Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Air Force	Date: February 2019
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 5: *System Development & Demonstration (SDD)*	**R-1 Program Element (Number/Name)** PE 0604201F / *PNT Resiliency, Mods, and Improvements*

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
Total Program Element	-	97.943	46.731	67.782	0.000	67.782	45.000	51.000	11.000	0.000	0.000	319.456
651030: *GPS Receiver Development*	-	97.943	46.731	67.782	0.000	67.782	45.000	51.000	11.000	0.000	0.000	319.456
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

PE 0604201F Line Item Title, PNT Resiliency, Mods, and Improvements (RMI) changed from Integrated Avionics Planning and Development.

In FY 2018, specific efforts initiated under PE 0305164F, NAVSTAR Global Positioning System (User Equipment) (Space), Project 643833, Military Global Positioning System User Equipment were transferred to PE 0604201F, Integrated Avionics Planning & Development, Project 651030, Aircraft Receiver Development, to realign resources with the execution responsibilities supporting aircraft weapon system platforms along with increased transparency to stakeholders.

A. Mission Description and Budget Item Justification

Positioning, Navigation and Timing (PNT) solutions are critical to defense operations by enabling delivery of precision fires, safe aerial navigation, and time coordination across multiple platforms and subsystems. PNT must be maintained in the face of emerging and continuously evolving electronic and cyber threats, requiring increased system resiliency and rapid adaptability similar to that historically required of electronic warfare systems. Evolving threats will drive upgrades such as Global Positioning System (GPS) receiver modernization, development of standard navigational system formats/interfaces, increased use of open system architecture design principles, incorporation of alternative navigation sources into navigational solutions, advanced anti-jam antennas, antenna electronics, radio frequency monitoring/locating/reporting capabilities, and precision clock improvements to maintain current and future force capabilities.

Efforts transferred from PE 0305164F and now conducted under PE 0604201F, Project 651030 includes Embedded GPS/Inertial Navigation System (INS) Modernized (EGI-M), Miniaturized Airborne GPS Receiver 2000 Modernization (MAGR-2K-M), Defense Advanced GPS Receiver (DAGR), Resilient EGI (R-EGI) development, anti-jam antenna/antenna electronics development, situational awareness devices and other advanced/non-GPS PNT solutions. Activities also include, but are not limited to, current program planning, rapid prototyping/concept development, execution and future program planning and support to other GPS enabled systems as required. Funds may be used to address emerging and short-notice Diminishing Manufacturing and Material Shortage (DMSMS) issues.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver PNT solutions. The use of such program funds would be in addition to the civilian pay expenses budgeted in program elements 0605826F, 0605827F, 0605828F, 0605829F, 0605830F, 0605831F, 0605832F, 0605898F, and 0605833F.

As directed in the FY 2018 NDAA, Sec 825, amendment to PL 114-92 FY 2016 NDAA, Sec 828 Penalty for Cost Overruns, the FY 2018 Air Force penalty total is $14.373M. The calculated percentage reduction to each research, development, test and evaluation and procurement account will be allocated proportionally from all programs, projects, or activities under such account.

Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Air Force	Date: February 2019
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 5: *System Development & Demonstration (SDD)*	**R-1 Program Element (Number/Name)** PE 0604201F / *PNT Resiliency, Mods, and Improvements*

This program is in Budget Activity 5, System Development and Demonstration (SDD) because it has passed Milestone B approval and is conducting engineering and manufacturing development tasks aimed at meeting validated requirements prior to full rate production.

B. Program Change Summary ($ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Previous President's Budget	101.203	58.531	16.782	0.000	16.782
Current President's Budget	97.943	46.731	67.782	0.000	67.782
Total Adjustments	-3.260	-11.800	51.000	0.000	51.000
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	-11.800			
• 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	-3.260	0.000			
• Other Adjustments	0.000	0.000	51.000	0.000	51.000

Change Summary Explanation

FY 2018 reduction of -$3.260 million for SBIR

FY 2019 Congressional reduction of $11.8 million due to early to need.

