PMA-209 develops, integrates, and delivers avionics solutions that meet customer requirements, enable interoperability, and maximize affordability.

OA Industry Day
17 October 2017
BLUF

• New strategies for development and integration of Required Navigation Performance Area Navigation (RNP RNAV) capability for Department of the Navy (DoN) aircraft are required to enable cost-wise solutions across multiple platforms that require similar capabilities

• Processes have been identified involving Open Architecture (OA) techniques to achieve cost avoidance

• DISCLAIMER: This brief covers a project that is in active stages of Source Selection and/or Competition. The briefing contains no Source Selection sensitive information and no information concerning the pending competition will be disclosed. Some questions/topics cannot be discussed.
Agenda

• Background
• Why Open Architecture (OA) and Future Airborne Capability Environment (FACE™)?
• Technological Hurdles
• New Business Environment
• Product Line Engineering/Management
• How To Develop
• Previous Efforts/Lessons Learned
• Basic Acquisition Strategy
  – Make or Buy?
  – FMF Application Strategy
  – FMF Application Functionality
  – Platform Integration Requirements
  – Intellectual Property Rights
• Response From Industry
• Independent Verification & Validation (IV&V) Lab/Multi Use Laboratory Environment (MULE)
• Wrap-Up/Final Thoughts
• Questions
Background

- **What is Future Airborne Capabilities Environment (FACE™)**
  - Public-Private collaboration to establish value for both customer and supplier
  - Establishes a standard common operating environment to support portable capability-based applications across Department of Defense (DoD) avionics systems
  - Achieved by defining interfaces and processes (design and implementation)
  - Provides Trade-Space for Intellectual Property (IP) rights to fit the requirement
    - Government owns/manages data rights at the interfaces
    - Protects Industry investment by allowing retention of IP to business logic of the capability
  - Standards are platform, software and hardware agnostic

- **FACE™ Conformant Application Definition (for this brief):**
  - A software module which enables a specific capability, whose interfaces and data modeling are conformant with the FACE™ standard to enable portability of a capability module across multiple platforms
Why OA and FACE™?

- Increasing Cost of system development across DoN portfolio requires new strategies to reduce cost growth trends
- Development costs for RNP RNAV capability are projected to be approximately $50M for each platform
  - Requires DoN to re-invest in creating same capability multiple times
  - Limits competitive environment and opportunities
  - Government has limited rights to majority of the system (must go to Original Equipment Manufacturer)
  - Limits potential growth of the system (ease of upgrades/competitive environment)
- Directed by Senior Leadership
  - Charter for the Definition, Roles, and Responsibilities for the Naval Aviation Open Architecture Strategy
    - Signed by Commander, Naval Air Systems Command on 3 November 2015
    - Initial step in implementing a NAVAIR-wide OA process
- Example:
  - Previous effort for platform integration of RNP RNAV, utilizing the traditional approach was $60M+, which proved to be unaffordable

The value of OA has been recognized
Technological Hurdles?

- **Can we use OA modular software in our legacy systems?** YES!!!
  - Strategies to introduce an OA, FACE™ supporting environment into legacy systems:
    - Insert into existing system with an appropriate translation layer/library
    - Introduction of an Adjunct Processor

- **Is there FACE™ conformant hardware?** NO!!!
  - FACE™ conformant hardware is a misnomer. If the platform provides hardware that can support FACE™ conformant operating system interfaces, it follows that the system can host FACE™ conformant software modules
  - It is highly desired that a modular software architecture is utilized for partitioned software, but not necessary
New Business Environment

- **FACE™ aligns with Better Buying Power initiatives**
  - Grows the competitive environment to achieve affordability and better control life cycle costs
  - Incentivizes productivity and innovation in Industry and Government
  - Reduces subsequent software development times through modularity and portability (capability driven development)
  - Eliminates redundancy within Warfighter portfolios (software re-use)

- **FACE™ Facilitates Enterprise Level Decision Making**
  - Ability to re-use applications across multiple platforms without cross-platform dependencies
  - No need to invest multiple times for same capability
  - Common operating environment and data architecture enables system of systems integration and interoperability
  - Alignment and adaptation with new, existing, and evolving standards

**Business Case: More opportunities at lower cost**
Product Line Engineering/Management

- **Product-Centric Development vs. Product Line Engineering**
  - Legacy systems development process vs. New shared software modules development

- **Move away from many platform specific, “stove pipe” solutions**
  - Separate the hardware and software dependencies

- **Goal: Have a single product or specification that can be modified if necessary to enable a common capability**

- **Likely DoN Model - Provide central management of common capabilities to provide efficiencies in:**
  - Procurement costs
  - Requirements tracking and management
  - Capability certification processes
  - Sustainment

- **Additional future common capability product lines have been identified by PMA-209**
How To Develop

Customer

Capabilities Management Team

Product Delivery

Product Evaluation

Product Development Team

Refined Requirements

Process/Developmental Support

Standards/Subject Matter Experts

Additional Customers

Requirements

Product Line Development
Previous Efforts/Lessons Learned

- **Identified hurdles from previous PMA-209 efforts to develop RNP RNAV software module:**
  - **Contracts and Specification**
    - Limited OA software specifications and requirements
    - Result: Additional unplanned work to correct “deficiencies”
  - **Developers familiarity with the FACE™ standard and modular code**
    - Inadequate working knowledge of processes and techniques
    - Result: Impacts to Cost/Schedule/Performance (C/S/P)
  - **Re-use of existing software**
    - Attempt to modularize existing monolithic Operational Flight Program code into FACE™ conformant software modules
    - Result: Encountered unanticipated technical issues and difficulty. Caused additional impacts to C/S/P.
Make or Buy?

