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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Air Force **Date:** May 2021

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	45.882	35.841	46.591	0.000	46.591	-	-	-	-	-	-
633720: <i>EW Quick Reaction Capabilities</i>	-	26.928	0.000	29.484	0.000	29.484	-	-	-	-	-	-
63431G: <i>RF Warning & Countermeasures Tech</i>	-	11.691	31.142	9.255	0.000	9.255	-	-	-	-	-	-
634335: <i>Cyber Concepts</i>	-	2.903	0.000	4.147	0.000	4.147	-	-	-	-	-	-
63691X: <i>EO/IR Warning & Countermeasures Tech</i>	-	4.360	4.699	3.705	0.000	3.705	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This program develops and demonstrates technologies to support Air Force electronic combat warfighting capabilities. The program focuses on developing components, subsystems, and technologies with potential aerospace, special operations, and airlift electronic combat applications. It develops and demonstrates technologies for integrating electronic combat sensors and systems into a fused and seamless whole. It integrates and focuses research efforts in electronic warfare and cyber warfare to rapidly demonstrate a capability for rapid fielding. It develops and demonstrates technologies for navigation and timing in radio frequency (RF) contested and denied environments. It develops and demonstrates advanced technologies for radio frequency electronic combat suites and advanced warning and countermeasure technologies to defeat electro-optical, infrared, and laser threats to aerospace platforms. It also develops and demonstrates technologies that will enable mission systems to be more resilient, agile, autonomous, and be able to operate in multiple domains. This program has been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication.

The Department of the Air Force technologies in this program are both enabling and enduring as we invest in maturing emerging technologies that address established mission gaps, and transformational technologies that address integrated enterprise capabilities intended to reshape the future force across air, space, and cyber warfighting domains. Development of transformational operational capabilities through advanced technology solutions focuses on five strategic capabilities: Global Persistent Awareness; Resilient Information Sharing; Rapid, Effective Decision-Making; Complexity, Unpredictability, and Mass; and Speed and Reach of Disruption and Lethality.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of such program funds would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, 1206601SF, and 0602298F.

This program is in Budget Activity 3, Advanced Technology Development because this budget activity includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

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Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>
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B. Program Change Summary (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	48.408	0.000	0.000	0.000	0.000
Current President's Budget	45.882	35.841	46.591	0.000	46.591
Total Adjustments	-2.526	35.841	46.591	0.000	46.591
• Congressional General Reductions	0.000	-0.065			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	35.906			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-0.780	0.000			
• Other Adjustments	-1.746	0.000	46.591	0.000	46.591

Change Summary Explanation

FY 2020 Other Adjustments: Decrease of \$1.746 million due to Air Force reprogramming.
 FY 2021 and 2022: Congressional directed realignments from program element restructure.

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Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>				Project (Number/Name) 633720 / <i>EW Quick Reaction Capabilities</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
633720: <i>EW Quick Reaction Capabilities</i>	-	26.928	0.000	29.484	0.000	29.484	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project establishes a capability to rapidly assess, develop and demonstrate new electronic warfare concepts, techniques, and capabilities as well as the required position navigation and timing (PNT) technologies and capabilities in the context of systemic electronic warfare (EW) effects (electronic warfare threat interactions) in a congested/contested electromagnetic spectrum, system-of-systems (SoS) environment of the future. It develops disruptive electronic warfare and countermeasures concepts specifically selected for high-impact, game-changing effects; evaluates them in high fidelity virtual and hardware evaluation settings; and demonstrates them in an operationally relevant environment. It establishes and maintains an all-source, physics-based, threat-to-countermeasures electronic warfare systems engineering methodology. It develops a core analytic function, supported by simulation-based wargaming and interactive engineering modeling capabilities to evaluate advanced countermeasures concepts.

