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May 14, 2019

Statement of
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Before the

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

Chairman Cruz, Ranking Member Sinema, and Members of the Subcommittees, thank you for the opportunity to appear before you today to discuss the emerging space environment.

NASA is going forward to the Moon. We are building a sustainable, open architecture that returns humanity to our nearest neighbor as the next step in our long-term drive to send humans on to Mars. We are incentivizing speed, drawing on the commercial sector, and we look to land humans on the Moon within five years. We are completing development of Orion, the spacecraft that will carry humans to lunar orbit, and the Space Launch System (SLS), the rocket on which Orion will launch. We are pressing forward toward Exploration Mission-1 (EM-1), an uncrewed test flight of Orion around the Moon. At the same time, we are also pressing forward with the rapid development of the lunar Gateway, a spacecraft that will orbit the Moon and serve as a reusable command module enabling greater access for human missions to the lunar surface than ever before. Working with commercial partners and international partners, we seek to land humans on the surface of the Moon's South Pole by 2024, develop a sustainable presence on and around the Moon, and continue to build our experience and technology base to enable human missions to Mars.

We are building for the long term, and this time we are going to the Moon using an open, durable, reusable architecture that will support exploration for decades to come. Sustainability on and around the Moon requires cost-effective and reusable systems – tugs, landers, and rovers - and an openness to partnerships from across the commercial sector and around the world.

NASA will create new opportunities for collaboration with industry on the International Space Station (ISS) that will enable exploration, continue research that benefits humanity, and work to reduce operations and maintenance costs while establishing the public-private partnerships for exploration systems that will extend human presence into the solar system. NASA is working to transition our work in low-Earth orbit (LEO) to leverage commercially-provided services that help enable deep space exploration and spur private sector growth in LEO. To support this transition, the ISS will focus near-term activities on supporting commercial industry as well as meeting government requirements in LEO. In parallel, NASA is creating a focused effort aimed at further developing long-term American commercial space operations in LEO.

In November 2018, NASA selected nine companies as part of the Commercial Lunar Payload Services (CLPS) procurement, making them eligible to provide transportation services to the lunar surface for science, technology, and exploration payloads. In February 2019, NASA selected thirteen NASA-provided payloads that could be flown on the early CLPS missions. NASA is now reviewing proposals from the CLPS providers for the first commercial delivery service to transport some of these payloads to the lunar surface. These missions will enable new science and demonstrate new technologies supporting sustainable human return to the lunar surface.

For human missions to the lunar surface, astronauts will employ vehicles developed by the private sector and procured by NASA. NASA is moving rapidly to support development of these critical pieces of the exploration architecture. We will seek proposals from U.S. industry in support of rapid development, integration, and crewed demonstration of the lander as elements of a functional human landing system that can fulfill NASA and industry requirements for a 2024 Moon landing. This approach will enable rapid development and flight demonstrations of human lunar landers.

We are actively seeking partner contributions and commercial participation for our Moon to Mars exploration plans. NASA is working to identify international and commercial partnership opportunities that widen the pool of resources, enhance capabilities and sustainability, and advance our most important exploration objectives. We are working to take full advantage of the rapidly developing commercial space sector to enhance sustainability and accelerate progress.

Key to these efforts is a stable, predictable regulatory environment and strong mutually supportive relationships within the U.S. government space community. Exploration will benefit from a regulatory environment that enables a vibrant commercial sector. NASA expects to incorporate emerging commercial capabilities into our exploration plans, transition activity in LEO to the commercial sector and leverage commercial capabilities wherever it is feasible to do so. We look forward to working with our federal partners to promote the space economy both to return benefits to Earth and to support deep space exploration.

Civil Military Coordination

As we work to deliver on our mission, the space domain is becoming increasingly congested and contested, with a multitude of new space actors as access to space becomes commonplace. At the same time, economic and scientific opportunities are expanding in new areas of space, including satellite internet constellations in LEO, ISS commercial opportunities, and new architectures to conduct scientific Earth observation.

Today, national power is in part tied to space-based commerce and operations. More than virtually any other nation, the U.S. is one of the largest beneficiaries of the use of space and also one of the countries most reliant upon it. The Global Positioning System (GPS) timing signal is used to regulate the flow of electricity on our power grids, synchronize cell towers and computer networks, and enable the transfer of funds between bank accounts. If America's potential

adversaries disrupt GPS, the power grid, computer networks, cell towers, and banking may degrade over time. Due to these dependencies, potential adversaries have identified the American space enterprise as the "American Achilles heel" and its potential disruption poses an existential threat to our country.

Other countries also rely on space. Just as the U.S. Navy protects access to and use of global shipping lanes, so the United States must assure access to space to enable economic prosperity. Just as freedom of the seas also extends to the world's scientific vessels – from Arctic icebreakers to deep sea submarines – NASA requires freedom to operate in space for its scientific spacecraft. Furthermore, in addition to our commercial ISS cargo providers and soon, commercial crew providers, NASA utilizes commercial satellites for remote sensing and Earth observation, and commercial launch vehicles for major missions. In addition to maintaining a safe, stable environment for our own scientific and technology demonstration missions, we have a stake in the safety of our commercial partners.

Space Situational Awareness (SSA)

NASA is a civilian space agency. However, we rely on the Air Force and soon, the Space Force, to protect our assets and operations. Not only do we operate billions of dollars of hardware in space, we work diligently to ensure our astronauts aboard the ISS remain safe in orbit.

