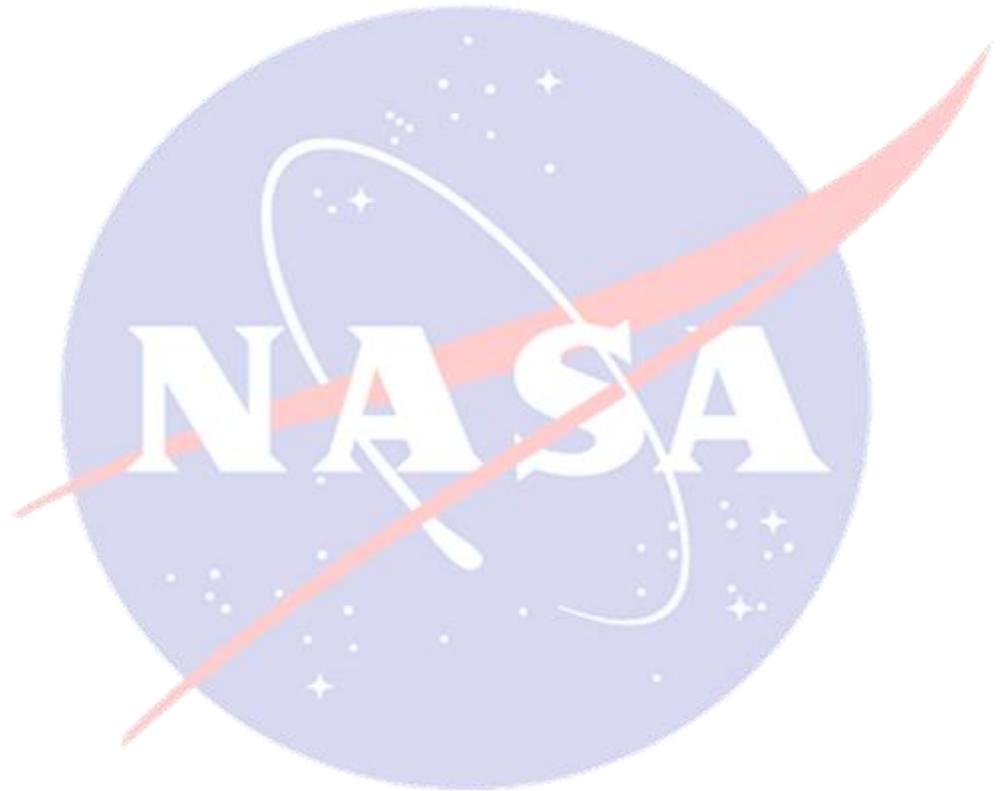




National Aeronautics and Space Administration

OFFICE OF INSPECTOR GENERAL

**Space Communications and
Navigation: NASA's Management
of the Space Network**



OFFICE OF AUDITS

AUDIT REPORT
APRIL 29, 2014

IG-14-018

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Paul K. Martin
Inspector General

Acronyms

FY	Fiscal Year
GAO	Government Accountability Office
KDP	Key Decision Point
NPR	NASA Procedural Requirements
OIG	Office of Inspector General
SCaN	Space Communications and Navigation
SGSS	Space Network Ground Segment Sustainment
TDRS	Tracking and Data Relay Satellite

OVERVIEW

SPACE COMMUNICATIONS AND NAVIGATION: NASA'S MANAGEMENT OF THE SPACE NETWORK

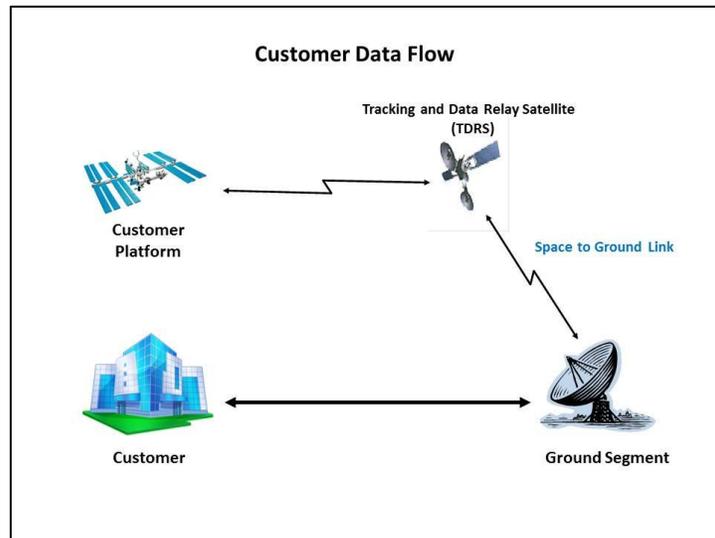
The Issue

The Space Network Project – part of the Space Communications and Navigation (SCaN) Program – provides continuous connectivity with NASA spacecraft operating in low Earth orbit, including the International Space Station, the Hubble Space Telescope, and the Van Allen Probes.¹ Other Government agencies, including the Department of Defense and the National Science Foundation, as well as commercial entities also rely on the Space Network to communicate with various spacecraft. During fiscal year (FY) 2014, the Space Network plans to perform more than 175,000 hours of service to support 25 to 30 missions, and without these services space hardware worth tens of billions of dollars would be little more than orbital debris, unable to communicate with Earth.

Currently, the Space Network consists of a constellation of nine geosynchronous tracking and data relay satellites (TDRS) and three ground stations – two at the White Sands Complex near Las Cruces, New Mexico, and a third in Guam.² The Network

operates by sending data from a ground station to a TDRS, which then relays the data to the designated spacecraft. Return data from the spacecraft is relayed through a TDRS to

Flow of Data to and from the Space Network



Source: NASA Office of Inspector General (OIG) representation of Project data.

¹ The Van Allen Probes are robotic spacecraft that measure the properties of charged particles that comprise the Earth's radiation belts.

² A geosynchronous orbit is one in which the satellite is always in the same position with respect to the rotating Earth. The satellites orbit at an elevation of approximately 35,790 kilometers to allow time for one orbit equal to the period of rotation of the Earth (23 hours, 56 minutes, 4.09 seconds). By orbiting at the same rate in the same direction as Earth, the satellites appear stationary – synchronous with respect to the rotation of the Earth.

a ground station, which in turn sends the data to a location designated by the spacecraft owner or customer (as shown in the figure). As a spacecraft moves in orbit around the Earth, its signal moves from one TDRS to another.

NASA has provided these tracking and communications services for more than 30 years, and many of its satellites and ground systems are aging and increasingly difficult to repair. Moreover, the recent decision to extend International Space Station operations until at least 2024 will add to the demand for communications provided by the Network.

To ensure continued service for existing and planned missions, the Space Network requires six operating TDRSs and at least one spare TDRS in on-orbit storage, as well as the three supporting ground terminals. Recognizing the Network's maintenance, replenishment, and modernization needs, over the past 7 years the SCaN Program has initiated the TDRS Replenishment Project and the Space Network Ground Segment Sustainment (SGSS) Project. The TDRS Replenishment Project purchased three third-generation TDRSs – identified alphabetically as TDRSs K, L, and M – to replace aging satellites. The SGSS Project focuses on replacing aging hardware and data systems in the Space Network's ground systems. Failure to replace these aging satellites and systems in a timely manner increases the risk that the Space Network will be unable to provide adequate communication and navigational services to its customers and could lead to the loss of critical mission data, or in the worst case, loss of an entire mission.

In this audit, we assessed how the Space Network Project was managing risks and adjusting capabilities to meet cost, schedule, and performance goals. Specifically, we examined whether NASA has effectively (1) managed key Space Network system upgrade projects within cost and schedule goals and (2) planned for current and future funding requirements. Details of the audit's scope and methodology are in Appendix A.

Results

We found that NASA's Space Network faces significant challenges. Specifically, key components necessary for NASA to continue providing Space Network communication services are not meeting planned cost, schedule, and performance goals. Taken together, these delays and cost growth increase the risk that the Space Network will be unable to continue to provide adequate communication services to NASA missions and its customers. In addition, because of budget reductions and other lost revenue, beginning in FY 2016, the Space Network will not have sufficient funding to meet all planned commitments. Finally, as we had in a prior audit, we found that NASA has not kept up-to-date the rate it charges customers for use of the Space Network and, as a result, may be absorbing costs for services used by other Federal agencies and commercial customers.

Key Space Network Components Are Not Meeting Cost, Schedule, and Performance Goals. By 2016, three of the TDRSs NASA is currently using to communicate with and track spacecraft will reach the end of their expected operational lives. Moreover, a NASA study indicates that one of the spare satellites the Agency has in on-orbit storage is already operating 15 years past its design life and could fail as soon as 2014. However, NASA currently has only two new third-generation satellites – TDRSs K and L – in orbit to replace four aging satellites. Although NASA had planned to launch TDRS-M as early as December 2015, it now expects to delay that launch by as many as 6 years because it lacks funding to procure a launch vehicle. Further, the Agency’s decision not to exercise the option to purchase a fourth satellite – TDRS-N – at a favorable price will result in NASA paying considerably more for a replacement satellite in the future.

