Exhibit R-2, PB 2010 Air Force RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602702F Command Control and Communications					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	119.545	115.559	0.000						Continuing	Continuing
624519: Communications Technology	32.111	36.975	0.000						Continuing	Continuing
624594: Information Technology	31.257	32.470	0.000						Continuing	Continuing
625581: Command and Control (C2) Technology	39.216	36.152	0.000						Continuing	Continuing
6266SP: Space Optical Network Tech	16.961	9.962	0.000						Continuing	Continuing

Note

Note: In FY 2010, efforts in this PE move to PE 0602788F, Dominant Information Technology.

A. Mission Description and Budget Item Justification

This program develops technology for Air Force Command, Control, and Communications (C3). Advances in C3 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 program has four projects. The Communication Technology project develops assured and secure communications technology, and the capability to attack and exploit adversarial information and information systems. The Information Technology project develops improved and automated capabilities to generate, process, fuse, exploit, interpret, and disseminate timely and accurate information. The Command and Control Technology project investigates and develops planning, assessment, and knowledge base technologies to allow the warfighter to plan, assess, execute, monitor, and re-plan on the complex, compressed time scales required for tomorrow's conflicts. The Space Optical Networking Technology project develops the technology base for the next generation of ultra-wide-bandwidth, multi-channeled, air and space-based communications networks on and between platforms. This program is Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

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B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	121.417	109.492	123.122	
Current BES/President's Budget	119.545	115.559	0.000	
Total Adjustments	-1.872	6.067	0.000	
Congressional Program Reductions	0.000	-0.020		
Congressional Rescissions	0.000	-0.313		
Total Congressional Increases	0.000	4.800		
Total Reprogrammings	-0.848	1.600		
SBIR/STTR Transfer	-1.024	0.000		

Change Summary Explanation

Note: In FY 2009, Congress added $2.8 million for Compact Laser Terminal for Airborne Network Centric Warfare, and $2.0 million for Cyber Attack Mitigation Lab. Additionally, Congress added $1.6 million for Space Qualification of the Common Data link in PE 0602204F, Sensor Technology, which has been transfered to this PE for execution.

C. Performance Metrics
(U) Under Development.

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COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
624519: Communications Technology	32.111	36.975	0.000						Continuing	Continuing

Note

Note: In FY 2010, this effort moves to PE 0602788F, Project 5315, Connectivity and Protection Tech.

