Exhibit R-2, RDT&E Budget Item Justification: PB 2019 Air Force											Date: February 2018	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602788F / *Dominant Information Sciences and Methods*							
COST ($ in Millions)	**Prior Years**	**FY 2017**	**FY 2018**	**FY 2019 Base**	**FY 2019 OCO**	**FY 2019 Total**	**FY 2020**	**FY 2021**	**FY 2022**	**FY 2023**	**Cost To Complete**	**Total Cost**
Total Program Element	-	165.517	167.818	162.420	0.000	162.420	173.761	177.163	183.401	174.984	Continuing	Continuing
625315: *Connectivity and Protection Tech*	-	30.429	30.914	32.482	0.000	32.482	32.309	32.700	35.777	33.951	Continuing	Continuing
625316: *Info Mgt and Computational Tech*	-	12.868	10.720	12.089	0.000	12.089	13.252	12.978	14.007	13.291	Continuing	Continuing
625317: *Information Decision Making Tech*	-	14.747	28.349	16.719	0.000	16.719	17.501	18.500	18.693	17.737	Continuing	Continuing
625318: *Operational Awareness Tech*	-	21.217	21.514	22.338	0.000	22.338	24.893	25.727	26.164	24.828	Continuing	Continuing
625319: *Cyberspace Dominance Technology*	-	64.528	55.801	57.742	0.000	57.742	64.281	65.144	66.255	62.876	Continuing	Continuing
62OMMS: *Research Site Support*	-	21.728	20.520	21.050	0.000	21.050	21.525	22.114	22.505	22.301	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program develops enterprise-centric information technology for the Air Force. Advances in enterprise-centric information technologies are required to increase warfighter readiness and effectiveness by providing the right information, at the right time, in the right format, anytime, anywhere in the world. The Connectivity and Protection Tech project provides the technologies for multi-level, secure, seamless networks; advanced communications processors; anti-jam and low probability of intercept techniques, as well as technologies that deter any adversary from attacking computer systems while allowing access to, presence on, manipulation of, and operational effects on adversary computer systems. This project also develops the technology base for the next generation of ultra-wide-bandwidth, multi-channeled, air- and space-based communications networks. The Information Management and Computational Tech project provides advances in information management and dissemination technologies to ensure the delivery of high-quality, timely, secure information to the warfighter, and develop technologies to produce both advanced on demand computational processing and computer architectures with greater capacity and sophistication for addressing dynamic mission objectives under constraints imposed by Air Force systems. The Information Decision Making Tech project develops the technology to support the commander and staff's ability to command all viable options to achieve desired effects across the full spectrum of operations. The Operational Awareness Tech project develops technologies that improve their capability to generate, process, manage, fuse, exploit, interpret, and disseminate timely and accurate information. The Cyberspace Dominance Technology project develops technologies to deliver a full range of options in cyberspace on par with air and space dominance in each of the areas of cyber-attack, cyber defense, and cyber support to achieve the strategic capability of cyber dominance. The Research Site Support project provides the Rome Research Site infrastructure at Rome, New York and provides for the continued operations of all Rome Research Site properties, buildings, and services necessary for the research mission. Efforts in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication.

Exhibit R-2, RDT&E Budget Item Justification: PB 2019 Air Force	Date: February 2018
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602788F / *Dominant Information Sciences and Methods*

The Air Force Future Operating Concept established a science and technology challenge to enable operational agility (the ability to rapidly generate and shift among multiple solutions for a given challenge) as a way to adapt swiftly to any situation or enemy action by 2035. Operational agility will require flexibility (manifested as multi-domain operations), speed (manifested as superior decision speed), coordination (manifested as dynamic command and control), balance (manifested as presenting a balanced capability mix), and strength (manifested as performance-optimized teams). In order to enable operational agility, this program will begin to shape future research and development (R&D) to focus on technologies in support of operational agility through multi-domain command and control (MDC2) capabilities.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of program funds in this PE would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602601F, 0602602F, 0602605F, 1206601F, and 0602298F."