In addition, the SGSS Project may cost \$329 million, or 38 percent, more than NASA’s baseline commitment agreement of \$862 million and its schedule for completion likely delayed by more than 1.5 years. The cost overrun will require SGSS Project managers to reassess their original requirements and the 1.5-year schedule slip will necessitate Space Network officials to reassess, reprioritize, and mitigate the Network’s obsolescence risks for a longer period than planned – actions that will require additional funding. Moreover, although the amount of operations and maintenance savings NASA expected to achieve through implementation of the SGSS Project is still unclear, the savings will be delayed for several years.

Shortsighted Planning Resulted in Inadequate Funding for the Space Network.

Because of budget reductions and the loss of other expected revenue, in FY 2016, the Space Network will not have sufficient funding to meet all planned commitments for services. Beginning with FY 2014, the SCaN Program reduced the Space Network’s proposed operating budget to \$85 million from \$115 million the previous year. Moreover, although NASA agreed to provide free access to Space Network services for some customers beginning in FY 2014 in exchange for their contributions to the design and development of TDRSs K and L several years earlier, the Agency failed to adequately plan for the resulting approximately \$70 million per year in lost revenue. Consequently, the Space Network Project has a projected \$63 million budget shortfall in FY 2016 and even larger estimated shortfalls in subsequent years.

Other Matters. Since 2009, between 9 and 13 external customers have used Space Network assets each fiscal year and reimbursed NASA between \$2.1 and \$3.1 million. In September 2010, we reported that NASA had not updated the rates it charged customers for use of the Space Network for more than 4 years.³ Following our audit, NASA agreed to update the rates annually. However, in this audit we found that NASA had not updated the rates for FY 2014 and, as of March 2014, continued to charge FY 2013 rates that may not accurately capture current operating costs.

³ NASA OIG, “Review of NASA’s Tracking and Data Relay Satellite System” (IG-10-023, September 21, 2010).

Conclusion. NASA's Space Network is a critical component of the Agency's space communications and navigation capability while providing essential services to other Government and commercial customers. The success of the Network depends upon a complex system of satellites and ground terminals, and ensuring continued service for existing and planned missions requires maintenance, replenishment, and modernization of both the TDRSs and ground stations.

The Space Network needs six operating satellites and a spare TDRS in on-orbit storage to provide the needed level of service.⁴ While the Network currently has nine TDRSs in orbit (six active, two in storage, and one in testing), four of these satellites have been in orbit for 18 or more years and are rapidly reaching the end of their useful lives. Moreover, within the next 4 years, three other satellites will have been in operation for 15 years or longer. Failure to replace these aging satellites in a timely manner increases the risk that the Space Network will be unable to provide adequate communication and navigational services to support its customers, placing missions at risk.

Similarly, the Space Network's ground terminals are expensive to maintain and rapidly wearing out. As such, the ability of the Network to continue to provide reliable communications services to customer missions hinges on successful implementation of the SGSS Project that will replace aging ground hardware and expensive-to-maintain equipment. Given the central role the SGSS Project plays in the Agency's continued ability to provide space communications and navigation capabilities, it is imperative that NASA develop a realistic and achievable plan to address the \$329 million cost overage and 1.5-year schedule slippage in an effort to meet the SGSS Project's cost, schedule, and performance goals.

Management Action

To ensure NASA meets resource requirements for the Space Network Project, we recommended the Associate Administrator for Human Exploration and Operations

1. require the SGSS Project Office to (a) revise its cost estimate and (b) based on those results, adjust the Project baseline and Agency baseline commitment as necessary;
2. report the appropriate baseline commitment and/or status to Congress;
3. ensure that the SGSS Project passes a termination review prior to any rebaselining; and
4. examine options to increase funding for the Space Network, including acquiring funds from other less critical priorities within the Agency.

⁴ Once the SGSS Project is complete, the Network will need seven operating TDRS.

In response to our draft report, the Associate Administrator for Human Exploration and Operations concurred with recommendations 1, 2, and 4, stating that NASA is evaluating a revised cost and schedule estimate for the SGSS Project against anticipated budget and program requirements and will adjust the Project's baseline and report to Congress based on the results of that evaluation. In addition, the Associate Administrator indicated that the Program will continue to seek reimbursable customers and that NASA will balance resources across its programs and obligations to assure effective, continuous Space Network operations and sustainment. We consider the actions the Associate Administrator proposes responsive and will close the recommendations upon their completion and verification.

The Associate Administrator partially concurred with recommendation 3 to ensure the SGSS Project passes a termination review prior to rebaselining. He indicated that NASA is working to determine whether it should manage the SGSS Project as a development or sustainment activity and will factor that determination into the decision on the way forward. He also indicated that the SCaN Program will follow Agency guidelines for rebaselining. However, he said that while contracts and discrete projects may be terminated if warranted, maintenance and upgrade of the Space Network ground system is not optional. While we agree that given its importance the Agency must maintain and upgrade the Space Network ground system, we believe a termination review should be conducted irrespective of whether NASA decides to manage the Project as a "development" or "sustainment" activity to ensure the Agency's senior leadership and external stakeholders are fully aware of the factors that influenced the Project's cost, schedule, and performance issues. Accordingly, we consider the recommendation unresolved.

Finally, in order to reflect current operating costs and maximize revenue potential, we recommended the Deputy Associate Administrator for SCaN document the cost factors and formulas for reimbursable rates and ensure those rates are reevaluated and adjusted as necessary on an annual basis. The Deputy Associate Administrator concurred with our recommendation and published new rates for FY 2014 effective April 11, 2014. However, NASA has not established a process to document cost factors and formulas and ensure annual adjustments. Accordingly, we do not consider management's actions fully responsive and the recommendation remains unresolved.

We incorporated management's technical comments on our draft into the final report as appropriate. Management's full response to the draft report is reprinted in Appendix B.

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INTRODUCTION

Background

NASA uses a combination of ground and space-based assets to relay information continuously between Earth and spacecraft owned by NASA, other Federal agencies, and commercial entities. Specifically, the Agency's Space Communications and Navigation (SCaN) Program provides space communication and navigation capabilities through three communications networks – the Deep Space Network, the Near Earth Network, and the Space Network. The Deep Space Network provides a continuous communications infrastructure for NASA robotic missions like Voyager, which is exploring the furthest points in our solar system. The Near Earth Network services missions that require periodic contact in certain orbital and suborbital locations, including low Earth orbit; lunar orbit; and highly elliptical orbits, such as the Lunar Reconnaissance Orbiter. The Space Network provides continuous connectivity with spacecraft operating in low Earth orbit, including the International Space Station, the Hubble Space Telescope, and the Van Allen Probes.⁵ Other Government agencies, including the Department of Defense and the National Science Foundation, and commercial entities also rely on the Space Network to communicate with various spacecraft.

Without SCaN services, space hardware worth tens of billions of dollars would be little more than orbital debris unable to communicate with Earth. Moreover, a failure in any part of these networks could lead to the loss of critical data or, in the worst-case scenario, an entire mission. Accordingly, all three networks require maintenance, replenishment, modernization, and expansion of capacity to ensure continued service for existing and planned missions.

This audit, the first of five planned by the NASA Office of Inspector General (OIG) on the SCaN Program and its portfolio of projects, focuses on the Space Network.

The Space Network. NASA began assembling the Space Network, originally known as the Tracking and Data Relay Satellites System, in the early 1970s. Currently, the Space Network consists of a constellation of nine geosynchronous tracking and data relay satellites (TDRS) and three ground stations – two at the White Sands Complex near Las Cruces, New Mexico, and a third in Guam.⁶ The Space Network also operates an antenna at the Australian TDRS System Facility in Dongara, Australia, which it uses as a

⁵ The Van Allen Probes are robotic spacecraft measuring the properties of charged particles that comprise the Earth's radiation belts.

