NASA
Office of Inspector General

AUDIT of THE NANCY GRACE ROMAN SPACE TELESCOPE PROJECT

July 31, 2024

IG-24-014

Office of Inspector General

RESULTS IN BRIEF

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July 31, 2024 IG-24-014 (A-23-12-00-SARD)

WHY WE PERFORMED THIS AUDIT

The Nancy Grace Roman Space Telescope (Roman) will look at billons of cosmic objects to explore how planets, stars, and galaxies form and develop over time. Scheduled to launch by May 2027, Roman will operate approximately 930,000 miles or 1.5 million kilometers away from Earth. Roman's large field of view and stability will enable large surveys of the sky to unveil the universe in ways that have never been possible before. The telescope provides a field of view that is 200 times greater than the Hubble Space Telescope, allowing it to capture more of space with less observing time.

With an estimated cost of $4.3 billion, Roman will need to produce an unprecedented amount of data to meet its objectives. It will rely on NASA's Deep Space Network (DSN) and Near Space Network (NSN), as well as network support from the European Space Agency (ESA) and the Japan Aerospace Exploration Agency (JAXA), to meet its space communication and navigation requirements.

We initiated this audit to assess whether NASA is managing the risks and mitigating future challenges with the Roman telescope while meeting its cost, schedule, and technological goals. Specifically, we assessed whether the project is meeting cost and schedule commitments, contractor performance, and Agency plans to mitigate the oversubscription of space communication and navigation networks. We performed this audit from September 2023 through June 2024. To determine whether NASA was meeting cost and scheduled commitments, we conducted interviews with Astrophysics Strategic Missions Program officials, Roman officials, and Coronagraph Instrument (CGI) officials and compared the project's Key Decision Point (KDP) documentation against its Monthly Status Reviews (MSR). To assess and review Roman contractor performance, we reviewed the major contracts and their modifications and the contract's Contractor Performance Assessment Reports. To evaluate NASA's space communication and navigation plan, we met with officials responsible for enabling Roman's space communication and navigation services. We also reviewed Roman's space communication and navigation plan, international agreements and memorandums of understanding with ESA and JAXA, space communication and navigation related risks held by Roman and Space Communications and Navigation (SCaN) program, and Roman KDPs and MSRs.

WHAT WE FOUND

Although critical system integration, testing, and associated tasks remain, as of March 2024, Roman was meeting its cost obligations and schedule to launch by May 2027. Roman was on track to launch despite encountering contractor performance issues and cost overruns related to hardware anomalies, under scoping of work, and inadequate oversight of subcontractors. Roman remains on schedule because Science Mission Directorate officials conducted a replan in May 2021 to mitigate the expected cost and schedule growth caused by COVID-19, increasing the life-cycle cost estimate from $3.9 billion to $4.3 billion. This replan also included delaying the launch readiness date from October 2026 to May 2027. As of March 2024, Roman was tracking its project reserves and potential delays with L3Harris as its top risks. Roman has been using its project reserves to mitigate cost growth related to L3Harris's performance challenges. Despite these contract value increases, Roman is still within its life-cycle cost estimate because the project's reserves cover these extra costs.

Significant risks remain in NASA's plan for transmitting Roman data to Earth. Roman is expected to produce an unprecedented amount of data. According to Roman's space communication and navigation plan, it will utilize four space communication networks to meet its communication needs. As of April 2024, Roman had a draft Service Level Agreement with the NSN for command and control, navigation support, and data downlinking. In addition, the draft NSN Service Level Agreement includes resources from the DSN for command and control and navigation. NASA also has international agreements with ESA and JAXA for use of their respective networks for data downlinking. According to SCaN, ESA, and JAXA officials, three out of the four networks that Roman will rely on for navigation and data downlinking—NASA's DSN, ESA's European Space Agency Tracking Stations Network, and JAXA's Usuda Deep Space Center—are currently oversubscribed and will be in even greater demand during Roman's mission. Returning Roman's science data to Earth is dependent on the ability to successfully downlink data through NASA's NSN, as well as ESA and JAXA's deep space communication networks. In addition, as of April 2024, the NSN did not have adequate capacity to support Roman's mission requirements without planned upgrades to the White Sands antenna and lacked the funding to implement the necessary upgrades by the mission's launch readiness date. Roman officials have not properly evaluated risks associated with transmitting data from these oversubscribed networks and do not have a contingency plan for downlinking data should any of the networks fail. However, NASA is planning to upgrade an existing NSN antenna by 2026 at its White Sands complex in New Mexico to support NASA missions, including Roman.

What We Recommended

We recommended NASA's Associate Administrator for Science Mission Directorate coordinate with the Associate Administrator for Space Operations Mission Directorate to: (1) further evaluate space communication and navigation risks, including running and reviewing loading analysis from all four networks; (2) develop a contingency plan for Roman's space communication and navigation services, including an assessment of the DSN's ability to support Roman; and (3) assess the potential impacts of the delayed upgrades to the NSN on Roman's scheduled launch timeline. We also recommended NASA's Associate Administrator for International and Interagency Relations: (4) ensure future international agreements for space communication and navigation services include information-sharing provisions that allow NASA to conduct proper risk analysis, such as through access to capacity and loading analysis.

We provided a draft of this report to NASA management who concurred with our recommendations and described planned actions to address them. We consider management's comments responsive; therefore, the recommendations are resolved and will be closed upon completion and verification of the proposed corrective actions.

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Acronyms

ABC	Agency Baseline Commitment
ASMP	Astrophysics Strategic Missions Program
CGI	Coronagraph Instrument
DSN	Deep Space Network
ESA	European Space Agency
ESTRACK	European Space Agency Tracking Station Network
FY	fiscal year
GAO	U.S. Government Accountability Office
HGA	High-Gain Antenna
JAXA	Japan Aerospace Exploration Agency
JPL	Jet Propulsion Laboratory
KDP	Key Decision Point
LRD	Launch Readiness Date
MSR	Monthly Status Review
NSN	Near Space Network
OBA	Outer Barrel Assembly
OIG	Office of Inspector General
OTA	Optical Telescope Assembly
SCaN	Space Communications and Navigation
SMD	Science Mission Directorate
UFE	Unallocated Future Expense
WFI	Wide Field Instrument
WFIRST	Wide-Field Infrared Survey Telescope
WIETR	WFIRST Independent External Technical Review
WOMA	WFI Opto-Mechanical Assembly

INTRODUCTION

Space telescopes play a critical role in transforming our understanding of the universe. In 1968, NASA launched its first operational space telescope, the Orbiting Astronomical Observatory-2. Since then, the Agency has launched several significant space telescopes including the Hubble Space Telescope (Hubble) and the James Webb Space Telescope (Webb). To continue advancing our understanding of the universe, in 2010 the National Academies Decadal Survey, *New Worlds, New Horizons in Astronomy and Astrophysics*, recommended NASA's next major astrophysics mission to be the Wide-Field Infrared Survey Telescope (WFIRST), now called the Nancy Grace Roman Space Telescope (Roman).[1] Roman entered Formulation in February 2016 and will look at billons of cosmic objects to explore how planets, stars, and galaxies form and develop over time.[2] With an estimated cost of $4.3 billion, Roman will need to produce an unprecedented amount of data to meet its objectives. It will rely on NASA's Deep Space Network (DSN) and Near Space Network (NSN), as well as network support from the European Space Agency (ESA) and the Japan Aerospace Exploration Agency (JAXA), to meet its space communication and navigation requirements.[3]

We initiated this audit to assess whether NASA is managing the risks and mitigating future challenges with the Roman telescope while meeting its cost, schedule, and technological goals. Specifically, we assessed whether the project is meeting cost and schedule commitments, contractor performance, and Agency plans to mitigate the oversubscription of space communication and navigation networks. See Appendix A for details of the audit's scope and methodology.

Background

While NASA has built a number of notable flagship telescopes, Hubble and Webb are two of NASA's most important and costly space observatories ever created.[4] Hubble, launched in 1990 at a cost of $2.1 billion, was designed to explore the universe in visible, ultraviolet, and some infrared wavelengths and continues to operate to this day.[5] Hubble's Wide Field Camera 3 has an ultraviolet and visible light

[1] Known as the "mother of the Hubble Space Telescope," Nancy Grace Roman was born May 16, 1925, in Nashville, Tennessee, and died December 25, 2018. One of the biggest challenges and greatest achievements of her career was getting Hubble approved by Congress. In May of 2020—15 months after her passing—NASA announced that their next flagship mission would be named in her honor and renamed WFIRST to the Nancy Grace Roman Space Telescope. For the purposes of this report, we will refer to the mission as the Nancy Grace Roman Space Telescope or Roman. National Academies of Sciences, Engineering, and Medicine, *New Worlds, New Horizons in Astronomy and Astrophysics* (2010).