A. Mission Description and Budget Item Justification

The Air Force requires technologies that enable assured, worldwide/theater, high capacity, communications and networking for Air Force Task Forces. These communication and networking technologies will provide capabilities for en-route and deployed distributed collaborative command, control, surveillance, reconnaissance, and exploitation. A rapidly deployed force requires assured connectivity with reliable, responsive, affordable information exchange via all available communications media. This project provides the technologies for: multi-level, secure, seamless networks; advanced communications processors; anti-jam and low probability of intercept techniques; lightweight, phased array antennas; and modular, programmable, low-cost software radios. It includes technologies for advanced processors and devices, advanced network protocols and services, intelligent communications management and control, advanced communications algorithms, and enabling communication signal processing techniques.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop assured and survivable information and networking technologies enabling worldwide command, control, surveillance, reconnaissance, and exploitation operations for the Air Force. Note: In FY 2010, this effort moves to PE 0602788F, Project 5315, Major Thrust 1. In FY 2008: Developed policy-based network management technologies for real-time network response to changes in INFOCON levels. Developed airborne content-based delivery networking (CBDN), synergistic with the Joint Tactical Radio System Wideband Networking Waveform's Network Service Layer, and applied to extremely dynamic airborne nets. Designed and developed airborne network modeling and simulation technology. Initiated design and development of cognitive networking technology that senses operating environment, learns application requirements, and intelligently adapts network protocols. Initiated design and development of network operations and security capability to provide policy-based, mission-based, cross-domain, heterogeneous network quality of performance, security, configuration, and fault management in a net-centric environment. Developed and completed intelligent network management agents designed to	9.477	9.996	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
monitor the airborne domain's handling of the flow of information from platform to platform through various interconnected communication nodes and links. Initiated development of a resilient and self-regenerating information Network Centric Warfare enterprise that dynamically recognizes, characterizes, and understands novel cyber attacks and service anomalies, aids in the creation of synthetically diverse, functionally equivalent software, and continuously monitors, reconfigures, and self optimizes the mission critical enterprise to resist new attacks. In FY 2009: Complete development of airborne CBDN, synergistic with the Joint Tactical Radio System Wideband Networking Waveform's Network Service Layer, and applies to extremely dynamic airborne nets. Continue design and development of airborne network modeling and simulation technology. Continue design and development of cognitive networking technology that senses operating environment, learns application requirements, and adapts network protocols. Complete development of policy-based network management technologies for real-time network response to changes in INFOCON levels. Continue design and development of network operations and security capability to provide policy based, mission based, cross domain, heterogeneous network quality of performance, security, configuration, and fault management. Initiate development of small hand-held multi-data rate, internet protocol compatible, covert network radios. Continue development of a resilient and self-regenerating information Network Centric Warfare enterprise that dynamically recognizes, characterizes, and understands novel cyber attacks and service anomalies, aids in the creation of synthetically diverse, functionally equivalent software, and continuously monitors, reconfigures, and self optimizes the mission critical enterprise to resist new attacks. Initiate development of secure data sharing to prevent the disclosure of sensitive information to untrustworthy users. In FY 2010: Not Applicable.					
MAJOR THRUST: Develop improved, higher bandwidth communications and signal processing technologies to provide secure, adaptive, covert, anti-jam, and assured global battlespace connectivity to highly mobile aerospace forces, while reducing the equipment footprint. Note: In FY 2010, this effort moves to PE 0602788F, Project 5315, Major Thrust 2.		4.244	3.704	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2008: Completed demonstration of adaptively combined multi-dimensional (space, time, frequency, coding, polarization) transmission techniques that enable high bandwidth information transmission and exploitation capabilities. Completed demonstration of multi-mode, multi-function, sense-and-adapt air-mobile communications capability to dynamically alter communications methods under fast-changing environment. Developed quantum key distribution and cryptography technologies to effect ultra-secure communications for wired and wireless networks. Initiated design and demonstration of assure access, anti jam communications capability that combines multi-dimensional (space, time, frequency, coding, polarization) transmission techniques, multi frequency, multi wavelength, multi path techniques and spectrum sense and adapt techniques. Initiated investigation to provide assured access (anti-jam) covert high capacity spectrum dominance for global networking while denying the adversary the same. Initiated development of scaleable video compression schemes which dynamically trade-off bandwidth and quality based upon the priority of the required information. Initiated the development of advanced, automated, network and bandwidth management technologies to move, manage, and process information in real-time for the warfighter. In FY 2009: Complete development of quantum key distribution and cryptography technologies to effect ultra-secure communications for wired and wireless networks. Continue design and demonstration of assured access anti-jam communications capability that combines multi-dimensional (space, time, frequency, coding, polarization) transmission techniques, multi-frequency, multi-wavelength, multi-path techniques, and spectrum sense and adapt techniques. Continue the development of advanced, automated, network and bandwidth management technologies to move, manage, and process information in real-time for the warfighter. In FY 2010: Not Applicable.				
