Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Air Force											Date: May 2017	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603788F / *Battlespace Knowledge Development and Demonstration*							
COST ($ in Millions)	**Prior Years**	**FY 2016**	**FY 2017**	**FY 2018 Base**	**FY 2018 OCO**	**FY 2018 Total**	**FY 2019**	**FY 2020**	**FY 2021**	**FY 2022**	**Cost To Complete**	**Total Cost**
Total Program Element	-	41.568	58.110	49.011	0.000	49.011	52.995	57.387	59.714	62.223	Continuing	Continuing
635319: *Anticipatory OPS Intent and Response*	-	3.516	3.562	3.602	0.000	3.602	6.144	6.267	6.392	6.520	Continuing	Continuing
635320: *Assured Worldwide Connectivity*	-	22.424	20.837	12.813	0.000	12.813	12.753	12.370	14.297	14.268	Continuing	Continuing
635321: *Global Battlespace Awareness*	-	10.592	8.425	11.017	0.000	11.017	12.874	14.616	14.908	15.205	Continuing	Continuing
635322: *Knowledge Management and Computing*	-	5.036	4.767	3.369	0.000	3.369	3.811	3.676	2.068	2.109	Continuing	Continuing
635329: *Cyber Battlespace Dev & Demo*	-	0.000	20.519	18.210	0.000	18.210	17.413	20.458	22.049	24.121	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program develops and demonstrates Air Force enterprise-centric information technologies for the warfighter. The Global Battlespace Awareness project develops, integrates, and demonstrates advanced technologies to achieve comprehensive net-centric operations and total battlespace awareness by using and exploiting information from all sources. The Assured Worldwide Connectivity project provides advanced net-enabled architectures and communications technologies in support of global military operations, including a secure information grid for worldwide information exchange of near-real-time multimedia (i.e., voice, data, video, and imagery) information. In addition, this project develops and demonstrates advanced optical networking and communications for Air Force air and space-based information exchange on and between platforms. These optical networks will be rapidly deployable, mobile, interoperable, and seamless between Air and Space Operations Centers (AOCs) and air and space- based platforms either en route or in theater. This project also provides tools and applications leading to the development and integration of cyber deterrence technologies resulting in a strategic capability of cyber dominance within the secure information grid. The Knowledge Management and Computing project develops the technology applications that will provide for a secure, tailored, seamless exchange of information among producers, consumers, and managers of information relevant to a particular community of interest (COI). The project also provides the development of interactive and real-time computing technologies that greatly improve the usability of high performance computing for the exchange, utilization, and management of information in the enterprise. The Anticipatory Operations Intent and Response project develops the technologies for dynamic planning and execution with the accuracy, fidelity, and timeliness needed to dominate the battlespace. 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.

Starting in FY 2017 to improve reporting to Congress, Project 635329, Cyber Battlespace Dev & Demo was created to capture all cyber activity that was previously performed in this program.

Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Air Force	Date: May 2017
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*

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.

B. Program Change Summary ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
Previous President's Budget	46.196	58.110	61.169	0.000	61.169
Current President's Budget	41.568	58.110	49.011	0.000	49.011
Total Adjustments	-4.628	0.000	-12.158	0.000	-12.158
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	-3.122	0.000			
• SBIR/STTR Transfer	-1.506	0.000			
• Other Adjustments	0.000	0.000	-12.158	0.000	-12.158

Change Summary Explanation

Decrease in FY 2016 because of reprogramming of funds to support Air Dominance activities and Research and Development Projects, 10 U.S.C. Section 2358.

Decrease in FY 2018 is due realignment of funds to focus on Directed Energy and Autonomy Game Changer efforts.