[2] Formulation is the phase where NASA establishes a cost-effective program that is capable of meeting Agency and mission directorate goals and objectives. NASA divides the life cycle of its projects into two major phases—Formulation and Implementation—that are further divided into Phases A through F. Formulation consists of Phases A and B.

[3] The European Space Agency is an international space agency composed of 22 member states, including founders such as Germany, France, Italy, Spain, and the United Kingdom. The Japan Aerospace Exploration Agency is a core executive organization that supports aerospace development and utilization for the Japanese government.

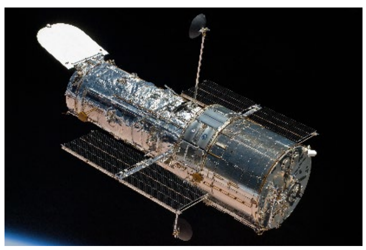
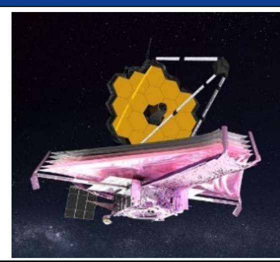
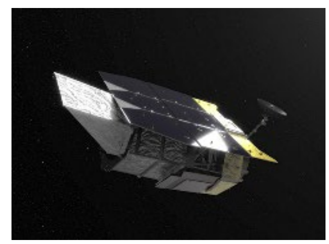
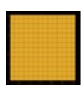
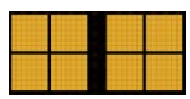
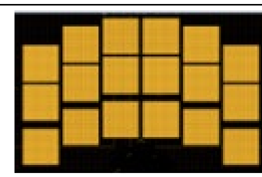
[4] Flagship missions are the highest costing and most capable large strategic science missions and are designed to answer the most compelling and challenging questions about our solar system.

[5] Infrared and ultraviolet light have longer and shorter wavelengths than visible light, respectively, and are invisible to the human eye.

channel with two 2,048-by-4,096-pixel detectors and a near infrared channel with one 1,024-by-1,024-pixel detector.[6] NASA discovered that Hubble produced pictures with significant optical distortion immediately after it began operations that prevented the telescope from operating at its full capacity for its first 3 years. However, since the problem was fixed by the crew of STS-61 in December 1993, the images Hubble has taken have led to groundbreaking research.

Webb, launched in December 2021 with a life-cycle cost estimate of $10 billion, was designed to continue Hubble's work and has the capability to study the universe in infrared wavelengths. Webb's Near Infrared Camera has a near infrared channel with eight 2,048-by-2,048-pixel detectors and a mid-infrared channel with two 2,048-by-2,048-pixel detectors. Webb was originally baselined in 2009 with an estimated cost of $4.9 billion and planned to launch in June 2014. However, the telescope experienced a number of significant technical and programmatic challenges that required NASA to re-baseline the project and delayed its launch by more than 7 years and increased its cost by more than $5 billion. Despite these challenges, Webb has revolutionized the study of the universe. Table 1 provides information on the Hubble, Webb, and Roman Space Telescopes.

Table 1: Hubble, Webb, and Roman Comparison (March 2024)

	Hubble	Webb	Roman
Telescope			
Detectors			
Detector Details	One 1,024-by-1,024-pixel infrared sensor in Wide Field Camera 3	Eight 2,048-by-2,048-pixel infrared sensors in Near Infrared Camera	Eighteen 4,096-by-4,096-pixel infrared sensors in Wide Field Instrument
Launch Year	1990	2021	2027
Lifetime	34 years	5-10 years (planned)	5-10 years (planned)
Mirror Size	2.4 m	6.5 m	2.4 m
Mass	11,000 kg	6,200 kg	10,150 kg (not to exceed)
Cost	$2.1 billion	$10.0 billion	$4.3 billion

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

Note: m is meters; kg is kilograms.

[6] Detectors absorb photons and convert them into electronic voltages that we measure. A telescope's mirror collects light from the sky and directs it to the science instrument. The instrument filters the light before focusing it onto the detectors. Extraordinarily sensitive detectors are needed to record the feeble light from far-away galaxies, stars, and planets.

Roman Overview

Roman is designed to investigate questions in the areas of dark energy, exoplanets, and infrared astrophysics.[7] To address these questions, the telescope uses a repurposed 7.9-foot (2.4-meter) diameter primary mirror, the same size as Hubble's primary mirror but less than one-fourth of its weight, weighing 410 pounds (186 kilograms).[8] The primary mirror, in concert with other optics, will send light to Roman's two instruments—the Wide Field Instrument (WFI) and the Coronagraph Instrument (CGI) technology demonstration. The WFI is a 300-megapixel infrared camera with eighteen 4,096-by-4,096-pixel detectors that will measure light from a billion galaxies over the course of the mission lifetime. This will help astronomers understand why the expansion of the universe is accelerating. It will also perform a galactic bulge survey of the inner Milky Way using microlensing to find approximately 2,600 exoplanets and inform planetary sizes and distributions in the Milky Way.[9] Additionally, this will allow characterization for the first time of the mass function of the majority of neutron stars and black holes in the galaxy.[10] The CGI will demonstrate the technology needed to directly image planets in orbit around other stars by greatly reducing the glare from the host star, potentially leading to the capability of seeing planets that are almost a billion times fainter than their star.

As shown in Figure 1, in addition to the WFI and CGI, Roman's main elements include:

- Solar Array Sun Shield —The solar panels collect sunlight for energy to power the observatory and shade the telescope and instruments beneath.
- High-Gain Antenna (HGA)—The HGA is part of the communications system along with the Radio Frequency Communications Electronics. The dual-band HGA accommodates S-band uplink/downlink data for commands and telemetry and Ka-band high-speed downlink data for science. With the use of pointing hardware called gimbals, the HGA can move in multiple directions to accurately point at ground stations.
- Observatory Support Systems (Spacecraft Bus)—This is the main body and structure that all other spacecraft pieces are attached to. It contains the power, data, navigation, and communications functions for the observatory and supports the telescope and instruments.
- Outer Barrel Assembly (OBA)—The OBA will protect the telescope from stray light and help keep the mirrors cool. It also serves as structural support for the Solar Array Sun Shield and Deployable Aperture Cover. The OBA is connected directly to the upper deck of the spacecraft support system's primary structure with a series of struts that extend past the WFI and the CGI.

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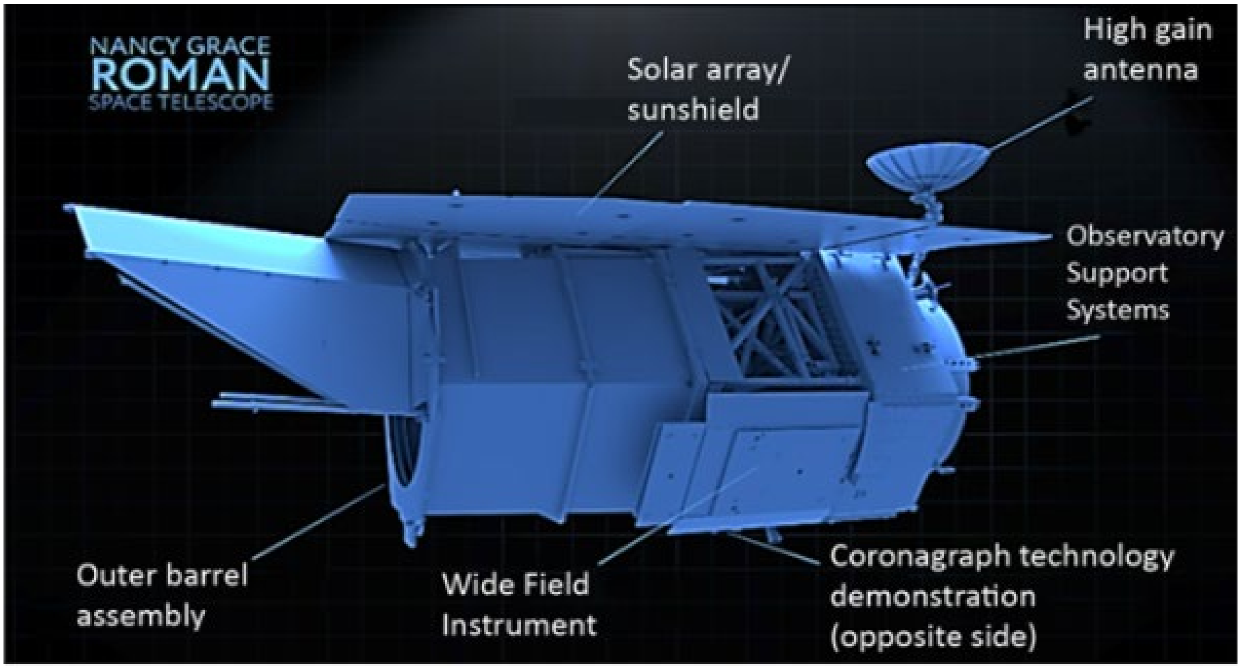
[7] Dark energy is the energy in empty space that is accelerating the expansion of the universe. It is theorized to be a factor of universal expansion. An exoplanet is a body that meets requirements of a planet—orbits a Sun-like star, has enough gravitational force to be spherical, and has its own orbit—outside of our solar system. Infrared astrophysics is a category of astrophysics that focuses on the use of infrared light to detect and analyze light in space in the infrared wavelength range.