MAJOR THRUST/CONGRESSIONAL ADD: Develop critical information transmission technologies to permit the seamless integration of aerospace weapon systems' C2, intelligence, surveillance, and reconnaissance data/information. Note: This effort includes Congressional Add funding of $2.0 million in FY 2008, and $2.8 million in FY 2009. Note: In FY 2010, this effort moves to PE 0602788F, Project 5315, Major Thrust 3.	3.425	4.281	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2008: Completed development, test, and assessment of exploratory radio frequency and optical information transfer technologies. Explored multiple technologies/techniques for tunable, high power radio frequency filtering to reduce overall radio frequency component equipment size, weight, and signal losses applicable to battlefield network operations. Conducted the Congressionally-directed Compact Laser Terminal for Airborne Network Centric Warfare to develop a compact, low power consumption wavelength tunable laser transmitter for free-space optical communications in an airborne network. In FY 2009: Complete exploring multiple technologies/techniques for tunable, high power radio frequency filtering to reduce overall radio frequency component equipment size, weight, and signal losses applicable to battlefield network operations. Conduct the Congressionally directed Compact Laser Terminal for Airborne Network Centric Warfare effort to develop acompact, low power comsumption wavelenght tunable laser transmitter for free-space optical communications in an airborne network. In FY 2010: Not Applicable.				
MAJOR THRUST/CONGRESSIONAL ADD: Develop cyber operations technologies for enabling worldwide command, control, communications, and intelligence. Note: Increased funding in FY 2008 and FY 2009 is due to emphasis on offensive cyber operations. Note: This effort includes Congressional Add funding of $1.9 million in FY 2008, and $2.0 million in FY 2009. Note: In FY 2010, this effort moves to PE 0602788F, Project 5315, Major Thrust 5. In FY 2008: Completed development of techniques for defining rapid defensive courses-of-action (COA) to counter adversary information warfare attacks. Developed defensive techniques for wireless, mobile, and embedded systems. Demonstrated detection and eradication techniques for malicious code. Completed development of advanced correlation fusion techniques for defensive course of action analysis. Completed efforts in self-healing systems. Initiated assured end-to-end quality of service (QoS) and quality of assurance (QoA) integration to the information system enterprise during malicious and non-malicious faults. Developed a prototype that is able to model the unique aspects of an IP-based airborne network (e.g., aircraft communications, antennas, and networking components) against a variety of cyber threats with the end-goal of	13.397	17.398	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
improving the overall defenses of the airborne network. Initiated development of access techniques allowing "cyber paths" to protected adversary information systems through a multiplicity of attack vectors. Initiated development of stealth and persistence technologies enabling continued operation within the adversary information network. Initiated programs to provide the capability to exfiltrate any and all types of information from compromised information systems enabling cyber intelligence gathering to achieve cyber awareness and understanding. Initiated technology programs to deliver D5 (deny, degrade, destroy, disrupt, and deceive) effects to the adversary information systems enabling integrated and synchronized cyber and traditional kinetic operations. Conducted Congressionally-directed Cyber Attack Mitigation Lab effort to develop malware detection and reverse engineering in order to provide a significant increase in understanding of malware as well as protection to the GIG and other critical infrastructures. In FY 2009: Initiate work in Cyber Command and Control for defensive cyber operations to achieve cyber awareness and understanding. Continue to develop defensive techniques for wireless, mobile, and embedded systems. Continue assured end-to-end QoS and QoA integration to the information system enterprise doing malicious and non-malicious faults. Initiate work in autonomic defensive response to rapidly recover from adversary cyber attacks. Continue development of information system access methods. Initiate efforts to propagate through adversary networks. Continue development of stealth and persistence technologies enabling network discovery, propagation to new locations, and data exfiltration/infiltration. Continue cyber intelligence gathering efforts to achieve cyber situational awareness and understanding. Continue cyber and traditional kinetic weapon integration technology development and initiate efforts for cyber delivery to influence operations effects. Conduct the Congressionally directed Cyber Attack Mitigation Lab effort. In FY 2010: Not Applicable.				
CONGRESSIONAL ADD: Adaptive Optics Lasercom System. In FY 2008: Continued the integration of the laser communications terminal into a Wescam turret and support an air to ground flight test scheduled for mid-2008. The flight test validated the laser beam pointing,	1.568	0.000	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
acquisition, and tracking; the laser communication terminal operation at altitude; and the performance of the adaptive optics in an airborne environment. In FY 2009: Not Applicable. In FY 2010: Not Applicable.					
CONGRESSIONAL ADD: Space Qualification of the Common Data Link. In FY 2008: Not Applicable. In FY 2009: Conduct the Congressionally-directed Space Qualification of the Common Data Link. In FY 2010: Not Applicable.		0.000	1.596	0.000	