This project includes the initiation and development of programs addressing DAF capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to DAF design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

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

	FY 2020	FY 2021	FY 2022
Title: Radio Frequency Electronic Warfare	10.008	0.000	3.476
Description: Develop electronic warfare focused knowledge databases, engineering models, mission simulations, analysis tools and assessment environments which enable the development of multi-domain electronic warfare technologies. The primary focus is on emulating complex battlespace radio frequency environments, electronic attack effects against emerging, networked weapon systems, and assessing flexible, software-defined electronic warfare systems with non-deterministic performance (for example, utilizing cognitive algorithms).			
FY 2021 Plans: In FY 2021, this work was performed out of Project 63431G, RF Warning & Countermeasures Tech, Radio Frequency Electronic Warfare effort.			
FY 2022 Plans: Mature fidelity of simulations of advanced electronic warfare systems to emulate the complex radio frequency threats and signals environment. Continue implementation of advanced digital signal synthesis to better represent complex emitters operating in complex environments containing sophisticated background emitters. Continue the development and demonstration efforts to			

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Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>	Project (Number/Name) 633720 / <i>EW Quick Reaction Capabilities</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>prove the concepts for full spectrum countermeasures capabilities. Continue expansion of software-in-the-loop and hardware-in-the-loop environments to assess closed-loop system performance.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: FY 2022 increased compared to FY 2021 by \$3.476 million. Funding increased due to realignment from Project 63431G, RF Warning & Countermeasures Tech, Radio Frequency Electronic Warfare effort.</p>				
<p>Title: Resilient Positioning, Navigation and Timing</p> <p>Description: Develop and transition robust Global Navigation Satellite System capabilities; resilient complementary position, navigation and timing techniques; precise position, navigation and timing technologies for distributed sensing/effects; position, navigation and timing technology to provide position, navigation and timing electronic warfare situational awareness and training; and position, navigation and timing architectures to enable resiliency against the rapidly evolving threat. Efforts will include prototypes and relevant Open Architecture standards where applicable to enable timely technology transition.</p> <p>FY 2021 Plans: In FY 2021, this work was performed out of Project 63431G, RF Warning & Countermeasures Tech, Position, Navigation and Timing for Contested/Denied Environments effort.</p> <p>FY 2022 Plans: Develop and demonstrate multi-ship geolocation of sources interfering with navigational satellite signals. Develop and demonstrate a transcoder that converts modernized Global Positioning System military signals into military signals useable by legacy Department of Defense Global Positioning System receivers. Continue software defined radio technology efforts to authenticate signals from foreign satellite navigation systems. Continue to define and refine navigational open architecture standards to permit integration of alternative/complementary position, navigation and timing approaches into future DoD systems including the resilient embedded Global Positioning System-inertial government reference architecture.</p> <p>In FY 2022 this effort renamed from Position, Navigation and Timing for Contested/Denied Environments to Resilient Positioning, Navigation and Timing.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: FY 2022 increased compared to FY 2021 by 14.947 million. Funding increased due to realignment from Project 63431G, RF Warning & Countermeasures Tech, Position, Navigation and Timing for Contested/Denied Environments effort.</p>		12.654	0.000	14.947
<p>Title: Electro-Optical/Infrared Warfare Demonstrator</p> <p>Description: Develop next generation countermeasure techniques to address the complete range of multispectral (for example, dual band infrared) threats including advanced techniques versus advanced man portable air defense system and air-to-air threats</p>		4.266	0.000	3.476

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>with multimode capabilities. Develop capabilities for situational awareness and countermeasure to integrated air defense systems and associated multispectral threats.</p> <p>FY 2021 Plans: In FY 2021, this work was performed out of Project 63431G, RF Warning & Countermeasures Tech, Electro-Optical/Infrared Threat Warning and Countermeasures effort.</p> <p>FY 2022 Plans: Develop a low cost, integrated missile and laser warning capability to identify, geo-locate, and counter, using both laser and expendable countermeasure response techniques, advanced laser and EO/IR guided missile threats to aircrews. Continue to apply analysis from field test to develop requirements for proactive detection and situation awareness for multiple Air Force platforms. Continue to iterate and refresh techniques for in-house at range data collection capabilities. Continue efforts to develop multispectrum electro-optical/radio frequency countermeasures and insert capabilities into existing and developing engagement modeling and simulation tools.</p> <p>In FY 2022 this effort renamed from Electro-Optical/Infrared Threat Warning and Countermeasures to Electro-Optical/Infrared Warfare Demonstrator.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: FY 2022 increased compared to FY 2021 by 3.476 million. Funding increased due to realignment from Project 63431G, RF Warning & Countermeasures Tech, Electro-Optical/Infrared Threat Warning and Countermeasures.</p>				
<p>Title: Transformational Technology Development</p> <p>Description: Continually funded effort. This funding allocation will start new and continue Transformational Technology Developments. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming; Battlespace Awareness; Integrated Base Defense; and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to new electronic warfare concepts, techniques and capabilities as well as new positioning, navigation and timing technologies and capabilities. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.</p> <p>FY 2021 Plans:</p>		0.000	0.000	7.585

