Exhibit R-2, RDT&E Budget Item Justification: PB 2019 Air Force											Date: February 2018	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603401F / *Advanced Spacecraft Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2017**	**FY 2018**	**FY 2019 Base**	**FY 2019 OCO**	**FY 2019 Total**	**FY 2020**	**FY 2021**	**FY 2022**	**FY 2023**	**Cost To Complete**	**Total Cost**
Total Program Element	-	69.338	58.910	54.895	0.000	54.895	53.979	55.891	58.966	60.113	Continuing	Continuing
632181: *Spacecraft Payloads*	-	13.034	15.767	15.093	0.000	15.093	15.078	15.886	17.114	17.493	Continuing	Continuing
633834: *Integrated Space Technology Demonstrations*	-	33.978	21.424	16.523	0.000	16.523	16.511	16.712	18.210	18.582	Continuing	Continuing
634400: *Space Systems Protection*	-	7.228	7.964	8.419	0.000	8.419	8.509	9.021	9.184	9.349	Continuing	Continuing
635021: *Space Systems Survivability*	-	2.474	1.820	1.571	0.000	1.571	1.581	1.610	1.644	1.674	Continuing	Continuing
63682J: *Spacecraft Vehicles*	-	12.624	11.935	13.289	0.000	13.289	12.300	12.662	12.814	13.015	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program develops, integrates, and demonstrates space technologies in the areas of spacecraft payloads, spacecraft protection, spacecraft vehicles, and space systems survivability. The integrated space technologies are demonstrated by component or system level tests on the ground or in flight. Efforts in this program have been coordinated through the Department of Defense Science and Technology Executive Committee process to harmonize efforts and eliminate duplication.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of program funds in this PE would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602601F, 0602602F, 0602605F, 0602788F, 1206601F, and 0602298F."

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

Exhibit R-2, RDT&E Budget Item Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	

B. Program Change Summary ($ in Millions)	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total
Previous President's Budget	61.593	58.910	57.237	0.000	57.237
Current President's Budget	69.338	58.910	54.895	0.000	54.895
Total Adjustments	7.745	0.000	-2.342	0.000	-2.342
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	10.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-2.255	0.000			
• Other Adjustments	0.000	0.000	-2.342	0.000	-2.342

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2017	FY 2018
Project: 633834: *Integrated Space Technology Demonstrations*		
Congressional Add: *Program Increase*	9.685	0.000
Congressional Add Subtotals for Project: 633834	9.685	0.000
Congressional Add Totals for all Projects	9.685	0.000

Change Summary Explanation

Decrease in FY 2019 due to realignment of Space Science and Technology Advanced Technology Development activities to Space Science and Technology Applied Research.

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force			Date: February 2018
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603401F / *Advanced Spacecraft Technology*	Project (Number/Name) 632181 / *Spacecraft Payloads*	

COST ($ in Millions)	Prior Years	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total	FY 2020	FY 2021	FY 2022	FY 2023	Cost To Complete	Total Cost
632181: *Spacecraft Payloads*	-	13.034	15.767	15.093	0.000	15.093	15.078	15.886	17.114	17.493	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds the development, demonstration, and evaluation of radiation-hardened space electronic hardware, satellite control hardware, and software for advanced satellite surveillance operations. Future improved space-qualifiable electronics and software for data and signal processing will be more interchangeable, interoperable, and standardized. In the near-term, this project's work concentrates on converting (for example, radiation-hardening) commercial data and signal processor technologies for use in Air Force space systems. For mid-term applications, this project merges advanced, radiation-hardened space processor, memory, and interconnect technologies with commercially-derived, open system architectures to develop and demonstrate robust, on-board processing capabilities for 21st century Department of Defense satellites. In the long-term, this project area focuses on developing low-cost, easily modifiable software and hardware architectures for fully autonomous constellations of intelligent satellites capable of performing all mission related functions without operator intervention.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Advanced Space Electronics	3.125	4.156	3.669
Description: Develop microelectronic devices, including radiation-hardened data processors and high-density hardened memories, advanced packaging technologies, and micro-electro-mechanical system components and applications. ***FY 2018 Plans:*** Continue development of advanced electronic circuit components. Verify split-fabrication as trusted method. Complete first stage of electron-beam lithography transition and begin productization. Continue as lead for Field-Programmable Gate Array development. Oversee qualification of processing and memory technology developments. Continue development of high-efficiency power conversion devices. Begin development of analog to digital and digital to analog technologies. ***FY 2019 Plans:*** Complete verification of split-fabrication as trusted method. Continue second (productization) stage of electron-beam manufacturing capability. Continue to lead trusted Field-Programmable Gate Array development. Continue development of next generation memory technologies for space. Oversee qualification of processing and memory technology developments. Continue assessments of tolerance of advanced electronic circuit components to space radiation environmental conditions. Continue development of novel payload processor technologies and necessary memory to support it. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $0.487 million. Justification for this decrease is described in the plans above.			
Title: Advanced Space Modeling and Simulation Tools	1.004	1.192	0.851

