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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Office of the Secretary Of Defense **Date:** February 2020

Appropriation/Budget Activity 0400: <i>Research, Development, Test & Evaluation, Defense-Wide I BA 5: System Development & Demonstration (SDD)</i>	R-1 Program Element (Number/Name) PE 0605294D8Z I <i>Trusted and Assured Microelectronics</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	59.516	94.617	175.032	107.585	-	107.585	115.315	91.871	68.596	69.991	Continuing	Continuing
812: <i>Trusted Mask Trust Approach</i>	0.000	2.000	2.000	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
809: <i>New Trust Approach Demonstration</i>	59.516	12.963	13.381	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
822: <i>Microelectronics Innovation for National Security and Economic Competitiveness (MINSEC) Enhancement and Demonstration</i>	0.000	79.654	159.651	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
902: <i>Access to State-of-the-Art (SOTA) Microelectronics - Demonstration</i>	-	0.000	0.000	54.045	-	54.045	54.355	55.871	44.596	45.503	Continuing	Continuing
903: <i>Access to Advanced Packaging and Testing - Demonstration</i>	0.000	0.000	0.000	39.040	-	39.040	38.960	23.000	10.000	10.203	Continuing	Continuing
905: <i>Address DoD Unique Needs Especially Radiation Hardening - Demonstration</i>	-	0.000	0.000	14.500	-	14.500	22.000	13.000	14.000	14.285	Continuing	Continuing

A. Mission Description and Budget Item Justification

This Program Element (PE) 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 PE supports the 2018 National Defense Strategy's (NDS) 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.

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This PE supports the OUSD(R&E) Microelectronics Modernization Roadmap. The primary areas of focus of this roadmap include the following: 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; 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 (USG)-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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	95.959	175.032	66.949	-	66.949
Current President's Budget	94.617	175.032	107.585	-	107.585
Total Adjustments	-1.342	0.000	40.636	-	40.636
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.328	-			
• Other Adjustments	-0.014	-	-0.548	-	-0.548
• Economic Assumption	-	-	-0.066	-	-0.066
• Increase for Access to SOTA Quantifiably Assured Microelectronics	-	-	41.250	-	41.250

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

Project: 822: *Microelectronics Innovation for National Security and Economic Competitiveness (MINSEC) Enhancement and Demonstration*

Congressional Add: *Next Generation Microelectronics*

	FY 2019	FY 2020
Congressional Add Subtotals for Project: 822	40.000	-
Congressional Add Totals for all Projects	40.000	-

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Appropriation/Budget Activity 0400: <i>Research, Development, Test & Evaluation, Defense-Wide I BA 5: System Development & Demonstration (SDD)</i>	R-1 Program Element (Number/Name) PE 0605294D8Z I <i>Trusted and Assured Microelectronics</i>
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Change Summary Explanation

In FY 2021, Project 812 "Trusted Mask" will be eliminated. Project 809 "New Trust Demonstration" and Project 822 "Microelectronics Innovation for National Security and Economic Competitiveness (MINSEC)" activities will be re-aligned under three new project codes to correctly align Program Element (PE) funding in support of a zero-trust philosophy and reflective of current priorities. The new project codes are: (1) P902 Access to State-of-the-Art (SOTA) Microelectronics - Demonstration; (2) P903 Access to Advanced Packaging and Testing - Demonstration; and (3) P905 Address DoD Unique Needs Especially Radiation Hardening - Demonstration.

In FY 2021, \$41.250 million was added to support enhanced and assured microelectronics design, domestic manufacturing capability, including heterogeneous integration and low volume applications, and a proactive awareness and security effort to identify and mitigate critical microelectronics supply chain threats.

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Office of the Secretary Of Defense **Date:** February 2020

Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / <i>Trusted and Assured Microelectronics</i>	Project (Number/Name) 812 / <i>Trusted Mask Trust Approach</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
812: <i>Trusted Mask Trust Approach</i>	0.000	2.000	2.000	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project staffs and supports operation of a new secure (SECRET-level) photomask manufacturing capability at an existing state-of-the-art (SOTA) commercial photomask manufacturing supplier to secure masks and design intellectual property (IP) of acquisition programs during photomask data preparation, parsing and manufacturing. This capability can be used in conjunction with both Trusted and untrusted foundries. This capability will mitigate a supply chain gap for trusted masks at technology node sizes between 130 nanometers (nm) and 12/14nm.