This program is in Budget Activity 2, Applied Research because this budget activity includes studies, investigations, and non-system specific technology efforts directed toward general military needs with a view toward developing and evaluating the feasibility and practicality of proposed solutions and determining their parameters.

B. Program Change Summary ($ in Millions)	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total
Previous President's Budget	161.650	167.818	162.216	0.000	162.216
Current President's Budget	165.517	167.818	162.420	0.000	162.420
Total Adjustments	3.867	0.000	0.204	0.000	0.204
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	5.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	1.179	0.000			
• SBIR/STTR Transfer	-2.312	0.000			
• Other Adjustments	0.000	0.000	0.204	0.000	0.204

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2017	FY 2018
Project: 625319: *Cyberspace Dominance Technology*		
Congressional Add: *Program Increase*	4.934	0.000
Congressional Add Subtotals for Project: 625319	4.934	0.000
Congressional Add Totals for all Projects	4.934	0.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2019 Air Force	Date: February 2018
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602788F / *Dominant Information Sciences and Methods*

Change Summary Explanation

Increase in FY 2017 reflects reprogramming to support Research and Development Projects, 10 U.S.C. Section 2358.

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force			Date: February 2018
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602788F / *Dominant Information Sciences and Methods*	Project (Number/Name) 625315 / *Connectivity and Protection Tech*	

COST ($ in Millions)	Prior Years	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total	FY 2020	FY 2021	FY 2022	FY 2023	Cost To Complete	Total Cost
625315: *Connectivity and Protection Tech*	-	30.429	30.914	32.482	0.000	32.482	32.309	32.700	35.777	33.951	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Air Force requires technologies that enable assured, worldwide communications among all elements of the force. These communication technologies will provide en-route and deployed reach-back communications for distributed, collaborative military operations. This project provides the technologies for secure, self-configuring, self-healing, seamless networks; advanced communications processors; anti-jam and low probability of intercept communications techniques; agile and dynamic policy-based network management capabilities; and modular, programmable, low-cost software radios. In addition, it develops both the technology base for ultra-wide bandwidth and multi-channeled communications networks (both air and space based) on and between platforms.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Advanced Connectivity Technologies	30.429	30.914	32.482
Description: Develop improved, survivable, higher bandwidth communications, networking, and signal processing technologies to provide secure, adaptive, covert, anti-jam, and assured global battlespace connectivity tailored to anti-access and area-denial environments and contested operations.			
FY 2018 Plans: Advance the development of Aerial Layer Network Components to develop and prototype technologies for robust, adaptive Mission Aware airborne networks. Continue the investigation and research into high frequency pathways (i.e. V and W band of the electromagnetic spectrum) to support aerial and space-based beyond line of sight communications. Continue dynamic map-to-mission software for operations continuity and agile info management technology for secure message exchange. Continue the investigation of the optimal use of autonomy on small unmanned aircraft system platforms to support semi-autonomous distributed cooperative airborne tactics using airborne networks. Progress on the development of advanced hardware with embedded cyber protection for multi-mission agile radio frequency capability.			
FY 2019 Plans: Continue the research and development of Aerial Layer Network Components and prototype technologies for robust, adaptive, and mission aware airborne networks. Advance the research and investigation of high frequency pathways (e.g. the V and W band of the electromagnetic spectrum) to support aerial and space-based beyond line of sight communications. Expand the research and development of dynamic map-to-mission for secure message exchange operations continuity and agile info management. Develop a waveform testbed and flight test a new multi-waveform radio. Conduct research and development to measure propagation at millimeter wave frequencies to validate previously developed models and enable future definition of			

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602788F / *Dominant Information Sciences and Methods*	**Project (Number/Name)** 625315 / *Connectivity and Protection Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
military satellite communications systems. Complete autonomic network model and simulation. Complete low overhead network monitoring and management protocol. Continue ionospheric research, propagation modeling and simulation. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $1.568 million. Justification for this increase is due to additional research and development in multi-waveform radio and new models for military satellite communications.			
Accomplishments/Planned Programs Subtotals	30.429	30.914	32.482

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force			Date: February 2018
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602788F / *Dominant Information Sciences and Methods*	Project (Number/Name) 625316 / *Info Mgt and Computational Tech*	