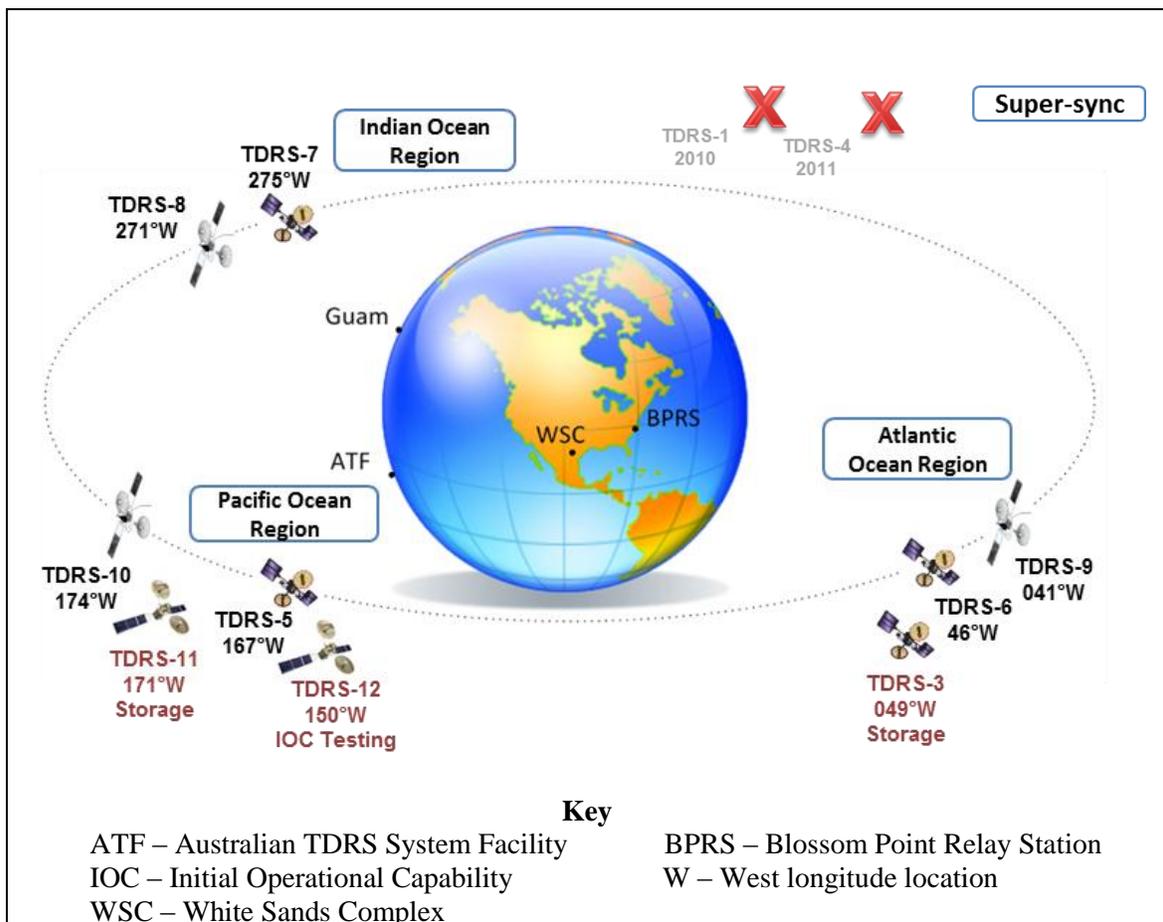
⁶ A geosynchronous orbit is one in which the satellite is always in the same position with respect to the rotating Earth. The satellite orbits at an elevation of approximately 35,790 kilometers to allow time for one orbit equal to the period of rotation of the Earth (23 hours, 56 minutes, 4.09 seconds). By orbiting at the same rate in the same direction as Earth, the satellite appears stationary (synchronous with respect to the rotation of the Earth).

backup to Guam. The Space Network will expand its operations with a ground station in Blossom Point, Maryland, which SCaN anticipates will be operational by early 2017.

The Space Network operates by sending data from a ground station to a TDRS, which then relays the data to the designated spacecraft. Return data from the spacecraft is relayed through a TDRS to a ground station, which in turn sends the data to a location designated by the spacecraft owner or customer. As a spacecraft moves in orbit around the Earth, its communication signal moves from one TDRS to another.

To be fully operational and cover the entire planet, the Space Network requires six active TDRSs in orbit at any one time. In addition, NASA keeps at least one other operational TDRS in on-orbit storage in the event an active satellite fails (see Figure 1). During fiscal year (FY) 2014, the Space Network plans to perform more than 175,000 hours of service to support 25 to 30 missions.

Figure 1. The Space Network’s Communication System (as of January 2014)



Note: Super-sync is a graveyard or disposal orbit that lies at least 350 kilometers above geosynchronous orbit. NASA places TDRSs in this orbit at the end of their operational lives to lower the probability of collisions with operational spacecraft.

Source: NASA.

Space Network Configuration. The first ground terminal at the White Sands Complex became operational in April 1983 with the launch of TDRS-1. As NASA launched more of the TDRS fleet, the second White Sands ground terminal went live in December 1994 to provide redundancy and update the original ground station's 1970s technology. The Space Network completed construction on the ground terminal in Guam in 1998 to provide better coverage over the Indian Ocean region, and started work on the ground terminal at Blossom Point in 2011.

Since the Space Network's inception, NASA has launched twelve TDRSs in three phases.⁷ The first-generation satellites (TDRSs 1–7) were built with a 10-year design life by TRW, Inc., (now Northrop Grumman Space Technology) and launched between 1983 (TDRS-1) and 1995 (TDRS-7).⁸ The second-generation satellites (TDRSs 8–10) were built by Hughes Space and Communications (now Boeing Satellite Systems) and launched between 2000 and 2002. With the launch of TDRS-11 in January 2013 and TDRS-12 in January 2014, NASA added two third-generation satellites to the Space Network. Boeing Satellite Systems (Boeing) built TDRSs 11 and 12.

The second-generation satellites improved the Space Network's communication capabilities by increasing the bandwidth available to users of the Network. Additionally their design life was increased to operate 15 years, including 4 years of on-orbit storage during which they are not in active service but available if needed to replace another satellite. The primary difference between the second- and third-generation satellites is that for third-generation satellites the processing of the communications signal occurs on the ground rather than on the satellite, allowing for a more secure system for transmitting command communications. In addition, unlike earlier versions, third-generation TDRSs were designed to be compatible with either an Atlas or Delta launch vehicle to maximize launch opportunities.⁹

Aging TDRSs. Of the twelve TDRSs NASA has launched over the past 31 years, eight are currently available for service – four first-generation satellites (TDRSs 3, 5, 6, and 7), three second-generation satellites (TDRSs 8, 9, and 10), and the first of the third-generation, TDRS-11.¹⁰ As of March 2014, NASA is using six of these satellites to relay communications between spacecraft and Earth (TDRSs 5, 6, 7, 8, 9, and 10) and two are in on-orbit storage (TDRSs 3 and 11), available if needed to replace one of the active satellites.

⁷ Before launch, NASA refers to the TDRS by letter. Once accepted by the Space Network, NASA renames the satellites with a number. For example, after launch and acceptance TDRS-A became TDRS-1.

⁸ Lost in the 1986 Space Shuttle Challenger accident, TDRS-2 never made it to orbit.

⁹ Any other launch vehicle could require changes to integrate the satellite with the vehicle and prepare it for launch.

¹⁰ NASA expects the second third-generation TDRS (launched January 2014) to join the operational fleet before the end of FY 2014.

The satellites have generally outlasted design expectations. For example, TDRS-1 was in orbit for 26 years before being decommissioned in 2009. Of the satellites NASA currently has available to relay data, four (TDRSs 3, 5, 6, and 7) have been in orbit for more than 18 years, have experienced various failures and system degradation, and are rapidly reaching the end of their useful lives. See Table 1 for a complete list of TDRSs and their status.

Table 1. TDRS Spacecraft by Launch Date

Spacecraft Name Before Launch	Launch Date	Spacecraft Name After Acceptance	Age of Spacecraft at Decommission or as of January 2014
First-Generation TDRS			
TDRS-A	April 4, 1983	TDRS-1 ^a	26 years ^a
TDRS-B	January 28, 1986	(lost in the Challenger accident)	N/A
TDRS-C	September 29, 1988	TDRS-3 ^b	25 years
TDRS-D	March 13, 1989	TDRS-4 ^a	23 years ^a
TDRS-E	August 2, 1991	TDRS-5 ^c	22 years
TDRS-F	January 13, 1993	TDRS-6 ^c	21 years
TDRS-G	July 13, 1995	TDRS-7 ^c	18 years
Second-Generation TDRS			
TDRS-H	June 30, 2000	TDRS-8	13 years
TDRS-I	March 8, 2002	TDRS-9	11 years
TDRS-J	December 4, 2002	TDRS-10	11 years
Third-Generation TDRS			
TDRS-K	January 30, 2013	TDRS-11 ^b	1 year
TDRS-L	January 23, 2014	TDRS-12 ^d	0 year
TDRS-M	2020s ^e	TDRS-13	N/A

^a TDRS-1 was decommissioned in October 2009 while TDRS-4 was decommissioned in December 2011.

^b TDRS-3 and 11 are in on-orbit storage until needed for service.

^c TDRSs 5, 6, and 7 are operating beyond their design life.

^d TDRS-L is in on-orbit testing and will be renamed TDRS-12 upon acceptance by the Space Network.

^e NASA has not established a confirmed launch date.

Source: NASA.