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

	FY 2019	FY 2020	FY 2021
Title: Trusted Mask Trust Approach	2.000	2.000	-
FY 2020 Plans: Continuation of FY 2019 plan to equip and staff the new secure (SECRET-level) photomask manufacturing capability at the SOTA commercial photomask manufacturing supplier.			
FY 2020 to FY 2021 Increase/Decrease Statement: Funding for this Project Code will end in FY 2020.			
Accomplishments/Planned Programs Subtotals	2.000	2.000	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Office of the Secretary Of Defense **Date:** February 2020

Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / <i>Trusted and Assured Microelectronics</i>	Project (Number/Name) 812 / <i>Trusted Mask Trust Approach</i>
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Product Development (\$ in Millions)				FY 2019		FY 2020		FY 2021 Base		FY 2021 OCO		FY 2021 Total	Cost To Complete	Total Cost	Target Value of Contract
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost			
Trusted Mask Trust Approach	MIPR	Defense Microelectronics Activity (DMEA) : California	0.000	2.000	Mar 2019	2.000	Mar 2020	-		-		-	Continuing	Continuing	-
Subtotal			0.000	2.000		2.000		-		-		-	Continuing	Continuing	N/A
Project Cost Totals			0.000	2.000		2.000		-		-		-	Continuing	Continuing	N/A

Remarks
NA

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Exhibit R-4, RDT&E Schedule Profile: PB 2021 Office of the Secretary Of Defense		Date: February 2020
Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / <i>Trusted and Assured Microelectronics</i>	Project (Number/Name) 812 / <i>Trusted Mask Trust Approach</i>

	FY 2019				FY 2020				FY 2021				FY 2022				FY 2023				FY 2024				FY 2025			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
<i>Trusted mask facility operation</i>																												
Trusted mask facility operation																												

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Exhibit R-4A, RDT&E Schedule Details: PB 2021 Office of the Secretary Of Defense		Date: February 2020
Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / <i>Trusted and Assured Microelectronics</i>	Project (Number/Name) 812 / <i>Trusted Mask Trust Approach</i>

Schedule Details

Events by Sub Project	Start		End	
	Quarter	Year	Quarter	Year
<i>Trusted mask facility operation</i>				
Trusted mask facility operation	1	2020	4	2020

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Office of the Secretary Of Defense										Date: February 2020		
Appropriation/Budget Activity 0400 / 5					R-1 Program Element (Number/Name) PE 0605294D8Z / <i>Trusted and Assured Microelectronics</i>				Project (Number/Name) 809 / <i>New Trust Approach Demonstration</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
809: <i>New Trust Approach Demonstration</i>	59.516	12.963	13.381	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project funds a program of research to demonstrate the next generation, technology-driven approach to microelectronics trust and assurance, to include state-of-the-art (SOTA) microelectronics, to ensure continued access to SOTA microelectronic technologies, while maintaining the required level of assurance in all environments. DoD's ability to access commercial technology for its custom secure, trusted and assured needs is diminishing as SOTA suppliers become fewer and more focused on serving the global commercial market. DoD's technology needs are broad, and relying on a single source supplier is not feasible. Alternative, advanced manufacturing methods, technologies, and design tools are needed to produce secure, trusted and assured SOTA parts from commercial sources and to preserve access to these advanced nodes while protecting DoD and Defense Industrial Base (DIB) intellectual property (IP) from exploitation. It is also intended to dramatically improve the capabilities of the core trusted and assured microelectronics (T&AM) laboratories with regard to verification and validation in support of microelectronics assurance.

This program of research will demonstrate quantitative and innovative design, manufacturing, imaging, tagging, and control and assessment approaches for protecting DoD's microelectronics supply chain and IP. Furthermore a quantitative assurance methodology using metrics from assurance mitigations will be demonstrated to enable access to SOTA microelectronics. Assurance mitigations will be demonstrated for Field Programmable Gate Array devices in advanced technology nodes for next-generation strategic systems, obfuscation and disaggregation technologies, and other assurance mitigations. It will demonstrate advanced imaging technologies and forensics, Design for Assurance techniques, active hardware assurance controls, electronic component markers, and a data and analysis capability to enable auditing, lifecycle provenance and traceability, and independent verification and validation of commercial and specialized DoD designs and IP. It also demonstrates and implements concepts for the cost-effective production of custom microelectronics in low volumes and protection of sensitive IP from exploitation. In addition it demonstrates and implements new technologies to assess the security of field-programmable gate array (FPGA) assurance mechanisms.

