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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Air Force **Date:** February 2020

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603032F / <i>Future AF Integrated Technology Demos</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	0.000	0.000	157.619	0.000	157.619	87.812	59.427	30.219	28.796	Continuing	Continuing
630320: <i>Air Force Vanguard</i> s	-	0.000	0.000	157.619	0.000	157.619	87.812	59.427	30.219	28.796	Continuing	Continuing

A. Mission Description and Budget Item Justification

This Program develops and delivers transformational operational capabilities through advanced technology solutions that 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.

Focused Advanced Technology Research efforts may also be referred to as Vanguard or Future Transformational Capabilities. Vanguard programs will advance and accelerate emerging weapon systems and warfighting concepts in the Air Force Science and Technology (S&T) portfolio, while demonstrating the viability of leap-ahead capabilities. High risk by design, their goal answers specific questions and informs future decisions by including the direction of future acquisition programs and identifying gaps where more research is still needed.

These programs are Air Force priority initiatives with enterprise commitment that incorporate multidisciplinary solutions for delivering transformational capabilities through the Air Force Capability Development Council (CDC), co-chaired by the Under Secretary of the Air Force and Vice Chief of Staff of the Air Force, owns the annual Vanguard approval process. The Air Force Warfighting Integration Capability (AFWIC), chartered to develop the Air Force future force design, leads activities that identify and recommend Vanguard candidates that could provide transformational capability.

The first three Air Force Vanguard programs are Golden Horde, Navigation Technology Satellite 3 (NTS-3), and Skyborg. Golden Horde will demonstrate collaborative autonomous networked weapons that share data, interact and execute coordinated actions, and work together to defeat targets. NTS-3 will experiment on key aspects for new GPS receivers that incorporate multiple signals and readily adapt to warfighter needs. The first iteration of Skyborg will integrate artificial intelligence into autonomous unmanned air vehicles to enable future manned-unmanned teaming.

In the FY 2021, the Air Force is consolidating its existing thirteen Advanced Technology Development (ATD), Research Development Test and Evaluation (RDT&E), Budget Activity 03 (BA 03) PEs into five new capability focused RDT&E BA 03 PEs to better align with the Air Force Science and Technology (S&T) Strategy signed by the Secretary of the Air Force in April 2019. This consolidation will improve and accelerate delivery of integrated transformational, multidisciplinary, collaborative technology solutions necessary to enable new Air Force warfighting capabilities that support of the National Defense Strategy. This new structure will provide the Air Force and Congress with a clearer understanding and increased transparency of integrated technology solutions and demonstrations key to enabling the Air Force future force design.

In FY 2021, the Air Force created PE 0603032F, Future AF Integrated Technology Demos, Project 630320, Air Force Vanguard, to consolidate Vanguard and Future Transformational Capabilities efforts and funding in order to better align with the Air Force S&T Strategy, April 2019, and execute transformational Advanced Technology Development. This PE creation and realignment of funding from existing Air Force RDT&E Advanced Technology Development PEs is an administrative realignment

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--	----------------------------

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and not a new start. These efforts and activities continued to be managed by the Air Force Technology Executive Officer (TEO), dual-hatted as the Air Force Research Laboratory (AFRL) Commander, and executed across the various AFRL Technology Directorate locations.

This PE 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 PEs 0601102F, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, 1206601SF, 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.

B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	0.000	0.000	0.000	0.000	0.000
Current President's Budget	0.000	0.000	157.619	0.000	157.619
Total Adjustments	0.000	0.000	157.619	0.000	157.619
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	0.000	0.000			
• Other Adjustments	0.000	0.000	157.619	0.000	157.619

Change Summary Explanation

Increase in FY 2021 of \$157.619 million is due the following:

1) Realignment and consolidation of Skyborg Vanguard activities and funding from PE 0603456F, Human Effectiveness Advanced Technology Development, Project 635327, Warfighter Interfaces; PE 0603211F, Aerospace Technology Dev/Demo, Project 634920, Flight Vehicle Tech Integration; PE 0603211F, Aerospace Technology Dev/Demo, Project 634927, Aerospace Power & Flight Control Integ & Demo; and PE 0603216F, Aerospace Propulsion and Power Technology, Project 634921, Aircraft Propulsion Subsystems Int.

2) Realignment and consolidation of Golden Horde activities and funding from PE 0603601F, Conventional Weapons Technology, Project 63670B, Weapon Concept Development.

3) Realignment and consolidation of Navigation Technology Satellite 3 activities and funding from PE 0603270F, Electronic Combat Technology, Project 63431G, RF Warning & Countermeasures Tech, and PE 0603401F, Advanced Spacecraft Technology, Project 633834, Integrated Space Technology Demonstrations.

UNCLASSIFIED

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4) Realignment of Future Transformational Capabilities funding from across the various Air Force S&T RDT&E Advanced Technology Development programs.

These transfers in FY 2021 are part of the Air Force RDT&E BA 03 PE consolidation in order to realign technology areas to better support the National Defense Strategy, Air Force Future Operating Concept, and the Air Force S&T Strategy, April 2019.

