Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Office of the Secretary Of Defense	Date: April 2022
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 5: *System Development & Demonstration (SDD)*	**R-1 Program Element (Number/Name)** PE 0605294D8Z / *Trusted and Assured Microelectronics*

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	324.982	104.180	113.536	302.963	0.000	302.963	302.818	224.663	218.064	188.517	Continuing	Continuing
902: *Access to State-of-the-Art (SOTA) Microelectronics - Demonstration*	324.982	39.479	51.017	200.061	0.000	200.061	199.252	147.842	143.486	124.048	Continuing	Continuing
903: *Access to Advanced Packaging and Testing - Demonstration*	0.000	39.040	41.784	76.149	0.000	76.149	44.142	32.759	31.838	27.521	Continuing	Continuing
905: *Address DoD Unique Needs Radiation Hardening and non-CMOS - Demonstration*	0.000	25.661	20.735	26.753	0.000	26.753	59.424	44.062	42.740	36.948	Continuing	Continuing

Note

New Start (Y/N): No

A. Mission Description and Budget Item Justification

This program supports the Department's initiatives to Build Sustainable and Long-Term Advantage, Defend the Homeland, and Deter Aggression.

This program supports microelectronics modernization activities that enable defense systems to keep pace with commercial microelectronics technological advances, reduce reliance on obsolete microelectronics, and mitigate the Department’s reliance on sole source foundries for assured state-of-the-art (SOTA) microelectronics. It addresses the challenges of 1) having enduring access to a multiplicity of modern manufacturing processes that require commercial volumes to maintain long term viability and 2) protecting the intellectual property (IP) of the microelectronic parts that are manufactured.

This program supports the National Defense Strategy (NDS) for 2018's line of effort to build a more lethal force through modernization of key capabilities, the NDS defense objective of establishing an unmatched twenty-first century National Security Innovation Base that effectively supports Department operations and sustains security and solvency, and the NDS strategic approach of reforming the Department’s business practices by simultaneously increasing performance and affordability while still minimizing risk.

This Program Element supports the Office of the Under Secretary of Defense for Research and Engineering (OUSD(R&E)) Microelectronics Modernization Roadmap. The primary areas of focus of this roadmap include the following: access to state-of-the-art (SOTA) microelectronics technology, access to advanced packaging and test; quantifiable assurance and secure design; foundry access; verification and validation; policies, standards, and Joint Federated Assurance Center (JFAC) governing body; access to radiation hardened microelectronics; access to non-complementary metal oxide semiconductor (CMOS) SOTA microelectronics for radio frequency

and optoelectronic applications; disruptive research and development; education and workforce development; trusted foundry and obsolescence; and supply chain awareness and security.

Recognizing that an assured supply of microelectronics is a U.S. Government-wide concern, this activity will interface with interagency partners to take into account interagency requirements, opportunities for collaboration, and strategic decisions that can be made to limit the overall cost of these requirements to the USG.

This activity is being led by the Under Secretary of Defense for Research and Engineering.

B. Program Change Summary ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	104.180	113.895	0.000	0.000	0.000
Current President's Budget	104.180	113.536	302.963	0.000	302.963
Total Adjustments	0.000	-0.359	302.963	0.000	302.963
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	0.000	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• FFRDC	-	-0.359	-	-	-
• Adjustments to Budget Year	-	-	90.623	-	90.623
• Economic Assumption	-	-	3.239	-	3.239
• Microelectronics Ecosystem	-	-	226.850	-	226.850
• Other Adjustment	-	-	-17.749	-	-17.749

Change Summary Explanation

In FY 2021, Program Element (PE) funding was re-aligned under three new project codes to correctly align Program Element (PE) funding in support of a Quantifiable Assurance philosophy and reflective of current priorities. The new project codes are: (1) Project Code 902 Access to State-of-the-Art (SOTA) Microelectronics - Demonstration; (2) Project Code 903 Access to Advanced Packaging and Testing - Demonstration; and (3) Project Code 905 Address DoD Unique Needs - Radiation Hardening and non-CMOS - Demonstration.

A Congressional rescission of $8.216 million was enacted as part of the FY 2022 Appropriation reducing the available FY 2021 budget to $95.964 million.

FY 2023 funding increase reflects the fact that the FY 2022 President’s Budget request did not include out-year funding.

The FY 2023 funding request was reduced by -$17.749 million to account for the availability of prior year execution balances.

Exhibit R-2A, RDT&E Project Justification: PB 2023 Office of the Secretary Of Defense			Date: April 2022
Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / *Trusted and Assured Microelectronics*	Project (Number/Name) 902 / *Access to State-of-the-Art (SOTA) Microelectronics - Demonstration*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
902: *Access to State-of-the-Art (SOTA) Microelectronics - Demonstration*	324.982	39.479	51.017	200.061	0.000	200.061	199.252	147.842	143.486	124.048	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project establishes multiple strategic partnerships with existing commercial state-of-the-art (SOTA) domestic foundries to develop a data-driven, risk-based approach to supply chain protection and demonstrate the assured manufacture of advanced electronic components.