Assurance technologies that can be applied in a broad range of trusted and commercial environments can mitigate the risks associated with sole-source suppliers, and increase the ability of the U.S. Government (USG) to leverage commercial capabilities. The suite of demonstrated technologies, e.g., alternative manufacturing methods and design tools, will enable DoD to obfuscate the purpose of sensitive devices, verify their origin and function, and protect sensitive IP from exploitation even while using the global supply chain for most hardware. In cases where the risk involved precludes that level of commercial collaboration, low-volume manufacturing technologies demonstrated under this project would permit DoD to more cheaply produce low volumes of sensitive microelectronics in secure environments. The project will also support demonstration of a repository of third-party IP and electronic design automation (EDA) and assurance tool marketplace to expedite circuit design and transition promising technologies to use.

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

	FY 2019	FY 2020	FY 2021
Title: New Trust Approach Demonstration	12.963	13.381	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Office of the Secretary Of Defense		Date: February 2020
Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / <i>Trusted and Assured Microelectronics</i>	Project (Number/Name) 809 / <i>New Trust Approach Demonstration</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<p><i>FY 2020 Plans:</i> Continuation of FY 2019 activities including the following:</p> <ul style="list-style-type: none"> • Demonstrate acquisition program pilots and technology demonstrations, followed by transition of these capabilities to new programs in the following fiscal years. • Evaluate quantifiable assurance technologies and techniques through efforts that may include the conduct of studies, broad agency announcements (BAAs), and other efforts to coordinate research programs across USG R&D organizations, academia and industry. • Identify potential transition issues and aid in transition through joint collaboration between research teams and stakeholders with a focus on evaluations of prototypes, test articles and beta versions of tools, IP, techniques, methods, etc. and their use in operationally-realistic scenarios. • Demonstrate and evaluate new quantifiable assurance technologies for FPGA devices through BAA awards selected in FY 2019 and throughout FY 2020. <p><i>FY 2020 to FY 2021 Increase/Decrease Statement:</i> P809 funds will transfer from this project code (Pcode) to new P902 "Access to SOTA Microelectronics Demonstration" to properly align funding in support of the zero-trust philosophy and reflect current priorities. Total funding will increase between the two years from \$13.381 million to \$23.215 million.</p>			
Accomplishments/Planned Programs Subtotals	12.963	13.381	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Office of the Secretary Of Defense **Date:** February 2020

Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / <i>Trusted and Assured Microelectronics</i>	Project (Number/Name) 809 / <i>New Trust Approach Demonstration</i>
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Product Development (\$ in Millions)				FY 2019		FY 2020		FY 2021 Base		FY 2021 OCO		FY 2021 Total	Cost To Complete	Total Cost	Target Value of Contract
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost			
New Trust Approach Demonstration Program Support	MIPR	Various (Defense Advanced Research Projects Agency, Air Force, Army, Navy, National Security Agency) : Various	59.516	12.963	Mar 2019	13.381	Mar 2020	-		-		-	Continuing	Continuing	-
Subtotal			59.516	12.963		13.381		-		-		-	Continuing	Continuing	N/A

Remarks
NA

	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	59.516	12.963	13.381	-	-	-	Continuing	Continuing	N/A

Remarks
N/A

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Exhibit R-4A, RDT&E Schedule Details: PB 2021 Office of the Secretary Of Defense		Date: February 2020
Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / <i>Trusted and Assured Microelectronics</i>	Project (Number/Name) 809 / <i>New Trust Approach Demonstration</i>

Schedule Details

Events by Sub Project	Start		End	
	Quarter	Year	Quarter	Year
<i>New Trust Approach Demonstration</i>				
Field programmable gate array (FPGA) integrated assurance analysis/logical and physical verification tool demonstration	1	2020	4	2020
Automated design and verification and demonstration	1	2020	4	2020
Validation of custom integrated circuits and demonstration	1	2020	4	2020
Cloud hardware emulation/virtual instrumentation	1	2020	4	2020
Third party intellectual property (IP) and electronic design automation (EDA) tool repository development and demonstration	1	2020	4	2020
Technical capability improvement development and demonstration	1	2020	4	2020
Microelectronics assurance and supply chain demonstrations	1	2020	4	2020
U.S. Government and industry engagement for demonstration of data driven quantifiable assurance tools, techniques, and risk based metrics	1	2020	4	2020
Microelectronics assurance and supply chain policy and guidance development/update	1	2020	4	2020
Management/Technical Support	1	2020	4	2020

