Exhibit R-2, RDT&E Budget Item Justification: PB 2012 Defense Advanced Research Projects Agency										DATE: February 2011	
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*				R-1 ITEM NOMENCLATURE PE 0603287E: *SPACE PROGRAMS AND TECHNOLOGY*							
COST ($ in Millions)	**FY 2010**	**FY 2011**	**FY 2012 Base**	**FY 2012 OCO**	**FY 2012 Total**	**FY 2013**	**FY 2014**	**FY 2015**	**FY 2016**	**Cost To Complete**	**Total Cost**
Total Program Element	172.728	98.130	97.541	-	97.541	138.704	213.546	211.308	211.308	Continuing	Continuing
SPC-01: *SPACE PROGRAMS AND TECHNOLOGY*	172.728	98.130	97.541	-	97.541	138.704	213.546	211.308	211.308	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Space Programs and Technology program element is budgeted in the Advanced Technology Development budget activity because it addresses high payoff opportunities to dramatically reduce costs associated with advanced space systems and provides revolutionary new system capabilities for satisfying current and projected military missions.

A space force structure that is robust against attack represents a stabilizing deterrent against adversary attacks on space assets. The keys to a secure space environment are situational awareness to detect and characterize potential attacks, a proliferation of assets to provide robustness against attack, ready access to space, the ability to neutralize man-made space environments, and a flexible infrastructure for maintaining the capabilities of on-orbit assets. Ready access to space allows the delivery of defensive systems and replenishment supplies to orbit. An infrastructure to service the mission spacecraft allows defensive actions to be taken without limiting mission lifetime. In addition, developing space access and spacecraft servicing technologies will lead to reduced ownership costs of space systems and new opportunities for introducing technologies for the exploitation of space.

Systems development is also required to increase the interactivity of space systems, space-derived information and services with terrestrial users. Studies under this project include technologies and systems that will enable satellites and microsatellites to operate more effectively by increasing maneuverability, survivability, and situational awareness; enabling concepts include solar thermal propulsion, novel ion-thruster applications, payload isolation and pointing systems.

B. Program Change Summary ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Previous President's Budget	183.477	98.130	97.395	-	97.395
Current President's Budget	172.728	98.130	97.541	-	97.541
Total Adjustments	-10.749	-	0.146	-	0.146
• Congressional General Reductions		-			
• Congressional Directed Reductions		-			
• Congressional Rescissions	-	-			
• Congressional Adds		-			
• Congressional Directed Transfers		-			
• Reprogrammings	-5.882	-			
• SBIR/STTR Transfer	-4.867	-			
• TotalOtherAdjustments	-	-	0.146	-	0.146

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

	FY 2010	FY 2011
Project: SPC-01: *SPACE PROGRAMS AND TECHNOLOGY*		
Congressional Add: *Mosaic Camera Technology Transition*	1.600	-
Congressional Add Subtotals for Project: SPC-01	1.600	-
Congressional Add Totals for all Projects	1.600	-

Change Summary Explanation

FY 2010: Decrease reflects internal below threshold reprogramming and SBIR/STTR transfer offset by the new start authorization.
FY 2012: Increase reflects minor repricing offset by a reduction for Defense Efficiencies for contractor staff support.

C. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Title: System F6	65.000	40.000	40.000

Description: The objective of the System F6 program is to demonstrate the feasibility and benefits of a satellite architecture wherein the functionality of a traditional "monolithic" spacecraft is replaced by a cluster of wirelessly-interconnected spacecraft modules. Each such "fractionated" module would contribute a unique capability, e.g., computation and data handling, communications relay, guidance and navigation, payload sensing, etc., or it can replicate the capability of another module. The fractionated modules would fly in a loose, proximate cluster orbit capable of semi-autonomous reconfiguration or a rapid defensive scatter/re-gather maneuver. Critical to this architecture is a robust, system-level approach to ensuring security, integrity, and availability, while implementing authentication and non-repudiation. While delivering a comparable mission capability to a monolithic spacecraft, System F6 significantly enhances architectural and programmatic adaptability and robustness-reducing risk through the mission life and spacecraft development cycle, enabling incremental deployment of the system, and enhancing survivability. The System F6 architecture provides valuable options to decision makers throughout the life cycle development of future space systems that are absent in present-day monolithic architectures.

