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Report to the Honorable
John P. Murtha, Chairman, Subcommittee on Defense, Committee on Appropriations, House of Representatives

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MILITARY SPACE OPERATIONS

Use of Mobile Ground Stations in Satellite Control

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Information Management and
Technology Division

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

Dear Mr. Chairman:

In your January 9, 1989, letter and in subsequent discussions with your office, you asked us to determine (1) how mobile ground stations fit into the Air Force's overall satellite control architecture, (2) how many stations exist and are planned, (3) what they cost by program element and appropriation account, and (4) how much the Department of Defense budgeted in fiscal year 1990 for mobile ground stations. As agreed with your office, our review focused primarily on mobile ground stations used by the Air Force's satellite programs and included mobile ground stations used for one Defense Communications Agency satellite program.

The Air Force's satellite control architecture establishes a requirement for mobile ground stations to provide command and control instructions to maintain the position of a satellite in orbit as well as to provide the capability to process information coming from satellites. This network of stations, when completed, is planned to supplement fixed stations and/or to totally command and control a satellite's position in orbit or process information. As of May 1989, there were 39 existing mobile ground stations. By 1998 the Department of Defense estimates it will have a total of 84 mobile ground stations to support satellite programs at a cost of about $1.6 billion. We identified about $92 million in the Fiscal Year 1990 Department of Defense budget request for new or upgraded mobile ground stations. Appendixes III and IV show the estimated cost for each mobile ground station by appropriation account and program element.

The Role of Mobile Ground Stations in the Satellite Control Architecture

The Air Force's satellite control network architecture provides for both fixed ground facilities and mobile ground stations to support the military's satellite programs. Satellites must have periodic contact with ground stations to receive command and control instructions to ensure that they are in proper orbit and to send back information relative to their mission. The current satellite control network includes two fixed command and control stations—the Consolidated Space Operations

Center located near Colorado Springs, Colorado, and the Consolidated Space Test Center located in Sunnyvale, California. The network also consists of fixed tracking stations and fixed dedicated satellite control stations located throughout the world to maintain continuous contact with the satellites. Mobile stations are intended to provide command and control or mission processing capability for satellites. They can also function as either a supplement or survivable back-up in the event the fixed stations were to become inoperable. Defense's intent is to increase its ability to control satellites beyond the existing use of fixed ground centers and stations by geographically dispersing and continuously moving the mobile ground stations to reduce their detection and increase their survivability. Figure 1 is an artist's conception of a mobile ground station consisting of two vans with an attached antenna.

Figure 1: Illustration of a Mobile Ground Station

The Air Force and the Defense Communications Agency plan to use the 84 mobile ground stations for six operational satellite programs and four research and development efforts. The six operational programs are the Boost Surveillance and Tracking System, Milstar, Defense Support Program, Defense Satellite Communications System, Defense Meteorological Satellite Program, and Global Positioning System. These satellite programs provide weather, missile warning, navigation, and communication

information. One or more mobile ground stations are planned to be used to support each operational program. The four research and development efforts are the Transportable Mobile Ground Station, Consolidated Space Test Center Transportable Ground Station, Transportable S-Band Terminal, and the Transportable Vehicle Check-out System. (See appendixes I and II for the purpose of each of the operational programs and research and development efforts.) The Air Force manages all the above satellite programs and related research and development efforts except for the Defense Satellite Communications System, which is managed by the Defense Communications Agency.

Department of Defense Direction for Mobile Ground Stations

As appendix I shows, mobile ground stations are currently used to support only the Defense Support Program and the Defense Meteorological Satellite Program. At the time these mobile ground stations were designed, the Department of Defense did not require that the stations be interoperable; that is, have the capability to command and control or process mission data from more than one satellite program. Accordingly, these mobile ground stations were designed to operate with their program's satellites only—for example, none of the Defense Support Program's six mobile ground stations can operate with satellites belonging to the Defense Meteorological Satellite Program.

In a September 1988 report entitled Multi-Command Required Operational Capability for an Integrated Satellite Control System, the Joint Chiefs of Staff established a requirement for achieving a standard, interoperable, survivable, mobile command and control system among satellite programs. According to a combined service concept draft paper,[1] one of the most important features of this requirement is a standard and interoperable mobile command and control system capable of supporting multiple spacecraft programs.

However, Air Force officials stated that each of the six operational satellite programs is built to unique hardware and software specifications that would have to be modified to be compatible with the hardware and software configuration of a standard mobile ground station. Because of the hardware and software revisions that would be necessary, the Air Force does not plan to retrofit operational satellite programs (except for the Boost Surveillance and Tracking System) to meet

[1] Mobile Satellite Control Proof of Concept Preliminary Operations Concept, Air Force Space Command, Navy Space Command, and U.S. Army Space Command, Dec. 13, 1988 (Draft).

the new requirement; future satellite systems would be required to meet the new capabilities.