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Office of the Secretary Of Defense										Date: February 2020		
Appropriation/Budget Activity 0400 / 5					R-1 Program Element (Number/Name) PE 0605294D8Z / <i>Trusted and Assured Microelectronics</i>				Project (Number/Name) 822 / <i>Microelectronics Innovation for National Security and Economic Competitiveness (MINSEC) Enhancement and Demonstration</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
822: <i>Microelectronics Innovation for National Security and Economic Competitiveness (MINSEC) Enhancement and Demonstration</i>	0.000	79.654	159.651	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project supports the DoD microelectronics strategy by ensuring the availability of and access to the advanced, assured microelectronics that are critical for DoD and national security systems. It will deliver tools to protect the IP confidentiality and integrity for a broad range of systems and missions and will provide a path for the production of these articles.

This project supports a broader national strategy to focus resources, policies, and incentives to enhance current and next generation defense capability by:

- 1) maintaining access to U.S. domestic production of state-of-the-art (SOTA) technology;
- 2) enabling solutions for DoD heterogeneous integration and advanced packaging needs;
- 3) leveraging commercial technology through demonstrations with industry of dual-use technologies with built in assurance, and incentivizing stronger commercial engagement through piloting acquisition reforms and providing incentives for cooperative R&D and trade;
- 4) enhancing state-of-the-practice (SOTP) foundries in the U.S. to produce more advanced technologies to better serve low-volume customers in the aerospace and defense community;
- 5) accelerating the transition and capture of the next generation of microelectronics through commercial partnerships and lowering domestic barriers to innovation in coordination with the Defense Advanced Research Projects Agency (DARPA) Electronics Resurgence Initiative (ERI); and
- 6) promoting threat awareness, proactive protection, and supply chain security to ensure these investments continue to benefit the U.S.

MINSEC activities are categorized into the following focus areas: access to specialized SOTA and dual use microelectronics technology, collection and analysis of data for metrics driven quantifiable assurance, maintaining and enhancing U.S capability though capture and secure, and transition of next generation microelectronics technology including demonstration and capability insertion; microelectronics-focused workforce training; radiation hardening by process (RHBP) and radiation hardening by design (RHBD) in advanced technology nodes for next-generation strategic systems; and radio frequency (RF) and optoelectronic (OE) microelectronics.

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

	FY 2019	FY 2020	FY 2021
Title: Microelectronics Innovation for National Security and Economic Competitiveness (MINSEC)	39.654	159.651	-

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Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / <i>Trusted and Assured Microelectronics</i>	Project (Number/Name) 822 / <i>Microelectronics Innovation for National Security and Economic Competitiveness (MINSEC) Enhancement and Demonstration</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<p>Description: This project’s activities will mature and evaluate quantifiable microelectronics access and assurance technologies and techniques through efforts that may include the conduct of studies and Broad Agency Announcements (BAAs) and other efforts to coordinate research programs across USG R&D organizations, academia, and industry.</p> <p>FY 2020 Plans: This project will engage early on with potential stakeholders to identify potential transition issues and aid in transition through joint collaboration between research teams and stakeholders with a focus on demonstration and evaluation of prototypes, test articles, and beta versions of tools, IP, techniques, methods, etc. and their use in operationally-realistic scenarios. It will continue to promote the use of data driven security features and software and hardware assurance tools and capabilities for DoD systems</p> <ul style="list-style-type: none"> • Pilot quantifiable secure co-design capabilities and supply chain tools using commercially-available cloud-based services with/at commercial partners to secure commercial IP. • Demonstrate secure, accessible and cost effective SOTA heterogeneous integration design, assembly and test capability. Establish a SOTA Heterogeneous Integrated Prototype Packaging sources for SOTA Digital and SOTA radio frequency (RF) applications. • Support the demonstration of proactive awareness and security of the microelectronics supply chain including supply chain intelligence/counterintelligence, crypto-provenance/tracking, informed authorities, and standards. • Coordinate with Office of the Director of National Intelligence, to define the full end-to-end supply chain issues and address critical security threats. • Leverage and enhance investments from local, state, federal government, and industry to demonstrate domestic and agile high-mix, low-volume microelectronics manufacturing and packaging capabilities. <p>FY 2020 to FY 2021 Increase/Decrease Statement: Project Code (Pcode) 822 funds will transfer from this Pcode to new Pcodes to correctly align Program Element (PE) funding in support of the zero-trust philosophy and reflect current priorities. They are: P902 Access to SOTA Microelectronics; P903 Access to Advanced Packaging and Test; and P905 Address DoD Unique Needs. Total funding will decrease between the two years from \$159.651 million to \$84.436 million with \$54.111 million transferring to SOTA Access, \$39.040 million transferring to Advanced Packaging Access, and \$14.500 million transferring to Address DoD Unique Needs.</p>			
Accomplishments/Planned Programs Subtotals	39.654	159.651	-

