Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Air Force	Date: May 2021
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603032F / *Future AF Integrated Technology Demos*

COST ($ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	0.000	147.350	131.643	0.000	131.643	-	-	-	-	-	-
630320: *Air Force Vanguards*	-	0.000	147.350	131.643	0.000	131.643	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Program develops and delivers transformational operational capabilities through advanced technology solutions which focus on five strategic capabilities: Global Persistent Awareness; Resilient Information Sharing; Rapid, Effective Decision-Making; Complexity, Unpredictability, and Mass; and Speed and Reach of Disruption and Lethality.

Department of the Air Force Vanguard programs are focused, priority initiatives with enterprise commitment which incorporate multidisciplinary solutions to advance and accelerate emerging Science and Technology driven capabilities and warfighting concepts. High risk by design, Vanguards seek to answer specific questions to inform future acquisition programs and identify gaps where additional research is still needed.

Air Force Futures (A5/7), partnered with the Assistant Secretary of the Air Force for Acquisition and the Air Force Research Laboratory, is chartered to identify and recommend emerging technologies as Vanguard candidates through a deliberate, multidisciplinary and multifunctional process. The annual Transformational Component investment process is co-chaired by the Under Secretary of the Air Force, Vice Chief of Staff of the Air Force, and Vice Chief of Space Operations. The Future Transformational Capabilities major thrust enables the Department of the Air Force to respond to these emerging Science and Technology investment opportunities within the budget cycle and "on-ramp" new Vanguards.

The current Air Force Vanguard programs are Skyborg, Golden Horde, Navigation Technology Satellite 3 (NTS-3), and Rocket Cargo. Skyborg will integrate artificial intelligence into autonomous unmanned air vehicles to enable future manned-unmanned teaming. Golden Horde will transition the demonstrated networked collaborative autonomous weapon core capability into a digital ecosystem for additional advancement. NTS-3 will experiment on key aspects for new GPS receivers which incorporate multiple signals and readily adapt to warfighter needs. Rocket Cargo will demonstrate new trajectories and ways to fly large rockets, the ability to land rockets at austere locations, and design & test an ejectable pod for air drop.

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.

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B. Program Change Summary ($ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	0.000	157.619	87.812	0.000	87.812
Current President's Budget	0.000	147.350	131.643	0.000	131.643
Total Adjustments	0.000	-10.269	43.831	0.000	43.831
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	-10.269			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	0.000	0.000			
• Other Adjustments	0.000	0.000	43.831	0.000	43.831

Change Summary Explanation

FY2021 decrease of 10.269 million Congressional Directed Reduction due to Unjustified request-Future Transformational Capabilities in the amount of 10.000 million and Undistributed Mark in the amount of 0.269 million.

FY2022 increase of 36.528 million to fund Rocket Cargo and provide additional support to the Skyborg and Navigation Technology Satellite 3 (NTS-3) efforts.

C. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Future Transformational Capabilities	0.000	0.000	9.063
Description: Identify game-changing transformational Science and Technology investment opportunities through the WARfighter-TECHnologist (WARTECH) process. The WARTECH process brings together technologists and DAF requirement officials to assess the best intersection of technology readiness and DAF future force design priorities. Select programs will be designated Vanguards indicating enterprise-level priority and a transition partner endorses the program. Future Transformational Capability funds will be used to kick-start newly designated Vanguard programs to accelerate capability development and transition and respond to emerging technology opportunities within the budget cycle.			
FY 2021 Plans: Utilize the WARTECH process to identify, scope, curate and consider six prioritized topic areas (down-selected from fourteen topics areas) for investment consideration. These topics include: Plan Tonight to Fight Tomorrow; Real-time Battlespace Awareness; Integrated, Layered Base Defense; Hypersonic, Multi-Mission ISR/Strike; Space Logistics and Mobility; and Space Domain Awareness. These six topics will be matured and candidate programs developed for consideration by DAF for formal programming, budgeting, and execution.			
FY 2022 Plans:			