The System F6 program will culminate in an on-orbit demonstration of a multi-module space system incorporating the F6 Technology Package-a suite of technologies, components, and algorithms which enables semi-autonomous multi-body cluster flight and secure, distributed, real-time sharing of various spacecraft resources at the cluster level. Multiple version of the F6 Technology Package will be developed on the basis of open-source interface standards, software, and reference designs. The on-orbit demonstration will be capable of accommodating one or more spacecraft payload modules supplied by a third-party mission partner. Residual capability to support future payloads with the existing on-orbit infrastructure will also remain, and the infrastructure can be upgraded for a perpetual on-orbit resource capability. The utility of the F6 architecture in low earth orbit (LEO) is significantly enabled by persistent broadband connectivity to the ground which allows resource sharing between space-

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
based modules and terrestrial network nodes. A solution to enable high-availability, low-latency, persistent, high-bandwidth communications with LEO spacecraft will be developed in the course of the F6 program. The anticipated transition partner is the Air Force, though the architecture will have the ability to simultaneously accommodate payloads from multiple other partners including the Army and Navy, the resultant architecture is expected to significantly lower the barrier to entry and enhance competiveness of the national security space industrial base. ***FY 2010 Accomplishments:*** - Began development of a persistent broadband terrestrial connectivity solution for low-earth-orbit fractionated clusters. - Commenced development of an information assurance architecture for the F6 space data network. - Developed a preliminary draft of the F6 Developer's Kit (FDK). - Restructured program to focus on architecture, open standards, interfaces, and F6 Technology Packages (F6TP). ***FY 2011 Plans:*** - Continue development of open-source interface standards, software, and reference hardware models for the F6 Developer's Kit (FDK). - Conduct preliminary design review for the persistent broadband terrestrial connectivity solution for LEO fractionated clusters. - Conduct critical design review for the persistent broadband terrestrial connectivity solution for LEO fractionated clusters. ***FY 2012 Plans:*** - Complete development and beta release of the FDK. - Continue FDK software testing and verification. - Begin build of one or more F6TP based on FDK specification. - Perform end-to-end hardware-in-the-loop testing of the persistent broadband terrestrial connectivity solution for LEO fractionated clusters.			
Title: Space Domain Awareness (SDA)* ***Description:*** *Formerly Space Situational Awareness (SSA) & Counterspace Operations Response Environment (SCORE) The goal of the Space Domain Awareness (SDA) program is to develop and demonstrate an operational framework and responsive defense application to enhance the availability of vulnerable space-based communications resources. SDA will investigate revolutionary technologies in two areas: 1) advanced space surveillance sensors to better detect, track, and characterize space objects, with an emphasis on deep space objects, and 2) space surveillance data processing/data fusion to provide automated data synergy, to increase space domain awareness, overall space safety of flight, and ultimately to allow space operators to make informed, timely decisions. Current space surveillance sensors cannot detect, track, or determine the future	2.052	9.000	20.000

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012

location and threat potential of small advanced technology spacecraft in deep space orbits, where a majority of DoD spacecraft are located. Additionally, manned servicing missions to geosynchronous (GEO) orbits will require exquisite situational awareness, from ultra high-accuracy debris tracking for safety of flight at GEO orbits to high resolution imaging of GEO spacecraft for service mission planning. The SDA program will leverage data fusion and advanced algorithms developed under the SST program, as well as seek to exploit new ground-breaking technologies across the electromagnetic spectrum and utilize already existing sensor technology in non-traditional or exotic ways, to bring advanced capabilities to the space domain. SDA will correlate a wide range of operational support and space system user data to rapidly identify threat activities, propose mitigating countermeasures, and verify the effectiveness of selected responses. Critical technologies include accessing disparate sources of relevant data, model-based situational awareness, and candidate response generation and evaluation. Particular emphasis will be placed on the ability to continuously adapt to changes in defended system components and usage patterns as well as validation of system integrity. The potential transition customer is the Air Force.

FY 2010 Accomplishments:
- Developed algorithms and software required to integrate disparate information into a single framework.
- Integrated software environment into a suite of visualization products that provide situational awareness and decision making tools.
- Conducted operational scenario testing of system, and refined algorithms and software.