	FY 2019	FY 2020
Congressional Add: Next Generation Microelectronics	40.000	-

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	FY 2019	FY 2020
<p>FY 2019 Accomplishments:</p> <ul style="list-style-type: none"> • Initiated partnership with commercial state of the art (SOTA) foundry to demonstrate design mobility. • Enhanced service lab design and verification expertise through on-site subject matter experts and engagements with commercial entities. • Initiated commercial IP assurance analysis • Conducted independent vetting of reduced instruction set computer (RISC) architectures using commercial partners. • Evaluated specialized field programmable gate array (FPGA) designs from multiple commercial vendors for potential benefits and vulnerabilities. • Completed design of 14nm artificial intelligence system on chip (SoC). • Engaged academia in demonstrating comprehensive pre-silicon security verification toolset. 		
Congressional Adds Subtotals	40.000	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-4A, RDT&E Schedule Details: PB 2021 Office of the Secretary Of Defense **Date:** February 2020

Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / <i>Trusted and Assured Microelectronics</i>	Project (Number/Name) 822 / <i>Microelectronics Innovation for National Security and Economic Competitiveness (MINSEC) Enhancement and Demonstration</i>
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Schedule Details

Events by Sub Project	Start		End	
	Quarter	Year	Quarter	Year
<i>MINSEC Enhancement and Demonstration</i>				
Commercial off the shelf (COTS) programmable integrated circuit demonstration	1	2020	4	2020
Government and industry engagement to demonstrate data driven quantifiable assurance and maintain U.S microelectronics technology dominance	1	2020	4	2020
Microelectronics assurance and supply chain policy and guidance development/update	1	2020	4	2020
Management/Technical Support	1	2020	4	2020

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Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / <i>Trusted and Assured Microelectronics</i>	Project (Number/Name) 902 / <i>Access to State-of-the-Art (SOTA) Microelectronics - Demonstration</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>902: Access to State-of-the-Art (SOTA) Microelectronics - Demonstration</i>	-	0.000	0.000	54.045	-	54.045	54.355	55.871	44.596	45.503	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

In 2021, this project incorporates portions of projects P809 and P822. It will establish 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.

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

	FY 2019	FY 2020	FY 2021
<p>Title: Design</p> <p>Description: The 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 DoD's ability to detect certain malicious supply chain attacks on DoD microelectronics.</p> <p>The 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. The 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 DoD's ability to detect certain malicious supply chain attacks on DoD microelectronics.</p> <p>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 DoD assurance policy and includes collaborating with industry to employ data driven quantifiable standards.</p> <p>FY 2021 Plans: Successful implementation will transition these technologies to use in DoD programs, obtain access to multiple (2) commercial microelectronics facilities, and solidify a data-driven approach to supply chain protection.</p>	-	-	16.000

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Office of the Secretary Of Defense		Date: February 2020
Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / <i>Trusted and Assured Microelectronics</i>	Project (Number/Name) 902 / <i>Access to State-of-the-Art (SOTA) Microelectronics - Demonstration</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<p>Planned activities transitioning from projects P809 and P822 as follows:</p> <ul style="list-style-type: none"> • Demonstrate vetted IP repository, which will be available for DoD use of assured tools distributed via cloud services. • Achieve initial operational capability (IOC) for secure co-design capabilities and supply chain tools using commercially-available cloud-based services with/at co-development partners for commercial IP. • Demonstrate enhance secure design and cloud capability with new tools and techniques. • Continue to build-out secured design environments and persistent technical expertise. <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transfer from P809 and P822 to properly align funding in support of the zero-trust philosophy and reflect current priorities.</p>			
<p>Title: Foundry</p> <p>Description: This activity will implement multiple foundries process design kit (PDK) environments ensuring the government is not dependent on one single source for critical components.</p> <p>FY 2021 Plans: Commercial foundries generate enormous amounts of data on their processes as a best practice for quality assurance to improve reliability and increase yield. It will collect and utilize 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.</p> <p>Planned activities transitioning from project P822 as follows:</p> <ul style="list-style-type: none"> • Demonstrate assured access to multiple SOTA domestic fabrication sources. • Continued build-out of secured design environments and persistent expertise. <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transfer from P809 and P822 to properly align funding in support of the zero-trust philosophy and reflect current priorities.</p>	-	-	3.798
<p>Title: Data Driven Quantifiable Assurance Demonstration</p> <p>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 foundries to develop a data-driven, risk-based approach to supply chain protection and demonstrate the assured manufacture of advanced electronic components.</p> <p>FY 2021 Plans: The project will demonstrate 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)</p>	-	-	34.247