Status and Cost of Existing and Planned Mobile Ground Stations

By 1998, the Air Force and Defense Communications Agency plan to have a total of 84 (76 operational and eight research and development) mobile ground stations at an estimated cost of $1.6 billion. As shown in table 1, these include an estimated $1.5 billion for mobile ground stations to support the six operational satellite programs and an estimated $69.4 million to provide eight mobile ground stations to support the four research and development efforts.

Table 1: Planned Number and Estimated Acquisition Cost for Mobile Ground Stations for Use by 1998

(Dollars in millions)

	Number of Stations	Acquisition Cost		
		Contracted	Planned	Total
Operational Programs	76	680.8	845.8	1,526.6
Research and Development Efforts	8	69.4	0.0	69.4
Total	**84**	**750.2**	**845.8**	**1,596.0**

As of May 1989, 39 (31 operational and eight research and development) mobile stations had been built; the remaining 45 (operational) stations are under development or are planned. According to Air Force officials, all 39 mobile ground stations provide mission processing capabilities; only one of them has been designed with command and control capability.[2] Table 2 summarizes how funds are being used or are planned to be used to provide mobile ground station capability for specific operational satellite programs.

[2]The Transportable Mobile Ground Station, one of the research and development efforts, has been designed to provide mobile command and control capability and has been delivered to the operator of a classified program.

Table 2: Mobile Ground Stations for the Operational Satellite Programs

(Dollars in millions)

	Number of Stations	Estimated Acquisition Cost		
		Contracted	Planned	Total
Defense Support Program	6	405.6	96.1	501.7
Boost Surveillance and Tracking System	7	18.0	406.2	424.2
Milstar	22	81.9	328.0	409.9
Defense Satellite Communications System	7	117.2	10.7	127.9
Defense Meteorological Satellite Program	33	58.1	0.0	58.1
Global Positioning System	1	0.0	4.8	4.8
Total	**76**	**680.8**	**845.8**	**1,526.6**

The purpose, capability, number, and estimated acquisition cost of each mobile ground system to support the six operational satellite programs is presented in appendix I. Appendix II identifies similar information for the four research and development efforts. The estimated acquisition cost for the 84 mobile ground stations by program element and appropriation account is depicted in appendix III.

Fiscal Year 1990 Budget for Mobile Ground Stations

The Department of Defense's fiscal year 1990 budget request for the mobile ground stations is about $92 million, as identified in appendix IV. Since costs for the mobile ground stations were combined with other, larger satellite program contracts, no summary documentation that specifies the budget requests for mobile ground stations exists. Consequently, the fiscal year 1990 mobile ground station costs were derived by us on the basis of our review of budget documents and through discussions with Defense officials.

Our review was conducted from January 1989 to April 1989 primarily at the United States Space Command in Colorado Springs, Colorado; Air Force Headquarters in the Pentagon, Washington, D.C.; Air Force Space Command in Colorado Springs, Colorado; Air Force Space Systems Division in El Segundo, California; and Defense Communications Agency in Arlington, Virginia. We interviewed Air Force, Joint Chiefs of Staff, and Defense Department officials and analyzed relevant contractual documents and other requirement documents including statements of need, program management directives, and satellite architecture master plans

and related studies and reports. We reviewed and analyzed cost, schedule, and budget documentation from the Air Force and Defense Department to determine the numbers and estimated acquisition cost of the mobile ground stations.

Although we did not obtain official written agency comments on a draft of this report, we discussed its contents with Air Force, Joint Chiefs of Staff, and Department of Defense officials, and have included their comments where appropriate. We conducted our review in accordance with generally accepted government auditing standards.

Copies of this report are being provided to the Chairmen, House and Senate Committees on Armed Services; the Chairman, Senate Committee on Appropriations; the Director, Office of Management and Budget; the Secretary of Defense; the Secretary of the Air Force; the Director, Defense Communications Agency; and other interested parties. Copies will also be made available to others upon request.

This report was prepared under the direction of Samuel W. Bowlin, Director for Defense and Security Information Systems. Other major contributors are listed in appendix V.