COST ($ in Millions)	Prior Years	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total	FY 2020	FY 2021	FY 2022	FY 2023	Cost To Complete	Total Cost
625316: *Info Mgt and Computational Tech*	-	12.868	10.720	12.089	0.000	12.089	13.252	12.978	14.007	13.291	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Air Force requires the capability to maximize the value, sharing, management, and use of its information and information assets in achieving its mission objectives as the importance of information grows in the current net-centric environment. Technology development in this project must be capable of taking advantage of future net-centric environments including new structured and ad hoc processes in response to rapidly changing warfare challenges. Advances in robust information management focus on quality of service and flow of information within the enterprise, information transformation and brokering, secure information sharing across and among domains, and collaboration of workflow within the enterprise. Technologies addressed in this project include the ability to globally share, discover, and access information across organizational, functional, and coalition boundaries and between and among domains, the timely delivery of information to tactical assets, the tailoring and prioritization of information based on mission needs and importance, and the scaling, robustness, and collaboration features required of the Air Force net-centric information management environment.

The Air Force Future Operating Concept established a science and technology challenge to enable operational agility (the ability to rapidly generate and shift among multiple solutions for a given challenge) as a way to adapt swiftly to any situation or enemy action by 2035. In order to enable multi-domain operations, this project will begin to shape future research and development to focus on the capability to maximize the value, sharing, management, and use of information and information assets in support of multi-domain command and control.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Dissemination Technologies	12.868	10.720	12.089
Description: Investigate and develop technologies for decision quality information dissemination services via publish, subscribe, and query across the Global Information Grid to enterprise and tactical assets and coalition partners.			
FY 2018 Plans: Initiate research and development that will enable multiple echelons of a battlefield command to adapt operations to changing situations and dynamically select from the best set of mission options. Continue the development and demonstration of a set of embedded information management software services and adaptable user interfaces that will automate sensor tasking based on sensor availability and multiple consumer information needs. Continue to develop highly scalable mission-oriented middleware that semantically characterizes and contextualizes information to automatically identify and deliver mission relevant information to consumers in federated environments.			
FY 2019 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602788F / *Dominant Information Sciences and Methods*	**Project (Number/Name)** 625316 / *Info Mgt and Computational Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Continue research that will enable multiple echelons of a battlefield command to adapt operations to changing situations and dynamically select from the best set of mission options. Advance the research of highly scalable mission oriented middleware that semantically characterizes and contextualizes information to automatically identify and deliver mission relevant information to consumers in federated environments. Focus research in the area of Multi-Domain Command and Control. Continue development of integrated and field tested tactical-to-enterprise information management services. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $1.369 million. Justification for this increase is due to additional investment in multi-domain command and control and increased focus on tactical to enterprise information management services.			
Accomplishments/Planned Programs Subtotals	12.868	10.720	12.089

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force			Date: February 2018
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602788F / *Dominant Information Sciences and Methods*	Project (Number/Name) 625317 / *Information Decision Making Tech*	

COST ($ in Millions)	Prior Years	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total	FY 2020	FY 2021	FY 2022	FY 2023	Cost To Complete	Total Cost
625317: *Information Decision Making Tech*	-	14.747	28.349	16.719	0.000	16.719	17.501	18.500	18.693	17.737	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Air Force requires advances in technologies enabling the effective execution of military objectives that will vastly improve the ability to support the commander and staff's ability to command all viable options to achieve desired effects across the full spectrum of operations (air, space, and cyberspace) at all levels of war (strategic, operational, and tactical) and during all phases of conflict. Technology development in this project includes anticipatory decision support; course of action development, planning, scheduling, and assessment; and the real-time effective portrayal of complex data sets.