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Office of the Secretary Of Defense		Date: February 2020		
Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / <i>Trusted and Assured Microelectronics</i>	Project (Number/Name) 902 / <i>Access to State-of-the-Art (SOTA) Microelectronics - Demonstration</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
<p>manufacturing. Efforts are on-going to update International Traffic in Arms Regulations (ITAR) and Export Administration Regulations (EAR) policy in this area. Funding will support activities to enhance the export control regime so that it maintains or strengthens current protections while enabling access to commercial capabilities, products, and IP.</p> <p>Planned activities transitioning from projects P-809 and P822 as follows:</p> <ul style="list-style-type: none"> • 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 scalable classified system for a design and verification ecosystem. • Establishment and demonstration of commercial field programmable gate array (FPGA) screening capability. • Continue to establish, demonstrate, and evaluate new quantifiable assurance technologies for FPGA devices. • Align stakeholders with common concerns to demonstrate assurance enabled SOTA fabrication technologies. <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transfer from P809 and P822 to properly align funding in support of the zero-trust philosophy and reflect current priorities.</p>				
Accomplishments/Planned Programs Subtotals		-	-	54.045
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
N/A				
D. Acquisition Strategy				
N/A				

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Exhibit R-4, RDT&E Schedule Profile: PB 2021 Office of the Secretary Of Defense **Date:** February 2020

Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / <i>Trusted and Assured Microelectronics</i>	Project (Number/Name) 902 / <i>Access to State-of-the-Art (SOTA) Microelectronics - Demonstration</i>
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FY 2019				FY 2020				FY 2021				FY 2022				FY 2023				FY 2024				FY 2025			
1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4

<i>Access to State-of-the-Art (SOTA) Microelectronics - Demonstration</i>	
Third party intellectual property (IP) and electronic design automation (EDA) tool repository demonstration	
New microelectronics demonstration, and capability insertion	
Demonstrate assured access to multiple SOTA domestic fabrication sources.	
Demonstrate access to multiple SOTA commercial foundry process design kit's (PDK's)	
Management/Technical Support	

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Exhibit R-4A, RDT&E Schedule Details: PB 2021 Office of the Secretary Of Defense		Date: February 2020
Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / <i>Trusted and Assured Microelectronics</i>	Project (Number/Name) 902 / <i>Access to State-of-the-Art (SOTA) Microelectronics - Demonstration</i>

Schedule Details

Events by Sub Project	Start		End	
	Quarter	Year	Quarter	Year
<i>Access to State-of-the-Art (SOTA) Microelectronics - Demonstration</i>				
Third party intellectual property (IP) and electronic design automation (EDA) tool repository demonstration	2	2021	4	2025
New microelectronics demonstration, and capability insertion	2	2021	4	2025
Demonstrate assured access to multiple SOTA domestic fabrication sources.	2	2021	4	2025
Demonstrate access to multiple SOTA commercial foundry process design kit's (PDK's)	2	2021	4	2025
Management/Technical Support	2	2021	4	2025

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Office of the Secretary Of Defense **Date:** February 2020

Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / <i>Trusted and Assured Microelectronics</i>	Project (Number/Name) 903 / <i>Access to Advanced Packaging and Testing - Demonstration</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
903: <i>Access to Advanced Packaging and Testing - Demonstration</i>	0.000	0.000	0.000	39.040	-	39.040	38.960	23.000	10.000	10.203	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 2019	FY 2020	FY 2021
Title: Access to Advanced Packaging and Testing - Demonstration	-	-	39.040
FY 2021 Plans: This project will deliver an on-shore SHIP assembly and test capability. It will provide access to, personalization of, and customization for supporting 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). Planned activities transitioning from projects P809 and P822 as follows: • Demonstrate enhance secure design and secure packaging with new tools and techniques. • Continue demonstration of heterogeneous integration for secure packaging and test.			
FY 2020 to FY 2021 Increase/Decrease Statement: Funding transfer from P809 and P822 to Properly align funding in support of the zero-trust philosophy and reflect current priorities.			
Accomplishments/Planned Programs Subtotals	-	-	39.040