FY 2011 Plans:
- Survey existing systems and identify critical technology gaps.
- Initiate data fusion modeling effort to determine limitations of currently developed algorithms.
- Begin investigating the applicability of using a dynamic track graph algorithmic approach to achieve timely cataloging of breakups and collisions.
- Evaluate high resolution passive imaging of GEO satellites using incoherent intensity correlation imaging.
- Investigate using remote ultra-low light imaging technology to significantly enhance incoherent intensity correlation for GEO-imaging.

FY 2012 Plans:
- Develop prototype next-generation collaborative space information fusion center to provide a revolutionary approach to integrating, collaborating and visualizing complex space system and environmental data, enabling operators to make informed decisions to protect critical space capabilities; concepts to be explored include intuitive applications and adaptive understanding.
- Develop architecture for low cost space situational awareness (SSA) data sources, initial sensors will focus on small, ultra wide field of view optical systems.
- Develop additional SSA data integration algorithms to incorporate cyber initiatives into the space information fusion center.

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
- Expand the concept of dynamically tasked sensors so that the entire SSA network is continuously optimized and capable of responding to any highlighted space threat.			
Title: XTIM ***Description:*** XTIM is an autonomous system of determining timing and positioning of space assets using X-ray pulsars and then broadcasting this information for navigation and time uses independent of, and supplemental to, GPS. XTIM autonomously calculates its position and absolute time from celestial sources. XTIM then broadcasts this information to users either on the ground or in space as a method to enhance their navigation solutions. In addition, XTIM reference data can be used to update the GPS constellation ephemerides and timing with limited or no ground support. XTIM also provides an alternative timing source that can be used as a checksum for GPS receivers to insure detection of spoofing or sophisticated jamming attacks. XTIM leverages previous work by DARPA which analytically demonstrated that X-ray pulsars could be used for navigation of space assets. XTIM will create a truly autonomous and universal time reference for military navigation and communication needs. The anticipated transition partner is the Air Force. ***FY 2010 Accomplishments:*** - Designed an architecture utilizing XTIM to seamlessly integrate into the current pointing, navigation and timing systems allowing them to utilize the strengths of the autonomous nature of XTIM to defeat current vulnerabilities. ***FY 2011 Plans:*** - Design a geosynchronous orbit demonstration mission to be launched aboard an evolved expendable medium class launch vehicle and proceed through preliminary design review. - Perform an X-ray beam line test of the brass board design to demonstrate feasibility of X-ray detection and timing. - Perform an electron background rejection measurement of the brass board design to demonstrate feasibility of the geosynchronous background mitigation concept. - Conduct preliminary design review. ***FY 2012 Plans:*** - Conduct critical design review. - Begin construction of a space qualified XTIM payload in support of a launch.	6.000	7.000	8.041
Title: Membrane Optic Imager Real-Time Exploitation (MOIRE)* ***Description:*** *Formerly Big Eye	5.000	5.000	10.000

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Leveraging advanced membrane optics demonstrating photon sieve optics, the Membrane Optic Imager Real-Time Exploitation (MOIRE) program will enable the technology for very large aperture optics for space platforms. MOIRE utilizes the fact that photon sieve optics can achieve diffraction limited images for very large structures where flatness is the primary concern. MOIRE will demonstrate the manufacturability of large membranes (up to 20 meters), large structures to hold the optics tight and flat, and also demonstrate the secondary optical elements needed to turn a diffraction based optic (such as photon sieve) into a wide bandwidth imaging device. MOIRE will end with a technology demonstration that significantly reduces the risk of using these types of optics for flight development. The anticipated transition partner is the Air Force. ***FY 2010 Accomplishments:*** - Began system engineering to identify the system requirements which a large (20 m) optic would need to satisfy to obtain near diffraction limited images at geo-synchronous orbit. ***FY 2011 Plans:*** - Complete system engineering to identify the system requirements which a large (20 m) optic would need to satisfy to obtain near diffraction limited images at geo-synchronous orbit. - Design, construct, and test an optic at least 1 m in diameter which shows how the material qualities needed for orbit could be obtained. - Conduct payload preliminary design review for a 10 m demonstration system. - Conduct system concept design review for a 10 m demonstration at geo-synchronous orbit. ***FY 2012 Plans:*** - Design, construct and test an optic at least 5 m in diameter which shows how the material qualities needed for orbit could be obtained. - Conduct a system preliminary design review for a 10 m demonstration at geo-synchronous orbit.			
Title: Manned Geostationary Earth Orbit (GEO) Servicing ***Description:*** The Manned Geostationary Earth Orbit (GEO) Servicing program, an outgrowth of the FREND program, will investigate the feasibility, risks, and technologies necessary for human and robotic servicing of spacecraft in GEO. To date, servicing operations have not been conducted on spacecraft beyond LEO. A large number of national security and commercial space systems operate at GEO altitudes, furthermore, many end-of-life or failed spacecraft drift without control through portions of the GEO belt, creating a growing hazard to operational spacecraft. DARPA has previously pursued technologies for servicing of spacecraft with the expectation such servicing would involve a mix of highly autonomous and remotely (i.e., ground-based) teleoperated robotic systems. The Manned GEO Servicing program will build upon this DARPA legacy, tackling the more complex GEO environment, and developing technologies to allow for both human and robotic servicing. Key challenges include	-	4.000	8.500