Sincerely yours,

Ralph V. Carlone

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Assistant Comptroller General

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Abbreviations

GAO	General Accounting Office
IMTEC	Information Management and Technology Division

Mobile Ground Stations Intended to Support Operational Satellite Programs

Dollars in millions

System	Purpose	Capability: Mission data processing
Defense Support Program	Missile Warning	Existing
Boost Surveillance & Tracking System	Missile Warning	Planned
Milstar	Communications	Planned
Defense Satellite Communications System	Communications	None
Defense Meteorological Satellite Program	Weather	Existing
Global Positioning System	Navigation	[b]
Total		

Capability			Estimated acquisition cost		
Telemetry, tracking & commanding	Number of stations	Delivery date	Contracted	Planned	Total
Planned	6 Existing	Mid 1985-Mid 1986	405.6	96.1	501.7
Planned	7 Planned	Mid 1995-Late 1997	18.0	406.2	424.2
Planned	2 Research & Development Planned 20 Operational Units Planned	Mid 1990-Late 1991 1993-1998	81.9	328.0	409.9
Planned	7 Planned (not finalized)[a]	1992-1993	117.2	10.7	127.9
None	7 Existing	Prior to 1980	[c]	[c]	[c]
	18 Existing 8 Planned	1980-1988 1989-1995	58.1	0.0	58.1
[b]	1 Planned	1991	0.0	4.8	4.8
	76		**680.8**	**845.8**	**1,526.6**

[a]The specific number of transportable/mobile ground stations varies from 0 to 7 stations. The specific mix between fixed versus mobile stations and related acquisition costs, were not finalized at the time of our review. The cost reported reflects all seven stations becoming mobile.

[b]The plan is to use this transportable station as a spare to back up three existing fixed ground antenna/monitor stations.

[c]No cost information is available.

Sources: Air Force Logistics Command, Air Force Space Systems Division, Army Communications-Electronics Command, and Defense Communications Agency.

Mobile Ground Stations Intended to Support Research and Development Efforts

(Dollars in millions)

System	Purpose	Number of stations	Delivery date	Estimated acquisition cost		
				Contracted	Planned	Total
Transportable Mobile Ground Station	Prototype mobile system whose purpose is to prove survivable capability concept	1 Existing	Mid-1988	57.5	0.0	57.5
Consolidated Space Test Center Transportable Ground Station	Data Relay and Routing	1 Existing 3 Existing	Late 1988 Early 1989	3.0 5.7	0.0 0.0	3.0 5.7
Transportable S-Band Terminal	Data Relay and Routing	2 Existing	Early 1987	2.4	0.0	2.4
Transportable Vehicle Check-out System	Data Relay and Routing	1 Existing	Early/Mid-1987	0.8	0.0	0.8
Total		**8**		**69.4**	**0.0**	**69.4**

Source: Air Force Space Systems Division.

Funding for Mobile Ground Stations by Program Element and Appropriation

(Dollars in millions)

		Appropriation account						
System	**Program element**	**3600**	**3080**	**3400**	**1810**	**0400**	**2035**	**Total**
Defense Support Program	12431F	185.2	311.2	5.3				501.7
Boost Surveillance & Tracking System	63220C					29.0		29.0
	64220C					177.8		177.8
	64407F		217.4					217.4
Milstar	33603F	81.9	328.0					409.9
	Classified[a]							[a]
Defense Satellite Communication System/ Contigency Defense Satellite Communication System Operations Control System	33142A						127.9	127.9
Defense Meteorlogical Satellite Program	35160F	10.2	24.2					34.4
	000000				23.7			23.7
Global Positioning System	35165F		4.8					4.8
Transportable Mobile Ground Station	63438F	33.4						33.4
	34111F	[b]	14.2					14.2
	39999I					9.2		9.2
	12311F	0.4						0.4
	35110F	0.3						0.3
Consolidated Space Test Center Transportable Ground Station	Classified[a]	[c]	[c]					8.7
Transportable S-Band Terminal	Classified[a]	[c]	[c]					2.4
Transportable Vehicle Check-out System	Classified[a]	[c]	[c]					0.8
Total								**1,596.0**

[a]The program element and/or related costs are classified.

[b]This amount is less than $100,000.

[c]Total funds appropriated consist of both 3600 and 3080 accounts. Because the program elements and/or related costs are classified, we did not obtain a breakout of these funds.

Sources: Air Force Logistics Command, Air Force Space Systems Division, Army Communications-Electronics Command, and Defense Communications Agency.

Fiscal Year 1990 Budget Requests for Mobile Ground Stations

(Dollars in millions)

System	Program element	Appropriation account				Total
		3600	3080	0400	2035	
Defense Support Program	12431F	36.5	12.4			48.9
Boost Surveillance & Tracking System	63220C			3.3		
	64220C			1.4		4.7
Milstar	33603F	22.9				22.9
Defense Satellite Communications System	33142A				10.7	10.7
Defense Meteorological Satellite Program	35160F	4.8				4.8
Total						**92.0**

Sources:Air Force Logistics Command, Air Force Space Systems Division, Army Communications-Electronics Division, and Defense Communications Agency.

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