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-4, RDT&E Schedule Profile: PB 2021 Office of the Secretary Of Defense		Date: February 2020
Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / <i>Trusted and Assured Microelectronics</i>	Project (Number/Name) 903 / <i>Access to Advanced Packaging and Testing - Demonstration</i>

FY 2019				FY 2020				FY 2021				FY 2022				FY 2023				FY 2024				FY 2025			
1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4

Access to Advanced Packaging and Testing - Demonstration

Demonstrate specialized DoD chiplets in a heterogeneous integrated (HI) assembly	[REDACTED]																							
Demonstrate advanced microelectronics packaging and test capabilities	[REDACTED]																							
Demonstrate secure, accessible, and cost effective SOTA heterogeneous integration design, assembly and test capability	[REDACTED]																							
Demonstrate a SOTA prototype packaging secure assembly and test source for SOTA digital and RF applications.	[REDACTED]																							
Demonstrate reduced DoD program packaging size, weight and power requirements	[REDACTED]																							
Demonstrate packaging advances in SOTA commercial off the shelf (COTS) processing technologies	[REDACTED]																							
Microelectronics Assurance and Supply Chain Standards and Best Practices Demonstration	[REDACTED]																							
U.S. Government and Industry Engagement for demonstration of data driven quantifiable assurance tools, techniques, and risk based metrics	[REDACTED]																							
ASIC netlist analysis capability demonstration	[REDACTED]																							
Field programmable gate array (FPGA) analyses tool demonstration	[REDACTED]																							

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Exhibit R-4, RDT&E Schedule Profile: PB 2021 Office of the Secretary Of Defense **Date:** February 2020

Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / <i>Trusted and Assured Microelectronics</i>	Project (Number/Name) 903 / <i>Access to Advanced Packaging and Testing - Demonstration</i>
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	FY 2019				FY 2020				FY 2021				FY 2022				FY 2023				FY 2024				FY 2025			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4

Assured design demonstration and evaluation																												
Government and industry engagement to demonstrate data driven quantifiable assurance																												
Management/Technical Support																												

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Exhibit R-4A, RDT&E Schedule Details: PB 2021 Office of the Secretary Of Defense		Date: February 2020
Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / <i>Trusted and Assured Microelectronics</i>	Project (Number/Name) 903 / <i>Access to Advanced Packaging and Testing - Demonstration</i>

Schedule Details

Events by Sub Project	Start		End	
	Quarter	Year	Quarter	Year
<i>Access to Advanced Packaging and Testing - Demonstration</i>				
Demonstrate specialized DoD chiplets in a heterogeneous integrated (HI) assembly	2	2021	4	2025
Demonstrate advanced microelectronics packaging and test capabilities	2	2021	4	2025
Demonstrate secure, accessible, and cost effective SOTA heterogeneous integration design, assembly and test capability	2	2021	4	2025
Demonstrate a SOTA prototype packaging secure assembly and test source for SOTA digital and RF applications.	2	2021	4	2025
Demonstrate reduced DoD program packaging size, weight and power requirements	2	2021	4	2025
Demonstrate packaging advances in SOTA commercial off the shelf (COTS) processing technologies	2	2021	4	2025
Microelectronics Assurance and Supply Chain Standards and Best Practices Demonstration	2	2021	4	2025
U.S. Government and Industry Engagement for demonstration of data driven quantifiable assurance tools, techniques, and risk based metrics	2	2021	4	2025
ASIC netlist analysis capability demonstration	2	2021	4	2025
Field programmable gate array (FPGA) analyses tool demonstration	2	2021	4	2025
Assured design demonstration and evaluation	2	2021	4	2025
Government and industry engagement to demonstrate data driven quantifiable assurance	2	2021	4	2025
Management/Technical Support	2	2021	4	2025

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Office of the Secretary Of Defense **Date:** February 2020

Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / <i>Trusted and Assured Microelectronics</i>	Project (Number/Name) 905 / <i>Address DoD Unique Needs Especially Radiation Hardening - Demonstration</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>905: Address DoD Unique Needs Especially Radiation Hardening - Demonstration</i>	-	0.000	0.000	14.500	-	14.500	22.000	13.000	14.000	14.285	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 DoD has future access to subject matter expertise, technology, and manufacturing.

