DAY ONE PROJECT

The Advanced Space Architectures Program (ASAP): Championing American Innovation through Next Generation In-Space Operations

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Summary

America's leadership in space exploration and utilization could greatly accelerate by using a fundamentally different approach to in-space operations than that which exists today. Most of today's spacecraft are locked into their launch configurations, with little or no ability to be updated or serviced once in space. But by leveraging recent and emerging capabilities to manufacture, assemble, and service spacecraft in space, we can dramatically improve the cost-effectiveness, productivity, and resiliency of our space systems. To achieve this, the Biden-Harris Administration should launch a new Advanced Space Architectures Program (ASAP) to enable a new generation of in-space operations. ASAP would operate under a public-private consortium model to leverage government investment, engage a broad community, and bring in the support of international partners. In this memo, we propose two specific missions that the next administration could undertake early to initiate the ASAP program and demonstrate its efficacy. Initiating ASAP as soon as possible will help the new administration's mission to build back better: for our economy, for science and exploration, for international leadership in mitigating the climate crisis, and for the security of our nation.

Challenge and Opportunity

With the notable exceptions of the International Space Station and the Hubble Space Telescope, today's spacecraft are launched tightly compacted in their launch shrouds, carrying all of the fuel and instruments they will ever have, with no ability to be replenished or improved over their lifetimes. Constraining our spacecraft designs to be constructed on Earth, to fit into a unitary launch shroud, and to never be revisited for service or improvement results in exquisitely complicated, expensive, and inflexible systems.

But thanks in part to new developments in Earth-to-space and in-space transportation and in-space operations, we now have the technology to manufacture, assemble, and service spacecraft in space. These new capabilities present opportunities to dramatically improve the cost, productivity, and resiliency of our space systems. We can launch raw materials and basic elements as commodity items on a variety of low-cost launch vehicles, to be converted into end-items, such as persistent platforms, large apertures, or fuel depots, in orbit. We can construct and operate very large structures in space—structures that would be impossible to launch from Earth—to achieve unimaginable capabilities for science, exploration, commercial enterprise, and national security. We can recover and repair high-value assets if they are compromised. And we can reconfigure multi-element space systems into new orbits and operational configurations.

All of these possibilities are within our technical grasp right now. The U.S. federal government can turn possibility into reality by creating markets for in-space operations, facilitating standards, initiating coordination among international partners, and supporting early-stage technologies for

in-space operations that can later be scaled and implemented by the private sector. Without federal direction, this new in-space paradigm will evolve piecemeal on its own, limited to narrow parochial interests and missing the power of American leadership. The new administration can shape and capitalize on these emerging developments in-space operations by launching a new Advanced Space Architectures Program (ASAP).

Plan of Action

The Biden-Harris administration should launch a new Advanced Space Architectures Program (ASAP) to enable a new generation of in-space operations that will renew American leadership in space operations of all kinds. ASAP would improve the cost-effectiveness, productivity, and resiliency of our space systems through a series of inter-related missions. The program would operate through a public-private consortium in order to effectively leverage direct government investment while facilitating the space economy through a healthy space industrial base and a variety of partnerships.

On the federal side, ASAP should be jointly led by the National Aeronautics and Space Administration (NASA) and the Department of Defense (DOD, including the Space Force, Defense Advanced Research Projects Agency (DARPA), and the Defense Innovation Unit (DIU)). Additional federal support would come from agencies such as the Department of Commerce (DOC, including the National Oceanic and Atmospheric Administration (NOAA)) and the Department of Transportation (DOT, including the Federal Aviation Administration (FAA)).

Close coordination among government agencies and consideration of industry will be essential to establish robust in-space operations as quickly as possible. The ASAP public-private consortium would leverage and integrate existing capabilities and workforces from national laboratories, companies, and academia to grow collaboratively in the short term and for decades to come. By bringing together traditional and non-traditional partners around the goal of a more flexible and efficient space presence, the consortium will strengthen the U.S. industrial base. The consortium will also mitigate redundancy between government-funded research and internal research and development investments made by individual companies. Finally, the consortium will ensure continuity of knowledge and know-how spanning the entire U.S. space enterprise, thus multiplying the effects of government investments throughout the nation.

We expect that requisite government investment for baseline consortium activities would be approximately $100 million per year. Achieving the specific near-term missions outlined below would require an additional $250 million per year for a period of 4–8 years. These funding levels would be amplified by the public-private nature of the consortium. Such additional financial investment from industry is not reflected in the amounts estimated here.

Though we envision ASAP as a long-term continuing endeavor, the new administration could initiate the program through two compelling new missions:

(1) **MPHP Mission.** The goal of this mission would be to develop an un-crewed, robotically assembled and serviced, multi-payload hosting platform (MPHP) that supports a variety of payloads—for example, a persistent Earth-imaging platform to enable climatological observations and other Earth-science measurements.