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Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>	Project (Number/Name) 633720 / <i>EW Quick Reaction Capabilities</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
Not applicable				
<p><i>FY 2022 Plans:</i> Select Transformational Technology Development efforts in FY 2022 that support the National Defense Strategy and Department of Air Force priorities.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> FY 2022 increased compared to FY 2021 by \$7.585 million. Increase is due to realignment of funding from Project 63431G, RF Warning & Countermeasures Tech, Radio Frequency Electronic Warfare, Position, Navigation and Timing for Contested/Denied Environments effort and Electro-Optical/Infrared Threat Warning and Countermeasures effort.</p>				
Accomplishments/Planned Programs Subtotals		26.928	0.000	29.484
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>				Project (Number/Name) 63431G / <i>RF Warning & Countermeasures Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
63431G: <i>RF Warning & Countermeasures Tech</i>	-	11.691	31.142	9.255	0.000	9.255	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced technologies for radio frequency electronic combat suites, including the required navigation technologies and capabilities, to enhance the survivability of aerospace vehicles and to provide crew situational awareness. The research addresses technologies for missile/threat warning, radio frequency receivers, electronic combat pre-processors, advanced sorting/pre-processing algorithms, and expert software for applications on existing and future electronic combat systems. The research also focuses on the development and demonstration of subsystems and components for generating on-board/off-board radio frequency countermeasure techniques. This includes the development of electronic countermeasures techniques, as well as advanced electronic countermeasures technologies such as antennas, power amplifiers, and preamplifiers.

This project includes the initiation and development of programs addressing DAF capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to DAF design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

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

	FY 2020	FY 2021	FY 2022
Title: Radio Frequency Electronic Warfare Demonstrator	11.691	6.710	8.575
Description: Develop aerospace platform jamming concepts, technologies and techniques to counter advanced radio frequency threats associated with current and future aerospace weapon systems. Provide position, navigation and system resilience via open architecture solutions.			
FY 2021 Plans: Continue research into radio frequency receiver technologies enhancing the ability to detect threats, measure increased radio frequency features with greater accuracy, identify or classify signals more reliably, track and predict signals, use reasoning algorithms to reduce ambiguities and errors, and deduce greater knowledge from the radio frequency spectrum. Conduct technology demonstrations to support transition into Department of the Air Force platforms. Continue expansion of modeling, simulation and laboratory assessment environments commensurate with technologies being researched, developed and tested including cognitive and autonomous electronic warfare technologies. Start the implementation of emerging electronic attack and electronic support capabilities into open architectures. Demonstrate the capability to rapidly respond to new and unexpected threats in realistic environments.			

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>Navigation Technology Satellite 3 activities are performed under the Navigation Technology Satellite 3 effort in PE 0603032F, Future Air Force Integrated Tech Demos, Project 630320, Air Force Vanguard.</p> <p>FY 2022 Plans: Continue the implementation of emerging electronic attack and electronic support capabilities into open architectures. Continue to conduct technology demonstrations to support transition into Air Force platforms. Use agile software defined process to demonstrate the capability to rapidly respond to new and unexpected complex emitters in realistic radio frequency environments. Continue expansion and maturation of modeling, simulation and laboratory assessment environments commensurate with technologies being researched, developed and tested including cognitive and autonomous electronic warfare technologies.</p> <p>In FY 2022 this effort was renamed from Electronic Attack to Radio Frequency Electronic Warfare Demonstrator.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: FY 2022 increased compared to FY 2021 by 1.865 million. Funding increased due to increased research support requirements.</p>				
<p>Title: Transformational Technology Development</p> <p>Description: Continually funded effort. This funding allocation will start new and continue Transformational Technology Developments. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming; Battlespace Awareness; Integrated Base Defense; and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to the development and demonstration of advanced technologies for radio frequency electronic combat suites. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.</p> <p>FY 2021 Plans: Not applicable</p> <p>FY 2022 Plans: Select Transformational Technology Development efforts in FY 2022 that support the National Defense Strategy and Department of Air Force priorities.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: FY 2022 increased compared to FY 2021 by \$0.680 million. Justification for the increase is described in the plans above.</p>		0.000	0.000	0.680
Title: Radio Frequency Electronic Warfare		0.000	5.800	0.000