[8] NASA obtained Roman's primary mirror telescope from the U.S. National Reconnaissance Office. The National Reconnaissance Office is part of the U.S. Intelligence Community and an agency of the U.S. Department of Defense. It designs and builds satellites for the federal government.

[9] In the Milky Way, the galactic bulge is the region around the galactic center, where stars are arranged in a less-flattened volume than in the surrounding disk-like region. Microlensing is an observational effect that occurs because the presence of mass warps the fabric of space-time. When two stars closely align from our vantage point, the nearer star—and any orbiting planets—can lens light from the farther star, making it briefly brighten.

[10] Neutron stars are the remains in the end stages of a star's life cycle and a possible cause of black holes. Neutron stars form when the power supply of a star is reduced to its core of neutrons, becoming smaller yet more massive than the Sun.

Figure 1: Roman Space Telescope Diagram (March 2024)



Source: NASA OIG representation of NASA information.

Scheduled to launch by May 2027, Roman will operate from a quasi-halo orbit around the second Sun-Earth Lagrange point, approximately 930,000 miles or 1.5 million kilometers away from Earth.[11] Roman's large field of view and stability will enable large surveys of the sky to unveil the universe in ways that have never been possible before. The telescope provides a field of view that is 200 times greater than Hubble's infrared instrument, allowing it to capture more of space with less observing time.

Organization

The Astrophysics Division of the Science Mission Directorate (SMD) at NASA Headquarters has overall responsibility for Roman. Goddard Space Flight Center (Goddard) is managing the overall project with the Jet Propulsion Laboratory (JPL) managing development of CGI. However, this was not originally how management of Roman was organized. After entering Formulation in 2016, JPL had additional programmatic responsibilities such as direction, insight, and oversight of Roman. This resulted in conflict between Goddard and JPL regarding prioritization of work, cost, and requirements.

In response to a 2016 National Academies Midterm Assessment recommendation, NASA commissioned an external independent review in 2017, termed the WFIRST Independent External Technical/Management/Cost Review (WIETR), to validate whether the requirements for the mission

[11] The quasi-halo orbit is a type of three-dimensional orbit around a Lagrange point. Lagrange points are areas around the Earth where gravity between the Sun and Earth are constant, requiring less fuel for satellites to maintain their position. Lagrange Point L2 is on the opposite side of the Earth from the Sun and the same Lagrange Point from which Webb is operating.

were aligned with the resources available and were executable.[12] Based on a WIETR recommendation, NASA created the Astrophysics Strategic Missions Program (ASMP) to address what the Review described as a "dysfunction" between Goddard and JPL and established their respective efforts as separate projects. This provided JPL sole responsibility for CGI and allowed Goddard to focus on work related to the primary Roman observatory, including WFI, with ASMP overseeing both projects. In addition, following Key Decision Point-C (KDP-C) in February 2020, NASA decided that CGI would be a cost-capped technology demonstration, with a requirement to "do-no-harm" to Roman's critical path and to not disrupt Roman's cost and schedule if it fails.[13]

Other contributors to Roman include the Space Telescope Science Institute, IPAC (formally known as the Infrared Processing & Analysis Center), several industrial partners, and science team members from many research institutions. Primary contractors include BAE Systems (previously Ball Aerospace), responsible for the WFI Opto-Mechanical Assembly (WOMA)—a component of WFI—and L3Harris Technologies, Inc. (L3Harris), responsible for the Optical Telescope Assembly (OTA).[14]

Mission Funding and Timeline

Roman is a cost-capped flagship mission that established its original Agency Baseline Commitment (ABC) life-cycle cost estimate of $3.9 billion and Launch Readiness Date (LRD) of October 2026 at KDP-C in February 2020.[15] It underwent a replan in June 2021 to address cost and schedule growth related to the COVID-19 pandemic that resulted in a new cost estimate of $4.3 billion and delayed its LRD to May 2027.[16]

As of March 2024, Roman is in the Final Design and Fabrication phase (Phase C). Following this phase, Roman's KDP-D is scheduled to take place in January 2025. If passed, this next phase will cover the system assembly, integration and test, and launch. Roman will have a primary mission lifetime of 5 years and anticipates a 5-year extended mission. Under current plans, 25 percent of the 5-year prime mission is expected to be dedicated to the General Investigator program and 5 percent to the CGI technology demonstration.[17] The remaining 70 percent of the 5-year prime mission is devoted to large-area surveys that will be designed to enable investigations in many areas of astrophysics as well as addressing the

12 The WIETR was an independent technical, management, and cost assessment of Roman. Of note, the WIETR documented concerns with Roman's governance structure as well as concerns with CGI's performance requirements, science community engagement, and risk classification. *WFIRST Independent External Technical/Management/Cost Review* (2017).

13 KDP-C is when NASA evaluates a project's plans to determine whether it should proceed into development (Implementation Phase), known as Phase C, when a project completes its final designs and starts to build the project's components. Critical path is the sequence of dependent tasks that determines the longest duration of time needed to complete the project.

14 The WOMA is a grouping of WFI hardware designed, built, aligned, and tested by BAE Systems (BAE Systems acquired the original contractor, Ball Aerospace, on February 16, 2024). The OTA is an imaging space telescope that has a 2.4-meter diameter primary mirror.

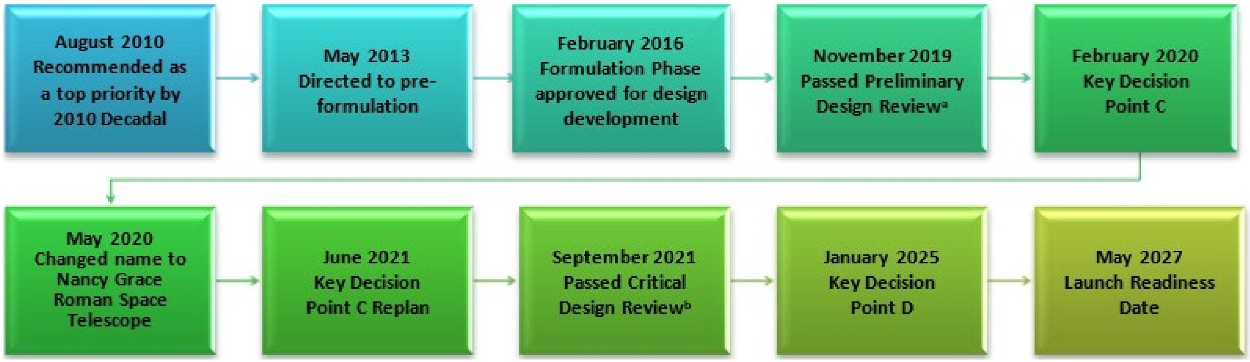
15 The ABC, as documented in a KDP-C Decision Memorandum, is the cost and schedule baseline against which a program or project is measured. The ABC establishes an integrated set of project requirements, cost, schedule, technical content, and agrees to a Joint Cost and Schedule Confidence Level that forms the basis for NASA's commitment to the Office of Management and Budget and Congress. A cost cap is the value that the mission cost is limited to.

16 Roman management cited on-site limitations imposed by the Office of Management and Budget and driven by social distancing requirements, supply chain interruptions, reduced efficiency, and other impacts as resulting in higher costs and schedule delays that caused the replan.

17 Roman's General Investigator program supports community-based observing programs. The large surveys in the baseline mission are also community defined to encompass a broad range of science and provide the data addressing the mission objectives in cosmology and exoplanet demographics. The additional surveys carried out via the General Investigator program will exploit Roman's unique capabilities to substantially broaden the science return of the mission.

mission objectives in exoplanet demographics and cosmology. Figure 2 details the planned Roman mission timeline.