The Air Force Future Operating Concept established a science and technology challenge to enable operational agility (the ability to rapidly generate and shift among multiple solutions for a given challenge) as a way to adapt swiftly to any situation or enemy action by 2035. In order to enable multi-domain operations, this project will begin to shape future research and development to focus on the capability to maximize the value, sharing, management, and use of information and information assets in support of multi-domain command and control.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Campaign Planning Technologies	9.930	5.405	9.888
Description: Develop advanced monitoring, planning, and assessment technologies enabling aerospace commanders to develop effects-based campaigns. ***FY 2018 Plans:*** Initiate development of software algorithms and architecture showing that an autonomous system can execute a tactical mission, in responding to commands and changing operational and environmental conditions, in a manner consistent with mission-planned contracts. Continue to develop and deliver combat planning and tactical assessment software services supporting distributed command and control capabilities. ***FY 2019 Plans:*** Continue to research combat planning and tactical assessment software services and increase applied research in the area of multi-domain command and control for campaign planning and battlefield management. Continue research for identifying and implementing state-of-the-art learning models. Develop algorithms for data-efficient leaning and integrate with a machine learning framework. Develop algorithms that will dynamically adapt to varying situations based on situational awareness. ***FY 2018 to FY 2019 Increase/Decrease Statement:***			

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602788F / *Dominant Information Sciences and Methods*	**Project (Number/Name)** 625317 / *Information Decision Making Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
FY 2019 increased compared to FY 2018 by $4.483 million. Justification for this increase is due to larger emphasis on artificial intelligence and machine learning for situational awaremenss.			
Title: Command and Control System Technologies ***Description:*** Investigate, analyze, and develop technologies for planning, execution, and automatic rapid reconfiguration of distributed intelligent and integrated command and control information systems to achieve the commander's intent throughout varying crisis levels. ***FY 2018 Plans:*** Continue development of assessment services allowing the ability to recognize plan deviations and determine the need for replanning across a degraded operational environment. Continue development of the application of group-sourcing methods, and advanced visualization capabilities, for Space Command and Control. Leverage the Defense Advanced Research Projects Agency Future Command and Control program activities and initiate $13 million effort to support Air Force Science and Technology need to develop solutions for a classified Air Combat Command capability gap. ***FY 2019 Plans:*** Leverage prior efforts in developing plan assessment services and conduct quantitative evaluations of cyber assets to cyber operators, enabling them to present viable cyber options to commanders for multi-domain (air, space, cyberspace, land, sea, undersea) integrated plans. Initiate research and development of command and control system technologies in the area of multi-domain command and control. Initiate research for applying machine learning techniques to enhance and optimize space operations. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $16.113 million. Justification for this decrease is due to completion of Defense Advanced Research Projects Agency future Command and Control program activities toward Air Combat Command capability gap.	4.817	22.944	6.831
Accomplishments/Planned Programs Subtotals	14.747	28.349	16.719

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602788F / *Dominant Information Sciences and Methods*	**Project (Number/Name)** 625317 / *Information Decision Making Tech*

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force			Date: February 2018
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602788F / *Dominant Information Sciences and Methods*	Project (Number/Name) 625318 / *Operational Awareness Tech*	