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 632181 / *Spacecraft Payloads*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Description: Develop modeling, simulation, and analysis tools for space-based surveillance systems, space capability protection technologies, access/mobility technologies, and flight experiments. ***FY 2018 Plans:*** Apply and analyze models for cross-platform modeling, simulation, and analysis support of multi-mission geosynchronous space flight demonstration. Continue trade studies and utility analysis for concept development of emerging space technologies, future space flight experiments and associated software algorithms, including advanced positioning, navigation, and timing technologies. ***FY 2019 Plans:*** Apply and analyze models for cross-platform modeling, simulation, and analysis support of multi-mission geosynchronous space flight demonstration. Continue trade studies and utility analysis for concept development of emerging space technologies, future space flight experiments (with associated software algorithms), and commercial space applications. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $0.341 million. Justification for this decrease is described in the plans above.			
Title: Advanced Space Sensors ***Description:*** Develop space infrared technology and hardened focal plane detector arrays to enable acquisition, tracking, and discrimination of hot targets, as well as "cold body" objects. ***FY 2018 Plans:*** Deliver a scanning Focal Plane Array for missile warning capability demonstration during laser impingement. Characterize performance of scanning Focal Plane Array in representative space environment to include natural and man-made radiation including focused photons. ***FY 2019 Plans:*** Deliver a scanning Focal Plane Array for missile warning capability demonstration during laser impingement. Characterize performance of scanning Focal Plane Array in representative space environment to include natural and man-made radiation including focused photons will take place to identify any shortfalls that may be present and resolve if necessary. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $0.206 million. Justification for this increase is described in the plans above.	2.162	2.316	2.522
Title: Positioning, Navigation, and Timing Space Payload Technologies ***Description:*** Develop, validate, and transition technologies that: enable new, or enhance existing, United States positioning, navigation, and timing satellite capabilities by increasing resiliency and availability of accuracy; and/or increase the affordability of	6.743	8.103	8.051

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 632181 / *Spacecraft Payloads*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
providing current capabilities. Develop, validate, and transition technologies to meet identified Air Force Space Command/Space and Missile Systems Center positioning, navigation, and timing space payload technology needs. ***FY 2018 Plans:*** Complete designs of on-orbit reprogrammable digital waveform generator for positioning, navigation, and timing / Global Positioning System and deliver engineering development units. Initiate development of broadband amplifier for Global Positioning System application. ***FY 2019 Plans:*** Conduct preliminary and critical design activities for multiple modular/hostable positioning, navigation, and timing payloads/ payload technologies for future Global Positioning System and Global Positioning System augmentation satellites. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $0.052 million. Justification for this increase is described in the plans above.			
Accomplishments/Planned Programs Subtotals	13.034	15.767	15.093

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

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

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force			Date: February 2018
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603401F / *Advanced Spacecraft Technology*	Project (Number/Name) 633834 / *Integrated Space Technology Demonstrations*	