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

	FY 2019	FY 2020	FY 2021
Title: Address DoD Unique Needs Especially Radiation Hardening - Demonstration	-	-	14.500
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).			
FY 2021 Plans: 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 Hardened By Process (RHBP) and Radiation Hardened By Design (RHBD) activities in support 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.			
Planned activities transitioning from projects P-809 and P-822 as follows:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Office of the Secretary Of Defense		Date: February 2020
Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / <i>Trusted and Assured Microelectronics</i>	Project (Number/Name) 905 / <i>Address DoD Unique Needs Especially Radiation Hardening - Demonstration</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<ul style="list-style-type: none"> • Demonstrate enhanced DoD Lab test and evaluation infrastructure required for verification and validation of radiation hardened microelectronics, technology characterization, and device modeling and simulation. • Demonstrate advance radiation harden System on Chip(SOC) and memory technology in support DoD program modernization efforts with radiation hardened requirements. • Demonstrate SOTP and SOTA technologies utilizing Radiation Hardened By Process (RHBP) and Radiation Hardened By Design (RHBD) activities in support DoD modernization programs with radiation hardened requirements. • Provide coordination and subject matter expertise in support of the Strategic Radiation Hardened Electronics council (SRHEC) for the identification of technology gaps, technology roadmap development, and inform future investments. • Procure and evaluate advanced Gallium Nitride (GaN) substrates to establish an assured source. • Demonstrate assured GaN radio frequency (RF) foundry technology and host secure design challenges to optimize SOTA radio frequency optoelectronics (RFOE) intellectual property (IP) and test articles for frequency, bandwidth, efficiency, power, etc. • Major milestones will be GaN wafer deliveries and assured GaN RF circuits via Secure Design Challenge. • Continue to enhance the foundations of assurance for RF and optoelectronics (OE) applications by demonstrating new capabilities such as additive manufacturing. <p><i>FY 2020 to FY 2021 Increase/Decrease Statement:</i> Funding transfer from P809 and P822 to properly align funding in support of the zero-trust philosophy and reflect current priorities.</p>			
Accomplishments/Planned Programs Subtotals	-	-	14.500

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-4, RDT&E Schedule Profile: PB 2021 Office of the Secretary Of Defense		Date: February 2020
Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / <i>Trusted and Assured Microelectronics</i>	Project (Number/Name) 905 / <i>Address DoD Unique Needs Especially Radiation Hardening - Demonstration</i>

FY 2019				FY 2020				FY 2021				FY 2022				FY 2023				FY 2024				FY 2025			
1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4

Address DoD Unique Needs - Demonstration																											
Radiation hardening by process and radiation hardening by design demonstration activities																											
Radio frequency (RF) and optoelectronics (OE) demonstration activities for assurance																											
Qualify new SOTA and SOTP sources for RH electronics to demonstrate radiation hardened capabilities																											
Establish 2nd source for strategic radiation hardened by process (RHBP) state-of-the-practice (SOTP) partially depleted silicon on insulator source																											
Demonstrate new RF and optoelectronics (OE) microelectronics capabilities using secured design environments, advanced non-CMOS substrates, and optimized SOTA IP and test articles																											
Management/Technical Support																											

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Exhibit R-4A, RDT&E Schedule Details: PB 2021 Office of the Secretary Of Defense		Date: February 2020
Appropriation/Budget Activity 0400 / 5	R-1 Program Element (Number/Name) PE 0605294D8Z / <i>Trusted and Assured Microelectronics</i>	Project (Number/Name) 905 / <i>Address DoD Unique Needs Especially Radiation Hardening - Demonstration</i>

Schedule Details

Events by Sub Project	Start		End	
	Quarter	Year	Quarter	Year
<i>Address DoD Unique Needs - Demonstration</i>				
Radiation hardening by process and radiation hardening by design demonstration activities	2	2021	4	2025
Radio frequency (RF) and optoelectronics (OE) demonstration activities for assurance	2	2021	4	2025
Qualify new SOTA and SOTP sources for RH electronics to demonstrate radiation hardened capabilities	2	2021	4	2025
Establish 2nd source for strategic radiation hardened by process (RHBP) state-of-the-practice (SOTP) partially depleted silicon on insulator source	2	2021	4	2025
Demonstrate new RF and optoelectronics (OE) microelectronics capabilities using secured design environments, advanced non-CMOS substrates, and optimized SOTA IP and test articles	2	2021	4	2025
Management/Technical Support	2	2021	4	2025