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
transportation and orbital maneuvering, life support, radiation protection, robotic systems and integration, and extravehicular tool requirements. The anticipated transition partners are NASA and the Air Force. ***FY 2011 Plans:*** - Identify and evaluate flight/ground servicing experience, satellite failures, and candidate servicing missions. - Define preliminary mission architecture and technology trade space to enable human and robotic GEO servicing missions. - Investigate technologies for key requirements of manned servicing, for both intravehicular and extravehicular activity. ***FY 2012 Plans:*** - Perform conceptual mission design and feasibility studies. - Perform conceptual design of selected demonstration mission, focusing on system architecture and key technology gaps.			
Title: Single Wafer Integrated Femto Satellites (SWIFT)* ***Description:*** *Formerly Advanced Nano/Micro-Satellite Technology for Tactical Applications The goal of the Single Wafer Integrated Femto Satellites (SWIFT) program is to demonstrate critically needed technologies enabling a very small (nano- and micro-) satellite constellation for persistent tactical military applications. SWIFT will develop, fabricate, and demonstrate fully functional "femtosat" spacecraft (less than 100 grams) which can enable new missions not currently possible with singular monolithic satellites by means of an adaptable hardware architecture and microfabrication technologies. Swarms of femtosats are ideally suited for distributed missions, such as sparse aperture arrays for remote sensing or fly-around inspectors for larger spacecraft. The U.S. Army, U.S. Air Force, intelligence community, and other potential users have identified such small satellites as a potential technical approach for delivering affordable support to the tactical warfighter. By deploying large numbers of very low cost nano-satellites in distributed constellations a persistent effect can be provided to terrestrial forces. Today's technology limits the ability to do this and advances in key areas are needed to make this vision a reality. Specifically, nanosatellites lack sufficient power, communications, propulsion and imaging capacity to address many tactical needs. Key technologies include: deployable communications antennas, crosslink communications, interferometric technologies, small imaging systems, attitude control subsystems, efficient solar electric arrays, efficient maneuver capability, efficient upper stages, and revolutionary manufacturing techniques. The anticipated transition partner is the Air Force. ***FY 2011 Plans:*** - Conduct trade study of available technologies and investment opportunities. - Initiate concept design. ***FY 2012 Plans:*** - Perform military utility analysis and develop concepts of operation.	-	2.400	3.000

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
- Conduct fabrication test run to validate novel fabrication technologies. - Perform detailed femtosat design and analysis.			
Title: Horizontal Launch* ***Description:*** *Formerly Responsive, Reliable Access to Space Program (R2A2 Space) The goal of the Horizontal Launch program is to mature and demonstrate technologies for low cost, routine, reliable, horizontal access to low earth orbit (LEO). The program will explore launch to LEO concepts for payload classes between 5,000 and 20,000 lbs, and will consider overall launch architectures to include ground processing flows, ground handling and associated infrastructure, methods for reducing turnaround time, and flexible basing. Combinations of reusable or expendable upper stages and hydrocarbon versus hydrogen fuels will be examined. Enabling technologies include composite or light weight structures, integral load bearing propellant tanks, thermal management systems, high energy density propulsion systems, advanced guidance and controls, rocket back maneuvering for a reusable first stage, and advanced upper stages. The program will validate critical technologies on the ground and, where practical, demonstrate them in flight. Where feasible, flight testing will leverage the substantial ongoing entrepreneurial private sector investments. The anticipated transition partner is the Air Force. ***FY 2011 Plans:*** - Conduct market/business case analysis for horizontal launch concepts. - Analyze alternative infrastructure options including cost considerations. ***FY 2012 Plans:*** - Perform conceptual design of selected architecture focusing on key technology gaps. - Initiate preliminary design.	-	5.000	8.000
Title: Fast Access Spacecraft Testbed (FAST) ***Description:*** The goal of the Fast Access Spacecraft Testbed (FAST) program is to demonstrate a suite of critical technologies including high efficiency solar cells, sunlight concentrating arrays, large deployable structures, and ultra light weight solar arrays. These technologies enable light-weight, high efficiency, and high-power satellites of 20kW scalable to 80kW or more. The specific power goal is 130 W/Kg yielding an ultra light-weight power system of approximately 230 Kg for a 30 kW array. Combined with electric propulsion, FAST enables fast-transfer roaming satellites with nearly five times the fuel efficiency of conventional chemical propulsion. For example, FAST will permit on-demand access to any point on the geosynchronous ring or within the high-altitude, super synchronous "graveyard" (where derelict systems are regularly repositioned in order to free up orbital slots within the ring), greatly improving our ability to rapidly deploy and reposition satellites, as well as monitor the geosynchronous environment. Alternatively, FAST will permit responsive launch capabilities including deployment of small geosynchronous	9.347	3.290	-