Figure 2: Roman's Mission Timeline (as of March 2024)



Source: NASA OIG presentation of NASA information.

[a] Preliminary Design Review demonstrates that the preliminary design meets all system requirements with acceptable risk and within the cost and schedule constraints. It establishes the basis for proceeding with detailed design.

[b] Critical Design Review demonstrates that the maturity of design is appropriate for proceeding with full-scale fabrication, assembly, integration, and testing.

Nancy Grace Roman Space Telescope's Data

Roman is uniquely designed to collect the data needed to significantly improve our understanding of the nature of dark energy and dark matter and the evolution of the universe. Most of Roman's mission will be devoted to surveys primarily focused on studies of dark energy and exoplanets, though the data will also be useful for studying other topics, such as the evolution of galaxies over time. Roman will do this through multiple observational methods, including surveys of exploding stars called supernovae and galaxy clusters and mapping out the distribution of galaxies in three dimensions. Measuring the brightness and distances of supernovae provided the first evidence of dark energy. Roman will extend these studies to greater distances and measure precise distances to galaxy clusters to map how they grew over time.

Roman will collaborate with other observatories such as the Rubin Observatory to conduct science together, and the data produced by Roman will also complement the data collected by other observatories.[18] For example, according to the National Academies, the combination of wide-area observations of distant galaxies by the Rubin Observatory and Roman will provide imaging information for millions of galaxies, complementing the in-depth observations from Webb and Hubble.

[18] The Vera C. Rubin Observatory, or the Rubin Observatory, is a new astronomical facility on top of Cerro Pachón ridge in Chile. The Rubin Observatory, funded by the National Science Foundation, Department of Energy, and private funding, will conduct a 10-year survey of the Southern Hemisphere sky.

ROMAN IS ON TRACK TO MEET ITS COST AND SCHEDULE COMMITMENTS, DESPITE CONTRACTOR PERFORMANCE ISSUES

As of March 2024, Roman was on track to launch within established project timelines despite encountering contractor performance issues and cost overruns related to hardware anomalies, underscoping work, and inadequate oversight of subcontractors. Roman remains on schedule because SMD officials conducted a replan in May 2021 to mitigate the expected cost and schedule growth caused by COVID-19, increasing the life-cycle cost estimate from $3.9 billion to $4.3 billion. This replan also included delaying the LRD from October 2026 to May 2027.

Roman Is Meeting Mission Cost and Schedule Commitments

Although the critical system integration and test phase and associated tasks remain, as of March 2024, Roman was meeting its ABC cost obligations and schedule to launch by May 2027. Under its June 2021 replan, the Roman observatory's ABC is $3.9 billion, and CGI's ABC is $407 million, for a total of $4.3 billion. Although the replan established Roman's ABC LRD as May 2027, project officials are working to stay within or as close to its original October 2026 LRD to provide necessary schedule margin.[19] Table 2 provides Roman's life-cycle cost estimate.

[19] Schedule margin provides a buffer to account for uncertainties and risks.

Table 2: Roman's Life-Cycle Cost Estimate (in Millions)

	KDP-C (February 2020)	COVID-19 Replan (June 2021)
Launch Readiness Date		
Agency Baseline Commitment	October 2026	May 2027
Life-Cycle Cost		
Roman Observatory Agency Baseline Commitment	$3,591.3	$3,909.3
CGI Project Agency Baseline Commitment	$342.7	$406.7
Agency Commitment	**$3,934.0**	**$4,316.0**

Source: NASA OIG representation of NASA data.

The Roman observatory and CGI each have their own project Unallocated Future Expenses (UFE), in addition to the UFE held by SMD.[20] The UFE held by SMD is considered a "backstop" to manage cost and schedule growth for both the Roman observatory and CGI. As of March 2024, the observatory reserves were at 18.6 percent, while CGI's reserves are above 30 percent of estimated cost remaining. Headquarters has released $66 million in UFE funding in fiscal year (FY) 2024 to replenish Roman observatory's reserves to 18.1 percent, which is below the minimum established by Goddard policy for this phase of development.[21] Consequently, Roman requested $107.5 million from SMD for FY 2025 to further replenish reserves, which will be evaluated at KDP-D.

Roman's Monthly Status Review (MSR) reports show how both the Roman observatory and CGI identify risks and mitigate potential cost and schedule growth. As of March 2024, Roman is tracking its project reserves and potential delays with L3Harris as its top risks. Roman has been using its project reserves to mitigate cost growth related to L3Harris's performance challenges by using approved Headquarters UFE releases in FY 2024 and anticipates additional UFE release requests in future FYs. Project officials have stated that Headquarters UFE releases should replenish project reserves and leave Roman sufficiently funded until at least FY 2026. KDP Decision Memos and interviews with Roman project officials corroborated that the mission has not exceeded its replanned cost and schedule commitments. In our opinion, Roman is meeting its cost and schedule goals because of preemptive project planning and collaboratively working with Headquarters to replenish reserves to mitigate COVID-19 impacts and contractor performance issues.

Roman Contractor Performance Issues

NASA is contracting with over 60 industry partners to develop Roman. Two of the project's largest contractors are BAE Systems, for the WOMA, and L3Harris, for the OTA. Figure 3 shows the building of the WOMA and the OTA.

[20] UFE, sometimes referred to as "reserves," is an essential project management tool that allows project managers to allocate funds to mitigate cost and schedule growth caused by both identified and unidentified risks. UFE is included as part of the ABC.

[21] Goddard Procedural Requirements 7120.7B, *Funded Schedule Margin and Budget Margin for Flight Projects* (September 17, 2018).

Figure 3: WOMA (left) and OTA (right) Build

Source: NASA.

NASA selected BAE Systems to design and develop the WOMA for Roman, as well as support the assembly and integration and testing of the WFI. The optical-mechanical assembly, which includes the optical bench, thermal control system, precision mechanisms, optics, electronics, and the relative calibration system, provides the stable structure and thermal environment that enables the wide field, high-quality observations of the WFI.

L3Harris is responsible for designing, developing, building, and testing the OTA. In addition, L3Harris is creating hardware to accommodate and interact with the WFI for the mission's core science goals and the CGI for future exoplanet direct-imaging technology development. As the prime contractor for the OTA, L3Harris is responsible for to fabricating, aligning, testing, verifying, and delivering the OTA to Goddard. In addition, they are to provide post-delivery support for both the observatory integration and test program and for on-orbit observatory checkout and commissioning.

BAE Systems and L3Harris Have Experienced Cost Growth and Schedule Delays

The original contracts for BAE Systems and L3Harris, valued at $309 million combined, have since increased by $372 million to $681 million (120 percent). While more than half of the increase is attributable to NASA-directed changes to requirements, approximately $153 million is related to unexpected cost overruns. Despite these contract value increases for BAE Systems and L3Harris, Roman is still within its life-cycle cost estimate because the project's reserves cover these extra costs. Table 3 contains a summary of the cost growth.

Table 3: BAE Systems and L3Harris Contracts Cost Growth in Millions (as of February 2024)

Contractor	Original Contract Value	Contract Value Increases		Current Contract Value
		NASA-Directed	Overrun	
BAE Systems	$113	$90	$101	$304
L3Harris	$196	$129	$52	$377
Total	$309	$219	$153	$681

Source: NASA.

Note: Combined contracts' total value increase ($219 + $153 = $372 million).

BAE Systems Performance Issues

According to NASA officials, increases in cost and schedule delays on the BAE Systems contract resulted from an underbid on the original contract. Subsequently, the firm submitted a $71 million overrun proposal, which was signed by NASA in August 2022. Based on the proposal, some of the major contributors to the cost growth included:

- Not accounting for design updates from the Preliminary Design Review to the Critical Design Review in their baseline.
- Underestimating the level of effort needed to respond to inquiries and changes needed following these life-cycle reviews.
- Not providing adequate oversight of one subcontractor, resulting in termination by NASA due to increased costs.
- Underscoping the effort and complexity of the ground support equipment effort.[22]
- Underscoping the design and fabrication complexity of various subsystems.

In February 2023, BAE Systems submitted an additional $30 million overrun proposal due to continued cost and schedule delays. As of March 2024, NASA is evaluating the proposal. Examples of issues BAE Systems identified in the proposal include:

- Gear motor assembly suffering a 4-month delivery delay and associated costs.
- Supplier manufacturing flaws with large aluminum machining that encapsulates the hardware that had to be reworked.

Despite these issues, WOMA is completely integrated into the WFI and going through instrument-level environmental testing at BAE Systems in Colorado and is expected to be delivered to Goddard in August 2024.