Successful implementation will transition these technologies to use in DoD programs, obtain access to multiple commercial microelectronics facilities, establish secure design capabilities, and solidify a data-driven approach to supply chain protection. It also includes keeping pace with the rapid advancements in microelectronics technology and the globalization of this industry sector. It will provide the basics for updating and strengthening the DoD assurance policy and includes collaborating with industry to develop data driven quantifiable standards.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Design	16.000	0.000	-
Description: This enhancement will demonstrate quantifiably assured design concepts in manufactured systems, enabling a formal risk-based approach to protection techniques. Manufactured microelectronics will be tested to ensure that IP protections meet or exceed current National Security Agency (NSA) standards for intellectual property (IP) protection, and to demonstrate the DoD's ability to detect certain malicious supply chain attacks on DoD microelectronics. This enhancement will also demonstrate a new data driven quantifiable assurance paradigm for supply chain protection. It will strengthen security while improving access, exposing no sensitive IP to the foundry and requiring post-manufacture validation of foundry products. This enhancement will demonstrate quantifiably assured design concepts in manufactured systems, enabling a formal risk-based approach to protection techniques. Manufactured microelectronics will be tested to ensure that IP protections meet or exceed current NSA standards for IP protection, and to demonstrate the DoD's ability to detect certain malicious supply chain attacks on DoD microelectronics. Successful implementation will transition these technologies to use in DoD programs, obtain access to multiple commercial microelectronics facilities, and solidify a data-driven approach to supply chain protection, including keeping pace with the rapid advancements in microelectronics technology and the globalization of this industry sector. It will provide the basics for updating and strengthening the DoD assurance policy and includes collaborating with industry to employ data driven quantifiable standards.			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Office of the Secretary Of Defense		Date: April 2022
Appropriation/Budget Activity 0400 / 5	**R-1 Program Element (Number/Name)** PE 0605294D8Z / *Trusted and Assured Microelectronics*	**Project (Number/Name)** 902 / *Access to State-of-the-Art (SOTA) Microelectronics - Demonstration*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
FY 2022 Plans: These efforts are being merged into a combined program for both secure design and quantifiable assurance activities beginning with FY 2022. See "Secure Design and Quantifiable Assurance Demonstration" program below. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** These efforts are being merged into a combined program for both secure design and quantifiable assurance activities beginning with FY 2022. See "Secure Design and Quantifiable Assurance Demonstration" program below.			
Title: Foundry ***Description:*** This activity implements multiple foundries process design kit (PDK) environments ensuring the government is not dependent on one single source for critical components. Demonstrate hardware through dedicated and multi-project wafer runs at multiple foundries. Commercial foundries generate enormous amounts of data on their processes as a best practice for quality assurance to improve reliability and increase yield. The Foundry program collects and utilizes this data to generate and allow quantitative comparison of performance and security metrics in the design and test stage of the microelectronics lifecycle, thereby mitigating risk. ***FY 2022 Plans:*** Planned activities are as follows: • Continued build-out of secured design environments and persistent expertise. • Conduct additional domestic SOTA fabrication demonstrations. ***FY 2023 Plans:*** Planned activities are as follows: • Continue to enhance access to SOTA fabrication ecosystem. • Maintain program of record access to assured fabrication flow and fund multi-project wafer production runs at multiple SOTA domestic sources. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Changes reflect a rebalancing of funding between this project and PE 0604294D8Z, Trusted and Assured Microelectronics (Budget Activity 4), Project 907: "Access to State-of-the-Art (SOTA) Microelectronics – Development." This increase will broaden and accelerate access to semiconductor foundries by enabling; • Access to foundry data for accelerating the implementation of quantifiable assurance.	3.834	4.000	13.000

Exhibit R-2A, RDT&E Project Justification: PB 2023 Office of the Secretary Of Defense		Date: April 2022
Appropriation/Budget Activity 0400 / 5	**R-1 Program Element (Number/Name)** PE 0605294D8Z / *Trusted and Assured Microelectronics*	**Project (Number/Name)** 902 / *Access to State-of-the-Art (SOTA) Microelectronics - Demonstration*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
• Access to foundry subject matter experts on foundry process design kits (PDK) by the proto-type design teams. This enables more rapid design schedules, lowers risk and raises the level of expertise amongst the DIB design teams and the government verification and validations teams. • Enables continues access to multi-project wafer (MPW) across the DoD programs and DIB. One a result of the chips shortage is increase costs of foundry production, including MPW runs.			
Title: Secure Design and Quantifiable Assurance Demonstration ***Description:*** This activity includes verifying the ability to fabricate classified and/or export-controlled designs in on-shore commercial foundries. Funding will establish multiple strategic partnerships with existing commercial domestic microelectronics design vendors and foundries to develop a data-driven, risk-based approach to supply chain protection and demonstrate the assured manufacture of advanced electronic components. This project demonstrates the technical means for protecting IP and obfuscating the final user function from the supply chain will be realized using personalization, programmability and software, following application specific integrated circuit (ASIC) manufacturing. Efforts are on-going to update International Traffic in Arms Regulations (ITAR) and Export Administration Regulations (EAR) policy in this area. Funding supports activities to enhance the export control regime so that it maintains or strengthens current protections while enabling access to commercial capabilities, products, and IP. ***FY 2022 Plans:*** Planned activities are as follows: • Enhance repositories with commercial and DoD relevant design IP for multi-foundry access • Continue to demonstrate enhanced secure design and cloud capability with new tools and techniques. • Continue to build-out secured design environments and persistent technical expertise • Enable enterprise licensing to tools and IP for rapid and scaled access to leading end technology. • Conduct enhanced IP demonstration and analysis of data driven risk assessments using independent verification and validation (V&V), data captures, intelligence reports, probability of detection and false alarm rates, and game theoretics. • Demonstrate rapid transition of DoD-relevant field programmable gate array-based capabilities to structured ASICs, with security capabilities to protect DoD intellectual property (IP) during manufacture. • Deploy integrated circuit deep inspection capability and conduct integrated circuit personalization demonstration. • Conduct additional foundry quantifiably assured fabrication demonstrations. ***FY 2023 Plans:*** Planned activities are as follows: • Continue to populate repositories with commercial and DoD relevant design IP for multi-foundry access • Continue to demonstrate enhanced secure design and cloud capability with new tools and techniques.	19.645	47.017	37.161