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Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>	Project (Number/Name) 63431G / <i>RF Warning & Countermeasures Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>Description: Develop electronic warfare focused knowledge databases, engineering models, mission simulations, analysis tools and assessment environments which enable the development of multi-domain electronic warfare technologies. The primary focus is on emulating complex battlespace radio frequency environments, electronic attack effects against emerging, networked weapon systems, and assessing flexible, software-defined electronic warfare systems with non-deterministic performance (for example, utilizing cognitive algorithms).</p> <p>FY 2021 Plans: Continue expansion of simulations to accommodate advanced electronic warfare systems and emulate the complex radio frequency threats and signals environment. Begin implementation of advanced digital signal synthesis to better represent complex emitters operating in complex environments containing sophisticated background emitters. Continue development of higher fidelity threat system and signal propagation models. Continue developing the tools, methods and demonstrations to assess both the performance of future electronic warfare systems as well as their effectiveness including cognitive and autonomous technologies. Continue the development and demonstration efforts to prove the concepts for full spectrum countermeasures capabilities. Continue expansion of software-in-the-loop and hardware-in-the-loop environments to achieve closed-loop system performance.</p> <p>FY 2022 Plans: Starting in FY 2022, this work is performed under Project 633720, EW Quick Reaction Capabilities, Radio Frequency Electronic Warfare effort and Transformational Technology Development effort.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: FY 2022 decreased compared to FY 2021 by 5.800 million. The decrease is due to the realignment of funding to Project 633720, EW Quick Reaction Capabilities, Radio Frequency Electronic Warfare effort and Transformational Technology Development effort.</p>			
<p>Title: Position, Navigation and Timing for Contested/Denied Environments</p> <p>Description: Develop and transition robust Global Navigation Satellite System capabilities; resilient complementary position, navigation and timing techniques; precise position, navigation and timing technologies for distributed sensing/effects; position, navigation and timing technology to provide position, navigation and timing electronic warfare situational awareness and training; and position, navigation and timing architectures to enable resiliency against the rapidly evolving threat. Efforts will include prototypes and relevant Open Architecture standards where applicable to enable timely technology transition.</p> <p>FY 2021 Plans: Continue to further research techniques to securely certify Global Navigation Satellite System software defined radio technology and methods to trust Global Navigation Satellite Systems. Complete advanced reconfigurable software defined radio navigation receivers to enable spectrum agile systems and integration as the user equipment component to the Navigation Technology Satellite-3 flight experimentation. Continue to develop alternative/complementary position, navigation and timing techniques which</p>	0.000	8.899	0.000

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Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>	Project (Number/Name) 63431G / <i>RF Warning & Countermeasures Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>increase the availability of the position, navigation and timing solution and support creation of an integrated position, navigation and timing solution focused on increasing the precision needed to support novel radio frequency coherent sensing and electronic warfare techniques. Continue to define and refine navigational open architecture standards to allow for integration of Global Navigation Satellite System and alternative/complementary position, navigation and timing approaches into future systems. Demonstrate integration of improved Global Navigation Satellite System position, navigation and timing and alternative position, navigation and timing solutions into an advanced resilient embedded Global Positioning System-inertial government reference architecture.</p> <p>FY 2022 Plans: Starting in FY 2022, this work is performed under Project 633720, EW Quick Reaction Capabilities, Resilient Positioning, Navigation and Timing effort.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: FY 2022 decreased compared to FY 2021 by \$8.899 million. The decrease is due to the realignment of funding to Project 633720, EW Quick Reaction Capabilities, Resilient Positioning, Navigation and Timing effort.</p>				
<p>Title: Electro-Optical/Infrared Threat Warning and Countermeasures</p> <p>Description: Develop next generation countermeasure techniques to address the complete range of multispectral (for example, dual band infrared) threats including advanced techniques versus advanced man portable air defense system and air-to-air threats with multimode capabilities. Develop capabilities for situational awareness and countermeasure to integrated air defense systems and associated multispectral threats.</p> <p>FY 2021 Plans: Apply analysis from field test to develop requirements for proactive detection and situation awareness for multiple Department of the Air Force platforms. Iterate and refresh techniques for in-house at range data collection capabilities. Perform test against real threats at significant range. Continue to evaluate acquisition alternatives for a proactive advanced technology demonstration. Continue efforts to develop multispectrum electro-optical/radio frequency countermeasures and insert capabilities into existing engagement modeling and simulation tools.</p> <p>FY 2022 Plans: Starting in FY 2022, this work is performed under Project 633720, EW Quick Reaction Capabilities, Electro-Optical/Infrared Warfare Demonstrator effort and Transformational Technology Development effort.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement:</p>		0.000	5.034	0.000