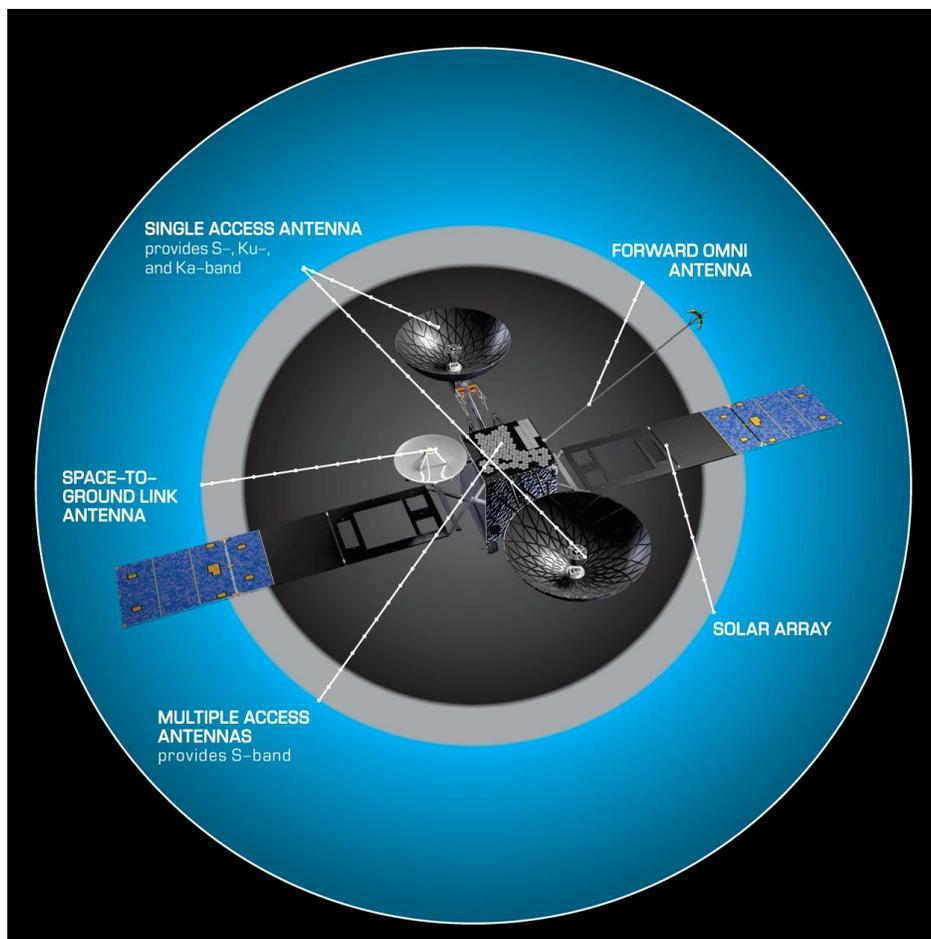
The Future of the Space Network. Over the past 7 years, the SCaN Program has initiated the TDRS Replenishment Project and the Space Network Ground Segment Sustainment (SGSS) Project. The TDRS Replenishment Project purchased three third-generation TDRSs – K, L, and M. The SGSS Project focuses on replacing aging hardware and data systems in the Space Network’s ground systems.

TDRS Replenishment Project. To avoid a system failure or loss of critical capacity, NASA has purchased new TDRSs to replace the satellites approaching the end of their useful lives. The TDRS Project Office, located at Goddard Space Flight Center (Goddard), is managing this effort. The Agency retired two first-generation satellites

(TDRSs 1 and 4) in 2009 and 2011, and the remaining four first-generation satellites still in orbit (TDRSs 3, 5, 6, and 7) are showing signs of age-related battery and electronics failures. NASA has predicted that without replacement satellites the Space Network will not have sufficient capacity to service customer missions adequately by 2016. Similarly, a 2013 Aerospace Corporation Study concluded that in order for the Space Network to continue to support anticipated communications, NASA may need to launch TDRS-M by 2016 and require an additional satellite in orbit by 2024.

NASA awarded a \$696 million fixed-price incentive contract for TDRSs K and L to Boeing in December 2007, with options to purchase two additional satellites (TDRSs M and N).¹¹ See Figure 2 for an illustration of TDRS-L.

Figure 2. Illustration of TDRS-L



Source: NASA.

¹¹ The contract also included modifications to the Space Network's ground systems to support the third-generation spacecraft.

In November 2011, NASA exercised the option to purchase TDRS-M for \$320 million, but due to budget constraints let lapse the option to purchase TDRS-N for \$262 million. NASA launched TDRS-K (now TDRS-11) in January 2013, and in December 2013 successfully integrated the satellite into the Space Network before placing it into on-orbit storage. NASA launched TDRS-L in January 2014. The TDRS Project Office plans to perform on-orbit testing on the spacecraft for several months before the Space Network accepts delivery before the end of FY 2014 at which time it will be renamed TDRS-12 and placed in on-orbit storage until needed to replace one of the older TDRSs currently in operation.

Boeing expects to finish integration and testing of TDRS-M in June 2015. NASA had planned to launch TDRS-M as early as December 2015, but in 2013 was forced to delay the launch until the early 2020s due to a lack of funding to purchase a launch vehicle.¹² According to Agency officials, NASA needs all three third-generation satellites in orbit to ensure continued service to customer missions as the remaining first-generation satellites fail. With the third-generation satellites in place, NASA expects to have adequate capacity until the second-generation TDRS begin retiring in the early 2020s, at which time additional satellites will be needed to keep the Space Network functioning at full capacity.

SGSS Project. The SGSS Project is replacing aging ground hardware and expensive-to-maintain equipment and systems at the Space Network's ground stations. The SCaN Program manages the Project through the SGSS Project Office at Goddard.¹³ The Project is planning to replace nearly all the electronics and software at the ground stations, including high-power transmitters and receivers on the ground antennas, low-noise amplifiers, digital signal processors, fleet management software, and tracking software. Integrating high-power electronics, digital switchgear, and controlling software into a functional, reliable, and low-cost system is a major goal of the SGSS Project. Once the Project is complete, all ground stations will be able to support first, second, and third-generation TDRS, something only the White Sands Complex currently is able to do. Further, the SGSS Project will expand the Space Network with a new fully operational ground terminal at Blossom Point, Maryland.

NASA's baseline budget to develop the SGSS Project is \$862.6 million. This baseline represents the Agency's commitment to the Office of Management and Budget and Congress regarding the overall cost of the Project.

¹² Based on a December 2013 contract award in support of a science mission, the estimated cost of an Atlas V launch vehicle is \$160 million.

¹³ SGSS is considered an independent development project within the SCaN Program until the upgraded ground systems become operational, at which time the Space Network will assume responsibility for the SGSS Project.

To move the SGSS Project forward, NASA awarded a cost-plus-award-fee contract in June 2010 to General Dynamics C4 Systems (General Dynamics) for approximately \$495 million (excluding fee) with a planned delivery date not to exceed September 2015. However, as of January 2014, the contract value has increased to \$556 million (excluding fee) and the delivery date has slipped almost 2 years to June 2017.

The SGSS Project contemplates three remaining phases for SGSS completion: implementation, integration and test, and deployment and transition. During the implementation phase, NASA will procure software and hardware as well as develop custom software and hardware to meet the detailed requirements of the Space Network. In the integration and test phase, the Agency will integrate and test the components on a complete system at the General Dynamics facility. During the deployment and transition phase, NASA and General Dynamics will deploy the tested and integrated systems to the ground stations and transition operations to the SGSS systems. NASA expects the upgraded system to be more reliable and less costly to operate and maintain than the existing Space Network system.

Prior OIG Work. In 2010, we examined whether NASA had taken steps to ensure that development of TDRSs K and L were on schedule, within budget, and met technical requirements and had identified and sufficiently mitigated acquisition risks. We also examined NASA's contract administration and reviewed whether other users of the Space Network properly reimbursed NASA for services provided to them.¹⁴

We reported that development of TDRSs K and L was generally on schedule and meeting the planned budget. However, we found that NASA had not revised the rates it charged Space Network customers since 2006, NASA officials did not know what factors had been used to formulate the 2006 rates, and internal controls for continuity of operations were not established. In the audit, we made several recommendations to remedy these issues. NASA management concurred with our recommendations, including agreeing to update the methodology used to calculate reimbursable rates to ensure they are reasonable and to revise the rates annually.

Objectives

In this audit, we assessed how the Space Network Project was managing risks and adjusting capabilities to meet cost, schedule, and performance goals. Specifically, we examined whether NASA has effectively (1) managed key Space Network system upgrade projects within cost and schedule goals and (2) planned for current and future funding requirements. Details of the audit's scope and methodology are in Appendix A.

¹⁴ NASA OIG, "Review of NASA's Tracking and Data Relay Satellite System" (IG-10-023, September 21, 2010).

KEY SPACE NETWORK COMPONENTS ARE NOT MEETING COST, SCHEDULE, AND PERFORMANCE GOALS

Key components necessary for NASA to continue to provide adequate Space Network communication services are not meeting planned cost, schedule, and performance goals. Specifically, we found that because the Agency has not procured a launch vehicle in a timely manner, it will be unable to launch TDRS-M until 6 years later than originally planned. Further, the Agency's decision not to exercise the option to purchase TDRS-N at a favorable cost under its contract with Boeing will result in NASA paying considerably more for a replacement satellite in the future. In addition, the SGSS Project may cost \$329 million more than NASA's baseline commitment agreement of \$862 million and its schedule for completion delayed more than 1.5 years. This cost and schedule growth is primarily the result of General Dynamics significantly underestimating the complexity of the software needed to meet system requirements and NASA's acceptance of the contractor's assumptions. Taken together, these delays and cost growth increase the risk that the Space Network will be unable to continue to provide adequate communication services.

Additional Time and Money Needed to Maintain Constellation of TDRS Spacecraft

The Space Network needs six operating TDRSs and a spare in on-orbit storage to support its customers at the current level of service.¹⁵ While the Network currently has nine TDRSs in orbit (six in service, two in on-orbit storage, and one in testing), four of these satellites have been in orbit for 18 or more years and are rapidly reaching the end of their useful lives (TDRSs 3, 5, 6, and 7). Moreover, within the next 4 years three other satellites will have been in orbit for 15 years or longer (TDRSs 8, 9, and 10). Failure to replace these aging satellites in a timely manner increases the risk that the Space Network will be unable to continue to provide adequate communication and navigational services to support its customers at the current level.

