Tri-Service GPS Sustainment Management Office (GPS SMO)

Airborne Instrumentation Development for the Navy JSF Operational Test Program

International Test & Evaluation Association 12th Test Technology Review

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Background

- **The Air Warfare Battle Shaping (AWBS) is a Navy initiative to install a comprehensive new test capability**
  - Support the Navy/Marine Corps Joint Strike Fighter (JSF) Operational Testing (OT) requirements in FY17/18
  - Involves Point Mugu, China Lake, Nevada Test & Training Range (NTTR) and Edwards AFB.
  - This new OT requirement involves installing a ground based infrastructure and it involves an air segment for both the JSF and F/A-18 air platforms.
  - The JSF aircraft are being instrumented by a different group.
  - The Navy is addressing the new ground infrastructure and the airborne infrastructure associated with the F/A-18
  - This brief will address the F/A-18 air segment portion of this program.

Background

- **This program address the need for the Navy to utilize a unique test capability currently available only at NTTR**
- **This test capability involves utilizing the Air-To-Air Range Infrastructure, 2nd generation (AARI 2) air and ground systems**
- **This capability is largely based on the ability to interface with the air platforms 1553 bus and information systems**
  - Downlink key weapons bus data and uplink Real Time Kill (RTK) notifications.
  - Ground infrastructure to receive and process this data real-time, including weapon simulations and fly out models for a variety of threat systems

Background

- **The Navy program office came to the Tri-Service GPS Sustainment Office (GPS SMO) to take on the airborne segment of this program**
  - Involves developing 10 AARI 2 pods for use on the F/A-18's so they can support the JSF testing
  - These are unique pods capable of interfacing with the F/A-18 1553 weapons bus data
  - This capability does not currently exist in the Advanced Range Data System (ARDS) pods
  - Also requires a new high throughput Data Link Transceiver (DLT) known as the Rapid Prototype Initiative (RPI) DLT developed by Rockwell Collins
    - **Predecessor to the Common Range Integrated Instrumentation System (CRIIS) DLT currently under development on a separate program**

Options Summary

- **The SMO started this task by creating an Analysis of Alternatives (AOA) for what options the Navy had in creating 10 AARI 2 pods**
  - This study looked at the various options available including retrofitting existing pods and procuring new pods
  - It also looked at, and generated the associated cost and technical risk associated with each option evaluated.
  - The study looked at the schedule and technical challenges with getting these pods certified to interface with the aircraft 1553 weapons bus
    - **Detailed pod 1553 interface as defined in a "yet to be completed" Interface Control Document (ICD).**
    - **Currently in work by the SMO**
    - **This ICD is crucial regardless of what option is finally selected to pursue the pods**

Options Summary

- The AOA identified 4 different options for getting ten operational AARI 2 pods – Required date Sept 2016
- Option 1: Obtain the 10 never flown ARDS pods from the Joint Pacific Alaska Range Complex (JPARC) and modify them
- Option 2: Obtain 10 decommissioned P4R1 training pods and refurbish/modify them
- Option 3: Procure 10 new pods from DRS Training and Control proposed as a potential solution
- Option 4: Obtain 10 pods from the China Lake inventory and modify them

Technical Challenges

- **The Navy has already procured 10 RPI DLTs from Rockwell Collins under a separate contract and these would be GFE to the SMO.**
  - The pods require a unique power supply currently only available from DRS
  - They require a unique cable harness adaptor kit that allows the RPI DLT to work without changes to the current ARDS cable harnesses
  - Neither of these two crucial items have been procured yet
  - The SMO is working with Rockwell Collins and NTTR to see if:
    - **Obtain the input power requirements for the RPI DLT from Rockwell and to determine what documentation on this power supply is available from NTTR**
    - **Objective to have a new power supply developed**
    - **Alternative, determine if the new CRIIS DLT power supply is backwards compatible with the RPI DLT (preferred solution)**

Technical Challenges

- **Other technical challenges common across all options (except #3) reviewed include:**
  - DRS has not decided if they will perform any more work or software development on the legacy Advanced Digital Interface Units (ADIU) necessary to incorporate the required 1553 interface capability
  - Requires the use of the new Eglin developed Eglin Digital Interface Unit (EDIU) currently in use by the majority of the ARDS community
  - Requires the 46th TW at Eglin to modify the EDIU software to incorporate the necessary 1553 interface capability
    - **The EDIU currently has an obsolete CCA that must be engineered around before software development can proceed**
  - Completing the required F/A-18 Software Integration Laboratory (SIL) testing and certification for allowing interface with the F/A-18 1553 weapons bus
  - SIL testing requires both lab testing and actual flight testing.

Technical Challenges

- **Other technical challenges common across all options (except #3) reviewed include:**
  - The current ARDS pods utilize a DC/DC power supply for everything except the DLT. The exception being the GNP-10 GPS receiver and the Upgrade Range Encryption Module (UREM) which draw 28 VDC directly from the AIM-9 umbilical.
  - The AARI 2 pod configuration will only have 115 VAC available.
  - Requires the DC/DC power supply be replaced with a AC-DC/DC power supply.
  - This requires cable harness modifications to allow the power up of the UREM and GNP-10

Technical Challenges

- **Other technical challenges common across all options (except #3) reviewed include:**
  - The current ARDS pod utilize a Relay Reporter Responder (R3) cable harness configuration.
  - The AARI 2 pod, due the inclusion of the UREM, requires a Synchronous Data Link Control (SDLC) cable harness configuration
  - Options 1 and 4 will require a complete cable harness change out as well as the necessary modifications to the current SDLC harness drawing package to accommodate the AC-DC/DC power supply requirement
  - Options 2 will also require the current SDLC cable harness drawing package be modified to accommodate the AC-DC/DC power supply requirement, and procurement of new harnesses
  - Modified cable harness will have to be procured for Options 1, 2, and 4