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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
FY 2022 decreased compared to FY 2021 by 5.034 million. The decrease is due to the realignment of funding to Project 633720, EW Quick Reaction Capabilities, Electro-Optical/Infrared Warfare Demonstrator effort and Transformational Technology Development effort.			
<p>Title: Avionics Cyber Vulnerabilities</p> <p>Description: Develop and demonstrate methods, techniques, and technical tools to enable, assist, and improve the vulnerability discovery processes. Use developed tools and techniques to assess avionics boxes, systems, busses, and components. Investigate techniques to mitigate discovered vulnerabilities. Develop and demonstrate mitigation and protection technologies on future concept platforms for adaptability and resilience.</p> <p>FY 2021 Plans: Complete transition of vulnerability mitigation technologies to legacy weapon systems. Begin demonstrations of agile, resilient and lethal capabilities of next-generation architecture. Provide integration support for emerging technologies such as autonomy, alternative-navigation technologies, open system architecture standards and approaches, multispectral and distributed intelligence surveillance and reconnaissance, and electromagnetic spectrum warfare. Continue to transition next-generation architectures to adopting programs/platforms, and open architecture approaches to rapidly integrate advanced mission system capability for next generation architectures.</p> <p>FY 2022 Plans: Starting in FY 2022, this work is performed under Project 634335, Cyber Concepts, Resilient and Agile Mission Systems Architecture effort and Transformational Technology Development effort.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: FY 2022 decreased compared to FY 2021 by 1.500 million. The decrease is due to the realignment of funding to Project 634335, Cyber Concepts, Resilient and Agile Mission Systems Architecture effort and Transformational Technology Development effort.</p>	0.000	1.500	0.000
<p>Title: Avionics Cyber Protections</p> <p>Description: Develop and demonstrate advanced automated analysis tools and protection techniques to prevent exploitation of cyber susceptibilities in avionics systems. This strategy would include discovery and mitigation of likely attack vectors, remediation of susceptibilities, and safeguards to assure the integrity of embedded software.</p> <p>FY 2021 Plans: Continue to enhance and extend cyber protection tools, techniques and test beds for manned and unmanned air vehicles, mission and support equipment. Complete development of system integration laboratories to test resilient and agile mission system architecture concepts on avionics; intelligence, surveillance, and reconnaissance; positioning, navigation, and timing systems. Continue to flight test and demonstrate advanced cyber protection capabilities on mission systems. Continue to collaborate with</p>	0.000	3.199	0.000

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>program offices and end-users to transition resilient and agile technologies. Leverage open system architecture standards and approaches to demonstrate agile, resilient and autonomous capabilities for current and next-generation architectures.</p> <p>FY 2022 Plans: Starting in FY 2022, this work is performed under Project 634335, Cyber Concepts, Resilient and Agile Mission Systems Architecture effort and Transformational Technology Development effort.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: FY 2022 decreased compared to FY 2021 by 3.199 million. The decrease is due to the realignment of funding to Project 634335, Cyber Concepts, Resilient and Agile Mission Systems Architecture effort and Transformational Technology Development effort.</p>				
Accomplishments/Planned Programs Subtotals		11.691	31.142	9.255
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>	Project (Number/Name) 634335 / <i>Cyber Concepts</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
634335: <i>Cyber Concepts</i>	-	2.903	0.000	4.147	0.000	4.147	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This project develops and demonstrates methods to discover cyber susceptibilities, assess avionics systems, formulate mitigation strategies, and investigate use of tools and technologies to automate this process. It is designed to apply developed vulnerability discovery, vulnerability mitigation, and cyber protection technology to avionics systems and components and embedded systems. This involves technologies for trusted sensors and trusted systems that deter exploitation of our critical hardware and software. This project aims to develop cyber resilience and protect systems through adaptation of the system to the threat. It demonstrates these technologies in open and adaptable architectures for system integration in field demonstrations and proves out the technologies through rapid integration of sensors and architectures for technology transition. It integrates research efforts in electronic and cyber warfare to rapidly demonstrate a capability for rapid fielding.