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
satellites on small launch vehicles. Scaled up systems will nearly double the effective satellite mass launched to high altitude orbits today, significantly downsizing the need for large launch vehicles. The anticipated transition partner is the Air Force. ***FY 2010 Accomplishments:*** - Conducted 30-day ground test of a FAST solar wing segment (10%) in thermal vacuum chamber to characterize key performance metrics including heat rejection capability, optical performance, and power generation capability. - Demonstrated full-scale mechanical deployment of FAST solar concentrator wing under 1g conditions. ***FY 2011 Plans:*** - Conduct system level testing of FAST technology to support future orbital demonstrations. - Conclude data analysis from test campaign and finalize test report.			
Title: Space Surveillance Telescope (SST) ***Description:*** The Space Surveillance Telescope (SST) program will develop and demonstrate an advanced ground-based optical system to enable detection and tracking of faint objects in space, while providing rapid, wide-area search capability. A major goal of the SST program is to develop the technology for large curved focal surface array sensors to enable an innovative telescope design combining high detection sensitivity, short focal length, wide field of view, and rapid step-and-settle to provide orders of magnitude improvements in space surveillance. This capability will enable ground-based detection of un-cued objects in deep space for purposes such as asteroid detection and space defense missions. The Air Force will participate in the DARPA funded developmental testing of SST and then take over operation of SST as a sensor in the Air Force Space Surveillance Network. An MOA has been established with Air Force Space Command (AFSPC) for transition. In addition, the program will investigate data fusion and advanced algorithms for correlation of unknown objects. SST is expected to generate a large number of uncorrelated targets (UCTs), and new methods will need to be employed to rapidly characterize and attribute the new objects. Furthermore, the program will investigate methods which combine observations from disparate sensors (such as optical and radar installations) to more rapidly, accurately, and completely provide knowledge about UCTs, as compared to the existing system where no data fusion is employed. Where appropriate, SST will investigate new concepts which would provide complementary or further advances in ground-based deep space object detection and characterization. ***FY 2010 Accomplishments:*** - Assembled rapid slewing telescope mount on site. - Completed integration and testing of high-speed shutter and mosaic, curved focal plane array. - Completed fabrication of primary and secondary telescope mirrors. - Initiated integration of telescope elements (optics, gimbal mount) on site.	14.960	10.840	-