FY 2020 increase of $51.0 million to R-EGI, program studies resulted in increased AF investment.

C. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Embedded GPS/INS - Modernized (EGI-M)	64.386	37.461	15.282
Description: EGI-M is a combined INS/GPS aircraft position, navigation, and timing system. Program upgrades EGI design to enhance resiliency against existing and emerging navigational warfare threats, incorporating design features (such as interface standardization and software modularity) to incorporate alternative navigation and timing sources, where cost effective, to reduce DoD cost and time lines to respond to newly identified threats and maintain current force capabilities. Incorporates M-Code and ADS-B compliance capability into EGI receivers while addressing parts obsolescence, reducing configuration count from 260+ to a desired end-state of 16, and decreasing production and sustainment costs.			
FY 2019 Plans: Finalize Initial Capabilities Documents (ICD), conduct Preliminary Design Reviews (PDR) and Critical Design Reviews (CDR), and begin full qualification and environmental testing.			
FY 2020 Plans:			

Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Air Force	Date: February 2019
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C. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Completes vendor CDR, begin delivery of engineering development models (EDM) and production development units, conduct test readiness reviews and begin test & evaluation (T&E) to include environmental and initial qualification testing. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Funding decreased due to higher priority Air Force requirements.			
Title: MAGR-2K-M ***Description:*** MAGR-2K-M is an aircraft GPS receiver. Program increases MAGR-2K resiliency against existing and emerging navigational warfare threats while reducing cost and time lines to incorporate agile capabilities to respond to newly identified threats. Incorporates M-Code capability into MAGR-2K receivers while addressing parts obsolescence and providing a pathway to ADS-B Out implementation. Performs appropriate trade studies and incorporates additional resiliency features, such as alternate navigation inputs, where cost effective. ***FY 2019 Plans:*** Complete box level testing, complete group A qualification testing (safety of flight) and initiate group B testing (full qualification) to include environmental testing, and deliver Production Representative Units (PRU) for platform integration and flight test. ***FY 2020 Plans:*** Complete full qualification testing, PRU integration and flight test support. Conduct anomaly resolution. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Funding decreased because the requirements are decreasing as the system transitions from development to fielding.	26.012	5.270	1.000
Title: PNT RMI - DAGR ***Description:*** DAGR is a vehicle-mounted and hand-held GPS receiver. Program improves DAGR receiver performance by integrating software and hardware capability enhancements into DAGR receivers while also addressing parts obsolescence and M-code integration, providing improved resiliency to mitigate current and emerging operational threats and maintain the navigational capability required for ground personnel and vehicles. ***FY 2019 Plans:*** Continue maturing system enhancements and initiate new trade studies to address any emerging operational threat to the DAGR system (as required). ***FY 2020 Plans:*** Develop M-code prototypes ***FY 2019 to FY 2020 Increase/Decrease Statement:***	3.773	2.000	0.500

Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Air Force	Date: February 2019
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C. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Funding decreased due to higher priority Air Force requirements.			
Title: PNT RMI - Resilient EGI (R-EGI)	3.772	2.000	51.000
Description: Establishes a Government Reference Architecture (GRA) embodying open systems architecture concepts, enabling and accelerating the transition of future resilient PNT DoD systems. Enables design and development of various aircraft PNT Line Replaceable Units (LRUs) that are rapidly upgradeable to counter evolving threats. Demonstrates the GRA through prototyping of an open R-EGI LRU. Program matures, prototypes, and tests promising PNT technologies/systems and develops transition paths to flow new technologies into new and/or existing PNT systems. Provides improved PNT resiliency to counter navigational warfare threats through the design, development, test, and transition of science and technology efforts to PNT systems. ***FY 2019 Plans:*** Continue development of hardware standards, software navigation protocols and aircraft data/communication networking protocols required to address increased navigational data requirements, simulation capability, advanced receiver design. Initiate a R-EGI LRU prototyping effort necessary to demonstrate and test capabilities prior to product transition, evolving the prototype through to Preliminary Design Review. Develop programmatic plans for transition of hardware and software technologies into new and/or existing PNT systems. ***FY 2020 Plans:*** Continue the R-EGI LRU prototyping effort, fabricating, and testing initial prototypes. Continue development of hardware standards and software navigation protocols, aircraft data/ communication networking protocols and advanced receiver designs. Continue to mature resilient PNT hardware and software technologies into new and/or existing PNT systems. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Funding increased due to the initiation of the R-EGI LRU prototyping effort which increased the requirements over and above the previous standards and component development efforts.			
Accomplishments/Planned Programs Subtotals	97.943	46.731	67.782