This project includes the initiation and development of programs addressing DAF capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to DAF design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

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

	FY 2020	FY 2021	FY 2022
<p>Title: Avionics Cyber Vulnerabilities</p> <p>Description: Develop and demonstrate methods, techniques, and technical tools to enable, assist, and improve the vulnerability discovery processes. Use developed tools and techniques to assess avionics boxes, systems, busses, and components. Investigate techniques to mitigate discovered vulnerabilities. Develop and demonstrate mitigation and protection technologies on future concept platforms for adaptability and resilience.</p> <p>FY 2021 Plans: In FY 2021, this work is performed under Project 63431G, RF Warning & Countermeasures Tech, Avionics Cyber Vulnerabilities effort.</p> <p>FY 2022 Plans: Not applicable</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Not applicable</p>	1.613	0.000	0.000
<p>Title: Avionics Cyber Protections</p>	1.290	0.000	0.000

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Air Force		Date: May 2021		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>	Project (Number/Name) 634335 / <i>Cyber Concepts</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>Description: Develop and demonstrate advanced automated analysis tools and protection techniques to prevent exploitation of cyber susceptibilities in avionics systems. This strategy would include discovery and mitigation of likely attack vectors, remediation of susceptibilities, and safeguards to assure the integrity of embedded software.</p> <p>FY 2021 Plans: In FY 2021, this work is performed under Project 63431G, RF Warning & Countermeasures Tech, Avionics Cyber Protections effort.</p> <p>FY 2022 Plans: Not applicable</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Not applicable</p>				
<p>Title: Resilient and Agile Mission Systems Architecture</p> <p>Description: This effort performs advanced development and demonstration of methods, technologies, and tools to enable resilience and protect mission systems against threats. This involves open and adaptable architectures for rapid integration and agile systems, cyber protections and resilience technologies to protect against threats. It integrates research efforts in electronic and cyber warfare to demonstrate novel operational capabilities through laboratory, field, and flight tests and experimentation. The goal is to reduce risk for rapid transition of novel operational capabilities into Department of the Air Force mission systems.</p> <p>FY 2021 Plans: In FY 2021, this work was performed under Project 63431G, RF Warning & Countermeasures Tech, Avionics Cyber Vulnerabilities effort and Avionics Cyber Protections effort.</p> <p>FY 2022 Plans: Continue ongoing investigations to evolve and mature open architecture standards. Initiate development of advanced networking, processing, advanced computing paradigms, and cybersecurity technologies for next-generation avionics mission system capabilities. Apply agile software technologies and digital engineering techniques for rapid and affordable development, integration, and prototype capability demonstrations.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: FY 2022 increased compared to FY 2021 by \$3.260 million. Increase is due to realignment of funding from Project 63431G, RF Warning & Countermeasures Tech, Avionics Cyber Vulnerabilities effort and Avionics Cyber Protections effort.</p>		0.000	0.000	3.260
<p>Title: Transformational Technology Development</p>		0.000	0.000	0.887