In December 2007, NASA negotiated a fixed-price contract with Boeing to build TDRSs K and L – renamed TDRSs 11 and 12, respectively, following launch and acceptance – with options to build TDRSs M and N. The Agency exercised the option for TDRS-M at a cost of \$320 million, but citing inadequate funding opted not to buy TDRS-N for \$262 million. As shown in Figure 3, an Agency study predicts at least six TDRS will continue to operate through 2015. However, by 2016 three satellites on which NASA is currently relying – TDRSs 5, 6, and 7 – will reach the end of their expected

¹⁵ When the Blossom Point Terminal becomes operational, the Space Network will expand to seven TDRS providing customer service for as long as the Constellation's health permits it to meet customer demand.

operational lives. Moreover, the study indicates that TDRS-3, which is already operating 15 years past its design life, could fail as soon as 2014. However, NASA has only TDRSs 11 and 12 (TDRS-L) to replace these four satellites. Although NASA had planned for TDRS-M to be in orbit as early as December 2015, it is now reporting it may delay launch of this satellite by as many as 6 years because it lacks funding to procure a launch vehicle (estimated to cost upwards of \$160 million). Further, because the Agency elected not to exercise the option to purchase TDRS-N from Boeing at the favorable fixed-price in its contract with the company, it will likely have to expend tens of millions of dollars more than the option price to acquire its next satellite.

Figure 3. Status of TDRS Fleet’s Anticipated Availability to Meet Space Network Requirements

	TDRS 3	TDRS 5	TDRS 6	TDRS 7	TDRS 8	TDRS 9	TDRS 10	TDRS 11(K)	TDRS 12(L)	TDRS M	
2014	▲	√	√	√	√	√	√	√	√		Meets
2015		√	√	√	√	√	√	√	√		
2016		▲	▲	▲	√	√	√	√	√		Does Not Meet
2017		▲			√	√	√	√	√		
2018		▲			√	√	√	√	√		
2019					√	√	√	√	√		
2020					√	√	√	√	√		
2021					√	√	√	√	√		
2022					√	▲	√	√	√	√	
2023					√		√	√	√	√	
2024					▲		√	√	√	√	
2025					▲		√	√	√	√	
Key ▲ Predicted end of life √ Full capability available											

Source: OIG Analysis of Space Network Data.

The third-generation TDRSs are at different stages of development. We assess each below.

TDRS-K (11). Boeing was ready to launch TDRS-K by the contractually required December 2012 date. However, NASA delayed the launch until January 2013 to allow for completion of an investigation on issues observed during launch of a U.S. Air Force satellite on an Atlas V in October 2012. As a result, Boeing stored TDRS-K for an extra month beyond the contract date, for which the company claimed \$1 million in costs.¹⁶ Following launch, testing of TDRS-K (now TDRS-11) was completed in August 2013, at which time NASA accepted the satellite. In December 2013, NASA successfully integrated the satellite into the Space Network and will keep TDRS-11 in on-orbit storage until needed.

TDRS-L (12). Boeing completed development of TDRS-L in April 2013, and NASA launched the satellite as scheduled in January 2014. However, in November 2013, while building TDRS-M, Boeing discovered quality problems with the power divider units that the company had also installed on TDRSs 11 and 12.¹⁷ To evaluate the risk of not replacing the divider units, Boeing performed an accelerated life test on the TDRS-M units and concluded they posed little risk.¹⁸ In addition, TDRS-11 showed no sign of degraded payload performance after 8 months in space and hundreds of passes with spacecraft. Accordingly, Boeing decided and NASA agreed not to replace the divider units on TDRS-L and proceeded with the launch in January 2014. Boeing and NASA will spend the next several months performing on-orbit testing of TDRS-L. Once the Network accepts delivery, the Agency will rename the satellite TDRS-12 and use it as a spare. As a precaution, Boeing replaced the faulty power divider units on the TDRS-M.

TDRS-M. NASA exercised the option to purchase TDRS-M in 2011 and Boeing is on schedule to complete development in June 2015. NASA had planned to launch TDRS-M as early as December 2015, but due to insufficient funding has not procured a launch vehicle for the satellite.¹⁹ NASA officials state it normally takes 2.5 to 3 years to procure

¹⁶ NASA is responsible for paying the additional costs, and as of the date of this report, continues to negotiate a final price.

¹⁷ Power divider units are microwave passive components that distribute the uplinked frequency reference signal from White Sands Complex to the frequency converters in the TDRSs. Microwave passive devices are high-reliability parts routinely used in communications spacecraft where redundancy is not practical. If these devices failed while in orbit, TDRS telecommunications services could be affected. The number of services affected is a function of the particular device in question and will range from losing redundancy to failure of an affected communication service.

¹⁸ NASA completed this test on December 17, 2013. Reliability calculations using empirical data and conservative failure rates showed the impact to TDRS spacecraft reliability to be less than 1 percent (less than 0.01percent) over a 15-year mission life.

¹⁹ The third-generation TDRSs were designed to be launched on an Atlas V or Delta IV launch vehicle. However, a Falcon 9V1.1 launch vehicle is another option, but could require the Project to make changes to the satellite. An approximate cost of a Falcon 9V1.1 is not available because NASA has yet to award a mission for that vehicle, but in December 2013, NASA procured an Atlas V with related launch services for about \$160 million in support of a science mission.

a launch vehicle and prepare it for launch. Consequently, NASA will not meet the December 2015 launch date and, according to Agency officials, is considering delaying the launch until the early 2020s.

NASA's contract with Boeing has provisions for up to 2 years of additional storage for TDRS-M beyond 2015 at a cost of \$10 million. If NASA delays the launch beyond that date, it is likely to incur additional costs. NASA has directed Boeing to examine the technical and cost implications of extended storage.

TDRS-N. NASA did not pursue its option under the Boeing contract to purchase TDRS-N for \$262 million because, according to SCA Program officials, it did not have adequate funds available. Accordingly, no additional TDRSs are in development and NASA will need to enter into a new contract to acquire additional satellites in future years. The cost to NASA when it commissions the next satellite is likely to be far more than \$262 million. An analysis of the Boeing contract shows that the company underestimated the cost of building TDRSs K and L by approximately \$110 million – costs that could not be passed on to NASA under its fixed-price contract with the company. Prices under any new contract would likely take into consideration the cost overruns experienced on TDRSs K and L.

SGSS Development to Cost More and Take Longer Than Planned

The cost to NASA of developing the SGSS Project is likely to exceed the Agency's baseline commitment by \$329 million, or approximately 38 percent. Additionally, final acceptance of the SGSS Project by NASA may not occur until February 2019, more than 1.5 years from the originally scheduled June 2017 date. The cost overrun will press SGSS Project Managers to reassess requirements and the 1.5-year schedule slip will require the Space Network to reassess, reprioritize, and mitigate the Network's obsolescence risks for a longer period than anticipated – actions that will require additional funding. Moreover, although the amount of operations and maintenance savings NASA expects to achieve through implementation of the SGSS Project is still unclear, this savings will be delayed for several years.

Agency Commitment Based on Flawed SGSS Cost and Schedule Estimates. The SGSS Project and its contractor underestimated the level of effort needed to meet software requirements for the upgraded system. The Project held its Preliminary Design Review in July and September 2012 and accepted the contractor's flawed estimate and established insufficient reserves to cover identified risks before proceeding to key decision point (KDP) C in February 2013.²⁰ During the KDP C process, NASA and the Standing Review Board performed a joint cost and schedule confidence level review

²⁰ A preliminary design review requires a project to demonstrate planning, technical, cost, and schedule baselines are complete and consistent and preliminary design complies with requirements. KDP C is based on the results of the preliminary design review and signifies that a project is sufficiently mature to begin implementation and the cost and schedule are adequate to enable mission success with acceptable risk.

using the flawed estimates and insufficient reserves, which helped form the basis of the Agency's baseline commitment to complete the Project.²¹ The Review Board reviewed the data and recommended the Project continue into implementation, but noted that uncertainty with the contractor's software development productivity had potential for cost growth. Nonetheless, NASA committed funding to meet the SGSS Project Office's estimated life-cycle costs of \$862.6 million and agreed to a final acceptance date of June 2017.²²

NASA assumed that General Dynamics' very good cost and schedule performance achieved during the preliminary design phase was a predictor of continued performance. However, during the SGSS Project's review of the contractor's performance prior to the Critical Design Review in June 2013 – the first milestone review after KDP C – the Agency discovered that General Dynamics had based the cost and schedule estimates accepted at the Preliminary Design Review and KDP C on flawed assumptions.²³ Specifically, the joint confidence level cost and schedule calculations used to develop the baseline commitment were significantly understated, did not adequately account for risks associated with software development, and made unrealistic schedule assumptions. For example, after the June 2013 Critical Design Review the SGSS Project found that General Dynamics' estimated productivity assumptions for software development were unachievable when compared to industry standards and the company used metrics from another of its projects – the U.S. Navy's Mobile User Objective System – as a baseline for SGSS software development.²⁴ However, the Navy project is significantly smaller and less complex than SGSS. In addition, General Dynamics did not appropriately account for the risk that it might not achieve expected productivity improvements and assumed it would perform major activities in parallel. For example, the company planned to have personnel available to begin to assemble hardware and to write, review, and test custom software all before the critical design was complete. However, it had to delay these activities because personnel were still resolving design issues and could not proceed to the other tasks as originally planned. These software and schedule challenges could ultimately result in costly hardware design and requirement changes throughout the system – costs that would be passed on to NASA under its cost-plus contract with the company.