L3Harris Performance Issues

According to the last available Contractor Performance Assessment Report (November 30, 2021, to November 29, 2022), L3Harris experienced schedule delays and was not able to meet OTA development

[22] Ground support equipment is needed to build spacecraft and can be quite large, including hardware rotation fixtures, cranes, hardware used in specialized lifts and movers, shipping crates, and ladders.

milestones primarily due to continued impacts from global supply challenges and staffing issues.[23] The industry-wide supply chain challenges were addressed through continuous engagement between NASA and L3Harris. However, the staffing issues persisted as L3Harris was not able to hire the number of staff required to accomplish the contract goals, and the inexperienced staff hired required more training and oversight than planned.

For the period ending May 2023, NASA awarded L3Harris the lowest performance rating since the contract was established November 2018, with an overall score of 57.7 percent.[24] Regarding schedule performance, NASA stated that Roman's critical path was affected because L3Harris was not adequately prioritizing the most critical work. Also, processes the contractor used for flight hardware added excessive complexity when applied to non-flight hardware, particularly in resource-constrained areas of the L3Harris workforce. Regarding cost control, there was continued cost growth on a multitude of cost elements, a greater difference between the budgeted and estimated cost to complete, and the decline in schedule margin eroded confidence in L3Harris's estimate at completion.

As of March 2024, NASA is evaluating L3Harris's $52-million overrun proposal, submitted in September 2023 to address errors and failures encountered during the OTA build. For example:

- The Optical Large Aperture Flat System's tight requirements for stability and repeatability drove a design that was not sufficiently reviewed prior to manufacturing. This created challenges and delays during manufacturing that required the design to be modified.
- The drawings for the Wavefront Sensing special test equipment revealed that the heat produced by the equipment would not be dissipated sufficiently and could overheat and fail during a thermal vacuum chamber test. A failure during this test would necessitate redesign of the hardware and result in multiple weeks of schedule to recover.
- A Telescope Control Electronics Box failure related to a faulty vendor part required rework and retest on all the electrical boards associated with the OTA. Consequently, the build and test of these boards for the voltage regulators had to be repeated, adding about 8 months and costing approximately half a million dollars.

After the June 2021 Roman replan, Roman and L3Harris officials scheduled the OTA for delivery in August 2023, which was further delayed by 12 months to August 2024, according to those officials. However, Roman's March 2024 MSR showed a schedule slip due to various issues including errors L3Harris identified with aligning the telescope and daily operational issues they had with completing OTA work. This delayed the OTA delivery date approximately 5 weeks to September 2024. NASA officials explained they anticipate L3Harris submitting a new cost overrun proposal that would increase costs by at least $3 million to account for these most recent developments. Despite the issues noted with L3Harris's performance, as of March 2024 Roman had sufficient reserves to stay within its cost commitments.

[23] A Contractor Performance Assessment Report assesses a contractor's performance and provides a record, both positive and negative, on a given contractor during a specific period of time.

[24] Delivered via an Award Fee Determination letter, NASA's Fee Determination Official for the evaluation period specifies the amount of award fee and the basis for that determination.

Significant Risks Remain in NASA's Plan for Transmitting Roman Data to Earth

Roman is expected to produce an unprecedented amount of data, and there are significant risks with its current plans for transmitting this information back to Earth. The primary network that NASA will use to downlink the data does not have adequate capacity to support Roman's data requirements. The project is planning to rely on three additional networks for telemetry and data downlinking, which are currently all oversubscribed—meaning demand on the networks is greater than their capacity. NASA policy includes guidance for a program to document its acquisition strategy that will meet mission objectives and provide the best value to NASA.[25] As part of this acquisition strategy, Roman developed a space communications plan to detail mission requirements and assess ground system risks. However, Roman officials have not properly evaluated risks associated with transmitting data from these oversubscribed networks and have no contingency plan for downlinking data should any of the networks fail.

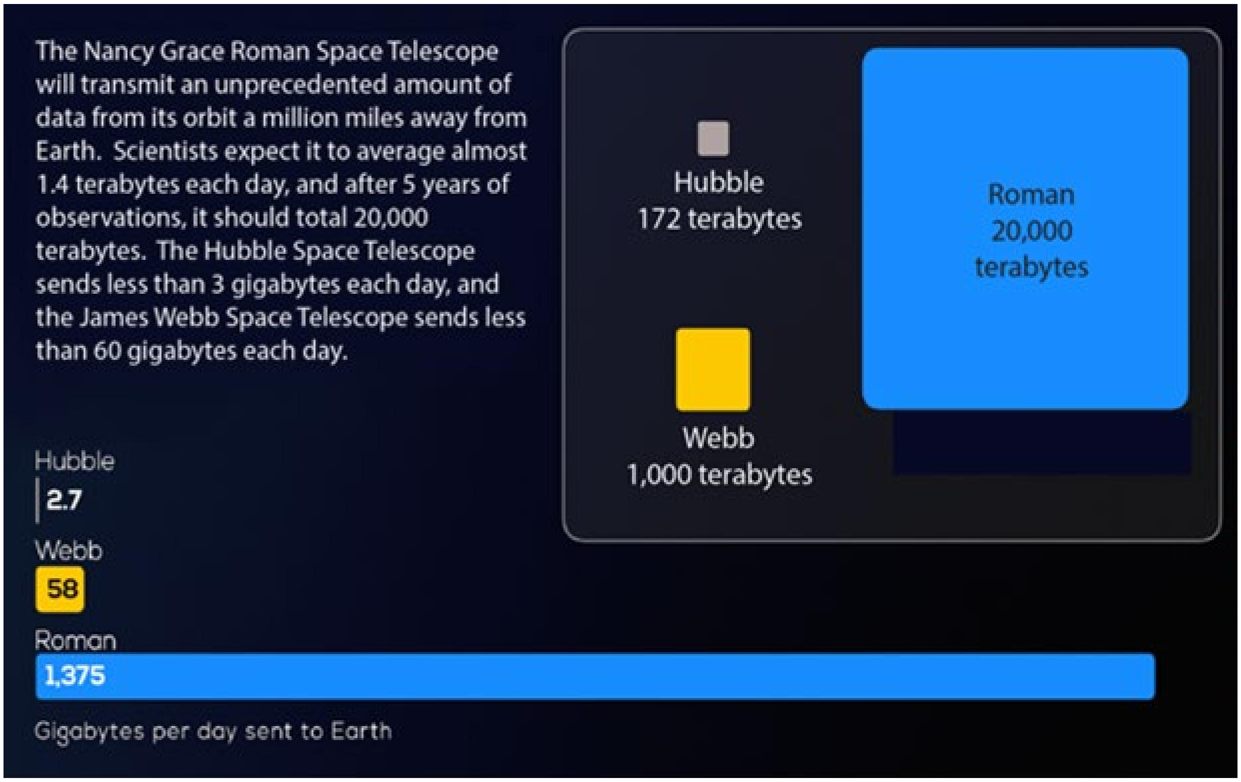
Roman's Space Communication and Navigation Plan

Roman is designed to collect large amounts of high-quality data needed to significantly improve our understanding of how the universe evolves. Roman's survey programs and other investigations will provide exceptionally large sample sizes and repeat observations, ideal for robust statistical analyses.

Roman will function as Hubble's wide-eyed cousin—a single Roman image will hold the equivalent detail of 100 pictures from Hubble. In 30 years of operation, Hubble has produced about 172 terabytes of data. For comparison, Webb expects to produce 1,000 terabytes of data over its 5-year mission, and Roman expects to produce 20,000 terabytes of data over its 5-year mission. Figure 4 shows the amount of data Roman will produce compared to Hubble and Webb.

[25] NASA Procedural Requirements 7120.5F, *NASA Space Flight Program and Project Management Requirements w/Change 3* (August 3, 2021).

Figure 4: Data Transmission Comparison of Hubble, Webb, and Roman Space Telescopes



Source: NASA.

The science return from a mission is ultimately determined by how much science data can be transmitted back to Earth and analyzed. NASA's Space Communications and Navigation (SCaN) program office, organizationally located within the Space Operations Mission Directorate, manages and directs all of NASA's space communication and navigation activities. This includes the ground-based facilities and services provided by the Deep Space Network (DSN) and the commercial and government-owned space communications ground-based facilities and satellites provided by the Near Space Network (NSN).