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force			Date: May 2017
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603788F / *Battlespace Knowledge Development and Demonstration*	Project (Number/Name) 635319 / *Anticipatory OPS Intent and Response*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
635319: *Anticipatory OPS Intent and Response*	-	3.516	3.562	3.602	0.000	3.602	6.144	6.267	6.392	6.520	Continuing	Continuing

A. Mission Description and Budget Item Justification

In order to achieve information dominance, the Air Force must be able to monitor, assess, plan, and execute missions rapidly 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 (pre-conflict, conflict through stability operations). This project develops and integrates decision support technologies that will enhance the commander's ability to anticipate and dominate the future battlespace by more effectively forecasting the evolution of the battlespace and by more rapidly generating options to "virtually checkmate" the adversary. It develops the decision aid technologies and processes to plan the use of various assets and assess their effects in the battlespace. It provides a tailorable information environment to effectively portray complex data sets accurately in real-time.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Adaptive Planning and Decision Tools	3.516	2.366	2.520
Description: Develop and demonstrate the integration of planning tools and information-based intelligent agents for adaptive replanning and decision support tools.			
FY 2016 Accomplishments: Prototyped a mission assurance framework and integrated service oriented architecture for a set of planning tools and services that proactively build and shape the portion of cyberspace employed in support of mission assurance objectives. Demonstrated net-centric mission planning and execution concepts to support a net-enabled dynamic decision support capability for a variety of air, space and cyber missions in support of combined, global operations. Validated the ability to synchronize efforts across warfighting domains (air, space, cyber, land and maritime) to create desired effects.			
FY 2017 Plans: Continue planned work in real-time course of action generation and prioritization, extensible command and control (C2) framework modernizing Joint Space Operations Center (JSpOC) operations, advanced indications and warning tipping C2 system for proactive countermeasure actions and visualization of the complete electromagnetic spectrum for enhancing JSpOC decision making. Initiate effort for Distributed Operations in a Contested Environment. Create and use scenarios and evaluation metrics for integrated demonstration and testing.			
FY 2018 Plans: Continue to execute experiments, based on operational scenarios, which demonstrate technologies that allow operators at tactical nodes to have the ability to conduct combat planning and tactical assessments of operations during periods of reduced communications with operational level nodes.			

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*	**Project (Number/Name)** 635319 / *Anticipatory OPS Intent and Response*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Continue planned work in real-time course of action generation and prioritization, extensible C2 framework modernizing JSpOC operations, advanced indications and warning tipping C2 system for proactive countermeasure actions and visualization of the complete electromagnetic spectrum for enhancing JSpOC decision making.			
Title: Next Generation Planning and Assessment Tools ***Description:*** Develop and demonstrate an effects-based approach for the next generation of planning and assessment techniques that enable decision makers to determine operational effects. ***FY 2016 Accomplishments:*** Due to higher Air Force priorities, delayed until FY 2017 development of links and tools to effectively employ cyber, directed energy and electronic warfare weaponry within a target folder environment. Delayed until FY 2017 the provision of a set of models that will give targeteers greater comprehension of the second and third order effects of targeting actions. ***FY 2017 Plans:*** Develop links and tools to effectively employ cyber, directed energy and electronic warfare weaponry within a target folder environment. Provide a set of models that will give targeteers greater comprehension of the second and third order effects of targeting actions. Initiate the subsequent development and demonstration of capabilities that utilize a mixture of analytics and visualization methods to determine progress relative to the achievement of objectives and end states. Initiate the development and demonstration of capabilities that provide ability to make actionable recommendations to assist the strategy division in identifying resource constraints, adversary actions, rules of engagement restrictions, and realignment of forces to assure commander's intent is met. ***FY 2018 Plans:*** Continue to develop software capabilities that employ cyber, directed energy, and electronic warfare weaponry. Refine previously developed models that will give operators and analysts an increased understanding of the second and third order effects of a set of targeting actions.	0.000	1.196	1.082
Accomplishments/Planned Programs Subtotals	3.516	3.562	3.602

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*	**Project (Number/Name)** 635319 / *Anticipatory OPS Intent and Response*

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: FY 2018 Air Force			Date: May 2017
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603788F / *Battlespace Knowledge Development and Demonstration*	Project (Number/Name) 635320 / *Assured Worldwide Connectivity*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
635320: *Assured Worldwide Connectivity*	-	22.424	20.837	12.813	0.000	12.813	12.753	12.370	14.297	14.268	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Air Force requires advanced net-enabled architectures and communications technologies in support of global kinetic and non-kinetic military operations including a secure information grid for worldwide information delivery and exchange of near-real-time information including voice, data, video, and imagery. This secure environment will be rapidly deployable, mobile, interoperable, and seamless between Air Operations Center (AOC) and aircraft, either en route or in theater. This project provides secure information transmission capabilities for a persistent, global, survivable communications backbone network accessible for warfighters operating in all domains. It provides self-healing, self-configuration, anti-jam communication networking capabilities, and provides enterprise networking capabilities for agile, policy-based network management. In addition, this project develops and demonstrates flight ready systems consisting of high capacity radio frequency (RF) and optical components and architectures for next generation communications. The Air Force also requires the ability to deliver sovereign options in cyberspace through the development and integration of cyber attack, cyber defense, and cyber support technologies for a strategic capability of cyber dominance. This project develops the ability to deliver cyber attack capabilities (access, stealth and persistence, cyber intelligence, and weapons delivery), cyber defense capabilities (attack detection, attack attribution, and response automation), and cyber support capability (situational awareness and war gaming.)