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
- Completed a survey of multi-aperture optical survey technologies. - Performed parametric trades to define candidate architectures. - Initiated development of algorithms for complex field reconstruction from sensor data. - Conducted experiments to determine image resolution capabilities of system prototype for near-horizontal 149km propagation. ***FY 2011 Plans:*** - Finish optics integration on site. - Integrate camera and data processing subsystems at site. - Complete initial alignment of full SST system ("First Light"). - Perform final focus and alignment. - Evaluate demonstration activities and SST mission functionality. - Validate SST system performance and demonstrate surveillance operations. - Investigate data processing algorithms to enhance contribution of SST data to SSA. - Investigate data fusion capabilities to enhance SSA through use of multiple optical sensors (multi-static observations, track handoffs). - Complete demonstration and transition system to AFSPC. - Complete targeted multi-aperture alternative trade studies and more detailed concept evaluations. - Initiate multi-aperture alternative proof of concept technology demonstrations. - Develop compensation and timing algorithms for maximum resolution improvement and near-real-time processing. - Develop capability for dynamic sensor tasking, resident space object signature analysis threat binning, and positive object identification.			
Title: Multi-Aperture Geosynchronous (GEO) Imager (MAGI) ***Description:*** The goal of the Multi-Aperture Geosynchronous (GEO) Imager (MAGI) program is to demonstrate a segment of a world-wide millimeter wave (MMW) surveillance capability by combining radar and radio astronomy technologies and techniques. By merging interferometric receiving and correlation techniques, used by radio astronomers for decades, with high power narrow-band radar transmitter technologies, MAGI hopes to prove the capability to obtain an order of magnitude improvement in imaging resolution of GEO and near-GEO satellites. A low cost demonstration using the NASA Goldstone X-Band radar and existing radio astronomy assets (the National Radio Astronomy Organization's Very Long Baseline Array) will be conducted to prove the concept at X-band. Based on resolution requirements, the follow-on prototype demonstration will be at MMW (~90GHz) and, to the greatest extent practicable, will utilize COTS MMW antennas and high power narrow-band transmitters. The anticipated transition partner is the Air Force. ***FY 2010 Accomplishments:***	4.749	2.600	-

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
- Conducted second measurement campaign on candidate deep space objects. - Refined algorithms. - Began development of requirements and system concept for a prototype MAGI system. ***FY 2011 Plans:*** - Conduct additional measurement campaigns. - Survey current state of the art and developmental MMW technologies to provide a development plan for high power sources that could be used for the prototype demonstration. - Investigate co-operative use of the bistatic radar and very long baseline interferometry data to improve satellite state vector information. - Perform MMW radar measurements of satellite mock-ups in the lab to simulate the MAGI experiment to more accurately predict and understand the results of the imaging campaigns.			
Title: Front-end Robotics Enabling Near-term Demonstration (FREND)	12.000	9.000	-
Description: The goal of the Front-end Robotics Enabling Near-term Demonstration (FREND) program is to develop, demonstrate, and fly robotic manipulator technologies designed to allow interaction with geosynchronous orbit (GEO)-based military and commercial spacecraft, extending their service lives and permitting satellite refueling, repair, refurbishment, repositioning or retirement. Existing GEO spacecraft are outfitted with sufficient propellant to provide for needed station keeping, repositioning, and retirement maneuvers, which in many cases defines their useful mission durations. Once the propellant is expended, the vehicle is retired and, in many cases, replaced. FREND technologies can enable significant service extension to these spacecraft through re-boosting near end-of-life. FREND technologies may also be applied to crewed servicing vehicles to provide robotic assistance to manned GEO servicing missions. Recent events have significantly increased the number of objects/debris in low earth orbit (LEO), particularly in orbital planes of most interest to DoD users, causing an increased threat to safe space operations. FREND combines detailed photogrammetric and laser imaging with robotic multi-degree-of-freedom manipulators to autonomously grapple space objects not outfitted with custom interfaces. A FREND-based servicing spacecraft offers the potential for spacecraft salvage, repair, rescue, reposition, de-orbit and retirement, and debris removal. The program will examine possible solutions for all classes of LEO debris to determine the most economical technical solution set to mitigating the problem. In addition, FREND will investigate neurorobotics as a potential replacement for the baseline suite of algorithms (e.g., arm trajectory planning, vehicle pose estimation, grapple feature identification, or compliance control) required to dock multiple robotic arms with a client spacecraft. The anticipated transition partner is the Air Force. ***FY 2010 Accomplishments:***			