Exhibit R-2A, RDT&E Project Justification: PB 2023 Office of the Secretary Of Defense		Date: April 2022
Appropriation/Budget Activity 0400 / 5	**R-1 Program Element (Number/Name)** PE 0605294D8Z / *Trusted and Assured Microelectronics*	**Project (Number/Name)** 902 / *Access to State-of-the-Art (SOTA) Microelectronics - Demonstration*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
• Continue to build-out secured design environments and persistent technical expertise • Enable enterprise licensing to tools and IP for rapid and scaled access to leading end technology. • Conduct enhanced IP demonstration and analysis of data driven risk assessments using independent verification and validation (V&V), data captures, intelligence reports, probability of detection and false alarm rates, and game theoretics. • Demonstrate rapid transition of DoD-relevant field programmable gate array-based capabilities to structured ASICs, with security capabilities to protect DoD intellectual property (IP) during manufacture. • Deploy integrated circuit deep inspection capability and conduct integrated circuit personalization demonstration. • Conduct additional foundry quantifiably assured fabrication demonstrations. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Changes reflect minor budget fluctuations.			
Title: Microelectronics Ecosystem	-	-	149.900
Description: This enhancement to existing programs RAMP and RAMP-C enables the DoD and the defense industrial base to collaborate with the commercial microelectronics industry to increase proto-type development, demonstration, and address the war fighter's need to maintain and modernize weapon systems as the threat landscape shifts. It enables the use of combined cyber-security methods/cryptography in the DoD hardware and utilization of complex computational capabilities in active electronically scanned array (AESA) phase array radar, electronic warfare (EW), and in secure communications, including 5G radio access network (RAN) systems. The department's future deployment of large constellations of networked satellites requires the use of leading-edge semiconductor components to enable real time communication and computation as well as for other advanced DoD system microelectronics applications. In addition, space based and strategic weapon systems require more advanced radiation hardened microelectronics. Virtually all DoD next-generation technology transition programs demand assured access to advanced microelectronics technology and components. This modernization enhancement ensures the full realization of the T&AM program investments already made. ***FY 2023 Plans:*** Develop and demonstrate access to a leading edge, commercially-viable, domestic U.S.-located wafer foundry ecosystem capability, on the order of more than 26,000 wafer starts per month for design and manufacturing of quantifiably assured, dual-use commercial and DoD custom integrated circuits. A successful WILL enable the following: • Access to a SOTA U.S. wafer foundry • Access to commercial and critical quantifiably assured dual-use COTS integrated circuits • Access to capabilities necessary to develop and demonstrate quantifiably assured custom DoD integrated circuits • The jump-start in commercial use of the domestic foundry by key U.S. fabless companies • Establishment and demonstration of a viable design ecosystem including access to 3rd party design modules • The reduction in the cost differential of building a U.S.-located wafer foundry verses off-shore			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Office of the Secretary Of Defense		Date: April 2022
Appropriation/Budget Activity 0400 / 5	**R-1 Program Element (Number/Name)** PE 0605294D8Z / *Trusted and Assured Microelectronics*	**Project (Number/Name)** 902 / *Access to State-of-the-Art (SOTA) Microelectronics - Demonstration*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
• The enablement of commercially-supported and enduring U.S. logic foundry capability • Development of the DoD proto-type demonstrator designs with DIB to accelerate technology transition ***FY 2022 to FY 2023 Increase/Decrease Statement:*** This enhancement to existing programs RAMP and RAMP-C enables T&AM program to demonstrate by FY2023-2025 full access to U.S. commercial SOTA design, foundry, and advanced packaging capability and meet DoD's unique needs within two to three years for modernization, including for RH and photonics applications. The capability will reduce the time needed to replace microelectronics components that are generations behind the commercial sector, move away from off-shore sources for SOTA commercial integrated circuits, and accelerate the demonstration and adoption of quantifiable assurance methods throughout the microelectronics lifecycle and supply chain. Reducing the timeline by up to two years not only benefits export control and classified system protection, but also the requirements of the National Defense Autorotation Act Section 224 for FY 2020 for the DoD to implement commercial standards for the acquisition of assured microelectronics products by 2023.			
Accomplishments/Planned Programs Subtotals	39.479	51.017	200.061

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

N/A

D. Acquisition Strategy

N/A

Exhibit R-3, RDT&E Project Cost Analysis: PB 2023 Office of the Secretary Of Defense		Date: April 2022
Appropriation/Budget Activity 0400 / 5	**R-1 Program Element (Number/Name)** PE 0605294D8Z / *Trusted and Assured Microelectronics*	**Project (Number/Name)** 902 / *Access to State-of-the-Art (SOTA) Microelectronics - Demonstration*

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2021 Cost	FY 2021 Award Date	FY 2022 Cost	FY 2022 Award Date	FY 2023 Base Cost	FY 2023 Base Award Date	FY 2023 OCO Cost	FY 2023 OCO Award Date	FY 2023 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Access to State-of-the-Art (SOTA) Microelectronics - Demonstration	MIPR	Defense Advanced Research Projects Agency, Air Force, Army, Navy, National Security Agency : Various	324.982	39.479	Mar 2021	51.017	Mar 2022	200.061	Mar 2023	-		200.061	Continuing	Continuing	-
		Subtotal	324.982	39.479		51.017		200.061		-		200.061	Continuing	Continuing	N/A

	Prior Years	FY 2021 Cost	FY 2021 Award Date	FY 2022 Cost	FY 2022 Award Date	FY 2023 Base Cost	FY 2023 Base Award Date	FY 2023 OCO Cost	FY 2023 OCO Award Date	FY 2023 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	324.982	39.479		51.017		200.061		-		200.061	Continuing	Continuing	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2023 Office of the Secretary Of Defense		Date: April 2022
Appropriation/Budget Activity 0400 / 5	**R-1 Program Element (Number/Name)** PE 0605294D8Z / *Trusted and Assured Microelectronics*	**Project (Number/Name)** 902 / *Access to State-of-the-Art (SOTA) Microelectronics - Demonstration*