Starting in FY 2017 cyber work previously performed within this project will be reported under Project 635329, Cyber Battlespace Dev & Demo.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Cyber Offense	4.986	0.000	-
Description: Develop and demonstrate offensive cyber operations capabilities in a series of experimental technology demonstrations. ***FY 2016 Accomplishments:*** Merged next generation cyber operations technologies with other relevant military programs and demonstrate enhanced capabilities that allow non-kinetic capabilities to aid kinetic missions. Developed technologies to remain current with new waveforms and signals. Continued Service Oriented Architecture component development for use in the Air Force Lifecycle Management Center (AFLCMC) Cyber Mission Platform (CMP). Scheduled final delivery and demonstration of the highly configurable cyber simulation environment which produces network traffic annotated with high fidelity cyber telemetry. ***FY 2017 Plans:*** For FY 2017, the work for this effort will be performed under Project 635329, Cyber Battlespace Dev & Demo in an effort of the same name.			
Title: Connectivity Technologies	10.547	20.837	12.813

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*	**Project (Number/Name)** 635320 / *Assured Worldwide Connectivity*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Description: Develop and demonstrate intelligent networking transport and management technology to provide assured, seamless, battlespace connectivity to the Air Force tailored to anti-access/area denial environments and contested operations. ***FY 2016 Accomplishments:*** Continued development of a network level encryption and traffic-aware router, allowing enclaves at different security levels to share common network. Continued research to push the limits of technologies that improve the Aerial Layer Networks used by the Air Force. Developed optimal universal waveform sets for multipath multi-access communications. Initiated the integration, test & evaluation, and demonstration of an integrated version of the capabilities developed under this program. Performed an advanced technology demonstration of key technologies on tactical software radios. ***FY 2017 Plans:*** Continue to develop a Compact Rugged High assurance Crypto-Router with Network. Continue to develop a set of domain specific ontologies, extractors, relevancy assessment rule sets, mission templates and interfaces to support an operationally relevant Limited Technology Experiment (LTE). Demonstrate the next-generation wireless communications and networking technology. Demonstrate public key infrastructure (PKI)-enabled authentication services to enable task submission from authenticated enterprise consumers. Initiate the development and transition of a componentized building-block approach for a modular upgradable design for rapid waveform development of multi-mission RF capability. Support the development of a high-speed strike capability in line with higher Air Force emphasis areas. ***FY 2018 Plans:*** Continue development and demonstration of a componentized building-block approach for a modular upgradable design for rapid waveform development of multi-mission RF capability. Continue the development and demonstration of a large area multiple-input and multiple-output (MIMO) antenna capabilities.			
Title: Resiliency ***Description:*** Integrate and demonstrate a resilient and self-regenerating information enterprise that dynamically recognizes, characterizes, and understands novel cyber attacks and reconfigures and self-optimizes to resist new attacks. ***FY 2016 Accomplishments:*** Continued developing techniques to allow rapid analytical assessments of mission-mapped information, enhancing mission monitoring and mission assurance capabilities to conform and interoperate with DoD standards. Continued developing mature doctrinal representations for cross-DoD mission ontologies and use cases. Continued developing SecureServe to include updating and enhancing virtual machine (VM) communication channels, network monitoring, failover, snapshot, and migration. Integrated	2.898	0.000	-

