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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Defense Advanced Research Projects Agency **Date:** March 2023

Appropriation/Budget Activity 0400: <i>Research, Development, Test & Evaluation, Defense-Wide / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603287E / <i>SPACE PROGRAMS AND TECHNOLOGY</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	173.606	74.388	134.809	-	134.809	227.314	186.670	177.880	203.773	-	-
SPC-01: <i>SPACE PROGRAMS AND TECHNOLOGY</i>	-	173.606	74.388	134.809	-	134.809	227.314	186.670	177.880	203.773	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) address the Advanced Technology Development associated with the Space Programs and Technology Program that addresses high payoff opportunities to dramatically reduce costs associated with advanced space systems and provides revolutionary new system capabilities for satisfying current and projected military missions.

A space force structure that is robust against attack represents a stabilizing deterrent against adversary attacks on space assets. This program element will examine concepts and architectures that move the U.S. away from a dependence on monolithic, ultra-capable, vulnerable, and unsustainably costly assets; replacing them with disaggregated assets that are agile, affordable, and easily replaced. Ready access to space requires the delivery of capabilities, replenishment of supplies into orbit, and rapid manufacturing of affordable space capabilities. In addition, developing space access and spacecraft servicing technologies will lead to reduced ownership costs of space systems and new opportunities for introducing technologies for the exploitation of space.

Systems development is also required to increase the interactivity and functionality of space systems, space-derived information, and services with terrestrial users. Studies under this program element include technologies and systems that will enable satellites and microsatellites to operate more effectively by increasing maneuverability, survivability, and situational awareness, and precision control of multi-payload systems. Studies will actively seek to take advantage of new commercial developments which may enable both rapid constitution/reconstitution of assets, and agility/functionality not previously available for military systems.

B. Program Change Summary (\$ in Millions)

	<u>FY 2022</u>	<u>FY 2023</u>	<u>FY 2024 Base</u>	<u>FY 2024 OCO</u>	<u>FY 2024 Total</u>
Previous President's Budget	181.524	81.888	103.364	-	103.364
Current President's Budget	173.606	74.388	134.809	-	134.809
Total Adjustments	-7.918	-7.500	31.445	-	31.445
• Congressional General Reductions	0.000	-7.500			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	-2.714	0.000			
• SBIR/STTR Transfer	-5.204	0.000			
• TotalOtherAdjustments	-	-	31.445	-	31.445

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Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: SPC-01: *SPACE PROGRAMS AND TECHNOLOGY*

Congressional Add: *Hypersonic Risk Reduction (Blackjack) - Congressional Add*

Congressional Add: *Hypersonic Risk Reduction (Robotic Servicing of Geosynchronous Satellites) - Congressional Add*

Congressional Add Subtotals for Project: SPC-01

Congressional Add Totals for all Projects

	FY 2022	FY 2023
Congressional Add Subtotals for Project: SPC-01	55.000	-
Congressional Add Subtotals for Project: SPC-01	25.000	-
Congressional Add Subtotals for Project: SPC-01	80.000	-
Congressional Add Totals for all Projects	80.000	-

Change Summary Explanation

FY 2022: Decrease reflects SBIR/STTR transfer and reprogrammings.

FY 2023: Decrease reflects a Congressional reduction.

FY 2024: Increase reflects initiation of the Otter program and a shift from design activities to procurement of long lead components for the Demonstration Rocket for Agile Cislunar Operations (DRACO) program.

C. Accomplishments/Planned Programs (\$ in Millions)

	FY 2022	FY 2023	FY 2024
Title: Demonstration Rocket for Agile Cislunar Operations (DRACO)	37.000	45.001	81.977
Description: Maintaining U.S. interests in cislunar space requires significant advances in nuclear thermal propulsion technology. Current space propulsion includes electric (high efficiency but low thrust) and chemical (high thrust but low efficiency) systems. The Demonstration Rocket for Agile Cislunar Operations (DRACO) program will develop and demonstrate a High-Assay Low-Enriched Uranium (HALEU) nuclear thermal propulsion (NTP) system on orbit by FY27. The NTP technology demonstrated by DRACO will achieve thrust similar to chemical rockets, but with 2-5 times the efficiency. The enhanced performance afforded by NTP will allow the U.S. to lead operations in the cislunar volume, in particular for missions that require moving heavy cargo across large distances in a timely manner.			
FY 2023 Plans:			
- Begin detailed design of the NTP demonstration engine.			
- Begin fabrication of long lead components for the NTP demonstration engine.			
- Begin detailed design of the Nuclear Thermal Rocket (NTR) which integrates the reactor with the associated turbomachinery to instantiate the demonstrator engine.			
- Begin fabrication of long lead components for the demonstration system NTR engine and DS.			
FY 2024 Plans:			
- Complete detailed design of the NTR demonstration engine.			
- Complete detailed design of NTR demonstration system.			