(2) **LTV Mission.** The goal of this mission would be to develop a long-range transfer vehicle (LTV) or "space tug" to enable in-space reusability. The LTV would initially be used to deliver new payloads to the MPHP.

Together, these two missions would create the first instance of the ASAP ecosystem. The MPHP would be robotically assembled in space, and the LTV would periodically revisit and refurbish the MPHP to keep it operating and updated for far longer than typical spacecraft. These missions would be far more than demonstrations. They would provide real advantages to space activities such as climate monitoring, enable cost reductions to science and engineering programs, and increase the speed of introduction of new technologies. These missions could also form the basis of international partnerships in instrumentation for shared scientific investigations.

Conclusion

Flexible, cost-effective space activities can make valuable contributions to pressing national and global challenges such as climate change and space situational awareness. A new generation of in-space operations will exponentially grow capacity to conduct such activities in the public and private sector alike. By launching the Advanced Space Architectures Program (ASAP), the new administration can establish and accelerate American leadership in space exploration, technological development, and fields such as climate science, geospatial monitoring, and telecommunications. These goals are within our technical grasp. Initial missions to demonstrate the potential of these advanced in-space operations could be completed in just 4–8 years. Creating a framework for sustained public-private collaboration will enable these initial missions to be followed by many more in the decades to come.

Frequently Asked Questions

Is there additional historical precedent or context that exists that this proposal builds on that one should be aware of?

NASA and DOD have both previously executed space programs as public-private partnerships, indicating the viability of this approach for ASAP:

- In 2005, perceiving the nation's need for new launch vehicles, the NASA Administrator launched the Commercial Orbital Transportation System (COTS) program. The COTS program split a grant of $500 million to two awardees; additional funding was provided by private investment. The program resulted in two new launch vehicles (Falcon 9 and Antares) for national purposes.
- In 2016, perceiving the importance of space robotics to expanding and improving space operations, DARPA began the Robotic Servicing of Geosynchronous Satellites (RSGS) program. The government's budget for the RSGS program was several hundred million dollars over several fiscal years, to develop the robotic equipment. Funding to build the satellite (which would carry the robotics) was provided by DARPA's commercial partner.

In both of these examples, private investment was motivated by the potential for future income. For COTS, NASA implied that the new launch vehicles would be used to resupply the International Space Station on a fee-for-service basis. For RSGS, investors anticipated future business opportunities for inspecting, repairing and upgrading satellites in geosynchronous orbit.

Other government-initiated public-private consortia, such as the U.S. Advanced Manufacturing Initiative, have successfully addressed numerous government and industry priorities. In fact, the key findings of the 2011 Report to the President "Ensuring American Leadership In Advanced Manufacturing"—that the United States is losing leadership, other nations are investing heavily, the United States lags in providing the right environment and workforce, national-security issues are at hand, and there is potential to create and retain high-quality jobs in the United States—describe manufacturing but also apply to the current state of space activities. Just as the two sectors face similar challenges, so too could they benefit from similar solutions.

How much does the government spend on in-space operations currently? How much has been spent in the past?

The three major ongoing federal efforts to advance ASAP-related technologies are DARPA's RSGS program and NASA's OSAM-1 and OSAM-2 missions. The RSGS program has a total federal budget of several hundred million dollars and the private-sector contribution to RSGS from DARPA's commercial partner is estimated to be several hundred million dollars. OSAM-1, previously known as Restore-L, has had an annual budget of around $160 million for several years. This mission is expected to launch in the mid-2020s. OSAM-2, previously known as Archinaut, has a total budget of $75 million and is expected to launch in 2023. Of these three projects, only RSGS will have a residual operations capability beyond the initial test phase.

Why does the federal government need to get involved to advance in-space operations? Why can't the private sector do it directly?

The proposed ASAP consortium would share investment between the government and the private sector to achieve the ASAP objectives. The technical risks inherent to ASAP missions, and the undeveloped market for their exploitation, are likely to discourage private-sector investment without government support. Government investment in pilot missions and laboratory research, as well as government commitment to serve as an anchor customer, is required to catalyze the space-operation industry and build confidence in potential business models.

How would ASAP affect international relations?

Development of ASAP-based platforms will provide numerous opportunities for international partnerships, including with developing nations that have nascent space programs. ASAP will also signal that the United States is not abandoning low Earth orbit (LEO), geosynchronous Earth orbit (GEO), or cislunar space, since ASAP-developed long-range transfer vehicles comprise an infrastructure that supports all of those orbital regimes.

Are there opportunities in ASAP for underserved/underutilized American communities?

Absolutely. Early ASAP investments in technology capabilities, as well as later investments in instrumentation and operations, offer multiple opportunities for small and mid-size businesses and academic institutions to partner with and, eventually, lead. Properly carried out, these opportunities can serve as "seeds" to nurture young talent underutilized to date, perhaps especially in rural and inner-city settings.

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