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*	**Project (Number/Name)** 635320 / *Assured Worldwide Connectivity*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
the dynamic attestation prototype into the SecureServe baseline. Continued development and evaluation of an agile, modular, and pluggable framework for integration of open source algorithms. ***FY 2017 Plans:*** For FY 2017, the work for this effort will be performed under Project 635329, Cyber Battlespace Dev & Demo in an effort of the same name.			
Title: Effects-based Cyber Defense ***Description:*** Integrate technology to demonstrate an effects-based strategic approach to cyber defense that focuses on avoiding, deterring, and minimizing the threat, and rendering the adversary ineffective. ***FY 2016 Accomplishments:*** Completed development and demonstration of new enhancements into the active steganalysis product. Initiated research into novel resiliency technologies to package into an adaptive systems solution. Completed the initial prototyping of defensive cyber deception technologies. ***FY 2017 Plans:*** For FY 2017, the work for this effort will be performed under Project 635329, Cyber Battlespace Dev & Demo in an effort of the same name.	3.993	0.000	-
Accomplishments/Planned Programs Subtotals	22.424	20.837	12.813

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: FY 2018 Air Force			Date: May 2017
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603788F / *Battlespace Knowledge Development and Demonstration*	Project (Number/Name) 635321 / *Global Battlespace Awareness*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
635321: *Global Battlespace Awareness*	-	10.592	8.425	11.017	0.000	11.017	12.874	14.616	14.908	15.205	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Air Force must be able to process and exploit data and information from a variety of sources and domains to create a common operating picture of the battlespace to allow commanders to maintain information dominance. This project develops, integrates, and demonstrates advanced technologies to achieve comprehensive net-centric operations and Predictive Battlespace Awareness using information from all sources. Technology development includes: tasking information collectors, such as intelligence, surveillance, and reconnaissance (ISR) platforms, national intelligence sources, etc; correlating and geo-registering the collected data; exploiting the data to extract information of military significance; fusing information from multiple sources to create a digital-and-dimensional representation of the battlespace; assessing the situation; predicting adversary courses of action (COA); and archiving the results for ready use by decision-makers. This is a dynamic, complex process that involves technologies for information exploitation, fusion, processing, storage, and retrieval, as well as technologies for machine reasoning, pattern recognition, and timeline analysis.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Advanced Signal and Data Exploitation Technologies	4.624	3.036	1.049
Description: Demonstrate advanced signal and data exploitation technologies for detection, tracking, identification, and targeting of time-critical targets, and information extraction.			
FY 2016 Accomplishments: Refined and tested technologies to enhance electronic signals intelligence (ELINT) detection and processing capabilities against emerging emitter weapon systems. Developed strategies for multi-source intelligence (multi-INT) exploitation. Investigated algorithms that can improve upon the audio prioritization capabilities, improvements to detection and correction methods, and mitigation techniques for modeling differences. Completed new enhancements and inserted them into active steganalysis products. Developed technologies to remain current with new waveforms and signals. Integrated full motion video object of interest detection and exploitation algorithms with multi-INT correlation algorithms and demonstrated the capability. Integrated enhanced motion imagery capabilities with existing imagery exploitation tools. Continued the development of automated capabilities to exploit signals of interest.			
FY 2017 Plans: Continue to refine and test technologies for ultra-wideband ELINT signal detection and prosecution. Continue planned development of data association/curation from historical analysis, multi-INT discovery, and entity resolution for contested			