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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0603789F/ C3I Advanced Development.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

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.

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COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
624594: Information Technology	31.257	32.470	0.000						Continuing	Continuing

Note

Note: In FY 2010, these efforts move to PE 0602788, Project 5318, Operational Awareness Tech, and Project 5317, Information Decision Making Tech.

A. Mission Description and Budget Item Justification

The Air Force requires technologies that improve and automate their capability to generate, process, manage, fuse, exploit, interpret, and disseminate timely and accurate information. This project improves global awareness at all levels, enabling warfighters to understand relevant military situations on a consistent basis with the timeliness and precision needed to accomplish their missions. Global awareness is achieved by exploiting information provided by the Air Force, other government agencies, and open source information. The information is fused to support the dynamic planning, assessment, and execution cycles via the global information enterprise. Knowledge, information, and data are all archived in the global information base for continued use and historical analysis. The information technologies required to achieve this capability are developed under this project in an affordable manner and include appropriate access mechanisms for our coalition partners. This project develops high-payoff embedded information systems technologies for the next generation of distributed information integration architectures to enable global information dominance and air and space superiority. The embedded information systems technologies provide affordable, innovative, secure, net-enabled embedded information systems to the warfighter.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop innovative multi-sensor collaborative fusion technologies in a fully distributed air and space environment. Note: In FY 2010, this effort moves to PE 0602788F, Project 5318, Major Thrust 1. In FY 2008: Evaluated fusion management and advanced the state-of-the-art in track-to-track fusion techniques. Developed the process of probabilistic identification though the use of multi-source fusion. Increased probabilistic confidence through the inclusion of higher-level fusion techniques in the situational assessment and process refinement area. Developed techniques to dynamically update advanced reasoning fusion engines to adapt to changing threat conditions. Developed intelligence, surveillance, and reconnaissance management techniques that optimize the fusion process for identification and continuous tracking of military significant threats. Evaluated network centric approaches to provide distributed fusion techniques to the warfighter. Developed new track algorithms that combine traditional kinematic associations	6.867	6.836	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
with multi-INT reasoning to improve the identification and track life times of ground moving targets; taking into account the limitations of gap times, dense target environments, and large sensor data inaccuracies. Developed a set of algorithms that can automatically develop, reason, dynamically update various sub-sets of the existing intelligence preparation of the battlespace products (e.g., named areas, target areas, COA, units, infrastructure areas, lines of communication). Initiated development of fused air, ground, and space information through machine-to-machine automatic fusion and dynamic re-tasking processes resulting in a single network centric operational picture. Processes examined include machine-to-machine automated multi-INT fusion, long term automated tracking and ID of nominated targets, and automated/adaptive pattern recognition. Initiated investigation of Fusion of CybINT (Cyber Intelligence) with traditional INTs. In FY 2009: Evaluate fusion management and advance the state-of-the-art in track-to-track fusion techniques. Complete the process of probabilistic identification through the use of multi-source fusion. Continue to increase probabilistic confidence through the inclusion of higher-level fusion techniques in the situational assessment and process refinement area. Complete the development of techniques to dynamically update advanced reasoning fusion engines to adapt to changing threat conditions. Complete the development and assessment of intelligence, surveillance, and reconnaissance management techniques that optimize the fusion process for identification and continuous tracking of military significant threats. Complete the development and assessment of network centric approaches to provide distributed fusion techniques to the warfighter. Continue the development of new track algorithms that combine traditional kinematic associations with multi-INT reasoning to improve the identification and track life times of ground moving targets; taking into account the limitations of gap times, dense target environments, and large sensor data inaccuracies. Complete the development of a set of algorithms that can automatically develop, reason, and dynamically update various sub-sets of the existing intelligence preparation of the battlespace products (e.g., named areas, target areas, COA, units, infrastructure areas, lines of communication). Continue development of fused air, ground, and space information through machine-to-machine automatic fusion and dynamic re-tasking processes resulting in a single network centric operational picture. Processes to be examined include machine-to-machine automated multi-INT fusion, long-term automated tracking and ID of nominated targets, and automated/adaptive pattern recognition. Continue investigation of Fusion of CybINT with traditional INTs. In FY 2010: Not Applicable.				

