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| Exhibit R-2, RDT&E Budget Item Justification: PB 2019 Air Force   |             |         |         |              |   |               |         |         |         | Date: February 2018 |                  |            |
|---|-------------|---------|---------|--------------|---|---------------|---------|---------|---------|---------------------|------------------|------------|
| Appropriation/Budget Activity<br>3600: Research, Development, Test & Evaluation, Air Force I BA 5: System Development & Demonstration (SDD) |             |         |         |              | R-1 Program Element (Number/Name)<br>PE 0604201F I Integrated Avionics Planning and Development |               |         |         |         |                     |                  |            |
| 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   | -           | 0.000   | 101.203 | 58.531       | 0.000   | 58.531        | 16.782  | 0.000   | 0.000   | 0.000               | Continuing       | Continuing |
| 651030: GPS Receiver Development  | -           | 0.000   | 101.203 | 58.531       | 0.000   | 58.531        | 16.782  | 0.000   | 0.000   | 0.000               | Continuing       | Continuing |
| Quantity of RDT&E Articles  | -           | -       | -       | -            | -   | -             | -       | -       | -       | -                   |                  |            |

## Note

In FY2018, 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 and precision clock improvements to maintain current force capabilities.

Efforts transferred from PE 0305164F and now conducted under PE 0604201F, Project 651030 include Embedded GPS/Inertial Navigation System (INS) Modernization (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/alternative PNT solutions. Activities also include, but are not limited to, both current program planning and execution and future program planning. 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, and 0605898F.

This program is in Budget Activity 5, Engineering and Manufacturing Development, because this budget activity includes development efforts to upgrade systems that have been fielded or have received approval for full rate production and anticipate production funding in the current or subsequent fiscal year. Production funding for modernized airborne receivers is not covered in this PE and will be requested by using platform when necessary.

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| Exhibit R-2, RDT&E Budget Item Justification: PB 2019 Air Force  |  |   |         | Date: February 2018 |             |               |
| Appropriation/Budget Activity<br>3600: Research, Development, Test & Evaluation, Air Force I BA 5: System Development & Demonstration (SDD)  |  | R-1 Program Element (Number/Name)<br>PE 0604201F I Integrated Avionics Planning and Development |         |                     |             |               |
| B. Program Change Summary (\$ in Millions)   |  | FY 2017   | FY 2018 | FY 2019 Base        | FY 2019 OCO | FY 2019 Total |
| Previous President's Budget  |  | 0.000   | 101.203 | 58.971              | 0.000       | 58.971        |
| Current President's Budget   |  | 0.000   | 101.203 | 58.531              | 0.000       | 58.531        |
| Total Adjustments  |  | 0.000   | 0.000   | -0.440              | 0.000       | -0.440        |
| • 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   | -0.440              | 0.000       | -0.440        |
| Change Summary Explanation   |  |   |         |                     |             |               |
| No Significant Changes   |  |   |         |                     |             |               |
| C. Accomplishments/Planned Programs (\$ in Millions)   |  |   |         | FY 2017             | FY 2018     | FY 2019       |
| Title: Embedded GPS/INS - Modernized (EGI-M)   |  |   |         | 0.000               | 66.300      | 49.261        |
| Description: EGI 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 any newly identified threats and maintain current force capabilities. Incorporates M-Code and potential ADS-B compliance capability into EGI receivers while addressing parts obsolescence, reducing configuration count from 260+ to approximately 16. |  |   |         |                     |             |               |
| FY 2018 Plans:<br>Conduct the EGI-M Preliminary Design Review, obtain Milestone B approval, and award Engineering & Manufacturing Development contracts in late 4QFY18 and early 1QFY19. Prepare for Critical Design Review and develop box level vendor and government test objectives/plans.   |  |   |         |                     |             |               |
| FY 2019 Plans:<br>Conduct the Critical Design Review (CDR), develop Initial Capabilities Documents (ICD), and begin full qualification and environmental testing.  |  |   |         |                     |             |               |
| FY 2018 to FY 2019 Increase/Decrease Statement:  |  |   |         |                     |             |               |