²¹ Joint confidence levels are the probability that the cost and schedule will be equal to or lower than estimates. A standing review board conducts independent review of a project and provides objective, expert judgments to the authorities. The SGSS Standing Review Board's joint confidence estimates at the 70 percent level were 5 percent higher and 6 months longer than the Project's estimates.

²² In an effort to manage costs, the SCaN Program funded the SGSS Project at the Project's 50 percent joint confidence level (\$832 million) and held the balance of the \$862.6 million (70 percent joint confidence level) as management reserves at the SCaN Program level. The Agency was 70 percent confident that SGSS costs would be \$862.6 million or lower and final acceptance would be on or before June 2017.

²³ Critical Design Review determines if a project is still on track with acceptable risk and is within the agency baseline commitment.

²⁴ The Mobile User Objective System provides communications and control interfaces between Mobile User satellites and existing and future Department of Defense terrestrial communication networks.

Updated Estimate and Replan Exceed Agency Commitment. After the Critical Design Review, SGSS Project officials directed General Dynamics to update its cost estimate. In September 2013, the company presented the Project with an updated estimate projecting a \$309.7 million cost increase and an approximately 1-year delay to May 2018. In November 2013, the Project Office reviewed this estimate and identified an additional \$50 million in cost growth, bringing the expected overrun to about \$360 million. Given the additional risks, SGSS Project officials estimated the Project would cost about \$1.2 billion rather than the initially promised \$862 million and would not be complete until July 2019.

In response to the cost and schedule overruns, the SCan Program, in conjunction with the Associate Administrator for the Human Exploration and Operations Mission Directorate, directed the SGSS Project to develop a replan that

- changes the development approach to improve cost and schedule performance,
- implements mitigations to risks identified against the updated estimate,
- limits costs to the current FY 2014 and FY 2015 available funding, and
- proposes scope reductions to reduce costs while maintaining the minimum success criteria.

Results of Replan. In March 2014, the SGSS Project presented the results of the replan to the SCan Program. The replan provided management with immediate reductions in costs and schedule and options for further reductions. The SGSS Project was able to reduce its November 2013 estimates by \$31.2 million and recovered 5 months in the schedule to February 2019. The reduction in the cost and schedule was the result of additional efficiencies the Project gained from better understanding its risks in the November 2013 estimate despite the negative effect in the contractor's cost from pushing work into FY 2016 because the Agency proposes to limit funds in FYs 2014 and 2015. Even with these reductions, the SGSS Project cost and schedule estimates continue to exceed the Agency Baseline Commitment Agreement by \$328.5 million, or 38.1 percent, and by more than 1.5 years. Further, the Project also stated that if the planned funding levels for FY 2016 were not available, there would be additional cost growth and schedule expansion. Table 2 provides details on these projections.

Table 2. Cost and Schedule Growth Areas between Agency Baseline Commitment Agreement and Updated Estimate (Dollars in Millions)

Growth Areas	Estimate at Agency Baseline Commitment	Updated Estimate Amount	Cost/Schedule Growth	Percentage of Total Cost Growth (38.1%)
Schedule expansion	\$ 14.5	\$ 72.5	\$ 58.0	17.7%
Software	99.6	148.5	48.9	14.9%
Materials	88.0	141.7	53.7	16.3%
Directed design changes	35.0	63.2	28.2	8.6%
Pending design changes	0.0	15.0	15.0	4.6%
Other ^a	305.2	411.1	105.9	32.2%
Contractor fee ^b	65.3	65.3	0.0	0.0%
Project office cost, risks, and reserves	255.0	305.0	50.0	15.2%
Replan estimate	<u>0.0</u>	<u>(31.2)</u>	<u>(31.2)</u>	(9.5%)
Total	<u>\$862.6</u>	<u>\$1,191.1</u>	<u>\$328.5^c</u>	
Final acceptance review date	June 2017	February 2019	20 months	

^a "Other" includes all other costs that could not be aligned with a specific growth area such as the effect of poor contractor performance throughout the contract.

^b Contractor fee is based on the current contract value and does not include fee on cost growth.

^c Cost growth was 38.1 percent over the Agency Baseline Commitment.

Source: OIG analysis of SGSS Project data.

During the replan, SGSS presented options for the SCaN Program to consider that could further reduce the cost of the SGSS Project. For example:

- NASA could agree to reduce capacity at the White Sands Complex by deferring an additional antenna and associated TDRS service capability. When funds become available, NASA would have an option to have the work performed by the Space Network's maintenance and operations contractor or a third party contractor.
- The Agency could also agree to defer the implementation of SGSS at the Guam ground terminal and add the work back as an option on the SGSS contract for implementation at a specified trigger date.

The SGSS Project is awaiting further direction from SCaN Program officials before presenting recommendations to the Associate Administrator in May 2014.

SGSS Delay Will Require Additional Funding to Mitigate the Space Network's Obsolescence Risks. Obsolescence of the Space Network's ground segment hardware and software has made sustainment and maintenance increasingly difficult and costly.²⁵ As a result, the Space Network only replaces those components and subsystems it deems necessary to keep the system operating until the SGSS Project upgrade is completed. However, the 1.5-year delay in the schedule for final acceptance of the SGSS Project will require the Space Network to reassess and reprioritize its obsolescence risks and necessitates additional funding to mitigate those risks. For example, after KDP C, the Space Network estimated that a 6-month delay in delivery (from June 2017 to December 2017) would require the Network to spend an additional \$3.8 million to address and mitigate obsolescence risks. An additional 14-month delay would increase both these costs and the risk that the Space Network will be unable to accommodate future missions. For example, SGSS upgrades were to provide capability to the Network for support and testing of the Agency's first exploration mission of the Space Launch System leading up to the scheduled FY 2018 launch.²⁶ The mission requires new services that the Space Network currently does not provide. An SGSS delay would require the Network to obtain additional funds in the near-term to provide the services to support the mission.

The Space Network was also counting on reduced annual operations and maintenance costs after implementation of the upgraded SGSS system. For example, as part of the SGSS Project's Critical Design Review, General Dynamics claimed that once the Project is fully operational NASA will be able to reduce a subset of the White Sands Complex operations staff by 58 percent from 304 to 129 full time equivalent staff performing similar operations functions. While NASA has not confirmed whether the new SGSS architecture will achieve this level of reduction, the 1.5-year schedule slippage will delay realization of any savings.

Accurate SGSS Project Costs, Schedule, and Funding Still Needed. NASA's Authorization Act of 2005 requires the Agency to report to the House Committee on Science and the Senate Committee on Commerce, Science, and Transportation if development cost is likely to exceed by 15 percent or more or be delayed by six or more months beyond the Agency's baseline commitment development cost and schedule.²⁷ The Act requires NASA to explain the increase or delay and the actions it plans to take as a result. In addition, if development costs are likely to exceed 30 percent of the baseline commitment, beginning 18 months after NASA's report the Agency is forbidden from expending funds other than termination costs on the program unless Congress has authorized its continuation. NASA policy also requires that a project be "rebaselined"

²⁵ Obsolescence risks include sustainment of the ability to control and monitor one or more of the TDRSs and information security issues.

²⁶ The Space Launch System will carry an uncrewed Orion vehicle into space for a 25-day journey beyond the Moon and back to Earth.

²⁷ Public Law 109-155, "National Aeronautics and Space Administration Authorization Act of 2005" (December 30, 2005). In accordance with the Act, a major program is defined as "an activity approved to proceed to implementation" that has an estimated life-cycle cost of more than \$250 million.

and the joint confidence level be recalculated and approved when estimated development costs exceed the baseline commitment by 30 percent or more.²⁸ In addition, SCA²N's Program Plan requires that the SGSS Project pass a termination review prior to any such rebaselining.²⁹

Because the SGSS Project's development costs are expected to exceed NASA's baseline cost and schedule commitments for the Project by 38 percent and 20 months, the Agency is required to report this information to Congress and perform a termination review. In March 2014, the Agency formally notified Congress that the Project may exceed its baseline development estimate by more than 15 percent and/or its schedule estimate by 6 months. In addition, the Agency indicated that it is considering redefining the SGSS effort as a sustainment rather than a development activity and is developing a replan for the Project that it expects to complete in June 2014. According to SCA²N Program officials, reclassifying SGSS as a sustainment effort would allow greater flexibility with respect to funding and other programmatic issues. As of March 2014 the Agency had not initiated a termination review of the Project.

Actions Taken by the Agency. The SGSS Project is working with General Dynamics to better align the revised cost estimate – currently \$1.19 billion – with SCA²N's ability to fund the Project. Because the replan may defer scope in the Project, we are concerned that any retrenchment may be shortsighted and result in a failure to upgrade SGSS in a way that makes long-term sense for ensuring the SCA²N Program's capabilities. This could lead to important capability gaps that are exacerbated by pushing out upgrades to a point in the future when costs are significantly higher. In addition, we are concerned that removing work from the SGSS contract only to transfer the work to another contractor might, in substance, be transferring costs and schedule without real savings.