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
MAJOR THRUST: Develop higher-level fusion and the enabling information/knowledge base technologies to achieve situational awareness and understanding at all command levels for the dynamic planning, assessment, and execution processes. Note: In FY 2010, this effort moves to PE 0602788F, Project 5318, Major Thrust 2. In FY 2008: Completed enhancement of techniques for interactive contextual reasoning with inference techniques for self-organizing data repositories and content-based extraction to support identification of potential events in the world. Enhanced web-based search techniques, data filtering techniques, and information aggregation methods to take advantage of the explosion of available open source data on the Web required for rapid situational awareness and understanding. Developed inferencing techniques for reasoning about the situation and for predicting adversarial intent and threat possibility. Developed a dynamic real-time information management capability with the objective of decreasing the execution speeds of embedded HPC and enterprise infospheres by 100X. Initiated development of multi-source and automated recognition techniques to support analysis of current situations. Initiated development of technology demonstration plans for cyber situational awareness and understanding using an autonomous set of cooperative agents under positive control to defend mission critical Air Force assets. Initiated development of technology demonstration plans for active intelligence, surveillance, and reconnaissance (ISR) defense on wired networks to perform an adaptive response to multiple, coordinated, sustained attacks. Initiated research to forecast actionable futures to support a decision maker's ability to appraise and plan the "best" blue course of action for Rapid, Decide, Act, and Adapt. Initiated research to achieve the capability to analyze multiple courses of action (COA) having cascading effects in near real-time. The capability is able to mix kinetic and non-kinetic options, continuously forecast the direct and indirect effects of each COA, and play COAs forward in time to identify key plan dependencies, decision points, and the foreclosure of options. In FY 2009: Complete enhancement of web-based search techniques, data filtering techniques, and information aggregation methods to take advantage of the explosion of available open source data on the Web required for rapid situational awareness and understanding. Continue developing inferencing techniques for reasoning about the situation and for predicting enemy intent and threat possibility. Continue development of multi-source and automated recognition techniques to support analysis of current situations. Continue development of technology demonstration plans for cyber situational awareness and understanding using		7.117	9.119	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
an autonomous set of cooperative agents under positive control to defend mission critical Air Force assets. Initiate development of technology demonstration plans for active ISR defense on wired networks to perform an adaptive response to multiple, coordinated, and sustained attacks. Continue research to achieve the capability to analyze multiple COAs having cascading effects in near real-time. The capability will be able to mix kinetic and non-kinetic options, continuously forecast the direct and indirect effects of each COA, and play COAs forward in time to identify key plan dependencies, decision points, and the foreclosure of options. Continue research to forecast actionable futures to support a decision maker's ability to appraise and plan the "best" blue course of action for Rapid, Decide, Act, and Adapt. Complete the development of a set of algorithms that can automatically develop, reason, and dynamically update various sub-sets of the existing intelligence preparation of the battlespace products (e.g., named areas, target areas, COA, units, infrastructure areas, lines of communication). In FY 2010: Not Applicable.				
MAJOR THRUST: Develop automatic and dynamically reconfigurable, affordable, scalable, distributed petaflop processing technologies for real-time C2 global information systems. Note: In FY 2010, this effort moves to PE 0602788F, Project 5317, Major Thrust 1. In FY 2008: Initiated implementation of architectural features for cognitive information processing. Developed algorithms for next generation information technologies for C2 systems. Developed and characterized high performance computers for quantum computing applications. Developed and characterized the next generation of high performance computers. Developed a prototype chip that contains a hybrid architecture design; which will provide an emulation capability for large scale cognitive architecture evaluations. Initiated the development of the tools, techniques, standards, and technologies required to build highly complex software-intensive systems. In FY 2009: Continue implementation of architectural features for cognitive information processing. Complete algorithm development for next generation information technologies for C2 systems. Complete architectural development for cognitive information processing. Complete development and characterization of high	6.100	7.015	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
performance computers for quantum computing applications. Continue development and characterization of the next generation of high performance computers. Complete the development of a prototype chip that contains a hybrid architecture design, which will provide an emulation capability for large-scale cognitive architecture evaluations. Continue the development of the tools, techniques, standards, and technologies required to build highly complex software-intensive systems. Initiate development of high capacity processing on demand, which will reduce the ever increasing amounts of raw data to actionable information. Provide hardware and system/support software that enables complex software to be readily composed. In FY 2010: Not Applicable.					
MAJOR THRUST: Develop modeling and simulation technologies for the next generation of planning, assessment, and execution environments. Note: In FY 2010, this effort moves to PE 0602788F, Project 5318, Major Thrust 5. In FY 2008: Completed demonstrations of advanced modeling and simulation technologies to support next generation planning, assessment, and execution environments. Demonstrated adversarial behavior models and modeling techniques for courses of action (COA) assessment and prediction. Conducted concept demonstrations of integrated interaction and assessment of friendly versus adversary courses of action. Demonstrated a prototypical dynamic situation assessment and prediction system. Investigated advanced concepts to provide approaches for a modeling toolset that enables the warfighter to build composable simulations. Initiated investigation of ability to forecast potential adversaries and events based on indications of known evidence and projected known and/or anticipated threat(s). In FY 2009: Complete demonstrations of adversarial behavior models and modeling techniques for courses of action assessment and prediction. Continue to conduct concept demonstrations of integrated interaction and assessment of friendly versus adversary courses of action. Complete demonstration of a prototypical dynamic situation assessment and prediction system. Continue to investigate advanced concepts to provide approaches for a modeling toolset that enables the warfighter to build composable simulations. Continue		2.713	2.262	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
investigation of ability to forecast potential adversaries and events based on indications of known evidence and projected known and/or anticipated threat(s). In FY 2010: Not Applicable.					
MAJOR THRUST: Develop real-time embedded information system technologies for complex, time-critical, embedded systems to enable affordable design and development of state-of-the-art hardware and software, innovatively incorporate new capabilities, reactively adapt to multiple missions and changing environments, verify, validate, and assure functionality and integrity, and facilitate rapid insertion to support real-time, collaborative operations within a net-centric enterprise. Note: In FY 2010, this effort moves to PE 0602788F, Project 5317, Major Thrust 2. In FY 2008: Developed dynamically reconfigurable aerospace systems using adaptive computing techniques to support image/video processing and data compression. Developed affordable, high assurance architecture components for real-time embedded systems supporting Multi-Level Security/Multiple Single Levels of Security (MLS/MSLS) and mixed criticality. Developed methods of computation and computing processes using biologically-inspired and biologically-based computation for embedded systems application. Initiated development of power-aware, polymorphic aerospace systems for mission-aware computing. In FY 2009: Complete development of dynamically reconfigurable aerospace systems using adaptive computing techniques to support image/video processing and data compression. Complete development of affordable, high assurance components for real-time embedded systems supporting MLS/MSLS and mixed criticality. Complete development of methods of computation and computing processes using biologically-inspired and biologically-based computation for embedded systems application. Complete development of power-aware, polymorphic aerospace systems for mission-aware computing. In FY 2010: Not Applicable.		2.624	1.948	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST/CONGRESSIONAL ADD: 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 value to the decision maker. Note: In FY 2010, this effort moves to PE 0602788F, Project 5318, Major Thrust 3. In FY 2008: Developed multi-intelligence toolsets for the processing, exploitation, and dissemination of actionable intelligence. Developed more effective multi-sensor signature exploitation algorithms to enhance detection (by 50%), identification (by 25%), and assessment (10X reduction in analyst time) of difficult targets; taking into account the complementary signature features (e.g., geo-physical, materials) that can be derived from multiple MASINT sensors. Developed algorithms to automatically detect and identify audio protection and channelization effects in modern modulated personal communications systems (PCS) with the goal of providing analysts the capability to automatically detect speech privacy and identify methods and means used. In FY 2009: Continue the development of the multi-intelligence the processing, exploitation, and dissemination of actionable intelligence. Complete the development of more effective multi-sensor signature exploitation algorithms to enhance detection (by 50%), identification (by 25%), and assessment (10X reduction in analyst time) of difficult targets; taking into account the complementary signature features (e.g., geo-physical, materials) that can be derived from multiple MASINT sensors. Complete the development to automatically detect and identify audio protection and channelization effects in modern modulated personal communications systems with the goal of providing analysts the capability to automatically detect speech privacy and identify methods and means used. Initiate development of methods and mechanisms to achieve robust/tamper-proof self-authenticating, self-regenerating code/data and detection and eradication systems for polymorphic malware. Research will include the detection and prevention of embedded malicious software (malware), system self-optimization/diagnosis/recovery, and the development of self-correcting watermarked code and data for trusted and optimized computing. In FY 2010: Not Applicable.	5.836	5.290	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0603789F/ C3I Advanced Development.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