According to Roman's space communication and navigation plan, it will utilize four space communication networks to meet its communication needs. Roman has a draft Service Level Agreement with the NSN for command and control, navigation support, and data downlinking. In addition, the draft NSN Service Level Agreement with Roman includes resources from the DSN for command and control and navigation. The NSN is planning to upgrade an existing antenna by 2026 at its White Sands Complex in New Mexico to support NASA missions, including Roman. NASA also has international agreements with the European Space Agency (ESA) and the Japan Aerospace Exploration Agency (JAXA) for use of their respective networks for data downlinking. ESA is building a new antenna at the New Norcia, Australia, complex that will be used for its own missions as well as by Roman. JAXA is also upgrading the existing Misasa Deep Space Station antenna in Japan to support Roman. Table 4 lists the services and hours that Roman plans to utilize on these communication networks.

Table 4: Planned Roman Space Telescope Service Hours for Communication Networks (as of March 2024)

Network	Owner	Use	Hours/Day
Deep Space Network	NASA	Telemetry, Tracking, and Command	6
Near Space Network	NASA	Telemetry, Tracking, Command, and Science Data Downlink	7
ESTRACKa	ESA	Science Data Downlink	4
Usuda Deep Space Centerb	JAXA	Science Data Downlink	4

Source: NASA.

[a] ESTRACK–European Space Agency Tracking Station Network is a global system of ground stations providing links between satellites in orbit and the European Space Operations Centre in Darmstadt, Germany. ESA will downlink Roman science data to its facility in New Norcia, Australia.

[b] JAXA's Usuda Deep Space Center conducts command transmission operations to deep space probes and receives observation data from them as they fly closer to satellites, planets, comets, and the moon.

Roman Is Planning to Rely on Unprepared and Oversubscribed Networks

Returning Roman's science data to Earth is dependent on the ability to successfully downlink data through NASA's NSN, as well as ESA and JAXA's deep space communication networks. According to SCaN, ESA, and JAXA officials, three out of the four networks that Roman will rely on for navigation and data downlinking—NASA's DSN, ESA's European Space Agency Tracking Stations Network (ESTRACK), and JAXA's Usuda Deep Space Center—are currently oversubscribed and will be in even greater demand during Roman's mission. In addition, the NSN does not currently have adequate capacity to support Roman's mission requirements without planned upgrades to the White Sands antenna and lacks the funding to implement the necessary upgrades by the mission's current LRD.

As of April 2024, upgrades to the NSN antenna at White Sands Ground Station are over budget and behind schedule. In 2020, SCaN expected to award a contract for NSN upgrades to be completed in 2025 at a total cost of $4.3 million. However, technical, cost, and schedule growth on the upgrade plan triggered a SCaN programmatic review delaying the award until approximately May 2024.[26] The projected total cost to complete the upgrades now total at least $27.5 million.[27] According to SCaN officials, the $23 million difference in cost is due to contractor bids that came in at much higher cost than the Agency projected, mostly related to increased labor costs. Additional cost increases were due to reliability improvements to reduce the possibility of downtimes during prime science operations. SCaN reprioritized funding in future years to cover a majority of this difference, leaving approximately $2 million unfunded.

[26] After our audit, SCaN officials stated that SMD agreed to provide funding for the upgrade; however, we have not reviewed or verified the terms of the agreement.

[27] The $27.5-million figure does not include additional costs related to transitioning current missions utilizing the White Sands Ground Station to temporary support during the upgrades (when this antenna will need to be offline for at least a year).

Similarly, ESA's new antenna and JAXA's upgrades to one of its existing antennas have yet to be completed. ESA's ESTRACK is oversubscribed by about 30 percent, which will be mitigated somewhat by the introduction of a new deep space terminal in New Norcia, Western Australia, in 2026. However, the total capacity is estimated to be exceeded again in 2027 by 25 percent, which corresponds to the need for one additional terminal. That terminal in Malargüe, Argentina, is planned but not funded. JAXA's deep space network is also oversubscribed and will be in high demand due to multiple missions including Japan's Moon-to-Mars endeavors.

Multiple missions vying for time and bandwidth further strain space communication network management. When there is more than one mission competing for network usage, the DSN leaves it to the missions to work with each other to deconflict, and the NSN leaves it to the mission directorates (in this case SMD) to deconflict. ESA and JAXA officials said their own missions will take priority over Roman when there is excess demand on their networks. Without the planned daily downlinks, Roman's data recorder is filled within 7 days and the observatory cannot collect further data, effectively halting scientific survey operations until the stored data can be transmitted to Earth. For Webb, low network capacity resulted in delays to some planned objectives such as those that required high-quality data. For a survey mission like Roman—which is meant to capture changes over time and to create maps of the universe via continuous image captures—halting operations that require high-quality data could pose greater challenges. For example, if Roman is surveying the changes to a particular galaxy over 6 months or a year, it is critical that the observatory continue to survey the galaxy over that entire period without interruption.

Roman management has not developed a contingency plan for its space communication and navigation needs should the NSN or any of the oversubscribed networks be unavailable or fail. According to Roman officials, utilizing multiple networks negates the need for contingency planning. We spoke to SCaN officials who disagree with Roman's decision to not develop a contingency plan for space communication and navigation services. SCaN officials have raised concerns to Roman management about the ability of the NSN to support Roman with a single antenna and recommended the DSN provide primary support for Roman until additional resiliency is built into the NSN. SCaN also recommended a more thorough analysis of the DSN support scenario, as minor upgrades would need to be made to the DSN for compatibility with Roman. However, according to SCaN officials, SMD has asked them not to explore support through DSN due to concerns with mission prioritization and current oversubscription of DSN assets. As of March 2024, no additional funding had been provided to the DSN to complete upgrades.

Roman Is Underestimating Risks of Relying on Unprepared and Oversubscribed Networks

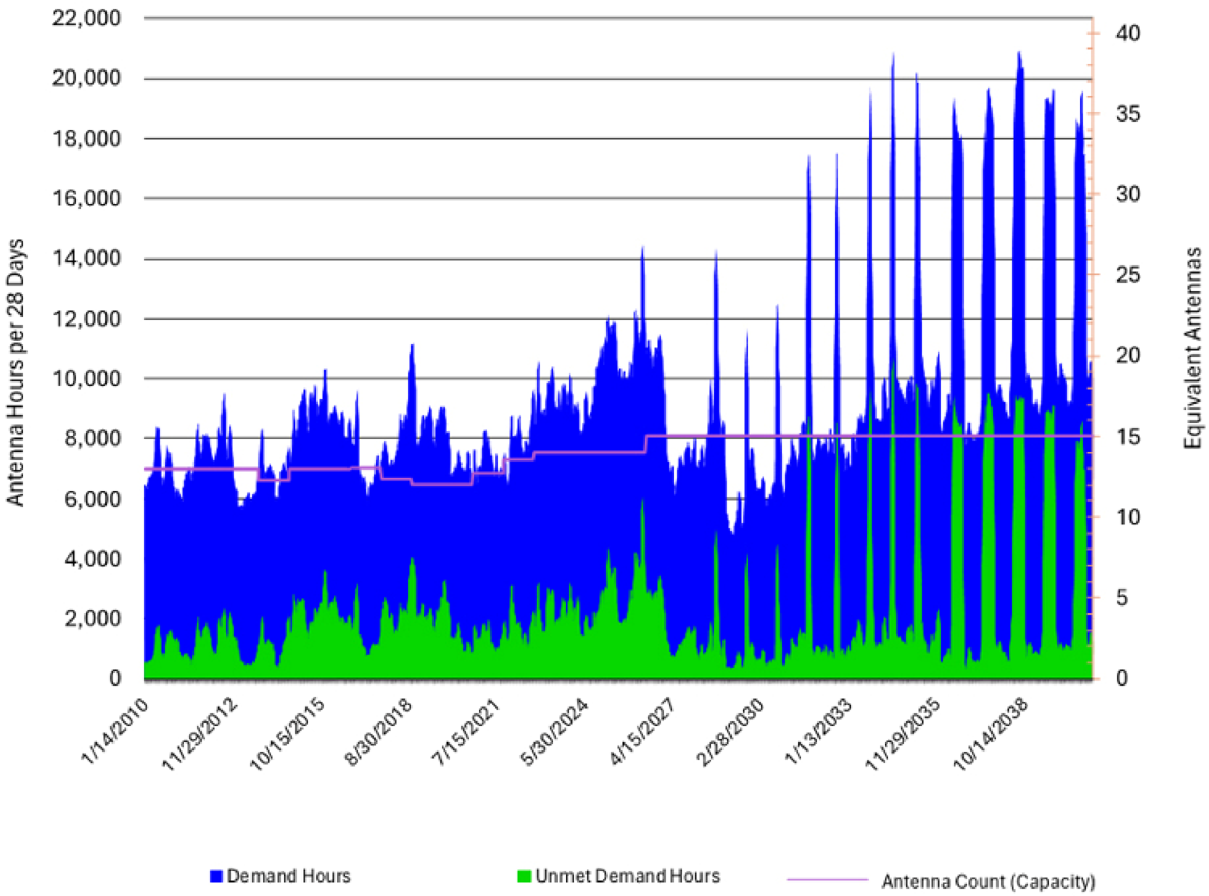
We believe that Roman officials are not sufficiently considering or addressing the risks associated with relying on the NSN upgrades and three oversubscribed networks. We requested capacity and loading studies from all the space communication and navigation networks for our review. However, as of the writing of this report, Roman project officials were not able to provide this information because they had not reviewed nor considered capacity and loading analysis from the DSN, ESA, or JAXA when developing their space communication and navigation services plan. In April 2024, we met with SCaN program officials who said that they also requested information from Roman to complete the loading analysis; however, the project had yet to provide this information. Space communication networks regularly (typically annually) conduct capacity and loading analysis to understand current and projected network demand and availability. According to SCaN officials, capacity and loading analysis are performed for each project when entering Service Level Agreements with the DSN and NSN (and then annually thereafter) because Service Level Agreements include the determination of network use (hours or download rates) required by the mission to meet objectives. According to ASMP and Roman officials, NASA did not request loading studies from ESA and JAXA because the studies were not required as part of the agreements signed with international partners for this mission. However, capacity and loading analysis provide important information about how much data a spacecraft's space communication equipment can generate, save, and transmit over a certain amount of time to a particular network, as well as overall network capacity to support mission requirements given planned network usage at the time of the analysis. Without proper loading analysis, Roman cannot adequately assess the risks associated with their plan to utilize the respective networks.