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| <b>Exhibit R-2, RDT&amp;E Budget Item Justification:</b> PB 2019 Air Force  |  | <b>Date:</b> February 2018  |                |                |
| <b>Appropriation/Budget Activity</b><br>3600: <i>Research, Development, Test &amp; Evaluation, Air Force I BA 5: System Development &amp; Demonstration (SDD)</i>   |  | <b>R-1 Program Element (Number/Name)</b><br>PE 0604201F <i>I Integrated Avionics Planning and Development</i> |                |                |
| <b>C. Accomplishments/Planned Programs (\$ in Millions)</b>   |  | <b>FY 2017</b>  | <b>FY 2018</b> | <b>FY 2019</b> |
| Requirements are increasing but funding is decreasing. Year of execution unfunded request will be needed to sustain program.  |  |   |                |                |
| <b>Title:</b> MAGR 2K-M<br><br><b>Description:</b> 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.<br><br><b>FY 2018 Plans:</b><br>Conduct MAGR 2K-M CDR, finalize modifications, incorporate new cyber security features, and conduct initial box-level bench testing,<br><br><b>FY 2019 Plans:</b><br>Complete box level bench testing, conduct full qualification testing to include environmental testing, and deliver Production Representative Units (PRU) for platform integration and flight testing.<br><br><b>FY 2018 to FY 2019 Increase/Decrease Statement:</b><br>Requirements are increasing but funding is decreasing. Year of execution unfunded request will be needed to sustain program. |  | 0.000   | 23.850         | 5.270          |
| <b>Title:</b> DAGR<br><br><b>Description:</b> 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, providing improved resiliency to mitigate current and emerging operational threats and maintain the navigational capability required for ground personnel and vehicles.<br><br><b>FY 2018 Plans:</b><br>Initiate trade studies to further define requirements and award development contract to mature promising system enhancements.<br><br><b>FY 2019 Plans:</b><br>Continue maturing system enhancements and initiate new trade studies to address any emerging operational threat to the DAGR system (as required).<br><br><b>FY 2018 to FY 2019 Increase/Decrease Statement:</b><br>Requirements are increasing but funding is decreasing. Year of execution unfunded request will be needed to sustain program.  |  | 0.000   | 3.653          | 2.000          |
| <b>Title:</b> Resilient EGI (R-EGI)   |  | 0.000   | 7.400          | 2.000          |