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, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602702F Command Control and Communications					PROJECT NUMBER 625581	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
625581: Command and Control (C2) Technology	39.216	36.152	0.000						Continuing	Continuing

Note

Note: In FY 2010, this effort moves to PE 0602788F, Project 5316, Info Mgmt and Computational Tech.

A. Mission Description and Budget Item Justification

The Air Force requires C2 technologies that will provide the next generation of weapon systems with improved processing and presentation of information for real-time, distributed battle management and control. Technologies 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. Technologies being developed will increase capability, quality, and information interoperability, while reducing the cost of C2 systems and infrastructure. Technology development in this project focuses on planning and assessing techniques knowledge bases, distributed information systems, and information management and distribution services. Advances in planning and assessment technologies will vastly improve the military decision making process within C2 systems. Advances in the ability to rapidly detect, classify, identify, and continuously track objects and events will improve the awareness and understanding and prediction of adversarial intentions, allowing the development of various courses of action to counter their intentions. Advances in the development of very large comprehensive knowledge bases to rapidly formulate and create new knowledge are needed by the Expeditionary Aerospace Force. Advances in distributed intelligent information systems will allow automatic rapid reconfiguration of C2 centers to respond to varying crisis levels, as required, by a Net-Centric Aerospace Force. Advances in robust information management and dissemination technologies will ensure the delivery of high-quality, timely, secure information to the warfighter.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Investigate and develop technologies for the rapid development and application of next generation knowledge bases for aerospace C2 systems. Note: In FY 2010, this effort moves to PE 0602788F, Project 5318, Major Thrust 4. In FY 2008: Developed foundations, technology, and tools to enable effective, practical automated reasoning of the scale and complexity required for computers to perform complex tasks in the real-world requiring intelligence. Investigated and developed specialized cognitive architectures using self-aware, learning agents that can generate well-focused knowledge bases for automated intelligent extraction, correlation, and classification of link patterns for discovering relevant linkages between entities. Developed a prototype that	6.391	4.876	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
will have the capability, given commander's policies and rules of engagement, to apply context-aware access control to rapidly detect significant events and initiate reprioritization as required using operational databases and an available information management infrastructure. Initiated development of automated capture and self-organization of knowledge in globally distributed repositories. In FY 2009: Continue to develop foundations, technology, and tools to enable effective, practical automated reasoning of the scale and complexity required for computers to perform complex tasks in the real-world requiring intelligence. Continue to investigate and develop specialized cognitive architectures using self-aware, learning agents that can generate well-focused knowledge bases for automated intelligent extraction, correlation, and classification of link patterns for discovering relevant linkages between entities. In FY 2010: Not Applicable.					
MAJOR THRUST: Investigate, analyze, and develop technologies for automatic rapid reconfiguration of distributed intelligent information systems to varying crisis levels faced by the Expeditionary Aerospace Force. Note: In FY 2010, this effort moves to PE 0602788F, Project 5316, Major Thrust 2. In FY 2008: Completed the development of dynamic and adaptable interface technology that allows commanders to create a mission-tailored view of the configuration and status of the currently executing AOC C2 process. Developed advanced interactive displays suitable for rapid deployment in harsh environments with C2 applications and command centers. Developed advanced techniques and AOC-based applications for information visualization for use in conjunction with multiple, heterogeneous data sets. Developed technologies to improve the fidelity, accuracy, and interconnection of computer-based wargames used to prepare contingency plans and response strategies. Developed technologies for a holistic tool set that commanders can use to probe, study, analyze, visualize, reason, and predict activities in and around the battlespace. Developed an advanced mission planning process that will provide a self-healing, secure, rule-based automatic scheduling process that resembles an auction style planning capability. Initiated development of capabilities to be more agile within a net centric enabled environment. Developed timely option generation selection and coordination capabilities that account for uncertainty and missing and erroneous information,		10.069	9.906	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009	
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
and supports intuitive decision making process between man and machine collaborating on complex, dynamic problems exploiting the respective strengths of machines (process lots of data) and human (analytical reasoning). Developed dynamic workflow and workload management capabilities to manage the command and control constellation of resources. In FY 2009: Continue to develop advanced interactive displays suitable for rapid deployment in harsh environments with C2 applications and command centers. Continue development of advanced techniques and AOC-based applications for information visualization for use in conjunction with multiple, heterogeneous data sets. Continue to develop technologies to improve the fidelity, accuracy, and interconnection of computer-based wargames used to prepare contingency plans and response strategies. Continue development of technologies for a holistic tool set that commanders can use to probe, study, analyze, visualize, reason, and predict activities in the battlespace. Continue development of capabilities to be more agile within a net centric enabled environment. Continue the development of timely option generation selection and coordination capabilities that account for uncertainty and missing and erroneous information, and supports intuitive decision making process between man and machine collaborating on complex, dynamic problems exploiting the respective strengths of machines (process lots of data) and humans (analytical reasoning). Continue the development of dynamic workflow and workload management capabilities to manage the command and control constellation of resources. In FY 2010: Not Applicable.				
MAJOR THRUST: Investigate and develop technologies to securely share information via publish, subscribe, and query with coalition partners as part of the overall Global Information Grid approach. Sharing of information is in part a function of secure sharing, but is also a function of the managing of the information in assessing the trustworthiness of the information and its markup. Note: In FY 2010, this effort moves to PE 0602788F, Project 5316, Major Thrust 1. In FY 2008: Researched and developed cross-domain information sharing to include collaborative monitoring and management of multi-national enterprise resources. Developed techniques and tools that will ensure	7.628	6.627	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