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*	**Project (Number/Name)** 635321 / *Global Battlespace Awareness*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
environments. Develop and implement speaker similarity tagging to improve model generation, cohort detection methods, and prioritization methods based on acoustics, radio traffic, keywords, and metadata. ***FY 2018 Plans:*** Continue to refine and test technologies for ultra-wideband ELINT signal detection and prosecution. Continue to develop and implement speaker similarity tagging to improve model generation, cohort detection methods, and prioritization methods based on acoustics, radio traffic, keywords, and metadata.			
Title: Advanced Data Handling, Visualization and Distributed Data Fusion ***Description:*** Develop and demonstrate advanced data handling, event visualization technologies, and distributed data fusion to enable a more effective utilization of data available. ***FY 2016 Accomplishments:*** Continued the application of object based processing and activity based intelligence tradecraft to selected domains and intelligence problems. Transitioned advanced activity-based intelligence (ABI) tools with built-in optimization tailored against operator objectives to National Air and Space Intelligence Center and National Geospatial-Intelligence Agency. Continued developing, demonstrating, and transitioning technology solutions for automated recognition of indicators to associate potential and emerging threats against blue assets. Continued developing computational capabilities that automate the decision-making process and that encompass sensing, data mining and analysis, information extraction and understanding, and activity recognition. Continued the development of technologies to create activity based intelligence from motion data. ***FY 2017 Plans:*** Continue the planned development of automated detection and recognition of indicators that associate threats against blue forces in multiple domain. Continue to develop near real time data mining and analysis capabilities by incorporating automated knowledge discovery, modeling and reasoning, and data fusion, exploitation and processing. Plan for forthcoming delivery of baseline advanced ABI toolkit. Complete multi-source/multi-INT raw data collection experiment at the Stockbridge Site in Rome, NY. Prepare to evaluate distributed multiple multi-INT Processing, Exploitation and Dissemination (PED) software framework capabilities compared to current methods for multi-INT data mining, correlation and fusion analytics. ***FY 2018 Plans:*** Continue development and demonstration of ABI analysis capabilities from multi-INT sources for both near-real time and post mission. Continue to develop near-real time data mining and analysis capabilities by incorporating automated knowledge discovery, pattern learning, modeling and reasoning, and data fusion, exploitation and processing. Continue to demonstrate the	2.311	3.138	6.829

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*	**Project (Number/Name)** 635321 / *Global Battlespace Awareness*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
distributed multi-node multi-INT PED software framework capabilities compared to current methods for multi-INT data mining, correlation, and fusion analytics. Initiate the automation of collected audio data for enhanced exploitation.			
Title: Autonomous Text Exploitation ***Description:*** Develop and demonstrate capabilities for reasoning and learning, text understanding, link and group discovery, and advanced analysis for situational awareness and understanding. ***FY 2016 Accomplishments:*** Continued developing cross-document co-reference capability integrated into document processing pipeline. Continued developing web-based Text Exploitation and Analysis framework. Initiated research and development for plug and play modules for deeper text understanding and large scale, time dependent, network based analytics. ***FY 2017 Plans:*** Continue plans to develop and transition end-to-end flexible and scalable technology transition platform enabling text exploitation and layered multi-intelligence network analysis and visualization in support of multi-source analysis. Continue research and development for plug and play modules for deeper text understanding and large scale, time dependent, network based analytics. ***FY 2018 Plans:*** Continue the development and demonstration of capabilities that enable automated text data extraction and exploitation. Continue development and demonstration of software tools and techniques that will fuse textual and non-textual information sources to increase semantic understanding. Continue research and development social media analytics tools and techniques for increased text understanding, as well as large scale, time dependent, network based analytics.	1.067	1.228	1.982
Title: Adversary Courses of Action ***Description:*** Develop models to provide detailed understanding of the adversary's probable intent and future strategy to identify adversary COAs, the most likely COA, and the COA most dangerous to friendly forces and mission accomplishment. ***FY 2016 Accomplishments:*** Continued developing links and tools to effectively employ cyber, directed energy and electronic warfare weaponry within a target folder environment and developing a set of models that will give targeteers greater comprehension of the second and third order effects of targeting actions. Continued developing a demonstration of advanced analytical capabilities that integrate kinetic and non-kinetic options for full spectrum targeting. Continued developing tools that assist the analyst/operator in determining the success/failure of a given target set and/or plan in meeting a stated set of mission objectives. Continued adding targeting capabilities to increase the full range of options available. ***FY 2017 Plans:***	2.590	1.023	1.157

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*	**Project (Number/Name)** 635321 / *Global Battlespace Awareness*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Continue developing kinetic and non-kinetic, full spectrum targeting tools to create a demonstrable concept where new batches of battlefield reports semi-automatically update the understanding of the target system analysis. ***FY 2018 Plans:*** Continue to develop and demonstrate kinetic and non-kinetic, full spectrum targeting software tools that will semi-automatically extracts and visualizes relationships within target system; automatically prioritize/rank targets based on identified relationships; and semi-automatically update understanding of the target system analysis (TSA) when new batches of reports arrive.			
Accomplishments/Planned Programs Subtotals	10.592	8.425	11.017