COST ($ in Millions)	Prior Years	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total	FY 2020	FY 2021	FY 2022	FY 2023	Cost To Complete	Total Cost
625318: *Operational Awareness Tech*	-	21.217	21.514	22.338	0.000	22.338	24.893	25.727	26.164	24.828	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Air Force requires technologies that improve and automate the capability to generate, process, manage, fuse, exploit, interpret, and disseminate timely and accurate information. This project provides not only a network-centric, collaborative intelligence analysis capability that enables the fusion of multi-intelligence and sensor sources to provide timely situational awareness, understanding, and anticipation of the threats in the battlespace, but also the advanced, novel exploitation technologies needed to intercept, collect, locate, and process both covert and overt raw data from intelligence and sensor sources. It leads the research, discovery, and development of technology that enables the fusion of multi-intelligence sources to provide accurate object tracking and identification, situational awareness, understanding, and anticipation of the threats in the battlespace (air, ground, space, and cyber). It also leads in the development of advanced exploitation technologies to maximize the intelligence gained from our adversaries in the areas of spectral detection and geolocation, signal recognition and analysis, and the data tagging, tracking, and tracing via the insertion of secure, imperceptible signal embedding for future fusion and understanding of the information.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Multi-Source Fusion Technologies	9.744	11.902	10.117
Description: Develop higher-level fusion and the enabling text information/knowledge base technologies to achieve situational awareness and understanding at all command levels for dynamic planning, assessment, and execution processes.			
FY 2018 Plans: Continue the research and development of technologies to achieve large data alignment, and to improve indexing and search on textual data, for large-scale, disparate data sources, both structured and unstructured, by employing various ontologies and machine learning techniques. Continue to develop multiple sourced intelligence techniques using context-based, pattern of life analysis for permissive and contested environments. Continue development of techniques for information extraction from network analysis. Continue to develop a distributed multi-sources intelligence processing, exploitation, and dissemination software framework. Incorporate automated or operator-assist product generation to expedite analyst workflow, and provide analytics with based on input from the analyst.			
FY 2019 Plans: Continue the research and development of data analytics and strategic indications and warnings technologies (including large data alignment, indexing and search on textual data, large-scale and disparate data sources, both structured and unstructured data, and employment of various ontologies and machine learning techniques). Advance research and development for cloud-based data and information sharing environment for optimized processing and automated association capability.			
FY 2018 to FY 2019 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602788F / *Dominant Information Sciences and Methods*	**Project (Number/Name)** 625318 / *Operational Awareness Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
FY 2019 decreased compared to FY 2018 by $1.785 million. Justification for this decrease is due to de-emphasis on certain types of information/text extraction mechanisms.			
Title: Exploitation Technologies ***Description:*** Develop digital information exploitation technologies for electronic communications and special signals intelligence, imagery, and measurement signatures to increase accuracy, correlation, and timeliness of the information. ***FY 2018 Plans:*** Continue to develop topological algorithm analytics to exploit features for anomaly and/or pattern detection. Continue signals intelligence characterization algorithm development and refine methods based on operator feedback. Develop specialized signals intelligence alerting and change detection. ***FY 2019 Plans:*** Focus signals intelligence characterization on audio and other electronic signals. Initiate research and development in exploitation technologies using audio processing for language modeling and deep learning techniques. Continue research on enhanced emitter feature extraction capabilities and development of automated electronics intelligence analysis toolsets. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $2.617 million. Justification for this increase is due to initiated research in machine learning techniques applied to audio/language processing.	8.724	8.353	10.970
Title: Next Generation Command Technologies ***Description:*** Develop modeling and simulation technologies for the next generation of planning, assessment, and execution environments. ***FY 2018 Plans:*** Continue research and development of capabilities to support battle damage assessment and situational awareness based on available data. Continue to conduct research and development of capabilities that semi-automatically extracts and visualizes relationships, automatically prioritize/rank entities based on identified relationships, semi-automatically updates understanding of each entity based on the situation analysis when new information is available. ***FY 2019 Plans:*** Continue research and development of capabilities to support situational awareness. Conduct extended user evaluations at designated operational sites to advance applied research for full spectrum targeting semantic capabilities and provide a cross-organization workflow. ***FY 2018 to FY 2019 Increase/Decrease Statement:***	2.749	1.259	1.251

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602788F / *Dominant Information Sciences and Methods*	**Project (Number/Name)** 625318 / *Operational Awareness Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
FY 2019 decreased compared to FY 2018 by $0.008 million. Justification for this decrease is described in plans above.			
Accomplishments/Planned Programs Subtotals	21.217	21.514	22.338

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force			Date: February 2018
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602788F / *Dominant Information Sciences and Methods*	Project (Number/Name) 625319 / *Cyberspace Dominance Technology*	