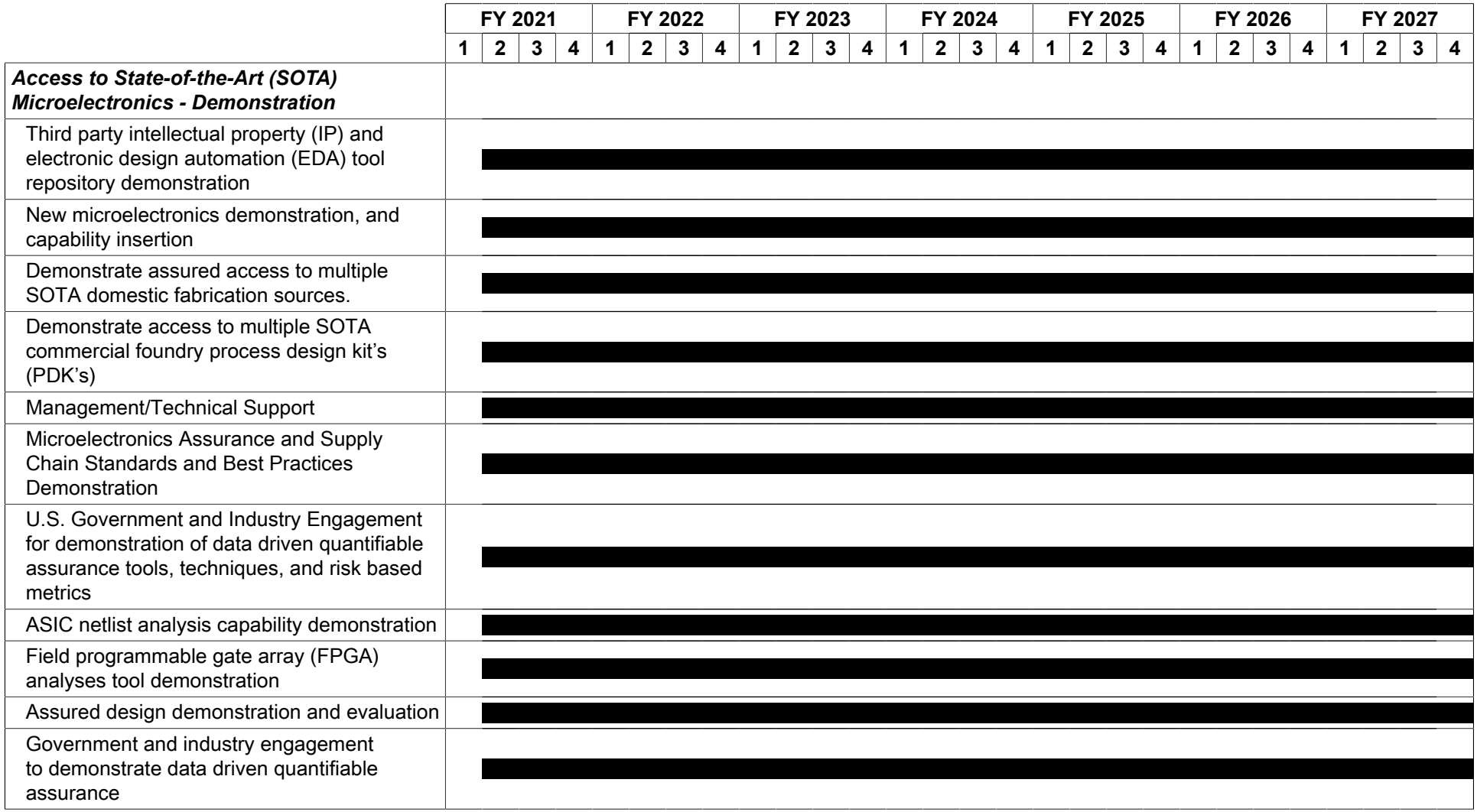

Exhibit R-4A, RDT&E Schedule Details: PB 2023 Office of the Secretary Of Defense		Date: April 2022
Appropriation/Budget Activity 0400 / 5	**R-1 Program Element (Number/Name)** PE 0605294D8Z / *Trusted and Assured Microelectronics*	**Project (Number/Name)** 902 / *Access to State-of-the-Art (SOTA) Microelectronics - Demonstration*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Access to State-of-the-Art (SOTA) Microelectronics - Demonstration				
Third party intellectual property (IP) and electronic design automation (EDA) tool repository demonstration	2	2021	4	2027
New microelectronics demonstration, and capability insertion	2	2021	4	2027
Demonstrate assured access to multiple SOTA domestic fabrication sources.	2	2021	4	2027
Demonstrate access to multiple SOTA commercial foundry process design kit's (PDK's)	2	2021	4	2027
Management/Technical Support	2	2021	4	2027
Microelectronics Assurance and Supply Chain Standards and Best Practices Demonstration	2	2021	4	2027
U.S. Government and Industry Engagement for demonstration of data driven quantifiable assurance tools, techniques, and risk based metrics	2	2021	4	2027
ASIC netlist analysis capability demonstration	2	2021	4	2027
Field programmable gate array (FPGA) analyses tool demonstration	2	2021	4	2027
Assured design demonstration and evaluation	2	2021	4	2027
Government and industry engagement to demonstrate data driven quantifiable assurance	2	2021	4	2027

Exhibit R-2A, RDT&E Project Justification: PB 2023 Office of the Secretary Of Defense			Date: April 2022
Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / *Trusted and Assured Microelectronics*	Project (Number/Name) 903 / *Access to Advanced Packaging and Testing - Demonstration*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
903: *Access to Advanced Packaging and Testing - Demonstration*	0.000	39.040	41.784	76.149	0.000	76.149	44.142	32.759	31.838	27.521	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project will leverage existing commercially available expertise and capability to deliver self-sustaining digital and radio frequency (RF) state-of-the-art (SOTA) heterogeneous integrated packaging (SHIP), assembly, and test capability.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Access to Advanced Packaging and Testing - Demonstration	39.040	41.784	19.199

Description: This project will deliver an on-shore SHIP assembly and test capability. It will provide access to, personalization of, and customization for supporting the DoD programs. It will enable a revolutionary leap in system performance that will greatly reduce size, weight and power (SWaP) by incorporating the immense advances in SOTA commercial off the shelf (COTS) processing technologies, such as field programmable gate arrays (FPGAs), microprocessors, and Graphic Processing Units (GPUs).