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| Exhibit R-2, RDT&E Budget Item Justification: PB 2019 Air Force  |         |         |                 |   |                  |         | Date: February 2018 |         |         |                     |            |
| Appropriation/Budget Activity<br>3600: Research, Development, Test & Evaluation, Air Force I BA 5: System Development & Demonstration (SDD)  |         |         |                 | R-1 Program Element (Number/Name)<br>PE 0604201F I Integrated Avionics Planning and Development |                  |         |                     |         |         |                     |            |
| C. Accomplishments/Planned Programs (\$ in Millions)   |         |         |                 |   |                  |         | FY 2017             | FY 2018 | FY 2019 |                     |            |
| <p><b>Description:</b> Provide improved EGI resiliency to counter navigational warfare threats through the design, development, test and transition of science and technology efforts to EGI-M. Establish a Government Reference Architecture (GRA) embodying open systems architecture concepts and enabling future resilient PNT DoD systems. Provide upgrade and transition paths to flow new technologies into EGI-M hardware and software wherever practical.</p> <p><b>FY 2018 Plans:</b><br/>Begin development of hardware standards and software navigation/communication protocols. Develop simulation capability and implement prototyping to include ability to demonstrate and test capabilities prior to development. Develop programmatic plans with insertion points for potential hardware and software upgrades to EGI-M.</p> <p><b>FY 2019 Plans:</b><br/>Continue development of hardware standards and software navigation/communication protocols, simulation capability and implement prototyping to include ability to demonstrate and test capabilities prior to development, and programmatic plans with insertion points for potential hardware and software upgrades to EGI-M.</p> <p><b>FY 2018 to FY 2019 Increase/Decrease Statement:</b><br/>Requirements are increasing but funding is decreasing. Year of execution unfunded request will be needed to sustain program.</p> |         |         |                 |   |                  |         |                     |         |         |                     |            |
|  |         |         |                 |   |                  |         |                     |         |         |                     |            |
|  |         |         |                 |   |                  |         |                     |         |         |                     |            |
|  |         |         |                 |   |                  |         |                     |         |         |                     |            |
|  |         |         |                 |   |                  |         |                     |         |         |                     |            |
| Accomplishments/Planned Programs Subtotals   |         |         |                 |   |                  |         | 0.000               | 101.203 | 58.531  |                     |            |
| D. Other Program Funding Summary (\$ in Millions)  |         |         |                 |   |                  |         |                     |         |         |                     |            |
| Line Item  | FY 2017 | FY 2018 | FY 2019<br>Base | FY 2019<br>OCO  | FY 2019<br>Total | FY 2020 | FY 2021             | FY 2022 | FY 2023 | Cost To<br>Complete | Total Cost |
| • RDTE 04 PE   | 70.387  | -       | 0.000           | -   | 0.000            | 0.000   | 0.000               | 0.000   | -       | 0.000               | 70.387     |
| 0305164F: Navstar GPS  |         |         |                 |   |                  |         |                     |         |         |                     |            |
| Remarks  |         |         |                 |   |                  |         |                     |         |         |                     |            |
| In FY2018, PE 0305164F, NAVSTAR Global Positioning System (User Equipment) (Space), Project 643833, Military Global Positioning System User Equipment specific efforts are being transferred to PE 0604201F, Integrated Avionics Planning & Development, Project 651030, Aircraft Receiver Development for transparency and to realign resources with execution responsibilities that support various aircraft weapon system platforms.  |         |         |                 |   |                  |         |                     |         |         |                     |            |
| E. Acquisition Strategy  |         |         |                 |   |                  |         |                     |         |         |                     |            |
| Modifications to existing receivers designs will occur via Engineering Change Proposals (ECPs)/Task Orders on existing USAF contracts. The GRA and open standards associated with R-EGI will be developed in cooperation with an industry consortium.  |         |         |                 |   |                  |         |                     |         |         |                     |            |

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| <b>Exhibit R-2, RDT&amp;E Budget Item Justification:</b> PB 2019 Air Force  |   | <b>Date:</b> February 2018 |
| <b>Appropriation/Budget Activity</b><br>3600: <i>Research, Development, Test &amp; Evaluation, Air Force I BA 5: System Development &amp; Demonstration (SDD)</i>   | <b>R-1 Program Element (Number/Name)</b><br>PE 0604201F <i>I Integrated Avionics Planning and Development</i> |                            |
| <b>F. Performance Metrics</b><br>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. |   |                            |