availability, integrity, and survivability of information within a coalition net-centric environment. Investigated and prototyped the application of information fusion and information management technologies such as fuselets to extend composite views of events across a multi-domain enterprise into fused events. Developed publish/subscribe/query technologies for application to a content-based delivery networking (CBDN) system for intelligent network management of user information. Initiated development of technologies to systematically integrate information sources across COI's. In FY 2009: Complete cross-domain information sharing research and development to include collaborative monitoring and management of multi-national enterprise resources. Continue development of techniques and tools that will ensure availability, integrity, and survivability of information within a coalition net-centric environment. Continue to investigate technologies, which can determine the pedigree of information in a coalition environment and assess the trustworthiness of the marked up information to be shared throughout the coalition. Continue to investigate and prototype the application of information fusion and information management technologies such as fuselets to extend composite views of events across a multi-domain enterprise into fused events. Continue development of publish/subscribe/query technologies for application to a CBDN system for intelligent network management of user information. In FY 2010: Not Applicable.				
MAJOR THRUST: Develop next generation monitoring, planning, execution, and assessment technologies and tools enabling distributed aerospace commanders to efficiently and collaboratively develop effects based campaigns. Note: In FY 2010, this effort moves to PE 0602788F, Project 5316, Major Thrust 3. In FY 2008: Investigated application of decision support sciences and advanced decision-making concepts to C2 activities within a Coalition AOC. Developed intelligent information systems capable of supporting joint/coalition C2 for various missions in a dynamically changing environment. Developed tools to increase situational awareness and understanding through intelligent information processing. Applied system-of-systems and federation-of-systems engineering in the creation of joint C2 capabilities. Explored the application of intelligent software agents as virtual battle staff members to enhance various C2 processes. Completed	7.791	6.717	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009			
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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
the development and demonstration of an effects-based dynamic tasking process enabled by dynamically accessible data and information services. Initiated development of capability for a full-spectrum analysis for effects attainment at all levels of a campaign, linking leading indicators to desired and undesirable effects. The capability uses causal reasoning, linking effects to actions to desired end-state, develops non-deterministic, non-linear causal linkages, and is capable of reasoning through uncertainty and ambiguity. Initiated research to achieve the ability to predict the current and future impact of an adversary cyber attack on Air Force information systems. Developed effects-based defense models to help predict the first and second order impact of cyber attacks on an information system/mission. Developed cyber defense containment scenarios that minimize current and future adversary impact to net-centric warfare (NCW) mission. In FY 2009: Continue to investigate application of decision support sciences and advanced decision-making concepts to C2 activities within a coalition AOC. Continue to develop intelligent information systems capable of supporting joint/coalition C2 for various missions in a dynamically changing environment. Continue to develop tools to increase situational awareness and understanding through intelligent information processing. Continue the application of system-of-systems and federation-of-systems engineering in the creation of joint C2 capabilities. Continue to explore the application of intelligent software agents as virtual battle staff members to enhance various C2 processes. Continue the development of capability for a full-spectrum analysis for effects attainment at all levels of a campaign, linking leading indicators to desired and undesirable effects. The capability will utilize causal reasoning, linking effects to actions to desired end-state, will develop non-deterministic, non-linear causal linkages, and will be capable of reasoning through uncertainty and ambiguity. In FY 2010: Not Applicable.					
MAJOR THRUST: Investigate and develop technologies to implement flexible, high performance, secure, scalable, and survivable information management and dissemination services to enable a Global Information Grid-based COI Infosphere. Note: In FY 2010, this effort moves to PE 0602788F, Project 5316, Major Thrust 2.		1.996	1.891	0.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2008: Developed high-payoff publish, subscribe, and query laboratory prototypes, which provide higher levels of performance, security, and scalability capable of exceeding commercial products and support Air Force net-centric environment needs. Investigated automated methods of tailoring the user perspective of the COI Infosphere to reduce information overload and increase information awareness and utilization. Developed technology and techniques to monitor, obtain feedback, and assert control over the COI Infosphere. Investigated the security policy enforcement between COI Infospheres at various levels of security classification. Investigated methods and techniques for dynamically evolving the net-centric environment so as to avoid system crashes or latency as new information sources arrive or depart the environment. Initiated decentralization and fault tolerant information management services for the tactical environment. Initiated development of information transformation services and adaptive information management services that learn, self-configure, self-manage, and are self-healing. Initiated a study on collaboration services on demand that will exploit dynamic information services matching end user devices (laptops, cell phones, etc.) with appropriate information formats. In FY 2009: Continue to develop high-payoff publish, subscribe, and query laboratory prototypes, which provide higher levels of performance, security, and scalability capable of exceeding commercial products and support Air Force net-centric environment needs. Develop the security policy enforcement between COI Infospheres at various levels of security classification. Investigate methods and techniques for dynamically evolving the net-centric environment so as to avoid system crashes or latency by exploiting information technologies based on quality of service mechanism. Initiate integration of information services across operational boundaries and dissimilar infrastructure based systems. Continue development of information transformation services and adaptive information management services that learn, self-configure, self-manage, and are self-healing. In FY 2010: Not Applicable.				
MAJOR THRUST: Develop distributed collaboration technologies, advance collaboration science, virtual environments, and predictive simulation tools to facilitate the development and fielding of next generation	5.341	6.135	0.000	