FY 2022 Plans:

Planned activities are as follows:

- Continue to demonstrate enhanced secure design and secure packaging with new tools and techniques.
- Continue demonstration of heterogeneous integration for secure packaging and test.
- Demonstrate prototype hardware and additional program-driven designs of increasing complexity and capability/performance.

FY 2023 Plans:

Planned activities are as follows:

- Continue to demonstrate enhanced secure design and secure packaging with new tools and techniques.
- Continue demonstration of heterogeneous integration for secure packaging and test.
- Demonstrate prototype hardware and additional program-driven designs of increasing complexity and capability/performance.

FY 2022 to FY 2023 Increase/Decrease Statement:

Exhibit R-2A, RDT&E Project Justification: PB 2023 Office of the Secretary Of Defense		Date: April 2022
Appropriation/Budget Activity 0400 / 5	**R-1 Program Element (Number/Name)** PE 0605294D8Z / *Trusted and Assured Microelectronics*	**Project (Number/Name)** 903 / *Access to Advanced Packaging and Testing - Demonstration*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Funding will decrease following the establishment of the initial advanced packaging and testing capability, which will continue to deliver proto-type designs and hardware for accelerating program adoption and for qualification, and further develop the infrastructure and process that supports ITAR/EAR, proprietary and security requirements.			
Title: Microelectronics Ecosystem	-	-	56.950
Description: Leading-edge semiconductor design and manufacturing technology forms the basis for many of the DoD modernization priorities. This program enhancement enables secure the DoD access to leading-edge semiconductor technology through domestic U.S.-located sources of custom and dual-use leading edge integrated circuits utilizing heterogeneous integration and advanced packaging. This enables implementation of complex, computation intensive AI algorithms for DoD AI and Autonomy applications. It will also facilitate use of integrated cyber-security methods/cryptography in the DoD hardware and utilization of the complex computational capability required for Active Electronically Scanned Array (AESA) Phase Array Radar System and Electronic Warfare (EW) and communications including 5G Radio access network (RAN) systems. The proposed large constellations of networked satellites will also require leading-edge semiconductor components to enable real time communication and on-satellite computation. ***FY 2023 Plans:*** • Accelerate and expand the development of multi-chip packaging (MCP) proto-type demonstrators in collaboration with DoD Programs and the defense industrial for process intensive applications and RF such as ASEA Radar, cognitive EW and autonomy, while enhancing security for protecting IP and CPI. • Expand and accelerate demonstration of prototype hardware and additional program-driven designs of increasing complexity and capability/performance. o Layered approach for IP & CPI protection o Enhanced resistance to security and cyber threats o Customized personalization per Program or MCP o Risk reduction by much greater visibility into the supply chain and assembly process, including quantifiable data for material tracking, meteorology and process control ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Access to quantifiably assured dual-use COTS integrated circuits that are fabricated, assembled, tested and personalized in U.S.-located manufacturing facilities. Most dual-use COTS parts used for modernization priorities are currently manufactured in Asian facilities that do not provide measurable assurance. This situation is very unlikely to change without this enhancement. This increase will be use to accelerate and expand adoption & use in military systems to design, packaging, and assembly to shorten transition time to DoD programs. These proto-type could include the following features critical to DoD weapon system modernization and protection of intellectual property (IP):			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Office of the Secretary Of Defense		Date: April 2022
Appropriation/Budget Activity 0400 / 5	**R-1 Program Element (Number/Name)** PE 0605294D8Z / *Trusted and Assured Microelectronics*	**Project (Number/Name)** 903 / *Access to Advanced Packaging and Testing - Demonstration*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
• Demonstrate DIB and DoD maturation leveraging commercial design using developed PDKs and ADKs to design custom devices. • Demonstrate DoD access to SOTA MCP products utilizing commercial packaging, assembly, and test and efficiencies gained in IP/design re-use to lower cost, risk and shorten schedules o Demonstrate the use of a catalog of designs, die, chiplets, package types, etc. o Ensure Reuse and Standardization for sustainability and costs. • All proto-type demonstrators shall implement microelectronics quantifiable assurance to ensure product integrity and ensure confidentiality of critical IP.			
Accomplishments/Planned Programs Subtotals	39.040	41.784	76.149

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-3, RDT&E Project Cost Analysis: PB 2023 Office of the Secretary Of Defense		Date: April 2022
Appropriation/Budget Activity 0400 / 5	**R-1 Program Element (Number/Name)** PE 0605294D8Z / *Trusted and Assured Microelectronics*	**Project (Number/Name)** 903 / *Access to Advanced Packaging and Testing - Demonstration*

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2021 Cost	FY 2021 Award Date	FY 2022 Cost	FY 2022 Award Date	FY 2023 Base Cost	FY 2023 Base Award Date	FY 2023 OCO Cost	FY 2023 OCO Award Date	FY 2023 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Access to Advanced Packaging and Testing - Demonstration	MIPR	Defense Advanced Research Projects Agency, Air Force, Army, Navy, National Security Agency : Various	-	39.040	Mar 2021	41.784	Mar 2022	76.149	Mar 2023	-		76.149	Continuing	Continuing	-
		Subtotal	-	39.040		41.784		76.149		-		76.149	Continuing	Continuing	N/A

	Prior Years	FY 2021 Cost	FY 2021 Award Date	FY 2022 Cost	FY 2022 Award Date	FY 2023 Base Cost	FY 2023 Base Award Date	FY 2023 OCO Cost	FY 2023 OCO Award Date	FY 2023 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	-	39.040		41.784		76.149		-		76.149	Continuing	Continuing	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2023 Office of the Secretary Of Defense		Date: April 2022
Appropriation/Budget Activity 0400 / 5	**R-1 Program Element (Number/Name)** PE 0605294D8Z / *Trusted and Assured Microelectronics*	**Project (Number/Name)** 903 / *Access to Advanced Packaging and Testing - Demonstration*