COST ($ in Millions)	Prior Years	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total	FY 2020	FY 2021	FY 2022	FY 2023	Cost To Complete	Total Cost
625319: *Cyberspace Dominance Technology*	-	64.528	55.801	57.742	0.000	57.742	64.281	65.144	66.255	62.876	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Air Force requires technologies to deliver a full range of options in cyberspace on par with air and space dominance in each of the areas of cyber-attack, cyber defense, and cyber support to achieve the strategic capability of cyber dominance. The Air Force requires the development of superior, intelligent, on-demand computing to enable information superiority to include advances in secure information sharing across domains and boundaries as well as technologies that successfully deter any adversary from attacking computer systems anytime, anywhere by ensuring the Air Force's ability to: access, maintain presence on, and deliver effects to adversary systems; detect, defend, and respond to attacks on friendly computer systems and provide forensic analysis concerning those attack attempts; and provide cyber situational awareness to Air Force Commanders. In addition, the Air Force requires technology development that produces computing architectures with greater capacity and sophistication for addressing constrained, dynamic mission objectives; "game-changing" computing power to the warfighter, disruptive computing power at the tactical edge and for federated grid services; and interactive and real-time computing improving the usability of high-performance computing to the Air Force. It includes technologies in computational sciences and engineering, computer architectures and software intensive systems.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Cyber Defense Technologies	15.311	17.850	18.768
Description: Develop cyber defense and supporting technologies to detect, defend, and respond to attacks on computer systems as well as provide forensic concerning attacks.			
FY 2018 Plans: Continue research and development to implement new, or improve existing, cyber security and mission assurance capabilities for Air Force systems and networks. Continue development of validation techniques that assess qualitative effects of mission awareness analytics and system command and control system cyber resiliency. Continue development of a secure foundation for mission models that cross Department of Defense network domains while maintaining robustness, awareness capabilities, and engage assurance technologies. Demonstrate live autonomous systems and integration of the Stockbridge facility into cyber exercise structure. Continue to address gaps identified in the initial research and development, expand upon the results obtained from previous research and development, and explore additional capabilities.			
FY 2019 Plans: Continue research in the area of autonomous integrated cyber operations. Initiate applied research in the area of biologically resilient cyber technologies, mission-specific blockchain capabilities, and the alignment of cyber resilient services and dynamic management tailored towards unmanned aerial systems.			
FY 2018 to FY 2019 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602788F / *Dominant Information Sciences and Methods*	**Project (Number/Name)** 625319 / *Cyberspace Dominance Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
FY 2019 increased compared to FY 2018 by $0.918 million. Justification for this increase is described in plans above.			
Title: Cyber Offense Technologies ***Description:*** Develop offensive cyber operations technologies to access, maintain presence on, and deliver effects to adversary systems. ***FY 2018 Plans:*** Continue to research and develop dynamic waveform techniques and cyberspace capabilities in order to detect, identify, locate and attack in anti-access, area-denial environments. Continue to develop technologies to accommodate new waveforms and signals that emerge. Continue to conduct research and development of new, leading-edge technologies that are "game changing" for cyber offensive operations. ***FY 2019 Plans:*** Continue to conduct research and development of new, leading-edge technologies that are game changing and employ dominant power for cyber offensive operations. Increase activity in capabilities for multi-function, non-kinetic cyber effects against adversarial systems. Demonstrate ground-based and airborne delivery of disrupt, deny, degrade, destroy, or deceive effects that are both cyber and physical/kinetic. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $4.672 million. Justification for this increase is due to added emphasis in multi-function, non-kinetic cyber effect capabilities.	15.975	6.079	10.751
Title: Advanced Architectural Technologies ***Description:*** Develop the architectural mechanisms that form the basis for predictable software and high assurance systems. ***FY 2018 Plans:*** Continue research and development of a cyber hardened processor for embedded weapon systems. Develop a runtime environment that can monitor and maintain a trusted and resilient envelope of operation. Continue research and development on neuromorphic processing technologies to assess the feasibility of autonomy on mobile and power-constrained platforms. ***FY 2019 Plans:*** Continue research and validation of a cyber hardened (robust, secure) processor for embedded weapon systems. Continue applied research to create trusted and resilient embedded systems that are capable of identifying, localizing, and automatically repairing previously unknown and/or unintended vulnerabilities. Continue research and development of the neuromorphic	8.786	12.165	10.105