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Kick-start one or more of the six WARTECH topics and initiate Transformational Component Vanguard program(s) identified through the FY21-22 WARTECH process and approved by DAF. Perform modeling, simulation, and analyses used to establish the future force effect of candidate Transformational Component investments and continue the next cycle of WARTECH process. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** FY 2022 increased compared to FY 2021 by 9.063 million. Note FY 2021 funding allocated to Rocket Cargo major thrust.			
Title: Navigation Technology Satellite 3 (NTS-3) ***Description:*** Develop and demonstrate advanced space-based navigation system technologies to provide resilient navigation support in contested environments. The demonstration includes a space-based test vehicle, ground based enterprise command and control, and agile software defined receivers for the user. ***FY 2021 Plans:*** Continue development of advanced space-based navigation technology demonstration for Space launch in FY 2022. Complete spacecraft bus. Complete assembly of the spacecraft; prepare for ground test verification campaign. Verify user terminal processing of all signal definitions for one year of on-orbit experimentation. Deliver all ground control system software for integration in mission operations center. Deliver developmental user terminals to verify utility of agile signals in support of experimental objectives and establishing relevance to future concepts of operations. ***FY 2022 Plans:*** Complete development of advanced space-based navigation technology demonstration. Complete Ground Control System software and hardware, and integrate in New Mexico and Colorado ground control sites. Complete final software defined receiver hardware and release final user equipment software, and conduct end-to-end system functional test and space signal validation. Complete final system integration, test, and launch. Complete spacecraft final integration, environmental testing, and functional tests, and ship to launch site for anticipated launch. Complete system End-to-End Integration and Test. Initiate entire system checkout, once on-orbit, to prepare for experimentation with potential for follow-on residual operations led by a non-Air Force Research Laboratory organization. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** FY 2022 decreased compared to FY 2021 by $33.022 million. Funding decreased due to the transition from finishing technology development and beginning test & payload integration phase ahead of launch.	0.000	49.132	16.110
Title: Skyborg ***Description:*** Skyborg is an autonomous, attritable vehicle architecture suite which will enable the Air Force to posture, produce and sustain multi-mission sorties at sufficient tempo to thwart adversary attempts at quick, decisive action in contested and	0.000	48.400	58.570

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
highly contested environments. Skyborg is organized into three main lines of effort (LOEs). LOE 1 develops, demonstrates, and prototypes the Autonomy Core System (ACS) consisting of Skyborg autonomy architecture and software, enabling machine-machine and manned-unmanned teaming, while also ensuring openness, modularity, and expandability of the Skyborg autonomy mission systems suite. The ACS LOE also develops, demonstrates, and prototypes the hardware components and Open Architecture standards needed to allow modular sensor, communication, and other payload integration into the Skyborg autonomy and vehicle architectures in systems integration laboratories and platforms. LOE 2 (Low-cost vehicles) develops, demonstrates, and prototypes new low cost attritable vehicle concepts and technologies for expeditionary mass generation including sortie generation employment concepts. LOE 3 (Operational Experimentation) conducts analysis and experimentation on concepts of operations and concepts of employment for attritable, autonomous, unmanned systems and assesses the openness, and modular capabilities / sensors integration for autonomous, attritable, aircraft and mission systems. ***FY 2021 Plans:*** Initiate development and demonstration of integrated software and hardware architecture and components. Continue flight demonstration of low cost unmanned aerospace systems capable of interoperations with different assets. Continue development and demonstration of technologies for situational awareness, autonomous control, and survivability for unmanned systems. Continue demonstration of teaming concepts and technologies among cooperative human-machine teams in networked simulation environments. Initiate integration and demonstration of operational concepts and employment for autonomous attributable aircraft. Initiate integration and demonstrate military utility of multiple lines of effort in an operationally representative exercise. ***FY 2022 Plans:*** Continue development and demonstration of Skyborg Autonomy Core System hardware and software open architecture and components. Continue maturation and transition of human-machine interfaces, human systems interfaces and live, virtual & constructive technologies for command and control of autonomous systems. Continue demonstration and transition of government open architectures for autonomous unmanned systems. Continue demonstration and transition of a DevSecOps pipeline for the Skyborg Autonomy Core system software architecture. Complete development and demonstration of technologies for situational awareness, advanced autonomous behaviors, and survivability for unmanned systems. Complete demonstration of teaming concepts and technologies among cooperative human-machine teams in networked simulation environments. Continue integration, demonstration and transition of a digital engineering enterprise autonomous low-cost weapon system model and system integration laboratory. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** FY 2022 increased compared to FY 2021 by $10.17 million. Funding increased due to planned program requirements and the development and maturation activities described above.			
Title: Golden Horde	0.000	40.087	0.000