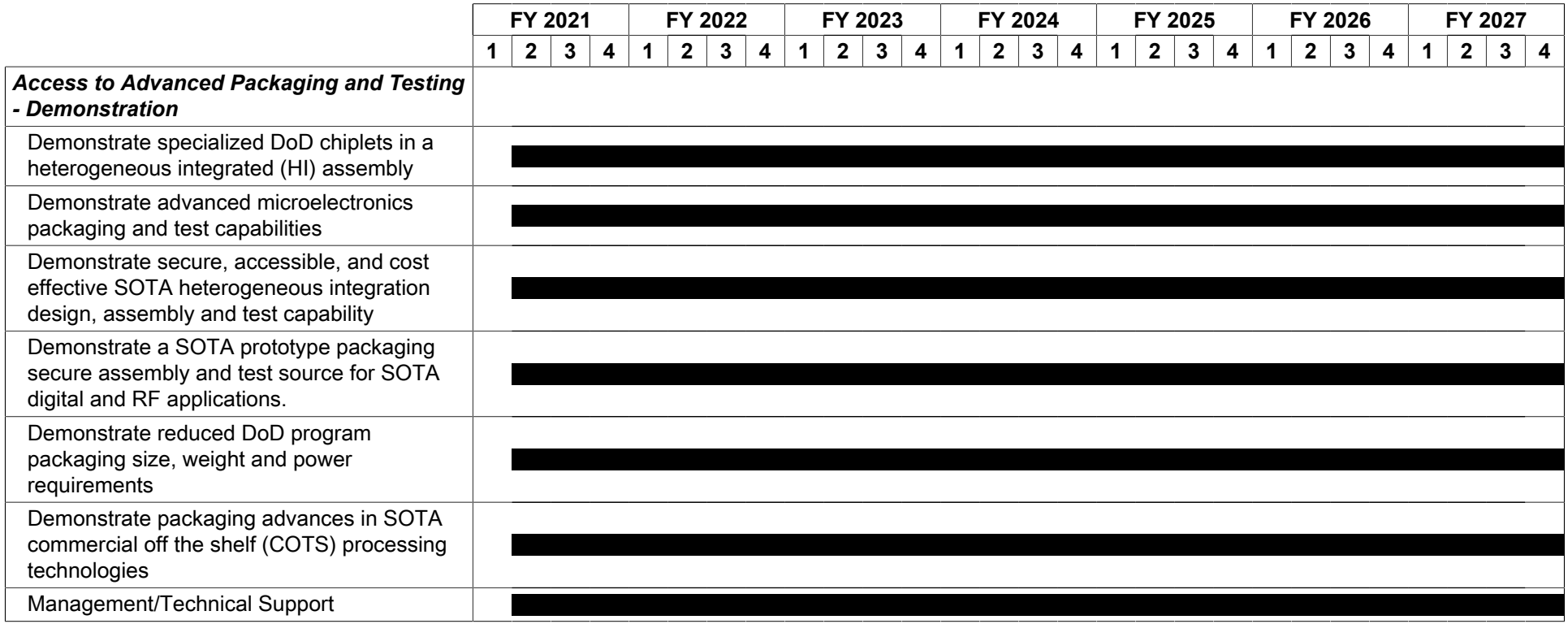

Exhibit R-4A, RDT&E Schedule Details: PB 2023 Office of the Secretary Of Defense		Date: April 2022
Appropriation/Budget Activity 0400 / 5	**R-1 Program Element (Number/Name)** PE 0605294D8Z / *Trusted and Assured Microelectronics*	**Project (Number/Name)** 903 / *Access to Advanced Packaging and Testing - Demonstration*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Access to Advanced Packaging and Testing - Demonstration				
Demonstrate specialized DoD chiplets in a heterogeneous integrated (HI) assembly	2	2021	4	2027
Demonstrate advanced microelectronics packaging and test capabilities	2	2021	4	2027
Demonstrate secure, accessible, and cost effective SOTA heterogeneous integration design, assembly and test capability	2	2021	4	2027
Demonstrate a SOTA prototype packaging secure assembly and test source for SOTA digital and RF applications.	2	2021	4	2027
Demonstrate reduced DoD program packaging size, weight and power requirements	2	2021	4	2027
Demonstrate packaging advances in SOTA commercial off the shelf (COTS) processing technologies	2	2021	4	2027
Management/Technical Support	2	2021	4	2027

Exhibit R-2A, RDT&E Project Justification: PB 2023 Office of the Secretary Of Defense			Date: April 2022
Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / *Trusted and Assured Microelectronics*	Project (Number/Name) 905 / *Address DoD Unique Needs Radiation Hardening and non-CMOS - Demonstration*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
905: *Address DoD Unique Needs Radiation Hardening and non-CMOS - Demonstration*	0.000	25.661	20.735	26.753	0.000	26.753	59.424	44.062	42.740	36.948	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project addresses the dual problems of commanding only a small market share while requiring an expansive range of unique microelectronics needs, from boutique and legacy components to state-of-the-art (SOTA) technologies. The Government must sustain specialty suppliers, given their criticality to national security. In particular, DoD needs access to a diverse microelectronics ecosystem to develop and acquire the application specific integrated circuit (ASICs) and personalized commercial off the shelf (COTS) components required for military radiation hardened and radio frequency and optical needs.

The Department frequently relies on commercial suppliers to optimize performance and reduce costs for sophisticated weapon system and secure network functionality. It is critical that the DoD has future access to subject matter expertise, technology, and manufacturing.