COST ($ in Millions)	Prior Years	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total	FY 2020	FY 2021	FY 2022	FY 2023	Cost To Complete	Total Cost
633834: *Integrated Space Technology Demonstrations*	-	33.978	21.424	16.523	0.000	16.523	16.511	16.712	18.210	18.582	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project is a series of advanced technology demonstrations designed to address mission needs by applying emerging technologies from the Air Force Research Laboratory, other United States government laboratories, and industry. These technologies are integrated into system-level demonstrations that are used to test, evaluate, and validate the technologies in a relevant environment.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Integrated Satellite Demonstrations	24.293	21.424	16.523
Description: Develop satellite technologies for integrated, robust, and flexible satellite demonstrations building on previous work and leveraging investments by other organizations. ***FY 2018 Plans:*** Complete launch vehicle integration for geosynchronous spaceflight demonstration. Support launch operations. Begin on-orbit operations; conduct experimental flight operations of Hypertemporal Imaging sensor, integrated on-board sensing, threat assessment and autonomy payload, and increase autonomy and safety of advanced proximity operations. Continue space and ground segment design and build of advanced space-based integrated Global Positioning System demonstration for contested environments-target launch of FY 2021-2023. ***FY 2019 Plans:*** Conclude on-orbit operations; complete experimental flight operations of hypertemporal imaging sensor, integrated on-board sensing, threat assessment and autonomy payload, and increase autonomy and safety of advanced proximity operations. Begin transition of spacecraft operations to Air Force Space Command. Continue refining space and ground segments architecture and initial prototype hardware/software for an advanced Global Positioning System space-based integrated demonstration for contested environments with a target launch of FY 2021-2023. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $4.901 million. Justification for this decrease is due to a re-baseline of flight experiment program.			
Accomplishments/Planned Programs Subtotals	24.293	21.424	16.523

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 633834 / *Integrated Space Technology Demonstrations*

	FY 2017	FY 2018
Congressional Add: Program Increase ***FY 2017 Accomplishments:*** Conducted Congressionally directed efforts. ***FY 2018 Plans:*** N/A	9.685	0.000
Congressional Adds Subtotals	9.685	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

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

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force			Date: February 2018
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603401F / *Advanced Spacecraft Technology*	Project (Number/Name) 634400 / *Space Systems Protection*	

COST ($ in Millions)	Prior Years	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total	FY 2020	FY 2021	FY 2022	FY 2023	Cost To Complete	Total Cost
634400: *Space Systems Protection*	-	7.228	7.964	8.419	0.000	8.419	8.509	9.021	9.184	9.349	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and demonstrates tools, instruments, and mitigation techniques required to assure operation of United States space assets in hostile warfighting environments. The project performs assessments of critical components and subsystems, and evaluates susceptibility and vulnerability to radio frequency and laser threats. This project also develops technologies that mitigate identified vulnerabilities. Technologies are developed and demonstrated to support balanced satellite protection strategies for detecting and avoiding threats and operating in a hostile space environment.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Space Situational Awareness Capability Development ***Description:*** Develop tools and technologies that advance space-based proximity awareness capabilities and enable protection and countermeasure courses of action. Efforts will assess a variety of phenomenologies and concepts in response to multiple threat classes and scenarios. ***FY 2018 Plans:*** Complete all on-orbital-regime integrated tracking filter and transition to operational community. Continue maturing sensors with reduced solar exclusion angle for improved space situational awareness. Continue maturation of radio frequency sensing modalities. Complete processing chain showing end-to-end tracking and characterization capabilities incorporating real data. ***FY 2019 Plans:*** Develop and integrate processing techniques into evolved operations centers to autonomously detect, track, identify and characterize satellites to meet timelines needed for implementation of courses of actions mitigating potential gaps for evolving threats. Initiate development of prototypes utilizing multi-phenomenology based on the observables indicating a potential threat. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $0.348 million. Justification for this decrease is described in the plans above.	1.778	1.846	2.194
Title: Space Indicators and Warning Research ***Description:*** Develop passive satellite countermeasures and mitigation techniques for current and future threats to satellites. ***FY 2018 Plans:*** Integrate space cyber resilience indications and warning concepts into ground and flight experiments for verification and validation of efficacy in contested environments. Prepare and conduct ground experimentation in support of indications and warning	2.268	2.014	2.651