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C. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<ul style="list-style-type: none"> - Continue fabrication of long lead components for the NTR demonstration system engine and spacecraft. - Assemble engineering development unit of the NTR engine for FY25 cold-flow test. - Conduct cold-flow test for the NTR engine. - Begin making nuclear fuel into fuel elements to the specifications as determined by the detailed design of the NTR engine. <p>FY 2023 to FY 2024 Increase/Decrease Statement: The FY 2024 increase is due to the procurement of long-lead components, assembly of engine cold flow hardware test rigs, and beginning of assembly and manufacturing of flight unit NTR engine.</p>			
<p>Title: Blackjack</p> <p>Description: The Blackjack program is developing space technologies demonstrating a proliferated smallsat constellation capability in Low Earth Orbit (LEO). Capabilities demonstrated will provide constant custody of very large numbers of concurrent targets; target identification, tracking, and characterization; tactical communications; architectural resilience via massive proliferation; and rapid on-orbit technology refresh and experimentation. Blackjack is leveraging commercial industry plans to build constellations in LEO to provide global commercial broadband internet service. Key efforts include low size, weight, power, and cost (SWaP-C) multi-modality smallsat sensor payloads, algorithms for autonomous payload and architecture command and control, algorithms for satellite on-board processing and data fusion, and advanced manufacturing for military payload mass production. A Memorandum of Agreement (MOA) documents the partnership with U.S. Space Force and Air Force. The anticipated transition partners are the U.S. Space Force, Air Force and Space Development Agency. Blackjack will progress through design, build, and launch of six satellites with tactical communications and Intelligence, Surveillance, and Reconnaissance (ISR) payloads for the full Blackjack demonstration of a proliferated LEO constellation.</p> <p>FY 2023 Plans:</p> <ul style="list-style-type: none"> - Complete assembly and test of six ISR/Radio Frequency (RF) satellites and test. - Launch and conduct check-out and early operations of the first six ISR/RF satellites. <p>FY 2024 Plans:</p> <ul style="list-style-type: none"> - Conduct on-orbit Blackjack constellation demonstration. <p>FY 2023 to FY 2024 Increase/Decrease Statement: The FY 2024 decrease reflects completion of final launches and deployment monitoring.</p>	34.101	20.887	17.997
<p>Title: Robotic Servicing of Geosynchronous Satellites (RSGS)</p> <p>Description: A large number of national security and commercial space systems operate at geosynchronous earth orbit (GEO), providing persistence and enabling ground station antennas to point in a fixed direction. Technologies for servicing of GEO spacecraft would involve a mix of highly automated and remotely operated (from Earth) robotic systems. The Robotic Servicing</p>	19.005	5.000	4.900