In addition to Rad Hard needs, the DoD requires access to RF and opto-electronic materials, foundries, and packaging facilities, in order to enable next generation sensors and communications. The DoD must leverage state-of-the-art microelectronic technologies driven by mega-trends such as 5G wireless and datacenters in order to combat emerging threats and provide overmatch technology to the warfighter. At the same time, the DoD must fill the gaps which are left unaddressed these dual-use mega-trends in order to satisfy mission requirements. By partnering in the maturation of state-of-the-art material sources, foundries, and packaging facilities, the DoD is able to tailor process development towards unique DoD interests and encourage open access design, which stimulates innovation and drives affordability. Additionally, critical investments must be made in the domestic supply chains supporting both RF Gallium Nitride (GaN) and integrated photonics in order to maintain the integrity and security of the Defense Industrial Base.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Address DoD Unique Needs - Radiation Hardening and non-CMOS - Demonstration	25.661	20.735	6.753
Description: Government-unique trusted design and manufacturing flows have been developed to enable a tier of trust for select ASIC parts; however, this approach addresses only a small subset of DoD microelectronics requirements (e.g., processors, memory, microcontrollers, field programmable gate arrays (FPGAs), and radiation-tolerant processors). The DoD will partner with the intelligence community, the Department of Energy, and the National Aeronautics and Space Administration to demonstrate radiation hardened components that permit systems to operate in space and other harsh environments. State-of-the-practice (SOTP) and SOTA technologies will be characterized and developed in support of Radiation			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Hardened By Process (RHBP) and Radiation Hardened By Design (RHBD) activities in support the DoD modernization programs with radiation hardened requirements. A similar situation exists for radio frequency and optical applications. These two applications reflect only a small market with unique costs and specifications, which does not inherently create incentive for industrial investment. Within RF and opto-electronics, investments will be made in RF GaN and integrated photonic material sources, foundries, and packaging facilities in order to enable low-size, weight, and power devices which broadly access the millimeter wave spectrum, while providing high-bandwidth data transmission. ***FY 2022 Plans:*** Planned activities are as follows: • Continue to demonstrate SOTP and SOTA technologies utilizing RHBP and RHBD activities in support of DoD modernization programs with radiation hardened requirements. • Transition developed RH technologies into space and strategic programs. • Qualify large-diameter Nitrogen-Polar RF GaN material source and mature off-axis Silicon Carbide substrate. • Baseline at MRL-4 and mature towards MRL-6 multiple state-of-the-art RF GaN foundries offering open access to millimeter wave device design and advanced interconnect services. • Perform an industrial base assessment of the integrated photonics foundry ecosystem and generate actionable guidance for foundry maturation by the DoD. • Demonstrate access to state-of-the-art RF GaN and integrated photonic foundries via advanced prototype demonstrators. ***FY 2023 Plans:*** Planned activities are as follows: • Continue to demonstrate SOTP and SOTA technologies utilizing RHBP and RHBD activities in support of DoD modernization programs with radiation hardened requirements. • Transition developed RH technologies into space and strategic programs. • Continue to mature large-diameter Nitrogen-Polar RF GaN material source and off-axis Silicon Carbide substrate. Foundries will assess epiwafers and provide feedback critical to baselining the N-Polar recipe. • Continue to mature towards MRL-6 multiple state-of-the-art RF GaN foundries offering open access to millimeter wave device design and advanced interconnect services. • Act upon industrial base assessment of the integrated photonics foundry ecosystem and mature strategic components of the domestic integrated photonics supply chain.			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Office of the Secretary Of Defense		Date: April 2022
Appropriation/Budget Activity 0400 / 5	**R-1 Program Element (Number/Name)** PE 0605294D8Z / *Trusted and Assured Microelectronics*	**Project (Number/Name)** 905 / *Address DoD Unique Needs Radiation Hardening and non-CMOS - Demonstration*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
• Demonstrate access to state-of-the-art RF GaN and integrated photonic foundries via advanced prototype demonstrators. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Changes reflect a rebalancing of funding between this project and PE 0604294D8Z, Trusted and Assured Microelectronics (Budget Activity 4), Project 911: "Address DoD Unique Needs - Radiation Hardening and non-CMOS - Development."			
Title: Microelectronics Ecosystem ***Description:*** The DoD requires access to Radiation Hardened (Rad Hard), radio frequency (RF), and opto-electronics (OE) that requires additional investment to accelerate and expand demonstrate product design techniques and material maturation in next generation SOTA technology nodes. ***FY 2023 Plans:*** • Establish the first domestic production source of Nitrogen-Polar Gallium Nitride (GaN) material, and demonstrate production of mmW devices with maximum RF power and efficiency. • Demonstrate design and process capability with radiation hard by design tested chip, TRL-6Two new sources of radiation hard by design enabling onboard processing capability with 100x capability improvement. • Establish a mature portfolio of domestic RF GaN foundries, which offers open access to millimeter wave technology and product transition via the DoD Advanced Packaging ecosystem. • Demonstrate advanced integrated photonics prototypes via secure access to state-of-the-art domestic foundries. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Strategic and space radiation-hardened microelectronics, and are critical in support of ongoing and future nuclear modernization and sustainment programs. This funding eliminates gaps in research and development (R&D), domestic capability, memory technologies, and test and evaluation infrastructure to alleviate the significant nuclear modernization and sustainment program risks. Additionally, RF and opto-electronic investments Accelerates secure access to state of the art RF GaN and Silicon Photonic materials, foundries, and packaging facilities, which enables next generation sensors and communications. Demonstrate State -of -the -art prototypes and IP demonstrate low-size, weight, and power millimeter wave access and high-bandwidth data transmission for, which transition to DoD programs and the Defense Industrial Base.	-	-	20.000
Accomplishments/Planned Programs Subtotals	25.661	20.735	26.753

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2023 Office of the Secretary Of Defense		Date: April 2022
Appropriation/Budget Activity 0400 / 5	**R-1 Program Element (Number/Name)** PE 0605294D8Z / *Trusted and Assured Microelectronics*	**Project (Number/Name)** 905 / *Address DoD Unique Needs Radiation Hardening and non-CMOS - Demonstration*

D. Acquisition Strategy

N/A

Exhibit R-3, RDT&E Project Cost Analysis: PB 2023 Office of the Secretary Of Defense		Date: April 2022
Appropriation/Budget Activity 0400 / 5	**R-1 Program Element (Number/Name)** PE 0605294D8Z / *Trusted and Assured Microelectronics*	**Project (Number/Name)** 905 / *Address DoD Unique Needs Radiation Hardening and non-CMOS - Demonstration*