D. Other Program Funding Summary ($ in Millions)

N/A

Remarks

E. Acquisition Strategy

Modifications to existing receivers designs will occur via Engineering Change Proposals (ECP)/Task Orders on existing USAF contracts. The GRA and open standards associated with R-EGI may be developed in cooperation with an industry consortium or using Other Transaction Authorities (OTA). The R-EGI LRU prototyping will be conducted using an OTA. OTAs may be used where appropriate to support prototyping and/or open standards development.

Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Air Force	Date: February 2019
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F. 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-3, RDT&E Project Cost Analysis: PB 2020 Air Force			Date: February 2019
Appropriation/Budget Activity 3600 / 5	R-1 Program Element (Number/Name) PE 0604201F / *PNT Resiliency, Mods, and Improvements*	Project (Number/Name) 651030 / *GPS Receiver Development*	

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
EGI-M (Honeywell)	SS/CPFF	Honeywell : Clearwater, FL	-	2.717	Nov 2018	0.865	May 2019	8.861	Oct 2019	-		8.861	Continuing	Continuing	-
EGI-M (Northrop Grumman)	SS/CPFF	Northrop Grumman : Woodland Hills, CA	-	50.769	Sep 2018	30.252	Nov 2018	5.892	Oct 2019	-		5.892	Continuing	Continuing	-
MAGR-2K-M	SS/CPFF	Raytheon : El Segundo, CA	-	26.012	Apr 2018	3.670	May 2019	1.000	Jul 2020	-		1.000	Continuing	Continuing	-
PNT RMI - DAGR	SS/CPFF	Collins Aerospace : Des Moines, IA	-	0.550	Jul 2018	2.000	Jul 2019	0.500	Oct 2019	-		0.500	Continuing	Continuing	-
PNT RMI - R-EGI	C/CPFF	TBD : TBD	-	3.895	May 2018	2.000	May 2019	51.000	Oct 2019	-		51.000	Continuing	Continuing	-
		Subtotal	-	83.943		38.787		67.253		-		67.253	Continuing	Continuing	N/A

Support ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
EGI-M FFRDC	Various	MITRE Corp. : Bedford, MA	-	2.000	Oct 2017	1.590	Oct 2018	-		-		-	Continuing	Continuing	-
EGI-M Lab	PO	Integrated Spt Facility : GA	-	1.100	Jan 2018	-		-		-		-	0.000	1.100	-
		Subtotal	-	3.100		1.590		-		-		-	Continuing	Continuing	N/A

Test and Evaluation ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
EGI-M	PO	Various : TBD	-	0.000		1.000	Mar 2019	-		-		-	0.000	1.000	-
MAGR-2K-M	PO	Various : TBD	-	-		1.600	Mar 2019	-		-		-	0.000	1.600	-
		Subtotal	-	0.000		2.600		-		-		-	0.000	2.600	N/A

Remarks

MAGR-2K-M DT using 746th $800K and Cyber testing $800K not specified activity/location; EGI-M DT using 746th and Cyber testing $1M