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B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
operational collaborative decision support systems. Note: In FY 2010, this effort moves to PE 0602788F, Project 5316, Major Thrust 5. In FY 2008: Developed advanced information technologies for collaborative decision-making and knowledge management in support of capability-based planning and next generation planning, execution, and assessment environments. Prototyped distributed collaborative environment technologies for advanced decision support for high-profile system concepts, such as the Global Strike Concept of Operations and operations other then war. Initiated a study on collaboration services on demand that will exploit dynamic information services matching end user devices (laptops, cell phones, etc.) with appropriate information formats. Supported context aware collaborative user interfaces and semantic interoperability. In FY 2009: Complete development of advanced information technologies for collaborative decision-making and knowledge management in support of capability-based planning and next generation planning, execution, and assessment environments. Complete prototyping distributed collaborative environment technologies for advanced decision support for high-profile system concepts, such as the Global Strike Concept of Operations and operations other then war. Continue study on collaboration services on demand that will exploit dynamic information services matching end user devices (laptops, cell phones, etc.) with appropriate information formats. Support context aware collaborative user interfaces and semantic interoperability. In FY 2010: Not Applicable.					

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602702F Command Control and Communications	PROJECT NUMBER 625581

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0603617F/ C3 Applications.	0.000	0.000							Continuing	Continuing
PE 0303401F/ Communications-Computer Systems (C-CS) Security RDT&E.	0.000	0.000							Continuing	Continuing
PE 0603789F/ C3I Advanced Development.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

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, PB 2010 Air Force RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 3600 - Research, Development, Test & Evaluation, Air Force/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602702F Command Control and Communications					PROJECT NUMBER 6266SP	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
6266SP: Space Optical Network Tech	16.961	9.962	0.000						Continuing	Continuing

Note

Note: In FY 2010, this effort moves to PE 0602788, Project 5315, Connectivity and Protection Tech.

A. Mission Description and Budget Item Justification

This project develops the technology base for the next generation of ultra-wide bandwidth, multi-channeled, air- and space-based communications networks on and between platforms. As the application of laser-based, point-to-point communications between satellites emerges, air- and space-based optical networks, whose communications capacities are thousands of times greater than current communications satellites, become a realistic possibility. This project will assess and adapt the emerging communication and information technologies, for applications in air and space. This project will explore technologies for implementing photonic chip scale optical Code Division Multiple Access (CDMA) and Wavelength Division Multiplexed (WDM) transceivers and prototype networks, built to demonstrate the benefits associated with the advanced fiber optic, wireless, platform, and satellite networks that can be built from them. This project will develop and demonstrate technology to integrate current Radio Frequency (RF) with high data rate Optical Laser communications, along with network management techniques, tools and software to support them. These technologies have potential applications in specific military systems including reliable, high bandwidth, jam-resistant communications at the theater level, and multiplexing of multiple DoD users onto a common networking infrastructure for reduced manning and logistics.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop and assess optical network technologies for application in the space environment. Note: In FY 2010, this effort moves to PE 0602788F, Project 5315, Major Thrust 7. In FY 2008: Completed demonstration of 16 x 16 optical data router and optical backbone interface chips for integration with on board Integrated Core Processor. Initiated design and development of 40 channel multi-wavelength optical network for on-board air and space applications. In FY 2009: Continue development of 40 channel multi wavelength optical network for on-board air and space applications. In FY 2010: Not Applicable.	1.497	2.967	0.000	

Exhibit R-2a, PB 2010 Air Force RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MAJOR THRUST: Develop and assess existing and emerging Optical CDMA and WDM modulation schemes and protocols for use in space-based optical networks. Note: In FY 2010, this effort moves to PE 0602788F, Project 5315, Major Thrust 7. In FY 2008: Designed and developed optical burst switching and optical label switching protocols for applicability to air and space-based optical networks. Completed flight demonstration of industry standard single mode optical communications bus interface chip for airborne platforms. In FY 2009: Initiate flight demonstration of multi-gigabit, multi-wavelength optical communications bus interface chip for space and air platforms. In FY 2010: Not Applicable.	3.521	1.798	0.000	
MAJOR THRUST: Develop and demonstrate heterogeneous, seamless, secure, self-configuring high capacity air/space/surface wireless networks that integrate current RF with high data rate Optical Laser communications. Note: In FY 2010, this effort moves to PE 0602788F, Project 5315, Major Thrust 8. In FY 2008: Completed the characterization of the combiner RF/laser communications brassboard. Designed and developed higher throughput RF waveform data link technology for operation under adverse weather conditions. Conducted flight demonstration of combined RF/laser communications brassboard in cooperation with the demonstration of advanced airborne sensor technologies. In FY 2009: Complete the development and start the characterization of higher throughput RF waveform data link technology for operation under adverse weather conditions. Initiate the design of an integrated RF/laser communications airborne qualifiable brassboard. In FY 2010: Not Applicable.	11.943	5.197	0.000	

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C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Activity Not Provided/ Related Activities:	0.000	0.000							Continuing	Continuing
PE 0603789F/ C3I Advanced Development.	0.000	0.000							Continuing	Continuing
Activity Not Provided/ This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate	0.000	0.000							Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

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.