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C. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>of Geosynchronous Satellites (RSGS) program is establishing the capability to provide robotic services in GEO suitable for a variety of potential servicing tasks, in full collaboration and cooperation with existing satellite owners and national security space operators, and with sufficient propellant for several years of follow-on capability. Key RSGS challenges include robotic tool/end effector requirements, efficient orbital maneuvering of a servicing vehicle, robotic arm systems, automation of certain spacecraft operations, and development of the infrastructure for coordinated control between the servicer and client spacecraft operations teams. The transition agreement is with a commercial partner who will provide the satellite to carry the robotic payload and who will operate the robotic servicer. To support the development of a broadly accepted satellite servicing capability, DARPA is using the Consortium for Execution of Rendezvous and Servicing operations (CONFERS) approach to bring together experts from the private sector and Government to research, develop and publish nonbinding, consensus-based standards for safe operational approaches to on-orbit servicing.</p> <p>FY 2023 Plans:</p> <ul style="list-style-type: none"> - Complete payload flight software qualification. - Complete testing of second robotic arm. - Integrate robotic payload with spacecraft structure. - Begin testing and space qualification of integrated robotic payload. <p>FY 2024 Plans:</p> <ul style="list-style-type: none"> - Complete functional testing and space qualification of integrated robotic payload. - Deliver integrated and tested robotic payload. - Support combined testing of integrated robotic payload and spacecraft bus. - Develop partner training and detailed demonstration planning. - Conduct launch, on-orbit checkout, and calibration of integrated robotic payload. <p>FY 2023 to FY 2024 Increase/Decrease Statement: The FY 2024 decrease reflects minor program repricing.</p>				
<p>Title: Advanced Space Technology Concepts</p> <p>Description: Studies conducted under this program will examine and evaluate emerging technologies and concepts with the potential to provide substantial improvement in efficiency, effectiveness, and resilience of operations in space. This includes the degree and scope of potential impact and improvements to military operations, mission utility, and warfighter capability. Studies are also conducted to analyze emerging threats along with possible methods and technologies for countermeasures. The feasibility of achieving potential improvements, in terms of resources, schedule, and technological risk, is also evaluated. The results from these studies are used, in part, to formulate future programs or refocus ongoing work. Topics of consideration include applying artificial intelligence to low earth orbit (LEO) constellation operations to enable collaboration between space,</p>		3.500	3.500	12.500

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C. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>air, maritime, and ground platforms in anti-access/area denial (A2/AD) theaters; robust architectures for precision navigation and timing; enabling operations in Cislunar space; novel approaches to space domain awareness; integration of commercial capabilities into military operations; and on-orbit software environments.</p> <p>FY 2023 Plans:</p> <ul style="list-style-type: none"> - Initiate studies of novel approaches for reconfigurable satellite systems and payloads. - Initiate studies of novel techniques for space domain awareness. <p>FY 2024 Plans:</p> <ul style="list-style-type: none"> - Initiate studies of software architectures to enable collaboration between military and commercial proliferated LEO (p-LEO) constellations. <p>FY 2023 to FY 2024 Increase/Decrease Statement: The FY 2024 increase reflects initiation of software architectures studies.</p>			
<p>Title: Otter</p> <p>Description: The Otter program will develop and demonstrate space technologies that enable operations in new orbital domains that are currently inaccessible. Capabilities demonstrated will provide increased mission duration and ability to maneuver without regret. Key efforts include the development of new propulsion systems, improved ground test capabilities, and analysis tools to support system development. The anticipated transition partner is the U.S. Space Force. Otter will progress through development of analysis and test tools, design of candidate propulsion systems, build of a demonstrator satellite, and complete with a space demonstration.</p> <p>FY 2024 Plans:</p> <ul style="list-style-type: none"> - Conduct selection of propulsion system vendors, test facilities, and analysis tools developers. - Develop analysis tools to support system design. - Upgrade test facilities to support component testing. - Develop and mature propulsion systems through a Preliminary Design Review (PDR). <p>FY 2023 to FY 2024 Increase/Decrease Statement: The FY 2024 increase reflects program initiation.</p>	-	-	17.435
Accomplishments/Planned Programs Subtotals	93.606	74.388	134.809

	FY 2022	FY 2023
Congressional Add: Hypersonic Risk Reduction (Blackjack) - Congressional Add	55.000	-

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	FY 2022	FY 2023
FY 2022 Accomplishments: - Built Intelligence, Surveillance, and Reconnaissance (ISR)/Radio Frequency (RF) & Overhead Persistent Infrared (OPIR) satellite components including payloads, buses and on-board command and control module. - Completed assembly, integration, and testing of the first two satellites for laser communication and command and control. - Began assembly and test of two missile warning/missile defense satellites.		
Congressional Add: Hypersonic Risk Reduction (Robotic Servicing of Geosynchronous Satellites) - Congressional Add	25.000	-
FY 2022 Accomplishments: - Completed flight software integration and test. - Initiated partner training and detailed demonstration planning. - Completed integration of flight avionics, tools and robotic arms on spacecraft structure and test. - Completed space qualification testing and delivery of robotic payload components to commercial partner.		
Congressional Adds Subtotals	80.000	-

D. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

E. Acquisition Strategy

N/A