SSA provides decision makers indications and warning of hazards and threats: natural and manmade; non-hostile or hostile. SSA also underpins efforts to preserve, protect, and defend assets in space to include astronaut activities, the ISS and supporting safe management of space traffic – fostering access to, and responsible use of, space for all. Space Policy Directive-3 provides guidelines and initiatives to ensure that America is a leader in providing a safe and secure environment as space traffic increases. Common sense space situational awareness and space traffic management will be good for our economy and will help provide a more stable environment for the burgeoning space economy.

NASA maintains a strong, cooperative relationship with the Department of Defense (DoD) on SSA issues. NASA uses SSA information from DoD to avoid collisions between its assets and other tracked objects in Earth orbit. The Conjunction Assessment Risk Analysis (CARA) office at NASA Goddard Space Flight Center and the Human Space Flight Operations Directorate at the NASA Johnson Space Center comprise the NASA spaceflight safety functions. These NASA spaceflight safety functions currently maintain a direct interface with the U.S. Strategic Command's (USSTRATCOM) Combined Space Operations Center and the U.S. Air Force Space Command's 18th Space Control Squadron (18 SPCS), in order to ensure that the SSA needed for collision avoidance analysis is provided to NASA in a timely manner.

NASA does not create or maintain a catalog for SSA, i.e., NASA does not track detailed debris orbits, report where an object will be in the coming days, or compute close approach predictions. This activity is conducted by the DoD through the United States Space Surveillance Network (SSN), which detects, identifies, tracks, and catalogs large human-made objects (e.g., active/inactive spacecraft, spent rocket bodies, or fragmentation debris) orbiting Earth as small as

10 cm in Low Earth Orbit (LEO) and objects as small as 1 m in Geosynchronous Earth Orbit (GEO). The SSN is the responsibility of the USSTRATCOM Joint Force Space Component Commander.

Because there are more small debris than large debris and, due to the very high impact speed in space, mission-ending risks to human spaceflight and robotic missions are actually driven by debris too small to be tracked by the SSN, typically in the millimeter-size regime. NASA uses ground-based radars and telescopes and in-situ measurements to characterize such small debris. NASA uses the measurement data on small debris to conduct orbital debris impact risk assessments for human spaceflight and robotic missions and to support the development and implementation of cost-effective impact protection measures for the safe operations of the missions. NASA also shares the modeling tools with the DoD and commercial operators to better protect their operational satellites.

NASA belongs to major space debris organizations, such as Inter-Agency Space Debris Coordination Committee (IADC) that seeks to develop and propagate best practices to mitigate the risk from orbital debris. In addition, the Agency has adopted the NASA Procedural Requirements for Limiting Orbital Debris, a culmination of orbital debris mitigation policies at NASA per the U.S. Government Orbital Debris Mitigation Standard Practices. The Agency also created the "Debris Assessment Software" to assist NASA programs in performing orbital debris assessments. NASA shares this software with the community. For instance, many private organizations utilize the software to compile their orbital debris mitigation plans required by the FCC.

As directed by SPD-3, NASA is leading an interagency working group to update the U.S. Government Orbital Debris Mitigation Standard Practices to further strengthen the effort to mitigate the risk from orbital debris. NASA looks forward to continuing to collaborate with our interagency partners to ensure a safe and sustainable orbital environment. As a leading user of space situational awareness data, and a leader in characterizing the orbital debris environment, and the world's leading space exploration agency, NASA is a major beneficiary of the Administration's continuing attention to these issues.

Economic Opportunity

In 2018, the global space economy totaled nearly $400 billion according to the Space Foundation. Space commerce has improved conditions for humans on Earth including the way we communicate, navigate, produce food and energy, predict weather, understand climate, and provide disaster relief and national security. The space sector of our economy is booming. In fact, from 2012-2018, U.S. companies reestablished competitiveness in the global commercial launch market, with our share growing from 0% to 65%. Satellite communications manufacturing is a significant export for our country, with around 60% of global commercial orders – the United States is the best in the world at developing and building communication satellites for television, radio, and Internet. In 2015, space-related venture capital investment exceeded the previous 15 years combined and we saw similarly high levels of investment in 2016 and 2017. The majority of space firms in the world are headquartered in the United States.

A stable space environment and a stable policy and regulatory environment ensure these firms continue to do what they do best – innovate and drive economic development.

Conclusion

The Administration is taking the next steps forward to advance commerce, safety, and security in Earth's orbit. At NASA, we plan missions based on our experience building spacecraft and operating in space. We know it takes highly specialized knowledge, built over decades of trial and error, to achieve brilliant results. We are working with our colleagues across government to enable an environment that can enable exploration, foster burgeoning and increasingly complex space commerce, and prevent dangerous conjunctions, collisions, and interactions around our planet.

Many steps have been taken, from debris mitigation practices following the issuance of SPD-3, to our call for a dedicated Space Force, which could begin consolidating the space expertise that exists across the military, and organizing technology development in a more efficient and coordinated manner.

This Administration is developing the next-generation of American space launch capacity and developing deep space operational capabilities that will project American prominence around the world, extend global partnerships, and expand our strategic presence in the solar system. NASA's exploration campaign will send Americans to the lunar surface by 2024, develop a sustainable presence on and around the Moon, and prepare for human exploration of Mars. This Administration plans to develop American launch, in-space, and astronaut capabilities that project American power around the world, extend global partnerships, and establish a presence on the Moon. To support these ambitious and transformational goals, we are seeking a space environment which allows scientific observation, technology demonstration, and human exploration to be conducted for peaceful uses and free from malign interference.

Thank you for the opportunity to testify before you today and I look forward to answering your questions.