year 1995 included 21 civil servants and 210 contractor

personnel, provided under two separate contracts. The Systems, Engineering, and Analysis Support contract, awarded to Computer Sciences Corporation, is specifically for engineering and software development. The Network and Missions Operations Support contract, awarded to Allied Signal Technical Services Corporation, covers operations and maintenance functions Goddard-wide. Both contracts expire in September 1997.

NASA Science Internet (NSI)

Managed and operated at Ames, NSI provides connectivity between NASA's space science community and its computing facilities, archives, and databases. The NSI Project Office is responsible for operating and maintaining the network, identifying existing and future NASA science communications requirements, developing tools to enhance the usefulness of the network, and providing information on how to find and use networking services and resources.

NSI delivers operational services via existing network infrastructure. It allows the user to access remote X.500 services, data search tools such as Gopher, and World Wide Web applications, such as Netscape. NSI also offers training and assistance, including hotline emergency assistance, mid-level user and educational support, and science conferences and user working groups.

NSI interoperates with several other networks. Within NASA, NSI uses the PSCN intercenter links. Outside of NASA, NSI interoperates with other federal networks such as the Department of Energy's Energy Sciences Network, several thousand regional research and education networks, and major international networks in Europe, Japan, and throughout the Pacific to connect investigators, science databases and archives, computational facilities, universities, industry, and the global information infrastructure. Over 15,000 scientists and researchers worldwide exchange ideas and information via NSI.

NSI leases circuits through the FTS 2000 contract. NSI continually upgrades its circuits and adds new sites in order to meet new requirements. Upgrades generally have a higher capacity and increased interoperability with other networks, especially in foreign countries. NSI is also researching newer, more cost-effective technologies, such as ATM.

NSI's estimated budget in fiscal year 1995 was $7 million. Staff levels in 1995 for the NSI Project Office were 5 civil servants and 33 support contractor personnel under a contract with Sterling Software.

Program Support Communications Network (PSCN)

PSCN provides communications within NASA centers as well as between centers, contractor locations, and international locations. It provides a range of communications services to administrative, scientific, and program users. These services include procurement and maintenance of FTS 2000 access, facsimiles, voice and video teleconferencing, messages, packet data, and circuit-switched data.

PSCN is a fully digital network that enables various users to share a common set of centrally managed communications facilities. The backbone network consists of transmission and switching equipment and facilities necessary to provide basic switching and transmission for both circuit-switched and packet-switched applications. The backbone network is built in a ring architecture with the capability for alternate routing of critical traffic when a line fails. Every major NASA center has two or more connections to the rest of the network. Most long distance circuits are provided by FTS 2000, although other long distance carriers provide a limited number of circuits.

Several upgrades to current systems are planned for fiscal year 1996. These include capacity upgrades to common-user systems, secure access to PSCN Internet routers, installation of Synchronous Optical Network gateways to increase alternate access options, and replacement of an outdated facsimile broadcast system.

Additionally, PSCN is piloting the use of ATM technology. The pilot was established in August 1994 between the Marshall, Ames, Lewis and Langley centers. The goals of the pilot are to study the feasibility of using ATM as a potential replacement for the PSCN backbone in the future.

PSCN's estimated budget in fiscal year 1995 was $53 million. PSCN staffing in 1995 included 15 civil servants and 280 contract support staff. Marshall's Program Information Systems Mission Services contract with Computer Sciences Corporation supports the design, installation, and maintenance of network services.

Comments From the National Aeronautics and Space Administration

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

National Aeronautics and
Space Administration
Office of the Administrator
Washington, DC 20546-0001

MAR 13 1996

Mr. Gene L. Dodaro
Assistant Comptroller General
Accounting and Information
Management Division
U.S. General Accounting Office
Washington, DC 20548

Dear Mr. Dodaro:

See comment 1.

Thank you for the opportunity to review the GAO Draft Report, "TELECOMMUNICATIONS NETWORK: NASA Could Better Manage Its Planned Consolidation." We concur with most of your draft report; however, we do not agree to delay progress on consolidation, until an objective review is completed. We will continue with the consolidation while seeking an optimum Agencywide implementation. An Agency solution must be achieved. Each Center's contribution to the consolidation effort is essential. We strongly concur in the fact that technology has obviated much of the basis for NASA having separate communications networks. The field components of these networks have now been working together for several years to consolidate duplicative activities; and, our budget was developed anticipating resulting economies. It is essential that cost-effective consolidation be accomplished quickly since we have already removed the anticipated savings from NASA's budget.

During the Exit Briefing with GAO on February 9, 1996, the Office of Space Communications (OSC) clarified how the planned consolidation of the Telecommunication Networks would be managed. OSC reinforced its delegation to Marshall Space Flight Center to lead in integrating all related activities into a responsive, cost-effective NASA network. Your draft report emphasizes the urgency of achieving the most cost-effective consolidation of all the networks. Consolidation planning already includes the Program Support Communications Network, NASA Communications, Aeronautics Network/National Research and Educational Network and NASA Science Internet. Consolidation will also address the additional savings that will occur by bringing the Earth Observing System Backbone Network into the package. This consolidation offers economies of scale, increased efficiency, all without affecting quality of service to the customers.

See comment 2.

Enclosed are proposed editorial changes to page 13 of your draft report for your consideration. Please contact Dr. Wilson Lundy, 358-2030, if further assistance is required.

Sincerely,

J. R. Dailey
Acting Deputy Administrator

Enclosure

The following are GAO's comments on NASA's letter dated March 13, 1996.

GAO Comments

1. Discussed in "Agency Comments and Our Evaluation" section of the report.

2. Enclosure not reprinted. Additional changes were incorporated into the last paragraph of AERONET section of appendix I.

Major Contributors to This Report

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