²⁸ NASA Procedural Requirements (NPR) 7120.5E, "NASA Space Flight Program and Project Management Requirements, w/Changes 1-10," August 14, 2012. Rebaselining is a process that recalculates the original estimated cost and schedule and results in a change to the project's Agency Baseline Commitment. The project's future performance is then compared to the new baseline.

²⁹ SCA²N "Program Plan" (December 14, 2011). A termination review is performed to determine whether to continue or terminate a project.

SHORTSIGHTED PLANNING RESULTED IN INADEQUATE FUNDING FOR THE SPACE NETWORK

Because of budget reductions and other lost revenue, beginning in FY 2016 the Space Network will not have sufficient funding to meet all planned commitments for services, including supporting integration of the SGSS Project into the Space Network. Beginning in FY 2014, the SCaN Program reduced the Space Network's proposed operating budget from \$115 million to \$85 million. Moreover, although NASA agreed to provide free access to Space Network services for some customers beginning in FY 2014 in exchange for their earlier contributions to the design and development of TDRSs K and L, it failed to adequately plan for the resulting approximately \$70 million per year in lost revenue. Consequently, the Space Network Project has a projected \$63 million budget shortfall in FY 2016 and even larger estimated shortfalls in subsequent years.

The Space Network does not charge NASA missions for its services. However, it charges other Federal and private sector customers on a reimbursable basis. Until this year, the Space Network collected approximately \$70 million per year in reimbursable funding from these external customers and was largely self-sustaining. However, in 2006, NASA entered into a cost sharing arrangement with some of its customers to defray development costs for TDRSs K and L. In exchange for this up-front contribution, NASA agreed not to charge those customers for Space Network usage for 25 years – an estimated value of \$1.8 billion. However, NASA failed to develop a plan for replacing the lost revenue. The reasons for this failure are unclear because the Agency no longer has the documentation supporting the cost sharing decision and the personnel involved in the decision have left NASA.

The Space Network also faces additional budget reductions. Until FY 2014, the Space Network operated on an annual budget of at least \$115 million from both reimbursable and direct funding. However, beginning in FY 2014 the SCaN Program Office requested the Network reduce its operating budget to \$85 million as the SCaN Program attempted to balance its portfolio of projects within its overall budget.³⁰ The Space Network has found some ways to cut costs – for example, by reducing operations and maintenance staffing. In addition, during the course of our audit the Space Network reached an agreement with some of the customers that could be covered under the free Network usage arrangement to contribute to operating costs. These actions addressed the projected budget shortfalls for FY 2014 and most of FY 2015. However, without further changes, beginning in FY 2016 the Space Network will face a projected \$63 million budget shortfall, with larger shortfalls in subsequent years.

³⁰ In addition to the Space Network and the associated replenishment projects, the SCaN Program is responsible for the Deep Space Network and the Near Earth Network.

Although the Space Network expects to be able to support its day-to-day operations under current projected budgets through FY 2015, unless it secures additional funding, Network officials stated they will have to delay integration of SGSS into the Network, defer training of key technical staff and needed repairs and maintenance of obsolete hardware and facilities, and eliminate its support to the Network Integration Management Office.³¹ More notably, according to officials the Space Network will have to shut down significant, if not all, operational capacity and therefore be unable to meet customer commitments necessary to provide science and basic health and safety.

Conclusion

NASA's Space Network is a critical component of the Agency's space communications and navigation capability and provides essential services to other Government and commercial customers. Moreover, the recent decision to extend International Space Station operations until at least 2024 will add to the demand for communications provided by the Network. The success of the Network depends upon a complex system of satellites and ground terminals, and ensuring continued service for existing and planned missions requires maintenance, replenishment, and modernization of both the TDRSs and ground stations.

The Space Network needs six operating satellites and a spare TDRS in on-orbit storage to provide the needed level of service. When Blossom Point becomes operational, the Network will expand to seven operational TDRSs. While the Network currently has nine TDRSs in orbit (six active, two in storage, and one in testing), four of these satellites have been in orbit for 18 or more years and are rapidly reaching the end of their useful lives (TDRSs 3, 5, 6, and 7). Moreover, within the next 4 years three other satellites will have been in operation for 15 years or longer (TDRSs 8, 9, and 10). Failure to replace these aging satellites in a timely manner increases the risk that the Space Network will be unable to provide adequate communication and navigational services to support its customers.

Similarly, the Space Network's ground terminals are expensive to maintain and rapidly wearing out. As such, the ability of the Network to continue to provide reliable communications services to customer missions hinges on the successful development of the SGSS Project that will replace aging ground hardware and expensive-to-maintain equipment. Given the central role the SGSS Project plays in the Agency's continued ability to provide space communications and navigation capabilities, it is imperative that NASA develop a realistic and achievable plan to address the \$329 million cost overage and 1.5-year schedule slippage in an effort to meet the Project's revised cost, schedule, and performance goals.

³¹ The Space Network provides funding for requirements gap resulting from the ongoing SGSS system upgrade, as well as to integrate and train its personnel for the transition to the upgraded system. The Network Integration Management Office provides options, analysis, planning, and testing assistance, as well as network integration, to meet customers' technical and budgetary requirements. The Office can coordinate support from service providers throughout NASA, as well as U.S. agencies, foreign governments, and U.S. commercial entities.

Recommendations, Management's Response, and Evaluation of Management's Response

To ensure NASA meets resource requirements for the Space Network Project, we recommended the Associate Administrator for Human Exploration and Operations do the following:

Recommendation 1. Reevaluate the SGSS Project for KDP C authority and ensure the Project is funded at the required levels for success. At a minimum, (a) require the SGSS Project Office to complete a revised and realistic cost estimate with revised joint confidence levels and evaluate the revised estimates for KDP C success criteria and (b) evaluate the results of the revised KDP C estimates and adjust the SGSS Project baseline and Agency baseline commitment as necessary.

Management's Response. The Associate Administrator concurred, stating that the SGSS contractor has provided a new cost and schedule estimate, which NASA is evaluating against anticipated budget and program requirements to determine a way forward. He further stated that as the Agency develops its FY 2016 budget request and receives its final FY 2015 appropriation it will adjust the SGSS baseline as appropriate. The Associate Administrator anticipates completion of these actions by October 31, 2014 contingent upon passage of the final FY 2015 appropriation.

Evaluation of Management's Response. Management's proposed actions are responsive to our recommendation. Therefore, we consider the recommendation resolved and will close it upon receipt and verification of those actions.

Recommendation 2. Report the appropriate baseline commitment and/or status to Congress.

Management's Response. The Associate Administrator concurred, stating the SCaN Program will follow Agency guidelines and work with the Office of Legislative and Intergovernmental Affairs to report to Congress as needed. The Associate Administrator anticipates completion of this action by October 31, 2014.

Evaluation of Management's Response. Management's proposed actions are responsive to our recommendation. Therefore, we consider the recommendation resolved and will close it upon receipt and verification of those actions.

Recommendation 3. Ensure that the SGSS Project passes a termination review prior to any rebaselining.

Management's Response. The Associate Administrator partially concurred, stating that NASA is working to determine whether it should manage the SGSS Project as a development or sustainment activity and will factor that determination into the decision on the way forward. He also indicated that the SCaN Program will follow Agency guidelines for rebaselining. However, he said that while contracts and

discrete projects may be terminated if warranted, maintenance and upgrade of the Space Network ground system is not optional. The Associate Administrator anticipates completion of these actions by October 31, 2014.

Evaluation of Management's Response. While we agree that given its importance the Agency must continue to maintain and upgrade the Space Network ground system, we believe a termination review should be conducted irrespective of whether NASA decides to manage the Project as a "development" or "sustainment" activity to ensure the Agency's senior leadership and external stakeholders are fully aware of the factors that influenced the Project's cost, schedule, and performance issues. Accordingly, we consider the recommendation unresolved.

Recommendation 4. Examine options to increase funding for the Space Network, including acquiring funds from other less critical priorities within the Agency.

Management's Response. The Associate Administrator concurred, stating that SCaN continues to seek reimbursable customers to reduce the burden on the Agency. He also indicated that NASA will balance resources across its programs to assure effective, continuous Space Network operations and sustainment. Finally, he stated that NASA will present its funding proposal for FY 2016 to the Office of Management and Budget in the September 2014 timeframe and will provide that information to the OIG. The Associate Administrator anticipates completion of these actions by December 31, 2014.

Evaluation of Management's Response. Management's proposed actions are responsive to our recommendation. Therefore, we consider the recommendation resolved and will close it upon receipt and verification of those actions.

OTHER MATTERS

In September 2010, we reported that NASA had not updated the rates it charged customers for use of the Space Network for over 4 years.³² We recommended that NASA annually update the rates in order to reflect current operating costs. The Agency concurred with our recommendation and agreed to update the methodology used to calculate the rates and revise them annually. In November 2012, NASA published the rates for FY 2013. Since 2009, between 9 and 13 customers have used Space Network assets each fiscal year and reimbursed the Agency between \$2.1 and \$3.1 million.