C. Accomplishments/Planned Programs (\$ in Millions)

	FY 2019	FY 2020	FY 2021
<p>Title: Future Transformational Capabilities</p> <p>Description: Competitively develop and mature transformational efforts that may not have been approved as Air Force Vanguard programs. Activities will be responsive to future force design priorities.</p> <p>FY 2020 Plans: In FY 2020, this work is performed under multiple projects and efforts within the following Air Force RDT&E Advanced Technology Development Programs: 0603112F, Advanced Materials for Weapon Systems; 0603203F, Advanced Aerospace Sensors; 0603270F, Electronic Combat Technology; 0603401F, Advanced Spacecraft Technology; 0603444F, Maui Space Surveillance System; 0603456F, Human Effectiveness Advanced Technology Development; 0603601F, Conventional Weapons Technology; 0603605F, Advanced Weapons Technology; 0603680F, Manufacturing Technology Program; 0603788F, Battlespace Knowl Devel and Demo; 0603216F, Aerospace Propulsion and Power Technology; 0603199F, Sustainment Science and Technology; and 0603211F, Aerospace Technology Dev/Demo.</p> <p>FY 2021 Plans: Continue to develop and mature multidisciplinary solutions to provide transformational future force capabilities to connect the Joint Force, dominate Space, generate combat power, and provide logistics under attack.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: FY 2021 increased compared to FY 2020 by \$20.000 Million. Funding increased due to the realignment and consolidation of Air Force Advanced Technology Development Science and Technology funding for Future Transformational Capabilities efforts, as part of the Air Force RDT&E BA03 PE Consolidation.</p>	0.000	0.000	20.000
<p>Title: Navigation Technology Satellite 3 (NTS-3)</p> <p>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.</p> <p>FY 2020 Plans:</p>	0.000	0.000	24.632

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C. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
<p>In FY 2020 and prior years, this work is performed under the Electronic Attack effort in PE 0603270F, Electronic Combat Technology, Project 63431G, RF Warning & Countermeasures Tech, and the Integrated Satellite Demonstrations effort in PE 0603401F, Advanced Spacecraft Technology, Project 633834, Integrated Space Technology Demonstrations.</p> <p>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.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: FY 2021 increased compared to FY 2020 by \$24.632 Million. Funding increased due to the realignment and consolidation of NTS-3 Vanguard activities and funding from the Electronic Attack effort in PE 0603270F, Electronic Combat Technology, Project 63431G, RF Warning & Countermeasures Tech, and the Integrated Satellite Demonstrations effort in PE 0603401F, Advanced Spacecraft Technology, Project 633834, Integrated Space Technology Demonstrations, as part the Air Force RDT&E BA03 PE consolidation.</p>				
<p>Title: Skyborg</p> <p>Description: Develop and demonstrate an autonomous, attributable vehicle architecture suite which will enable the Air Force to posture, generate, and sustain multi-mission sorties at sufficient tempo to thwart adversary attempts at quick, decisive action in contested and highly contested environments. Develops and demonstrates autonomy architecture and software, enabling machine-machine and manned-unmanned teaming, while ensuring openness, modularity, and expandability. Develops, demonstrates, and integrates hardware components and Open Architecture standards needed to allow modular sensor, communication, and other payload integration into the autonomy and vehicle architectures in systems integration laboratories, platforms, and vehicles. Demonstrates low cost attributable vehicle concepts and technologies for expeditionary mass generation including sortie generation employment concepts. Conducts analysis and tests on concepts of operations and concepts of employment for attributable, autonomous, unmanned systems.</p> <p>FY 2020 Plans: In FY 2020 and prior years, this work is performed under the Battlespace Acoustics effort in PE 0603456F, Human Effectiveness Advanced Technology Development, Project 635327, Warfighter Interfaces; the Aerospace Vehicle Technology Integration effort and the Advanced Aerospace Structure Technologies effort in PE 0603211F, Aerospace Technology Dev/Demo, Project 634920, Flight Vehicle Tech Integration; the Autonomous Systems Control effort in PE 0603211F, Aerospace Technology Dev/Demo,</p>		0.000	0.000	40.900

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C. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
<p>Project 634927, Aerospace Power & Flight Control Integ & Demo; and the Missile/Remotely Piloted Aircraft Engine Performance effort in PE 0603216F, Aerospace Propulsion and Power Technology, Project 634921, Aircraft Propulsion Subsystems Int.</p> <p>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.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: FY 2021 increased compared to FY 2020 by \$40.900 Million. Funding increased due to the realignment and consolidation of Skyborg Vanguard activities and funding from the Battlespace Acoustics effort in PE 0603456F, Human Effectiveness Advanced Technology Development, Project 635327, Warfighter Interfaces; the Aerospace Vehicle Technology Integration effort and the Advanced Aerospace Structure Technologies effort in PE 0603211F, Aerospace Technology Dev/Demo, Project 634920, Flight Vehicle Tech Integration; the Autonomous Systems Control effort in PE 0603211F, Aerospace Technology Dev/Demo, Project 634927, Aerospace Power & Flight Control Integ & Demo; and the Missile/Remotely Piloted Aircraft Engine Performance effort in PE 0603216F, Aerospace Propulsion and Power Technology, Project 634921, Aircraft Propulsion Subsystems Int, as part the Air Force RDT&E BA03 PE consolidation.</p>				
<p>Title: Golden Horde</p> <p>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).</p> <p>FY 2020 Plans: In FY 2020 and prior years, this work is performed under the Air-to-Ground Concept Development effort in PE 0603601F, Conventional Weapons Technology, Project 63670B, Weapon Concept Development.</p> <p>FY 2021 Plans:</p>		0.000	0.000	72.087

UNCLASSIFIED

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C. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<p>Continue to integrate networked collaborative technologies into selected weapon systems. Continue to develop technologies including new payloads, weapon datalinks/radios, and collaborative software development. Continue 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.</p> <p><i>FY 2020 to FY 2021 Increase/Decrease Statement:</i> FY 2021 increased compared to FY 2020 by \$72.087 Million. Funding increased due to the realignment and consolidation of Golden Horde activities and funding from the Air-to-Ground Concept Development effort in PE 0603601F, Conventional Weapons Technology, Project 63670B, Weapon Concept Development, as part the Air Force RDT&E BA03 PE consolidation.</p>			
Accomplishments/Planned Programs Subtotals	0.000	0.000	157.619

D. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

E. Acquisition Strategy

N/A