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: FY 2018 Air Force			Date: May 2017
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603788F / *Battlespace Knowledge Development and Demonstration*	Project (Number/Name) 635322 / *Knowledge Management and Computing*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
635322: *Knowledge Management and Computing*	-	5.036	4.767	3.369	0.000	3.369	3.811	3.676	2.068	2.109	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Air Force requires technologies that will provide the decision maker and staff with seamless access to tailored information within a mobile, dynamic, and scalable, globally distributed AOC, as well as among other producers, consumers, and managers of information relevant to other particular Communities of Interest (COI). This project demonstrates the enterprise management capabilities needed for the rapid distribution of actionable information, as well as the needed advances in high performance computing to ensure this complex capability. This project develops an agile information environment that focuses on quality of service, transformation and brokering, a federated information environment focusing the relationship among the members of the environment, a secure cross-domain information sharing capability that focuses on the security layer and inter-COI information exchange in different security domains, and a collaboration environment focusing on the information workflow layer of the enterprise. This project will also develop: 1) a computational science and engineering capability demonstrating new models of computation; 2) novel approaches for high performance, interactive, net-centric, distributed, and embedded computing systems; and 3) the technological tools enabling affordable, large-scale, complex, software intensive systems.

Starting in FY 2017 cyber work previously performed within this project will be reported under Project 635329, Cyber Battlespace Dev & Demo.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Game Changing Computing Power	1.854	0.000	-
Description: Develop and demonstrate computer architectures with greater capacity and sophistication to enable game changing computing power to the warfighter, anywhere, anytime. ***FY 2016 Accomplishments:*** Continued designing, developing and demonstrating affordable, high performance, interactive, parallel data exploitation and massively parallel systems. Developed and demonstrate embedded high performance computing systems and integrate bio-inspired embedded computing hardware that delivers a set of autonomous sensing capabilities for Air Force Intelligence, Surveillance and Reconnaissance (ISR) missions in the contested anti-access/area denial (A2/AD) environments. Continued to develop capabilities to simultaneously assess, maintain or reestablish trust as resiliency actions respond to failures and/or attacks. Continued to develop new approaches to building trusted and resilient systems. Demonstrated trusted and resilient systems in a realistic operational environment. Initiated the development of technologies for neuromorphic co-processing, memristive technologies for use in reducing the size weight and power of conventional processing. This technology also will provide intrinsic, hardware based cyber security features for encryption, anti-tamper and unique identification, algorithm and system operation			

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*	**Project (Number/Name)** 635322 / *Knowledge Management and Computing*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
control for continuous, dynamic autonomous operations. The output will develop a processor capable of universal quantum computation. ***FY 2017 Plans:*** For FY 2017, the work for this effort will be performed under Project 635329, Cyber Battlespace Dev & Demo in an effort of the same name.			
Title: Advanced Information Management ***Description:*** Demonstrate how a publish, subscribe, and query information management (IM) paradigm can enable vertical and horizontal integration of Air Force information systems. ***FY 2016 Accomplishments:*** Continued developing, demonstrating and transitioning information management capabilities that securely bridge the gaps between enterprise and tactical domains for increased shared situational awareness (SA) across the theater of war for targeting and force protection operations. Initiated the development, transition and delivery of new technologies in the form of plugins and include security for bulk data at rest to deliver full functionality for AFSOC Special Tactics (ST) mission sets so that ST operators can have superior SA and communications. ***FY 2017 Plans:*** Continue plans to develop, demonstrate and transition information management capabilities that securely bridge the gaps between enterprise and tactical domains for increased shared SA across the theater of war for targeting and force protection operations. Focus will be on the development of capabilities for disruption tolerant information delivery, data synchronization, and improved Quality of Service (QoS) in congested and contested tactical network environments. Continue the development, transition and delivery of new technologies in the form of plugins and include security for bulk data at rest to deliver full functionality for AFSOC Special Tactics mission sets so that ST operators can have superior SA and communications. Starting in FY 2017, the cyber activities within this effort (advanced cross-domain solution capabilities) will move to Project 635329, Cyber Battlespace Dev & Demo within the effort, Autonomous, Multi-level Access & Transfer. ***FY 2018 Plans:*** Continue plans to develop, demonstrate and transition information management capabilities that securely bridge the gaps between enterprise and tactical domains for increased shared SA across the theater of war for targeting and force protection	3.182	4.767	3.369