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
- Demonstrated application of neurorobotic technology to FREND payload in "earth's gravity" environment. - Investigated the application of FREND technologies to support human GEO servicing spacecraft. ***FY 2011 Plans:*** - Conduct technology and utility trade studies to model the LEO debris problem, identify significant risks to operational assets, and determine possible technological solutions. - Develop debris remediation conceptual designs.			
Title: Falcon ***Description:*** The Falcon program objectives are to develop and demonstrate hypersonic technologies that will enable prompt global reach missions. The technologies include high lift-to-drag techniques, high temperature materials, precision navigation, guidance and control, communications through plasma, and an autonomous flight safety system. Falcon addresses the implications of long range hypersonic flight using the Hypersonic Technology Vehicle (HTV-2). The HTV-2 program will demonstrate enabling hypersonic technologies for future operational systems through rocket-boosted hypersonic flights with sufficient cross-range and downrange performance to evaluate thermal protection systems, aerodynamic shapes, maneuverability, and long-range communication for hypersonic cruise and re-entry vehicle applications. The Falcon program addresses many high priority mission areas and applications such as global presence and space lift. DARPA established an MOA with the Air Force for the HTV-2 program in May 2003 and with NASA in October 2004. Since 2008, the effort has been jointly funded with the Office of Secretary of Defense Global Strike program office. Falcon capabilities are planned for transition to the Air Force with data enabling further Conventional Prompt Global Strike (CPGS) developments in support of OSD efforts in this area. ***FY 2010 Accomplishments:*** - Completed assembly, integration and testing (AI&T) of first HTV-2 vehicle. - Completed second flight vehicle aeroshell. - Completed first Minotaur IV Lite Launch Vehicle. - Completed integration and stacking of HTV-2 vehicle to Minotaur IV Lite Launch Vehicle. - Successfully executed largest ever stationary and mobile (land, sea, air, and space) test asset deployment for hypersonic flight test in support of 100% real-time telemetry collection. - Completed first successful flight of Minotaur IV Lite Launch Vehicle. - Conducted flight test of first HTV-2 vehicle incorporating next generation hypersonic technologies. - Performed post-flight data reduction and analysis assessing technology performance in flight regime. - Complete AI&T of second HTV-2 vehicle. - Complete second Minotaur IV Lite Launch Vehicle. - Execute flight test of second HTV-2 vehicle.	24.170	-	-

Exhibit R-2, RDT&E Budget Item Justification: PB 2012 Defense Advanced Research Projects Agency	DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	**R-1 ITEM NOMENCLATURE** PE 0603287E: *SPACE PROGRAMS AND TECHNOLOGY*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
- Perform post-flight data reduction to assess hypersonic flight performance of the Minotaur IV and HTV-2 flight vehicle. - Transition technology development products to continue further maturation of OSD funded CPGS programs.			
Title: Integrated Sensor is Structure (ISIS) ***Description:*** The joint DARPA/Air Force Integrated Sensor is Structure (ISIS) program is developing a sensor of unprecedented proportions that is fully integrated into a stratospheric airship that will address the nation's need for persistent wide-area surveillance, tracking, and engagement for hundreds of time-critical air and ground targets in urban and rural environments. ISIS is achieving radical sensor improvements by melding the next-generation technologies for enormous lightweight antenna apertures and high-energy density components into a highly integrated lightweight multi-purpose airship structure - completely erasing the distinction between payload and platform. The ISIS concept includes ninety-nine percent on-station 24/7/365 availability for simultaneous airborne moving target indicator (600 kilometers) and ground-based moving target indicator (300 kilometers) operation; ten years of autonomous, unmanned flight; hundreds of wideband in-theater covert communications links; responsive reconstitution of failed space assets; plus CONUS-based sensor analysis and operation. An MOA has been signed by DARPA and the Air Force to pursue the program objectives through to transition. Starting in FY 2010, this program has also been budgeted in PE 0603286E, Project AIR-01. The ISIS technology demonstration system transitions to the Air Force in 2013. ***FY 2010 Accomplishments:*** - Conducted preliminary design review of demonstration system. - Conducted radar system operational modeling and simulation. - Developed and demonstrated flight dynamic controls in a lab environment. - Demonstrated large-scale manufacturing of prototypes and initial integration. - Conducted radar and power system critical design reviews.	27.850	-	-
Accomplishments/Planned Programs Subtotals	171.128	98.130	97.541

	FY 2010	FY 2011
Congressional Add: Mosaic Camera Technology Transition ***FY 2010 Accomplishments:*** - Continue research into the transition of mosaic camera technology.	1.600	-
Congressional Adds Subtotals	1.600	-

Exhibit R-2, RDT&E Budget Item Justification: PB 2012 Defense Advanced Research Projects Agency	DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603287E: *SPACE PROGRAMS AND TECHNOLOGY*

D. Other Program Funding Summary ($ in Millions)

Line Item	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
• Falcon: *OSD*	44.016	38.631	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

E. Acquisition Strategy

N/A

F. Performance Metrics

Specific programmatic performance metrics are listed above in the program accomplishments and plans section.