In 2023, we reported that NASA's DSN is operating at capacity with demand exceeding supply by 40 percent at times, an amount that is expected to grow as the Artemis missions advance.[28] To make this determination, we relied on the Agency's internal DSN capacity and loading studies, which showed that demand for DSN support will increase dramatically in the coming decade, projected at a factor of 10 by the early 2030s. According to the loading analysis, the growth in demand for the network is driven by the increase in the number of deep space missions, increases in uplink and downlink data rates and volumes, and the complexity of Artemis and future human exploration missions that will involve multiple, independently functioning elements with human-rated tracking requirements. Additionally, the amount of data collected and transmitted has significantly increased over the past 30 years. For example, missions like Webb collect and transmit data at roughly 50 times the rate of Hubble.

Figure 5 shows the projected growth in DSN demand through 2040. According to the DSN capacity and loading studies, the estimate of needed DSN capacity will double when factoring in the Artemis missions. Over the next 10 years, the average data rate needed to be processed from spacecraft sending images and data back to Earth will be six times what it was in 2024 while the volume of data will increase by an order of magnitude. The studies show that as the average data rates continue to increase, future unmet demand can result in very large data volume shortfalls.

[28] NASA OIG, *Audit of NASA's Deep Space Network* (IG-23-016, July 12, 2023). NASA's Artemis campaign will establish a robust human-robotic presence on and around the Moon. Artemis I, launched in November 2022, was an uncrewed test flight for the Space Launch System rocket and the Orion crew capsule. Future flights include Artemis II, which will fly four astronauts to the Moon's orbit and back while Artemis III will dock with the prepositioned Human Landing System Starship that two astronauts will use to travel to the lunar surface.

Figure 5: Projected Growth in DSN Demand Through 2040 (as of May 2024)



Source: NASA

Note: DSN capacity fluctuates based on the number of operational antennas. Each operational antenna has approximately 540 hours of capacity for a 28-day interval (28 days multiplied by 24 hours multiplied by a factor of 0.8 to account for maintenance time that is required to keep the antennas functioning).

In the same report, we also discussed DSN-related lessons learned by Webb. Webb officials investigated challenges experienced with the DSN and found that there were multiple areas during the mission planning and integration phases where the teams failed to communicate or understand critical information, or missed key technical items, identifying opportunities to improve early mission planning, project coordination, and testing. The investigation also found that the DSN's ongoing challenge to balance limited supply and growing mission demand was a key contributor to the issues faced by Webb, particularly in early operations. We believe Roman officials are not taking into account the lessons learned from Webb and failing to consider the critical information necessary for adequate mission planning and coordination. Specifically, Roman officials have not adequately mitigated the risk that the networks they are relying on to obtain data from Roman will not be available when needed. Although Roman management has been reluctant to consider utilizing the DSN as a contingency network for data downlinking, we believe the risks justify exploring the viability of utilizing the DSN as a contingency plan for times when the NSN or its partner networks (ESA and JAXA) are unable to meet Roman's data downlinking requirements.

Roman's science data will affect more than just its own science objectives. According to the National Academies, though the upcoming observations with Webb, the Rubin Observatory, and Roman will be profound, on their own they will not be able to address the central problem of understanding how galaxies grow. Roman plans to work with these and other observatories to survey the same areas of the sky at the same time to produce more complete pictures of those areas of the universe. If Roman is not able to downlink its science data due to network failure or capacity limitations, it will not meet its science objectives and will potentially limit the ability of other observatories to meet their National Academies objectives.

CONCLUSION

Roman will continue NASA’s efforts to advance our understanding of the universe and explore how planets, stars, and galaxies form and develop over time. As of March 2024, Roman development was on track to meet its cost and schedule commitments due to preemptive planning, such as the May 2021 replan by SMD officials. Despite contractor performance issues that required several cost-overrun proposals, Roman is still within its cost and schedule baselines because project- and SMD-held UFE (cost reserves) cover these costs. However, Roman faces additional risks because of its planned reliance on unprepared and oversubscribed space communication networks. Roman will need to produce an unprecedented amount of data to accomplish its objectives. The networks NASA plans to use to transmit Roman’s data either do not have the capacity to support Roman’s data downlinking requirements or are oversubscribed. Moreover, Roman officials have not properly evaluated risks associated with transmitting data from these unprepared and oversubscribed networks and have no contingency plan for downlinking data should any of the networks fail. Not adequately addressing these issues will hinder NASA’s ability to meet Roman’s unprecedented science objectives.

RECOMMENDATIONS, MANAGEMENT'S RESPONSE, AND OUR EVALUATION

To ensure Roman mitigates the risks associated with its plans for transmitting data back to Earth, we recommended NASA's Associate Administrator for Science Mission Directorate coordinate with the Associate Administrator for Space Operations Mission Directorate to:

1. Further evaluate space communication and navigation risks, including running and reviewing loading analysis from all four networks.
2. Develop a contingency plan for Roman's space communication and navigation services, including an assessment of the DSN's ability to support Roman.
3. Assess the potential impacts of the delayed upgrades to the NSN on Roman's scheduled launch timeline.

To enable future missions that will rely on international entities for space communication services to receive information necessary to mitigate risks, we recommended the Associate Administrator for International and Interagency Relations:

4. Develop procedures that ensure future international agreements for space communication and navigation services include information sharing provisions that allow NASA to conduct proper risk analysis, such as through access to capacity and loading analysis.

We provided a draft of this report to NASA management who concurred with our recommendations and described planned actions to address them. We consider management's comments responsive; therefore, the recommendations are resolved and will be closed upon completion and verification of the proposed corrective actions.

Management's comments are reproduced in Appendix B. Technical comments provided by management and revisions to address them have been incorporated as appropriate.

Major contributors to this report include Ray Tolomeo, Science and Aeronautics Research Audits Director; Adrian Dupree, Assistant Director; Matthew Anderson; David Lu; Mona Mann; Karlo Torres; Michele Schaeffer; and Amanda Perry.

If you have questions about this report or wish to comment on the quality or usefulness of this report, contact Laurence Hawkins, Audit Operations and Quality Assurance Director, at 202-358-1543 or laurence.b.hawkins@nasa.gov.

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George A. Scott
Acting Inspector General

APPENDIX A: SCOPE AND METHODOLOGY

We performed this audit from September 2023 through June 2024 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.

The scope of this audit included assessing NASA's management of the Nancy Grace Roman Space Telescope project. We assessed whether Roman was meeting cost and schedule commitments, contractor performance, and Agency plans to mitigate the oversubscription of space communication and navigation networks.

To determine whether NASA was meeting cost and scheduled commitments, we conducted interviews with ASMP, Roman, and CGI officials and compared the project's KDP documentation against its MSRs. Both Roman observatory and CGI have MSRs that give the most up-to-date information on their cost and schedule status and allowed us to determine if the project was operating within its replanned life-cycle cost estimate. We also reviewed prior NASA Office of Inspector General (OIG) reports and U.S. Government Accountability Office (GAO) reports to gather background information on NASA's prior flagship telescope missions and impacts from COVID-19.