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*	**Project (Number/Name)** 635322 / *Knowledge Management and Computing*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
operations. Focus will be on vulnerability assessments of the developed software; and field testing, technology integration, testing, and maturation. Continue the development, transition and delivery of new technologies in the form of plugins and include security for bulk data at rest to deliver full functionality for AFSOC Special Tactics mission sets so that ST operators can have superior SA and communications.			
Title: Agile Information Management Services ***Description:*** Demonstrate how agile information management services enable effective information sharing in a tactical environment. ***FY 2016 Accomplishments:*** Effort terminated due to higher DoD priorities.	0.000	-	-
Accomplishments/Planned Programs Subtotals	5.036	4.767	3.369

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: FY 2018 Air Force			Date: May 2017
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603788F / *Battlespace Knowledge Development and Demonstration*	Project (Number/Name) 635329 / *Cyber Battlespace Dev & Demo*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
635329: *Cyber Battlespace Dev & Demo*	-	0.000	20.519	18.210	0.000	18.210	17.413	20.458	22.049	24.121	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Air Force requires the ability to deliver sovereign options in cyberspace through the development and integration of cyber-attack, cyber defense, and cyber support technologies for a strategic capability of cyber dominance. This project develops the ability to deliver cyber-attack capabilities (access, stealth, persistence, cyber intelligence and weapons delivery), cyber defense capabilities (attack detection, attack attribution and response automation) and cyber support capabilities (situation awareness and war gaming). This project will also develop; 1) a computational science and engineering capability demonstrating new models of computation, 2) novel approaches for high performance, interactive, net-centric, distributed and embedded computing systems and 3) the technological tools enabling affordable, large scale, complex software intensive systems.

Project 635329, Cyber Battlespace Dev & Demo is new for FY 2017. Work from this effort was previously performed under Projects 635320, Assured Worldwide Connectivity and 635322, Knowledge Management and Computing in this program.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Cyber Offense	0.000	5.891	3.241
Description: Develop and demonstrate offensive cyber operations capabilities in a series of experimental technology demonstrations.			
FY 2016 Accomplishments: For FY 2016, the work for this effort originally was performed under Project 635320, Assured Worldwide Connectivity in an effort of the same name.			
FY 2017 Plans: Continue to research technologies that show maturation promise and enhance the capabilities to make it transitionable to the warfighter. Develop technologies to remain current with new waveforms and signals. Continue Service-Oriented Architecture (SOA) mission component development for use in the AFLCMC CMP. Transition components, including Cyber Time and Cyber Mission Planning, for use in CMP. Continue red-teaming new components to improve security.			
FY 2018 Plans: Adapt and demonstrate technologies to remain current with new waveforms and signals. Continue development and demonstration of software that holds adversary threats at risk by exploiting the electromagnetic spectrum (EMS), and other signals			

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*	**Project (Number/Name)** 635329 / *Cyber Battlespace Dev & Demo*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
of interest, for access and mission effects. Continue performing cyber vulnerability assessments to strengthen the security of the developed software.			
Title: Effects-based Cyber Defense ***Description:*** Integrate technology to demonstrate an effects-based strategic approach to cyber defense that focuses on avoiding, deterring, and minimizing the threat, and rendering the adversary ineffective. ***FY 2016 Accomplishments:*** For FY 2016, the work for this effort originally was performed under Project 635320, Assured Worldwide Connectivity in an effort of the same name. ***FY 2017 Plans:*** Continue to develop technologies for the proactive control of cyber defenses, integrating with existing mission assurance framework(s). Develop and deliver cyber capabilities with transition to AFLCMC, National Security Agency and U.S. Special Operations Command customers. Research technologies to assist in educating and training the next generation of cyber leaders. Enhance, mature, test, and demonstrate Cyber Agility and defensive cyber deception technologies through exercises and other user-focused venues toward the objective of transition. Integrate new capabilities with existing Intelligence, Surveillance, and Reconnaissance (ISR) systems, and, progress testing with the Cyber Experimentation Environment. ***FY 2018 Plans:*** Continue to develop and demonstrate technologies for the proactive control of cyber defenses, integrating with existing mission assurance framework(s). Demonstrate these technologies in a relevant environment. Continue to integrate new cyber capabilities with existing ISR systems and demonstrate in a relevant environment (such as the Cyber Experimentation Environment).	0.000	5.784	4.084
Title: Resiliency ***Description:*** Integrate and demonstrate a resilient and self-generating information enterprise that dynamically recognizes, characterizes, and understand novel cyber attacks and reconfigures and self-optimizes to resist new attacks. ***FY 2016 Accomplishments:*** For FY 2016, the work for this effort originally was performed under Project 635320, Assured Worldwide Connectivity in an effort of the same name. ***FY 2017 Plans:*** Develop effective red teaming techniques that sufficiently assess detection capabilities for mission-level critical events. Continue development of mission monitoring components, analytics engine, and C2 technology integration. Develop and rapidly evolve	0.000	3.737	6.997