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602788F / *Dominant Information Sciences and Methods*	**Project (Number/Name)** 625319 / *Cyberspace Dominance Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
processor and validate capabilities for dynamic learning on mobile and power-constrained platforms. Initiate development of software using evolutionary approaches to make embedded systems tolerant to unexpected and unforeseen situations. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $2.060 million. Justification for this decrease is due to de-emphasis on runtime environments.			
Title: Processing Technologies ***Description:*** Develop automatic and dynamically reconfigurable, scalable, affordable distributed peta-flop processing technologies for real-time global information systems. ***FY 2018 Plans:*** Research and develop a novel neuromorphic system for visual object detection using Google's open source deep learning framework, TensorFlow. Continue research and development to establish the memory-based network nodes, to further evolve and adapt the photon-based interconnects, and to develop an integration scheme to interface a quantum network with the existing freespace optical link between the Air Force Research Laboratory, Information Directorate laboratory facility in Rome and the Stockbridge remote test site. ***FY 2019 Plans:*** Continue to research the application of novel neuromorphic systems for robust machine learning. Continue research and development in the area of supreme and quantum computing information sciences to establish the memory-based network nodes, to further evolve and adapt the photon-based interconnects, and to develop an integration scheme to interface a quantum network. Test the ability to teleport quantum information between network nodes, and to establish two-way quantum communication between two memory nodes. Conduct an analysis of conventional/quantum channel interface for long-distance communication. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $2.000 million. Justification for this increase is due to added emphasis on quantum research.	7.775	6.938	8.938
Title: Survivability Technologies ***Description:*** Develop methods and technologies for controlled operation of information systems during attacks and fault conditions, minimizing vulnerabilities of cyber attacks, and guaranteeing the accuracy and correctness of data and codes. ***FY 2018 Plans:***	4.214	3.599	2.072

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Continue to research concepts and capabilities for automated and autonomous processes addressing cyber survivability using an operational system laboratory to host modular research, development, test and evaluation. Continue to integrate autonomous machine learning functions into defensive cyber operations systems. ***FY 2019 Plans:*** Continue to research concepts and capabilities for cyber survivability techniques and algorithms for counter-unmanned aerial systems. Design and develop a counter-unmanned aerial systems open architecture to enable interoperability. Continue to evolve autonomous machine learning functions. Validate and demonstrate automated workflows into defensive cyber operations systems. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $1.527 million. Justification for this decrease is due to additional support for cross domain research.			
Title: Cross-Domain Technologies ***Description:*** Develop secure cross-domain discovery services for access to services outside the existing domain. Develop the tools to allow collaboration of workflows required by the Air Force net-centric information management system. ***FY 2018 Plans:*** Continue research and development on cross-domain change detection, cross-domain machine to machine mediation layer, and multiple levels of security mobile secure foundation technologies. ***FY 2019 Plans:*** Continue research and development in for cross-domain solution technologies by developing content filtering, with an emphasis on improving support for rapid inclusion of new data types with minimal requirements for lengthy data type threat assessments and minimal custom coding. Continue research and development for machine to machine interfaces. Develop cross-domain solution command and control capabilities to manage cross-domain solution risk based upon changes in mission and threat. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $2.799 million. Justification for this increase is due to added emphasis on dynamic content filtering techniques in cross-domain management.	3.744	3.663	6.462
Title: Cyber Technologies for Spectrum Warfare ***Description:*** Develop technologies combining electronic warfare, signals intelligence, communications, and cyber technologies that provide synergistic access, exploitation and effects across air and cyber domains in congested and contested environments. ***FY 2018 Plans:***	3.789	5.507	0.646

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Continue development of active and passive methods to locate, acquire, and process data and signals of interest. ***FY 2019 Plans:*** Continue development of active and passive methods to locate, acquire, and process data and signals of interest. Advance research in systems to perform blind data discovery associated with the Internet of Things. Identify items of interest associated with the Internet of Things. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $4.861 million. Justification for this decrease is due to additional investment in offensive cyber technologies.			
Accomplishments/Planned Programs Subtotals	59.594	55.801	57.742

	FY 2017	FY 2018
Congressional Add: Program Increase	4.934	0.000
FY 2017 Accomplishments: Conducted Congressionally direct effort.		
FY 2018 Plans: N/A		
Congressional Adds Subtotals	4.934	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force			Date: February 2018
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602788F / *Dominant Information Sciences and Methods*	Project (Number/Name) 62OMMS / *Research Site Support*	