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|---|------------------------|---------------------------------------|-------------|---------|------------|---|------------|--------------|------------|--|------------|---------------------|------------------|------------|--------------------------|
| Exhibit R-3, RDT&E Project Cost Analysis: PB 2019 Air Force |                        |                                       |             |         |            |   |            |              |            |  |            | Date: February 2018 |                  |            |                          |
| Appropriation/Budget Activity<br>3600 / 5                   |                        |                                       |             |         |            | R-1 Program Element (Number/Name)<br>PE 0604201F / Integrated Avionics Planning and Development |            |              |            | Project (Number/Name)<br>651030 / GPS Receiver Development |            |                     |                  |            |                          |
| Product Development (\$ in Millions)                        |                        |                                       |             | FY 2017 |            | FY 2018   |            | FY 2019 Base |            | FY 2019 OCO  |            | FY 2019 Total       |                  |            |                          |
| Cost Category Item  | Contract Method & Type | Performing Activity & Location        | Prior Years | Cost    | Award Date | Cost  | Award Date | Cost         | Award Date | Cost   | Award Date | Cost                | Cost To Complete | Total Cost | Target Value of Contract |
| EGI-M   | SS/CPFF                | Honeywell : Clearwater, FL            | -           | -       |            | 13.573  | Nov 2018   | 14.305       | Jan 2019   | -  |            | 14.305              | Continuing       | Continuing | -                        |
| EGI - M   | SS/CPFF                | Northrop Grumman : Woodland Hills, CA | -           | -       |            | 44.112  | Sep 2018   | 20.726       | Jan 2019   | -  |            | 20.726              | Continuing       | Continuing | -                        |
| MAGR-2K-M   | SS/CPFF                | Raytheon : El Segundo, CA             | -           | -       |            | 18.465  | Apr 2018   | 4.300        | May 2019   | -  |            | 4.300               | Continuing       | Continuing | -                        |
| DAGR  | SS/CPFF                | Rockwell Collins : Des Moines, IA     | -           | -       |            | 3.653   | Jul 2018   | 2.000        | Jul 2019   | -  |            | 2.000               | Continuing       | Continuing | -                        |
| R-EGI   | TBD                    | TBD : NV                              | -           | -       |            | 7.400   | May 2018   | 2.000        | May 2019   | -  |            | 2.000               | Continuing       | Continuing | -                        |
| Subtotal  |                        |                                       | -           | -       |            | 87.203  |            | 43.331       |            | -  |            | 43.331              | Continuing       | Continuing | N/A                      |
| Support (\$ in Millions)                                    |                        |                                       |             | FY 2017 |            | FY 2018   |            | FY 2019 Base |            | FY 2019 OCO  |            | FY 2019 Total       |                  |            |                          |
| Cost Category Item  | Contract Method & Type | Performing Activity & Location        | Prior Years | Cost    | Award Date | Cost  | Award Date | Cost         | Award Date | Cost   | Award Date | Cost                | Cost To Complete | Total Cost | Target Value of Contract |
| EGI-M FFRDC   | Various                | MITRE : NV                            | -           | -       |            | 2.000   | Oct 2017   | 3.080        | Oct 2018   | -  |            | 3.080               | Continuing       | Continuing | -                        |
| EGI-M Lab   | PO                     | ISF : NV                              | -           | -       |            | 1.100   | Jan 2018   | 0.000        | Jan 2019   | -  |            | 0.000               | Continuing       | Continuing | -                        |
| Subtotal  |                        |                                       | -           | -       |            | 3.100   |            | 3.080        |            | -  |            | 3.080               | Continuing       | Continuing | N/A                      |
| Test and Evaluation (\$ in Millions)                        |                        |                                       |             | FY 2017 |            | FY 2018   |            | FY 2019 Base |            | FY 2019 OCO  |            | FY 2019 Total       |                  |            |                          |
| Cost Category Item  | Contract Method & Type | Performing Activity & Location        | Prior Years | Cost    | Award Date | Cost  | Award Date | Cost         | Award Date | Cost   | Award Date | Cost                | Cost To Complete | Total Cost | Target Value of Contract |
| EGI-M   | PO                     | Not specified. : NV                   | -           | -       |            | 0.000   |            | 0.000        |            | -  |            | 0.000               | Continuing       | Continuing | -                        |
| Subtotal  |                        |                                       | -           | -       |            | 0.000   |            | 0.000        |            | -  |            | 0.000               | Continuing       | Continuing | N/A                      |
|   |                        |                                       |             |         |            |   |            |              |            |  |            |                     |                  |            |                          |

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| Exhibit R-3, RDT&E Project Cost Analysis: PB 2019 Air Force |                        |                                |             |         |            |   |            |              |            |  |            | Date: February 2018 |                  |            |                          |
| Appropriation/Budget Activity<br>3600 / 5                   |                        |                                |             |         |            | R-1 Program Element (Number/Name)<br>PE 0604201F / Integrated Avionics Planning and Development |            |              |            | Project (Number/Name)<br>651030 / GPS Receiver Development |            |                     |                  |            |                          |
| Management Services (\$ in Millions)                        |                        |                                |             | FY 2017 |            | FY 2018   |            | FY 2019 Base |            | FY 2019 OCO  |            | FY 2019 Total       |                  |            |                          |
| Cost Category Item  | Contract Method & Type | Performing Activity & Location | Prior Years | Cost    | Award Date | Cost  | Award Date | Cost         | Award Date | Cost   | Award Date | Cost                | Cost To Complete | Total Cost | Target Value of Contract |
| Strategic Planning/PMA                                      | TBD                    | TBD : NV                       | -           | -       |            | 10.900  | Sep 2018   | 12.120       | Sep 2019   | -  |            | 12.120              | Continuing       | Continuing | -                        |
| Subtotal  |                        |                                | -           | -       |            | 10.900  |            | 12.120       |            | -  |            | 12.120              | Continuing       | Continuing | N/A                      |
|   |                        |                                | Prior Years | FY 2017 |            | FY 2018   |            | FY 2019 Base |            | FY 2019 OCO  |            | FY 2019 Total       | Cost To Complete | Total Cost | Target Value of Contract |
| Project Cost Totals   |                        |                                | -           | -       |            | 101.203   |            | 58.531       |            | -  |            | 58.531              | Continuing       | Continuing | N/A                      |
| Remarks   |                        |                                |             |         |            |   |            |              |            |  |            |                     |                  |            |                          |