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2021 Cost	FY 2021 Award Date	FY 2022 Cost	FY 2022 Award Date	FY 2023 Base Cost	FY 2023 Base Award Date	FY 2023 OCO Cost	FY 2023 OCO Award Date	FY 2023 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Address DoD Unique Needs - Demonstration	MIPR	Defense Advanced Research Projects Agency, Air Force, Army, Navy, National Security Agency : Various	-	25.661	Mar 2021	20.735	Mar 2022	26.753	Mar 2023	-		26.753	Continuing	Continuing	-
		Subtotal	-	25.661		20.735		26.753		-		26.753	Continuing	Continuing	N/A

	Prior Years	FY 2021		FY 2022		FY 2023 Base		FY 2023 OCO		FY 2023 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	-	25.661		20.735		26.753		-		26.753	Continuing	Continuing	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2023 Office of the Secretary Of Defense		Date: April 2022
Appropriation/Budget Activity 0400 / 5	**R-1 Program Element (Number/Name)** PE 0605294D8Z / *Trusted and Assured Microelectronics*	**Project (Number/Name)** 905 / *Address DoD Unique Needs Radiation Hardening and non-CMOS - Demonstration*

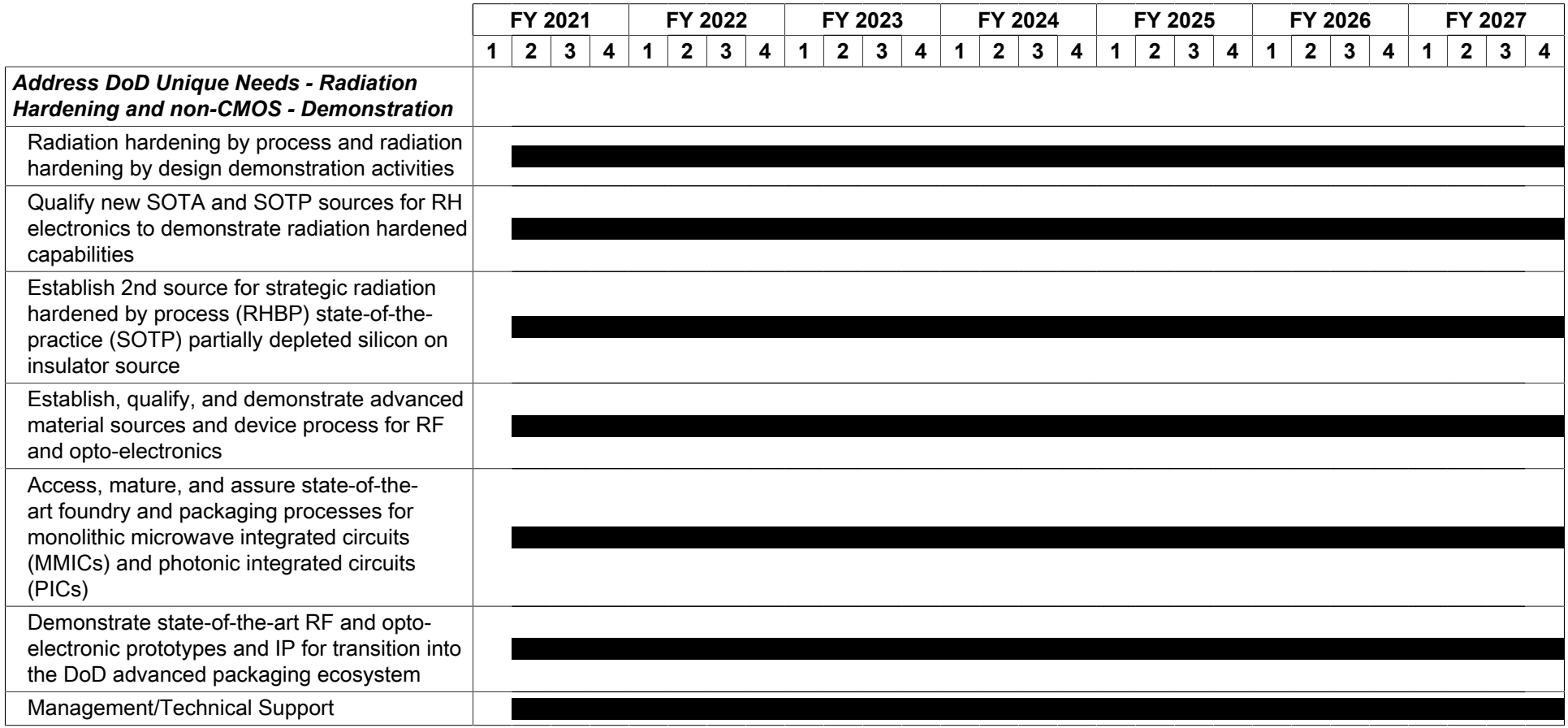

Exhibit R-4A, RDT&E Schedule Details: PB 2023 Office of the Secretary Of Defense		Date: April 2022
Appropriation/Budget Activity 0400 / 5	**R-1 Program Element (Number/Name)** PE 0605294D8Z / *Trusted and Assured Microelectronics*	**Project (Number/Name)** 905 / *Address DoD Unique Needs Radiation Hardening and non-CMOS - Demonstration*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Address DoD Unique Needs - Radiation Hardening and non-CMOS - Demonstration				
Radiation hardening by process and radiation hardening by design demonstration activities	2	2021	4	2027
Qualify new SOTA and SOTP sources for RH electronics to demonstrate radiation hardened capabilities	2	2021	4	2027
Establish 2nd source for strategic radiation hardened by process (RHBP) state-of-the-practice (SOTP) partially depleted silicon on insulator source	2	2021	4	2027
Establish, qualify, and demonstrate advanced material sources and device process for RF and opto-electronics	2	2021	4	2027
Access, mature, and assure state-of-the-art foundry and packaging processes for monolithic microwave integrated circuits (MMICs) and photonic integrated circuits (PICs)	2	2021	4	2027
Demonstrate state-of-the-art RF and opto-electronic prototypes and IP for transition into the DoD advanced packaging ecosystem	2	2021	4	2027
Management/Technical Support	2	2021	4	2027