COST ($ in Millions)	Prior Years	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total	FY 2020	FY 2021	FY 2022	FY 2023	Cost To Complete	Total Cost
62OMMS: *Research Site Support*	-	21.728	20.520	21.050	0.000	21.050	21.525	22.114	22.505	22.301	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Air Force Research Laboratory Information Directorate leads the discovery, development and implementation of information science and technology to drive transformation within the Air Force and across the Department of Defense. The focus of the work is to provide the warfighter with the required technology-based capabilities to defend the Nation by unleashing the power of innovative information science and technology to anticipate, find, fix, track, target, engage, and assess anything, anytime, anywhere. Since the site is a single-purpose location which is not located on a military installation, the Information Directorate has unique requirements for supporting its science and technology mission. As the host unit, the directorate is responsible to provide the Rome Research Site infrastructure at Rome, New York and provide for the continued operations of all Rome Research Site properties, buildings, and services necessary for the research mission. Operations include: logistics and communication services, utilities, maintenance of facilities and structures, safety and security of the workforce and visiting researchers, and ensures compliance with the laws, regulations, and directives that pertain to site operations. These services are host unit responsibilities and are necessary to provide a safe and effective environment for the Research Site's workforce and mission.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Rome Research Infrastructure	21.728	20.520	21.050
Description: Provide the necessary services and support including, but not limited to: fire inspections, refuse collection, water, electricity, steam, heat, custodial, and grounds maintenance services to the Research Site. Provide the necessary support for the maintenance and repair of Research Site facilities (buildings and other structures), vehicle and equipment lease and security/ safety inspections and services as necessary for compliance and safety/security of personnel and research assets. Provide the Research Site with long haul communications (using the Government Services Administration set of NETWORX contracts for Continental United States), trunk connectivity and wireless communications.			
FY 2018 Plans: Provide civilian payroll and non-pay costs for installation operations in support of the Rome Research Site property and all onsite personnel. Provide facilities, facility operations, facility sustainment, support equipment, contracts, and associated costs to plan, manage, and execute the following functions: fire prevention, disaster preparedness, plant operation and purchase of commodity, refuse collection, pavement clearance of snow and ice, grounds maintenance including landscaping, real property special inspections, pest control, and custodial services. Provide Real Property Management & Engineering Services, including: (1) Facility Management and Administration and (2) Installation Engineering Services. Facility Management includes public works management costs, contract management, material procurement, facility data management, furnishings management costs, and real estate management. Installation Engineering Services includes annual inspection of facilities, master planning, overhead of planning and design, overhead of construction management, and non Site Recovery Management service calls. Provide basic			

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602788F / *Dominant Information Sciences and Methods*	**Project (Number/Name)** 62OMMS / *Research Site Support*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
installation communication services, including long haul trunk and telecommunications services. Provide site vehicle lease under General Service Administration for logistics, security, and mission support. ***FY 2019 Plans:*** Continue to provide civilian payroll and non-pay costs for installation operations in support of the Rome Research Site property and all onsite personnel. Continue to provide facilities, facility operations, facility sustainment, support equipment, contracts, and associated costs to plan, manage and execute the following functions: fire prevention, disaster preparedness, plant operation and purchase of commodity, refuse collection, pavement clearance of snow and ice, grounds maintenance including landscaping, real property special inspections, pest control, and custodial services. Continue to provide Real Property Management and Engineering Services, including: (1) Facility Management and Administration and (2) Installation Engineering Services. Facility Management includes public works management costs, contract management, material procurement, facility data management, furnishings management costs, and real estate management. Installation Engineering Services includes annual inspection of facilities, master planning, overhead of planning and design, overhead of construction management, and non Site Recovery Management service calls. Continue to provide basic installation communication services, including long haul trunk and telecommunications services. Continue to provide site vehicle lease under GSA for logistics, security, and mission support. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $0.530 million. Justification for this increase is described in plans above.			
Accomplishments/Planned Programs Subtotals	21.728	20.520	21.050

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.