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*	**Project (Number/Name)** 635329 / *Cyber Battlespace Dev & Demo*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
capabilities and Concept of Operations (CONOPS) for active guidance and automated processes addressing cyber survivability using an operational system laboratory to host of modular RDT&E, including autonomous cyber survivability capabilities and CONOPS. Schedule to complete advanced technology demonstration for cyber-based mission assurance on trust enhanced hardware. ***FY 2018 Plans:*** Continue to develop and evolve software capabilities and CONOPS for active guidance and automated processes addressing cyber resiliency and survivability using a relevant system laboratory. Continue to develop effective red teaming techniques that sufficiently assess detection capabilities for mission-level critical events. Continue to develop and demonstrate ground vehicle protection prototype for automotive cyber-security. Continue development of mission monitoring components, analytics engine, and C2 technology integration.			
Title: Game Changing Computing Power ***Description:*** Develop and demonstrate computer architectures with greater capacity and sophistication to enable game-changing computing power to the warfighter anywhere, anytime. ***FY 2016 Accomplishments:*** For FY 2016, the work for this effort originally was performed under Project 635322, Knowledge Management and Computing in an effort of the same name. ***FY 2017 Plans:*** Test the Agile Condor embedded computing pod in the field on test platform with real-time processing and communication concepts. Develop a runtime environment that can monitor and maintain a trusted and resilient envelope of operation. This runtime environment may consist of monitors that are generated right along with formally verified code during the formal code generation process to monitor/ensure that the high level specifications are maintained through execution. ***FY 2018 Plans:*** Develop and demonstrate real-time neuromorphic computing architecture simulation framework. Conduct the first spiral demonstration of the inherently trusted & resilient architectures, mature for integration into a realistic operational environment. Continue development and demonstration of embedded computing pod in the field on a test platform with real-time processing and communication concepts.	0.000	3.325	2.663
Title: Autonomous, Multi-level Access and Transfer ***Description:*** Develop autonomous, secure information access and sharing capabilities required by the Air Force net-centric information enterprise.	0.000	1.782	1.225

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*	**Project (Number/Name)** 635329 / *Cyber Battlespace Dev & Demo*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
FY 2016 Accomplishments: For FY 2016, the work for this effort originally was performed under Project 635322, Knowledge Management and Computing. ***FY 2017 Plans:*** Continue development and transition of advanced cross domain solutions (CDS). Demonstrate and integrate into CDS a virtual detonation chamber filter to detect malicious/abnormal behavior. Demonstrate advanced CDS command and control capabilities to improve insight into cross domain service health and status and provide tools to manage CDS risk based upon changes in mission and threat. Continue robust protocol-to-CDS interfaces and techniques to enforce CDS compliance with machine to machine (M2M) interface specifications to make cross-domain enablement of M2M communications more robust and cost effective. Continue to improve the usability of multi-level security (MLS) access solutions with a focus on adding secure foundations to commercial-off-the-shelf mobile technologies as the basis for secure multi-level collaboration. ***FY 2018 Plans:*** Continue development and prototype development of advanced cross domain solutions. Refine interfaces and techniques to enforce CDS compliance with M2M interface specifications to enable cross-domain enablement of M2M communications more robust and effective. Demonstrate and prototype MLS access solutions, including commercial-off-the-shelf mobile technologies as the basis for secure multi-level collaboration.			
Accomplishments/Planned Programs Subtotals	0.000	20.519	18.210

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
• N/A: *N/A*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-	-

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.