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Description: Integrate networked collaborative technologies into selected inventory weapon systems. Technologies can include new payloads, weapon datalinks/radios, and autonomous behaviors that are bounded by operator-defined mission rules of engagement. Supports the integration of Air Force weapons into the Joint All-Domain Command/Control network. Perform proof-of-concept demonstrations via simulations, virtual and live testing, and operational analysis, experiments and wargames to show the value of collaborative weapons in increasing combat power across the spectrum of conflict. Work with operational users to define Concepts of Operation (CONOPs). ***FY 2021 Plans:*** Continue to integrate networked collaborative technologies into selected weapon systems. Continue to develop technologies including new payloads, weapon datalinks/radios, and collaborative software development. Conitune to support and define the integration of Air Force weapons into the Joint All-Domain Command/Control network. Continue to implement proof-of-concept demonstrations via simulations, live testing, operational analysis, experiments, and war-games to demonstrate the viability of collaborative weapons in highly contested environments. Continue to work with operational users to define Concepts of Operation (CONOPs) in future force structures and future employment scenarios. ***FY 2022 Plans:*** Vanguard effort will complete efforts in FY 2022 through final demonstrations of networked collaborative technologies via simulations, testing, operational analysis, experiments and war-games. Complete work with operational users to define Concepts of Operation (CONOPs) in future force structures and future employment scenarios. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** FY 2022 decreased compared to FY 2021 by 40.087 million. Funding decreased due to the transition of technology development and initiation of final demonstrations of networked collaborative technologies with development and acquisition users.			
Title: Rocket Cargo	-	9.731	47.900
Description: The Department of the Air Force seeks to leverage the current multi-billion dollar commercial investment to develop the largest rockets ever, and with full reusability to develop and test the capability to leverage a commercial rocket to deliver AF cargo anywhere on the Earth in less than one hour, with a 100-ton capacity. The Air Force is not investing in the commercial rocket development, but rather investing in the Science & Technology needed to interface the capability with DoD logistics needs, and extend the commercial capability to DoD-unique missions. Provides a new, faster and cheaper solution to the existing TRANSCOM Strategic Airlift mission. Enables AFSOC to perform current Rapid-Response Missions at lower cost, and meet a one-hour response requirement. Rocket Cargo uses modeling, simulation, and analysis to conduct operational analysis, verify military utility, performance, and operational cost. S&T will include novel "loadmaster" designs to quickly load/unload a rocket, rapid launch capabilities from unusual sites, characterization of potential landing surfaces and approaches to rapidly improve those surfaces, adversary detectability, new novel trajectories, and an S&T investigation of the potential ability to air drop a			

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
payload after reentry. This is not a rocket engine or launch vehicle development program. It is an S&T effort to leverage the commercial development into a novel new DoD capability. ***FY 2021 Plans:*** Utilize modeling, simulation, and analysis to conduct operational analysis of Rocket Cargo concepts, trajectories, and design considerations and verify military utility, performance, and operational cost. Gather operational data from on-going commercial large-scale, instrumented, reusable launch events. ***FY 2022 Plans:*** Mature effort in leveraging commercial space launch to create military capability in Rocket-based Cargo delivery. Complete S&T testing leveraging the current commercial prototype testing. Perform site measurements needed to integrate the capability onto DoD missions including plume-surface physics and toxicity, loads, detectability, and acoustics. Also, complete initial AFRL wind tunnel testing to assess novel trajectories needed for air-drop capability, and high-speed separation physics. Under contract and CRADA, partner with Commercial to test and demonstrate an initial one-way transport capability to an austere site. Seek to perform an early end-to-end test to fully identify the technical challenges. In addition, complete Industry outreach for loadmaster concepts including novel container designs, load/unload concepts, and testing the compatibility of AF cargo with rocket launch and space environments. Issue solicitation and award contracts. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** FY 2022 increased compared to FY 2021 by $38.169 million. Funding increased due to planned program requirements and the development and maturation activities described above.			
Accomplishments/Planned Programs Subtotals	0.000	147.350	131.643

D. Other Program Funding Summary ($ in Millions)

N/A

Remarks

E. Acquisition Strategy

N/A