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Air Force		Date: May 2021		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>	Project (Number/Name) 634335 / <i>Cyber Concepts</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>Description: Continually funded effort. This funding allocation will start new and continue Transformational Technology Developments. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming; Battlespace Awareness; Integrated Base Defense; and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to the development and demonstration of methods to discover cyber susceptibilities, assess avionics systems, formulate mitigation strategies and investigate use of tools and technologies to automate this process. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.</p> <p>FY 2021 Plans: Not applicable</p> <p>FY 2022 Plans: Select Transformational Technology Development efforts in FY 2022 that support the National Defense Strategy and Department of Air Force priorities.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: FY 2022 increased compared to FY 2021 by \$0.887 million. Justification for this increase is described in the plans above.</p>				
Accomplishments/Planned Programs Subtotals		2.903	0.000	4.147
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Air Force										Date: May 2021		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>				Project (Number/Name) 63691X / <i>EO/IR Warning & Countermeasures Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
63691X: <i>EO/IR Warning & Countermeasures Tech</i>	-	4.360	4.699	3.705	0.000	3.705	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project develops and demonstrates the advanced warning and countermeasure technologies required to negate electro-optical/infrared and laser threats to aerospace platforms. Develops off-board (decoys and expendables) and on-board countermeasure technologies for aircraft self-protection to provide robust, affordable solutions for protection against infrared missiles with autonomous seekers, multi-spectral threats, laser-guided weapons, and electro-optical/infrared tracking systems used to direct electro-optical/infrared and radar-guided missiles.

This project includes the initiation and development of programs addressing DAF capability gaps and provides technologies for transformational future force capabilities. Transformational efforts will be identified through a competitive process and be responsive to DAF design priorities. Selected efforts will be designated as transformational, indicating enterprise-level priority.

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

	FY 2020	FY 2021	FY 2022
Title: Advanced Electro-Optical/Infrared Warning and Countermeasure Technologies	4.360	4.699	2.791
Description: Analyze the vulnerabilities of current infrared missile systems and future imaging infrared sensors. Develop advanced countermeasure system techniques to exploit vulnerabilities for use against infrared and electro-optical guided missile threats. Develop advanced optical and infrared sensor systems for airborne and space situational awareness and threat warning.			
FY 2021 Plans: Continue threat characterization and countermeasures development and field testing of new advanced threats to include laser jam codes and techniques. Continue the incorporation of air to air threat radio frequency data links into validated engagement models and examine the combination of the infrared models with equivalent radio frequency models into the overarching Advanced Framework for Simulation, Integration and Modeling software environment to address multispectrum threats. Continue assessment of missile warning technologies and techniques for a variety of Department of the Air Force platforms. Develop the requirements for next generation laser threat sensors for combat aircraft and space situation awareness. Start the integration of the testbed supporting development of space sensors.			
FY 2022 Plans: Continue to mature the process for threat characterization and countermeasures development and field testing of new advanced threats to include laser jam codes and techniques. Mature the incorporation of air to air threat radio frequency data links into validated engagement models and examine the combination of the infrared models with equivalent radio frequency models into			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Air Force		Date: May 2021		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / <i>Electronic Combat Technology</i>	Project (Number/Name) 63691X / <i>EO/IR Warning & Countermeasures Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>the overarching Advanced Framework for Simulation, Integration and Modeling software environment to address multispectrum threats. Continue effectiveness assessment of laser and missile warning technologies and techniques for a variety of Air Force platforms.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: FY 2022 decreased compared to FY 2021 by \$1.908 million. Decrease is a result of Air Force reprogramming.</p>				
<p>Title: Transformational Technology Development</p> <p>Description: Continually funded effort. This funding allocation will start new and continue Transformational Technology Developments. The Transformational Technology Development program will select new projects, in alignment with mission focused areas which include, but are not limited to: Intelligent Planning and Wargaming; Battlespace Awareness; Integrated Base Defense; and Hypersonic Multi-Mission Aircraft. Investments focus on technology development efforts including, but are not limited to the development and demonstration of advanced warning and countermeasure technologies required to negate electro-optical/infrared and laser threats to aerospace platforms. This investment is overseen by senior representatives from Air and Space Forces who participate in the submission, initial review, and down-selection of Transformational Technology Development proposed efforts. Final selections will be reviewed by the Air Force Deputy Assistant Secretary for Science, Technology, and Engineering before a final recommendation for Congressional approval is made.</p> <p>FY 2021 Plans: Not applicable</p> <p>FY 2022 Plans: Select Transformational Technology Development efforts in FY 2022 that support the National Defense Strategy and Department of Air Force priorities.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: FY 2022 increased compared to FY 2021 by \$0.914 million. Justification for the increase is described in the plans above.</p>		0.000	0.000	0.914
Accomplishments/Planned Programs Subtotals		4.360	4.699	3.705
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				