Technical Challenges

- **The Option 1 (JPARC) pods will require the following modifications:**
  - Incorporate the new RPI DLT
  - Procure the required RPI DLT adaptor cable harness kit
  - Develop a new RPI DLT power supply
  - Procure a new modified SDLC cable harness set
  - Procure (or obtain used) AC-DC/DC power supplies
  - Replace the existing legacy ADIU and Intelligent Flash Solid State Recorder (IFSSR) and procure the EDIU and the accompanying Eglin Flash Solid State Recorder (EFSSR), as they are a matched set
  - Replace the pod tube hangers with the current Navy approved configuration (10” TCTS forward and P4RC center and aft)

Technical Challenges

- **Option 2: Decommissioned P4R1 pod refurbishment**
  - Requires the procurement of an ARDS nosecone
  - Requires the replacement of the existing rail end cap
  - Incorporate the new RPI DLT
  - Procure the required RPI DLT adaptor cable harness kit
  - Develop/Procure a new RPI DLT power supply
  - Procure a new modified SDLC cable harness set
  - Procure (or obtain used) AC-DC/DC power supplies
  - Procure the EDIU and EFSSR
  - Replace the pod tube hangers with the current Navy approved configuration (10” TCTS forward and P4RC center and aft)
  - Potentially procure and install a GNP-10 replacement receiver (some P4R1 rails still have GNP-10s in them)

Technical Challenges

- **Option 3: DRS proposed new pod**
  - New never before built pod that incorporates a P5 back end and a CRIIS front end
  - Production will not start until June 2016
  - Incorporates a new GPS receiver (called the EDGE) never before tested (accuracy or performance) or flown
  - Stand alone configuration with no ability to incorporate any existing ARDS parts should failures occur
  - Very high technical and schedule risk (and potential cost risk)

Technical Challenges

- **Option 4: China Lake Pod Retrofit**
  - Requires the incorporation of the EDIU software upgrade (pods already contain the EDIU and EFSSR)
  - Requires the new modified SDLC cable harnesses
  - Installation of the RPI DLT
  - Procure the required RPI DLT adaptor cable harness kit
  - Procure (or obtain used) AC-DC/DC power supplies

High Risk Areas

- **Across the board risks include the ADIU/EDIU software enhancements to incorporate a 1553 interface capability**
  - Includes a bi-directional interface capability
  - Includes having to respond properly to the weapons bus upon start up to avoid power shut down on that wing station (must respond as a smart weapon)
  - Ability to pass F/A-18 SIL testing and get the proper approvals and certifications (PMA-265 requirement)
- **For options 3 – will have to conduct full blown GPS receiver accuracy and performance flight testing – several dedicated flight tests and associated data reduction**
  - Schedule delay
  - Increased costs

High Risk Areas

- **Across the board – obtaining the necessary quantity of used REMs and converting them to UREMs**
  - Government GFE requirement
  - Requires a minimum of 10 plus some spares for the pods
  - The ground segment will require a minimum of 8 UREMs plus some spares
  - Still trying to locate 12 additional REMs to convert to UREM
  - Significant cost impact and potential schedule impact
- **RPI DLT Power Supply – development, ESS testing, and full certifications**
- **Obtaining the necessary flight clearances (across the board risk)**

F/A-18 SIL Testing Challenges

- **This is one of the biggest unknowns at this point**
- **Anticipated lab testing time required is 6-7 weeks**
- **Lead time to get on the schedule for the lab time (PMA-265 priority concern)**
- **Must have a fully verified AARI 2 pod 1553 interface requirement ICD for use in testing**
- **Must not require any changes to the current Block 12 OFP software on the F/A-18**
  - Any necessary changes to obtain additional information not already available will result in a 2+ year delay

F/A-18 SIL Testing Challenges

- **Includes not only proper integration and communication with the 1553 weapons bus data**
  - Bi-Directional
- **Also includes Information Assurance (IA) certification**
  - Can take much longer than the actual interface certification
  - The AARI 2 pod will be exposed to other classified bus data
  - Must prove that no classified data will be stored on the pod when shut down
  - Excludes the actual EFSSR recording media
  - Concerns with EDIU FPGA and any other components FPGAs
  - Not a trivial process and absolutely required for final certification and approval to connect to and receive aircraft 1553 bus data

AARI 2 ICD Development

- **ICD development is very complicated**
  - Requires merging P5 interface, F-15 interface and new AARI F/A-18 interface requirements
    - **Required to operate properly with the current AARI ground infrastructure**
    - **Must fully understand what is available in the F/A-18 Block 12 OFP software and how to pull the necessary messages required off the 1553 bus**
  - All messages received from the aircraft 1553 bus must be compiled into messages 28 and 29 for uplink and downlink
  - The message length for the RPI DLT is significantly different (79 word message) than the ARDS message length (45 word message) and will significantly increase the complexity of generating the 1553 interface ICD
  - ICD is currently in work and is approximately 70% complete

Summary

- There are 4 options being evaluated for a potential path forward for producing 10 fully certified AARI 2 pods for the Navy to use on F/A-18s
- Significant technical challenges will have to be overcome
- Significant technical, cost and schedule risk involved in most if not all of the options being evaluated
- The F/A-18 SIL testing requirements are a big unknown at this time
- It is crucial that the AARI 2 pod 1553 ICD be completed ASAP