NASA had not updated the rates for FY 2014 and, as of March 2014, continued to charge FY 2013 rates that may not accurately capture current operating costs. As a result, NASA may be absorbing costs for services used by other Federal agencies and commercial customers. NASA officials attributed the failure to update the rates to the absence of the staff member who developed the FY 2013 rates. During this audit, NASA officials began developing a methodology to revise the rates. Based on historical usage rates, 10 customers could utilize the Space Network in FY 2014 enabling NASA to collect nearly \$3 million in reimbursements based on the 2013 rates.

Recommendation, Management’s Response, and Evaluation of Management’s Response

In order to reflect current operating costs and maximize revenue potential, we recommended the Deputy Associate Administrator for SCan:

Recommendation 5. Document the cost factors and formulas used for reimbursable rates and ensure those rates are reevaluated and new rates set on an annual basis.

Management’s Response. The Deputy Associate Administrator concurred and published FY 2014 rates effective April 11, 2014.

Evaluation of Management’s Response. Despite the Deputy Associate Administrator’s concurrence and the publication of new rates, NASA has not established a process to document cost factors and formulas and ensure annual rate adjustments. Accordingly, we do not consider management’s actions fully responsive and the recommendation remains unresolved.

³² NASA OIG “Review of NASA’s Tracking and Data Relay Satellite System” (IG-10-023, September 21, 2010).

APPENDIX A

Scope and Methodology

We performed this audit from August 2013 through March 2014 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

In May 2013, we initially announced an audit of the SCaN Program. During the audit, we decided to review each of the Networks separately. In doing so, we narrowed our scope of this audit to include controls and management of the Space Network, TDRS, and SGSS projects. For this review, we performed audit fieldwork at NASA Headquarters, Goddard, and the White Sands Complex.

To accomplish the review, we identified and reviewed laws, regulations, policies, procedures, and controls pertaining to the management of the Space Network Project and its related projects. Specifically, we reviewed NASA Authorization Act of 2010, S. 3779, January 5, 2010; NASA Authorization Act of 2008, H. R. 6063, January 3, 2008; Public Law 109-155, NASA Authorization Act of 2005, S. 1281, December 30, 2005; and Title 14 of the Code of Federal Regulations, Part 1215.

To understand NASA's contract policies and their implementation of that policy, we reviewed NPR 7120.5E, "NASA Space Flight Program and Project Management Requirements, with Change 1," August 14, 2012; NPR 7123.1B, "NASA Systems Engineering Processes and Requirements," April 18, 2013; NPR 8000.4A, "Agency Risk Management Procedural Requirements," December 16, 2008; and NPR 9090.1A, "Reimbursable Agreements," February 25, 2013.

To accomplish our review of the processes used to manage the Space Network and its key component projects, we interviewed NASA Headquarters officials within the SCaN Program and officials for the Space Network Project Office, SGSS Project Office, and the TDRS Project Office at Goddard and White Sands Complex.

During fieldwork, we reviewed Space Network reimbursable agreements; Plan of Action and Milestone Items and Risk Acceptance; SGSS Quarterly Financial Reports for March 2011 through September 2013; and the available, earned, and paid award fees on the SGSS contract.

Use of Computer-Processed Data. We used computer-processed data to perform this audit. Specifically, we reviewed budget data, service level agreements, SGSS contract requirements and modifications, contractor quarterly financial management reports schedule reports, and the contractor’s award fee data. In addition, we reviewed TDRS planned schedules and NASA’s reimbursable rates. Generally, we concluded that we could rely upon this data, except as discussed in the results section of this report.

Review of Internal Controls

We evaluated internal controls, including Federal laws, the Code of Federal Regulations, and NASA policies and procedures and concluded that the internal controls were adequate, except in specific circumstances, as discussed in the body of this report. Our recommendations, if implemented, should correct the weaknesses identified.

Prior Coverage

During the last 5 years, NASA OIG and the Government Accountability Office (GAO) have issued two reports of particular relevance to the subject of this report. The unrestricted reports can be accessed over the Internet at <http://oig.nasa.gov/audits/reports/FY10/index.html> and <http://www.gao.gov>, respectively.

NASA Office of Inspector General

“Review of NASA’s Tracking and Data Relay Satellite System” (IG-10-023, September 21, 2010)

Government Accountability Office

“NASA: Assessments of Large-Scale Projects” (GAO-13-276SP, April 17, 2013)

MANAGEMENT COMMENTS

National Aeronautics and Space Administration
Headquarters
Washington, DC 20546-0001



April 23, 2014

Reply to Attn of: Human Exploration and Operations Mission Directorate

TO: Assistant Inspector General for Audits

FROM: Associate Administrator for Human Exploration and Operations

SUBJECT: Response to OIG Draft Audit Report, "Space Communications and Navigation: NASA's Management of the Space Network" (Assignment A-13-011-01)

The Human Exploration and Operations Mission Directorate (HEOMD) appreciates the opportunity to review your draft report entitled "Space Communications and Navigation: NASA's Management of the Space Network" (Assignment A-13-001-01), dated March 31, 2014.

In the report, the Office of Inspector General (OIG) makes five recommendations intended to ensure that NASA meets resource requirements for the Space Network Project and to reflect current operating costs and maximize revenue potential. The first four recommendations are addressed to the Associate Administrator for HEO and the fifth recommendation is addressed to the Deputy Associate Administrator for Space Communications and Navigation (SCaN). NASA's response to the recommendations, including planned corrective actions, follows:

Recommendation 1: Reevaluate the Space Network Ground Segment Sustainment (SGSS) Project for Key Decision Point (KDP) C authority and ensure the Project is funded at the required levels for success. At a minimum: a) require the SGSS Project Office to complete a revised and realistic cost estimate with revised joint confidence levels and evaluate the revised estimates for KDP C success criteria and b) evaluate the results of the revised KDP C estimates and adjust the SGSS Project baseline and Agency baseline commitment as necessary.

Management's Response: NASA concurs. The SGSS prime contractor has provided a new cost and schedule estimate, and NASA is evaluating this against anticipated budget and program requirements and options to determine a way forward. This will be addressed in the context of the Agency's development of its predecisional FY2016 budget request and final FY2015 appropriation. HEOMD will make this predecisional budget data available to the OIG, with the caveat that it may not be included in any external communications such as the final report. NASA will adjust the SGSS baseline based on the outcome of its matching of updated cost and schedule estimates with requirements and resources.

Estimated Completion Date: October 31, 2014. Achieving this date is dependent upon Congressional passage of the final FY2015 appropriation.

Recommendation 2: Report the appropriate baseline commitment and/or status to Congress.

Management's Response NASA concurs. The SCaN Program will follow Agency guidelines and will work with the Office of Legislative and Intergovernmental Affairs to prepare information for Congress as needed. Preliminary notification was provided to Congress as part of the Agency operating plan submittal.

Estimated Completion Date: October 31, 2014

Recommendation 3: Ensure that the SGSS Project passes a termination review prior to any rebaselining.

Management's Response: NASA partially concurs. SCaN will follow the Agency guidelines for rebaselining. NASA is working to determine whether SGSS is best managed as a development or a sustainment activity and will factor that into the decision on a way forward. While contracts and discrete projects can be terminated if warranted, the maintenance and upgrade of the Space Network ground system is not optional. It is a matter of finding the most effective implementation approach and executing well.

Estimated Completion Date: October 31, 2014

Recommendation 4: Examine options to increase funding for the Space Network, including acquiring funds from other less critical priorities within the Agency.

Management's Response: NASA concurs. SCaN continues to seek other reimbursable customers to reduce the burden on the Agency. However, such customers are few and do not require sufficient usage to fully reimburse Space Network Operations and Maintenance (O&M) costs. Therefore, NASA will balance resources across its programs and obligations to assure effective, continuous Space Network operations and sustainment. As in past budget cycles, HEOMD will attempt to mitigate funding issues internally and, if necessary, raise any remaining shortfalls to the Agency. The resulting funding proposal will be presented to the Office of Management and Budget in the September 2014 timeframe. While official announcement of the Space Network O&M budget will occur after the President releases the FY2016 budget, scheduled for February 2015, HEOMD will make this predecisional budget data available to the OIG, with the caveat that it may not be included in any external communications such as a final report.

Estimated Completion Date: December 31, 2014

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Recommendation 5: Document the cost factors and formulas used for reimbursable rates and ensure those rates are reevaluated and new rates set on an annual basis.

Management's Response: NASA concurs. For FY2014 rates, SCaN will use the FY2013 rates and escalate them for inflation on annual basis. SCaN FY2014 reimbursable rates were effective April 11, 2014. The SCaN Network Services Operations Manager will initiate the rate update with the SCaN Business Manager in September of each fiscal year, who will provide the next year's new rate. The SCaN Network Services Director will then issue a memorandum to the appropriate distribution to put the new rate into effect.

Estimated Completion Date: September 30, 2014

We have reviewed the draft report for information that we believe should not be publicly released and have no concerns regarding the release of information.

Thank you for the opportunity to review and comment on the subject draft report. If you have any questions or require additional information regarding this response, please contact Michelle Bascoe at (202) 358-1574.



William H. Gerstenmaier

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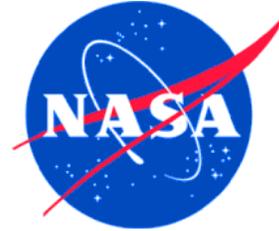
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