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Air Force		Date: February 2019
Appropriation/Budget Activity 3600 / 5	**R-1 Program Element (Number/Name)** PE 0604201F / *PNT Resiliency, Mods, and Improvements*	**Project (Number/Name)** 651030 / *GPS Receiver Development*

Management Services ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Strategic Planning/PMA	C/Various	Whitney, Bradley & Brown : Robins, AFB, GA	-	10.900	Sep 2018	3.754	Sep 2019	0.529	Sep 2020	-		0.529	Continuing	Continuing	-
		Subtotal	-	10.900		3.754		0.529		-		0.529	Continuing	Continuing	N/A

	Prior Years	FY 2018		FY 2019		FY 2020 Base		FY 2020 OCO		FY 2020 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	-	97.943		46.731		67.782		-		67.782	Continuing	Continuing	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2020 Air Force		Date: February 2019
Appropriation/Budget Activity 3600 / 5	**R-1 Program Element (Number/Name)** PE 0604201F / *PNT Resiliency, Mods, and Improvements*	**Project (Number/Name)** 651030 / *GPS Receiver Development*

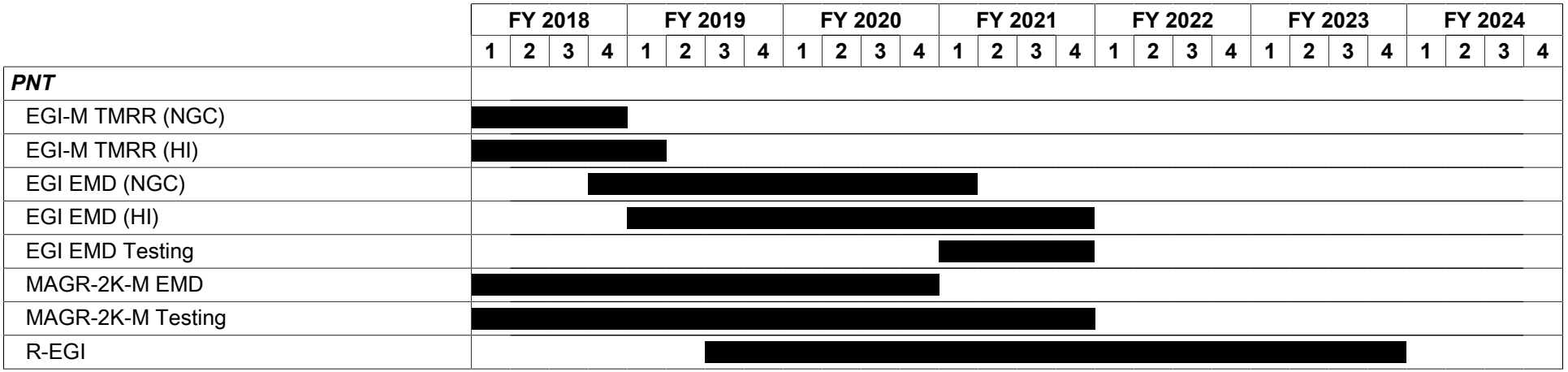

Exhibit R-4A, RDT&E Schedule Details: PB 2020 Air Force		Date: February 2019
Appropriation/Budget Activity 3600 / 5	**R-1 Program Element (Number/Name)** PE 0604201F / *PNT Resiliency, Mods, and Improvements*	**Project (Number/Name)** 651030 / *GPS Receiver Development*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
PNT				
EGI-M TMRR (NGC)	1	2018	4	2018
EGI-M TMRR (HI)	1	2018	1	2019
EGI EMD (NGC)	4	2018	1	2021
EGI EMD (HI)	1	2019	4	2021
EGI EMD Testing	1	2021	4	2021
MAGR-2K-M EMD	1	2018	4	2020
MAGR-2K-M Testing	1	2018	4	2021
R-EGI	3	2019	4	2023