To assess and review Roman contractor performance, we reviewed major contracts and their modifications and the contract's Contractor Performance Assessment Reports. We interviewed Roman's contracting officer and contracting officer representatives for its major contracts. In addition, we interviewed representatives of two of those contractors—BAE Systems and L3Harris—and analyzed documents related to these contracts' cost overrun proposals.

To evaluate NASA's space communication and navigation plan, we met with officials responsible for enabling Roman's space communication and navigation services, including those from Roman management, SCaN, ESA, and JAXA. We also reviewed Roman's space communication and navigation plan, international agreements and memorandums of understanding with ESA and JAXA, space communication and navigation related risks held by Roman and SCaN, and Roman KDPs and MSRs. To evaluate the capacity of space communication networks to meet Roman's space communication and navigation requirements, we reviewed capacity and loading studies from the DSN and NSN and a summary loading study from ESA. We also reviewed prior OIG reports on the DSN.

Finally, we reviewed federal and NASA criteria, policies, procedures, and supporting documentation; prior audit reports; external reviews; and other documents related to Roman. The documents we reviewed included:

- National Aeronautics and Space Administration Authorization Act, 2022, Pub. L. No. 117-167, Title VII (2022).
- National Aeronautics and Space Administration Transition Authorization Act, 2017, Pub. L. No. 115-10 (2017).
- NPR 7120.5F, *NASA Space Flight Program and Project Management Requirements* w/Change 1 (August 3, 2021).

- National Academies of Sciences, Engineering, Medicine, *Pathways to Discovery in Astronomy and Astrophysics* (2020).
- National Research Council, *New Worlds, New Horizons in Astronomy and Astrophysics* (2010).

Assessment of Data Reliability

We used limited computer-processed data that was submitted by NASA officials to evaluate the Agency's management of the Roman Space Telescope. Although we did not independently verify the reliability of this information, we compared it with other available documents to determine data consistency and reasonableness. From these efforts, we believe the information we obtained is sufficiently reliable for this report.

Review of Internal Controls

We reviewed internal controls associated with NASA's management of Roman relative to effectively meeting cost and schedule commitments, contractor performance, and its plans to mitigate the oversubscription of space communication and navigation networks. Control weaknesses are identified and discussed in this report. Our recommendations, if implemented, will improve those identified weaknesses.

Prior Coverage

During the last 5 years, the NASA Office of Inspector General and Government Accountability Office have issued six reports of significant relevance to the subject of this report. Reports can be accessed at https://oig.nasa.gov/audits/auditReports.html and https://www.gao.gov, respectively.

NASA Office of Inspector General

NASA's Deep Space Network (IG-23-016, July 12, 2023)

Final Memorandum, COVID-19 Impacts on NASA's Major Programs and Projects (IG-21-016, March 31, 2021)

Government Accountability Office

NASA Assessments of Major Projects (GAO-23-106021, May 31, 2023)

NASA Assessments of Major Projects (GAO-22-105212, June 23, 2022)

NASA Assessments of Major Projects (GAO-20-405, April 29, 2020)

NASA Assessments of Major Projects (GAO-19-262SP, May 30, 2019)

Appendix B: Management's Comments

National Aeronautics and Space Administration

Mary W. Jackson NASA Headquarters
Washington, DC 20546-0001

Reply to Attn of: Science Mission Directorate

TO: Assistant Inspector General for Audits

FROM: Associate Administrator for Science Mission Directorate
Associate Administrator for International and Interagency Relations

SUBJECT: Agency Response to OIG Draft Report, "Audit of the Nancy Grace Roman Space Telescope Project" (A-23-12-00-SARD)

The National Aeronautics and Space Administration (NASA) appreciates the opportunity to review and comment on the Office of Inspector General (OIG) draft report entitled, "Audit of the Nancy Grace Roman Space Telescope Project" (A-23-12-00-SARD), dated June 20, 2024.

In this draft report, the OIG found that while Roman was meeting its cost obligations and schedule to launch by May 2027, critical system integration, testing, and associated tasks remain. Additionally, the OIG found that risks remain in NASA's plan for transmitting Roman data to Earth.

The OIG makes three recommendations to the Associate Administrator (AA) for Science Mission Directorate (SMD) intended to ensure Roman mitigates the risks associated with its plans for transmitting data back to Earth. The OIG also makes one recommendation to the AA for International and Interagency Relations to enable future missions that will rely on international entities for space communication services to receive information necessary to mitigate risk.

Specifically, the OIG recommends the AA for SMD coordinate with the AA for Space Operations Mission Directorate to:

Recommendation 1: Further evaluate space communication and navigation risks, including running and reviewing loading analysis from all four networks.

> **Management's Response:** NASA concurs with this recommendation. NASA's Roman project will continue evaluating space communication and navigation risks and will present results at the Mission Operations Review (MOR), currently scheduled for the fourth quarter of 2024. Roman will continue to work with our partner organizations to assess any risks identified by their assessments. SMD, in conjunction with the Space Communication and Navigation (SCaN) program, has already taken measures toward mitigating capacity concerns outlined in this report. Additionally, the antenna upgrade

work is now under contract and on track to complete before the mission need date, which will resolve OIG schedule concerns regarding the upgrade plan.

Estimated Completion Date: March 31, 2025.

Recommendation 2: Develop a contingency plan for Roman's space communication and navigation services, including an assessment of the Deep Space Network's (DSN) ability to support Roman.

Management's Response: NASA concurs with this recommendation. The project's ground network contingency plans will be presented at the MOR.

Estimated Completion Date: March 31, 2025.

Recommendation 3: Assess the potential impacts of the delayed upgrades to the Near Space Network (NSN) on Roman's scheduled launch timeline.

Management's Response: NASA concurs with this recommendation. NASA's Roman project will assess the potential impacts of delayed upgrades to the NSN and present results at the MOR.

Estimated Completion Date: March 31, 2025.

In addition, the OIG recommends that NASA's AA for International and Interagency Relations:

Recommendation 4: Develop procedures that ensure future international agreements for space communication and navigation services include information sharing provisions that allow NASA to conduct proper risk analysis, such as through access to capacity and loading analysis.

Management's Response: NASA concurs with this recommendation. NASA's international agreements document the roles and responsibilities of NASA and its international partner(s) for a particular cooperative activity, as defined by the responsible NASA program or project office. If the program office identifies a requirement for the international partner to provide documentation necessary to conduct risk analysis, the Office of International and Interagency Relations (OIIR) will negotiate that requirement with the partner and document it accordingly in the agreement.

Implementing a requirement for information sharing is enabled by a standard provision in NASA international agreements, developed in coordination with the U.S. Department of State, in the "Transfer of Goods and Technical Data" article that allows for the transfer of data and information necessary to carry out the respective responsibilities identified in the agreement. OIIR will include instructions on this matter in internal procedures for developing and concluding international agreements.

Estimated Completion Date: January 31, 2025.

We have reviewed the draft report for information that should not be publicly released. As a result of this review, we have not identified any information that should not be publicly released.

Once again, 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 Peter Meister at (202) 358-1557.

Sandra Connelly
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Nicola Fox
Associate Administrator for
Science Mission Directorate

Karen Feldstein
Digitally signed by Karen Feldstein
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Karen Feldstein
Associate Administrator for
International and Interagency Relations

Appendix C: Report Distribution

National Aeronautics and Space Administration

Administrator
Deputy Administrator
Associate Administrator
Chief of Staff
Chief Program Management Officer
Associate Administrator for International and Interagency Relations
Associate Administrator for Science Mission Directorate
Associate Administrator for Space Operations Mission Directorate
Nancy Grace Roman Space Telescope Program Manager

Non-NASA Organizations and Individuals

Office of Management and Budget
    Deputy Associate Director, Climate, Energy, Environment and Science Division

Government Accountability Office
    Director, Contracting and National Security Acquisitions

BAE Systems

L3 Harris Technologies Incorporated

Congressional Committees and Subcommittees, Chair and Ranking Member

Senate Committee on Appropriations
    Subcommittee on Commerce, Justice, Science, and Related Agencies

Senate Committee on Commerce, Science, and Transportation
    Subcommittee on Space and Science

Senate Committee on Homeland Security and Governmental Affairs

House Committee on Appropriations
    Subcommittee on Commerce, Justice, Science, and Related Agencies

House Committee on Oversight and Accountability
    Subcommittee on Government Operations and the Federal Workforce

House Committee on Science, Space, and Technology
    Subcommittee on Investigations and Oversight
    Subcommittee on Space and Aeronautics

(Assignment No. A-23-12-00-SARD)