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 634400 / *Space Systems Protection*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
technology development. Conduct experiments to evaluate integration of resilience technologies and concepts into programs of record and high value assets; document and disseminate best practices and lessons learned. Continue maturing resilient spacecraft concepts. Conduct evaluation of on-orbit data from geosynchronous spaceflight demonstration and other flight experiment and operational test opportunities. ***FY 2019 Plans:*** Conduct RED-vs-BLUE space cyber indications and warning experimentation utilizing the on-orbit research satellite. Evaluate the efficacy of multi-spectrum indications and warning technology within the space resiliency testbed. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $0.637 million. Justification for this increase is described the in plans above.			
Title: Spacecraft Threat Detection ***Description:*** Develop active satellite local space awareness technologies and exploitation tools for satellite systems. ***FY 2018 Plans:*** Continue to advance technology in on-board threat detection and course-of-action generation and response using live satellite data. Continue advanced technology development for enterprise-level situation monitoring and demonstrate concepts of space battle management command and control through experimentation with ground stations and flight experiments. ***FY 2019 Plans:*** Complete advanced technology in on-board threat detection and course-of-action generation and response using live satellite data. Continue advanced technology development for enterprise-level situation monitoring and demonstrate concepts of space battle management command and control through experimentation with ground stations and flight experiments. Initiate advanced autonomy demonstrations to prove advanced concepts in multidomain real-time command and control. Expand our threat warning and response portfolio, including further maturation of both on board and off board threat sensor suites and supporting computing / comm systems. Demonstrate and experiment with prototype threat warning and response systems within the space resiliency lab. Integrate response options into the Air Force Research Laboratory's space resiliency lab in order to conduct end-to-end multi-spectral threat and response scenarios. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $0.530 million. Justification for this decrease is described in the plans above.	3.182	4.104	3.574
Accomplishments/Planned Programs Subtotals	7.228	7.964	8.419

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 634400 / *Space Systems Protection*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

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

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force			Date: February 2018
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603401F / *Advanced Spacecraft Technology*	Project (Number/Name) 635021 / *Space Systems Survivability*	

COST ($ in Millions)	Prior Years	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total	FY 2020	FY 2021	FY 2022	FY 2023	Cost To Complete	Total Cost
635021: *Space Systems Survivability*	-	2.474	1.820	1.571	0.000	1.571	1.581	1.610	1.644	1.674	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and demonstrates technologies to improve space system survivability and reliability of current and future Department of Defense space systems that must continue operation despite natural space hazards. It develops and demonstrates cost-effective solutions to mitigate hazardous space environmental interactions including electrical charge buildup and electronics failures due to both single radiation events and long-term radiation doses.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Spacecraft Survivability/Reliability	2.474	1.820	1.571
Description: Develop technologies to provide improved space radiation and ionospheric hazard specification and forecasting. ***FY 2018 Plans:*** Continue spiral one anomaly attribution tool demonstration and transition to operational use with common ground system. Continue spiral two development for anomaly attribution tool and begin transition to operational demonstration. Complete assembly and calibration of energetic particle sensor for use in contested space. Continue development of automated exploitation tool for on-orbit data for rapid detection and characterization of space environment impacts. Begin exploiting data from on-orbit radiation remediation mission for inclusion in standard radiation belt model for satellite design. Continue investigation and improvement of the forecasting of solar radio events that impact Air Force operational systems. ***FY 2019 Plans:*** Continue exploitation of data from on-orbit radiation remediation mission for inclusion in standard radiation belt model for satellite design. Transition updated radiation model to industry with modular architecture, additional data sources, and improved usability. Select concept to proceed to detailed design phase for next-generation highly-miniaturized energetic particle sensor for use in contested space. Begin anomaly attribution tool spiral two demonstration and transition to operational use with common ground system. Continue investigation and improvement of the forecasting of solar radio events that impact Air Force operational systems. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $0.249 million. Justification for this increase is described in the plans above.			
Accomplishments/Planned Programs Subtotals	2.474	1.820	1.571

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 635021 / *Space Systems Survivability*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

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

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force			Date: February 2018
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603401F / *Advanced Spacecraft Technology*	Project (Number/Name) 63682J / *Spacecraft Vehicles*	

COST ($ in Millions)	Prior Years	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total	FY 2020	FY 2021	FY 2022	FY 2023	Cost To Complete	Total Cost
63682J: *Spacecraft Vehicles*	-	12.624	11.935	13.289	0.000	13.289	12.300	12.662	12.814	13.015	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and demonstrates compact, low-cost, spacecraft power generation, storage, distribution, and thermal management technologies, including cryogenic cooling technologies. This project also develops composites for spacecraft structures and technologies for spacecraft control and mechanisms.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Space Power Technologies	0.990	1.110	1.063
Description: Develop power generation space technologies such as multi-junction solar cells, thin-film solar cells, lightweight solar cell arrays, and radiation resistant solar cell modules. ***FY 2018 Plans:*** Complete end-of-life optimization of solar cell architectures approaching 35%. Continue development of mitigation approaches for thermal excursion in resilient arrays. Initiate on-orbit flight experiment of resilient array technologies. ***FY 2019 Plans:*** Continue development of mitigation approaches for thermal excursion in resilient arrays. Continue on-orbit flight experiment development for resilient array technologies. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $0.047 million. Justification for this decrease is described in the plans above.			
Title: Spacecraft Structures Technologies	0.992	1.109	1.061
Description: Develop, integrate, and demonstrate composite spacecraft structures and thermal technologies for deployable structures, antennas, electronics cooling, and structural sensing. ***FY 2018 Plans:*** Complete spaceflight experiment to test structurally-integrated sensing technologies for on-orbit impact detection and situational awareness of potential threats. Continue flight experiment to test affordable deployable antennas for denied area communication and high-gain, anti-jam Global Positioning System applications. Initiate integrated experiment concepts testing structures and thermal technologies for high energy density, full spectrum radio frequency reconfigurabilty, adaptability, and protection. ***FY 2019 Plans:*** Complete ground experimentation to test affordable deployable antennas for denied area communication and high-gain, anti-jam Global Positioning System applications. Continue integrated experiment concepts testing structures and thermal technologies			