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| Exhibit R-4, RDT&E Schedule Profile: PB 2019 Air Force |  |  |  |  |  |  |  |   |  |  |  | Date: February 2018 |  |  |  |  |  |
| Appropriation/Budget Activity<br>3600 / 5              |  |  |  |  |  |  |  | R-1 Program Element (Number/Name)<br>PE 0604201F / Integrated Avionics Planning and Development |  |  |  |                     |  | Project (Number/Name)<br>651030 / GPS Receiver Development |  |  |  |

|                   | FY 2017 |   |   |   | FY 2018 |   |   |   | FY 2019 |   |   |   | FY 2020 |   |   |   | FY 2021 |   |   |   | FY 2022 |   |   |   | FY 2023 |   |   |   |
|-------------------|---------|---|---|---|---------|---|---|---|---------|---|---|---|---------|---|---|---|---------|---|---|---|---------|---|---|---|---------|---|---|---|
|                   | 1       | 2 | 3 | 4 | 1       | 2 | 3 | 4 | 1       | 2 | 3 | 4 | 1       | 2 | 3 | 4 | 1       | 2 | 3 | 4 | 1       | 2 | 3 | 4 | 1       | 2 | 3 | 4 |
| PNT               |         |   |   |   |         |   |   |   |         |   |   |   |         |   |   |   |         |   |   |   |         |   |   |   |         |   |   |   |
| EGI-M TMRR        |         |   |   |   |         |   |   |   |         |   |   |   |         |   |   |   |         |   |   |   |         |   |   |   |         |   |   |   |
| EGI EMD           |         |   |   |   |         |   |   |   |         |   |   |   |         |   |   |   |         |   |   |   |         |   |   |   |         |   |   |   |
| EGI EMD Testing   |         |   |   |   |         |   |   |   |         |   |   |   |         |   |   |   |         |   |   |   |         |   |   |   |         |   |   |   |
| MAGR-2K-M EMD     |         |   |   |   |         |   |   |   |         |   |   |   |         |   |   |   |         |   |   |   |         |   |   |   |         |   |   |   |
| MAGR-2K-M Testing |         |   |   |   |         |   |   |   |         |   |   |   |         |   |   |   |         |   |   |   |         |   |   |   |         |   |   |   |



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| <b>Exhibit R-4A, RDT&amp;E Schedule Details:</b> PB 2019 Air Force |   |  | <b>Date:</b> February 2018 |
| <b>Appropriation/Budget Activity</b><br>3600 / 5                   | <b>R-1 Program Element (Number/Name)</b><br>PE 0604201F / <i>Integrated Avionics Planning and Development</i> | <b>Project (Number/Name)</b><br>651030 / <i>GPS Receiver Development</i> |                            |

Schedule Details

| Events by Sub Project | Start   |      | End     |      |
|-----------------------|---------|------|---------|------|
|                       | Quarter | Year | Quarter | Year |
| <b><i>PNT</i></b>     |         |      |         |      |
| EGI-M TMRR            | 3       | 2017 | 4       | 2018 |
| EGI EMD               | 1       | 2019 | 4       | 2020 |
| EGI EMD Testing       | 1       | 2021 | 4       | 2022 |
| MAGR-2K-M EMD         | 1       | 2017 | 4       | 2020 |
| MAGR-2K-M Testing     | 1       | 2017 | 4       | 2022 |