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 63682J / *Spacecraft Vehicles*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
for high energy density, full spectrum radio frequency reconfigurabilty, adaptability, and protection. Initiate integrated ground experiment or flight experiment for extremely thin, multi-mission, radio frequency antennas for ensured capability in highly contested environments. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $0.048 Million. Justification for this decrease is described in plans above.			
Title: On-Orbit Satellite Controls ***Description:*** Develop technologies for spacecraft controls and mechanisms for on-orbit applications. ***FY 2018 Plans:*** Continue development and testing of advanced computer-vision based navigation algorithms and software for precision spacecraft relative motion control missions. ***FY 2019 Plans:*** Continue testing of advanced computer-vision based navigation algorithms and software for precision spacecraft relative motion control missions. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $0.018 Million. Justification for this decrease is described in plans above.	0.423	0.433	0.415
Title: Space Communication and Control Technologies ***Description:*** Develop technologies for next-generation space communications terminals and equipment, along with methods/ techniques to enable future space system operational command and control concepts. ***FY 2018 Plans:*** Support integration and test of the W and V frequency band flight instrument onto the host spacecraft. Support initial design and hardware test board testing of W and V frequency band follow-on project that would demonstrate W and V band satellite communications (bi-directional, modulated signals) and mitigate technology risks in order to facilitate transition to an operational system. Continue to support development of critical space and ground terminal technology, such as multi-beam antenna, high power amplifiers, low noise amplifiers, reconfigurable radios, and wideband modem and signal processing technology. ***FY 2019 Plans:*** Support launch of W and V frequency band flight instrument. Support execution of a W and V band propagation experiment. Conduct development and technology demonstrations to address future military satellite communications capability and technology needs, for example, high-gain antenna, high-power amplifiers, low-noise amplifiers, cognitive / resilient networks,	2.812	1.905	3.629

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 63682J / *Spacecraft Vehicles*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
reconfigurable satellite radios / transponders, and anti-jam signal processing technologies. Support development and demonstration of novel laser communications technology. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $1.724 Million. Justification for this increase is described in plans above.			
Title: Advanced Alternative Navigation Technologies ***Description:*** Develop new atomic clock technologies and transition these technologies to industry for potential application to future positioning, navigation, and timing space considerations. ***FY 2018 Plans:*** Continue transition of atomic clock technology to industry to build into flight experiment payload units for flight testing. Continue integration and testing of clock engineering models. Continue the development of radiation-hardened, ultra-stable laser needed for cold-atom atomic clocks, accelerometers, and gyroscopes operating in space or nuclear environments. Continue the development of technology to leverage communications links to provide positioning and time knowledge, and continue second spiral demonstration of performance on handheld military radios to inform technology development activity. ***FY 2019 Plans:*** Test industry-transitioned clock technology being built into flight experiment payload units for flight testing. Finalize integration and testing of clock engineering models. Start packaging of radiation-hardened, ultra-stable laser needed for cold-atom atomic clocks, accelerometers and gyroscopes operating in space or nuclear environments. Start testing of technology that leverages communications links to provide positioning and time knowledge, and continue second spiral demonstration of performance on hand held military radios to inform technology development activity. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $0.257 Million. Justification for this decrease is described in plans above.	7.407	7.378	7.121
Accomplishments/Planned Programs Subtotals	12.624	11.935	13.289

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 63682J / *Spacecraft Vehicles*

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.