- **Business Case Analysis (BCA) conducted for FACE™ Flight Management File (FMF) application**
  - Considerations
    - Stability of requirements
    - Commercial availability of the capability need

- **Major points from the BCA process**
  - Data compiled from Rough Order of Magnitude (ROM) estimates and Requests for Information (RFIs) since 2012 relating to the development of an FMF application
  - Integration costs for FMF application will vary depending upon the structure/architecture of existing platform avionics
    - Do not expect integration costs to go down initially!
  - Solutions generally break down into two categories (Make/Buy):
    - Make: Contract to develop an application wholly owned by Government
    - Buy: Lease a certified civil application
"Make" Option

- **Concept:** Vendors/NAVAIR will develop FMF Application (or set of associated modules) for one time cost/fee
- Re-use of existing software seems to be driving factor for cost and labor
- Limited offers for this solution *(high risk associated with ROMs)*
- **Pros:**
  - DoN would save on licensing
  - Able to compete the software for improvement without legal barriers
- **Cons:**
  - DoN assumes all costs associated with software maintenance and FAA civil certifications *(total cost of all these factors is currently unknown)*
  - Insufficient NAVAIR experience with FAA flight software development/certification process (not part of PMA-209 processes)
  - NAVAIR would also be solely liable for software errors in an area in which there is no institutional experience/knowledge
“Buy” Option

• Concept: “Buy” FMF Application via a license which includes vendor support and maintenance options
  – Possibility exists for short Non Recurring Engineering period
  – Integration, test, and certification costs to be the same as “Make” option

• Pros:
  – Provides the least amount direct labor to the Government in terms of development, maintenance and liability
  – Allows the Government to leverage vendor expertise in terms of quality and certification of civil software systems

• Cons:
  – Possible Government learning curve in managing this type of software leasing package
  – Risk of unavoidable reoccurring maintenance costs required after initial buy

PMA-209 Selected “buy” based upon Lowest Risk and Highest Return On Investment
FMF Application Strategy

• **Major requirements documents**
  – DoN RNP RNAV Functional Requirements Document (FRD) describes system level solution
  – PMA-209 is using primarily DO-283 and TSO-115 to capture software specific requirements for FMF Application

• **FMF application will be conformant with the FACE™ Technical standard and include a FACE™ Data Model**

• **FMF application will be abstracted from any platform specific computing or sensing requirements (with the exception all vendors were informed they can expect a PPS GPS)**

**Challenge:** Bounding the functionality needed but allowing flexibility

**RTCA/DO-283:** Minimum Operational Performance Standards for Required Navigation Performance for Area Navigation
**TSO-C115d:** Required Navigation Performance Equipment using Multi-Senor Inputs
FMF Application Functionality

- **Path Construction**
  - Constructs routes in accordance with RNP RNAV rules using procedures and waypoints extracted from the Navigation Data Base and/or user-defined fixes. Defines the precise path to be flown using Aeronautical Radio, Incorporated (ARINC) 429 leg types. Includes Direct-To, holding patterns, parallel offsets, etc.

- **Guidance**
  - Computes vertical and horizontal deviations for external use by a Course Deviation Indicator and/or flight director/autopilot. May provide Speed guidance

- **Aircraft State & Progress**
  - Continuously computes aircraft position, track, Actual Navigation Performance, and typical Progress Page data

- **Alerting**
  - Generates required RNP RNAV alerts

- **Navigational Database Ingestion (Digital Aeronautical Flight Information File)**
- Will accept specific Type/Model/Series performance data (FMF app will only have generic fixed wing/rotary models)
- Localizer performance with vertical guidance (LPV) capable (platform sensor dependent)

Provides the necessary foundation to enable aircraft to use IFR filing code of “/G”
Platform Integration Requirements

- Operator Machine Interface – does not come with pre-built Control Display Unit pages, i.e. no Human Machine Interface
- Sensor Management
- Database Management
- Navigation Database
- Specific Aircraft Performance Data (Personality Module)
- Mission Patterns or Mission Management (No tactical operations)
- Data Concentrator
- Controls & Displays

Platform system specific requirements are handled during integration process
Intellectual Property (IP) Rights

- **Using OA and modular approaches allows Government to be flexible in IP contracting**
  - Only buy what you need

- **Government Rights to all Parts of the software are unnecessary**
  - Only buy those IP Rights necessary to ensure integration into host environment (Minimal Government purpose rights)
    - Includes additional software/coding required to “wrap” software to achieve FACE conformance
  - Utilize existing software to the greatest extent possible; allow vendor to retain all rights to their IP RNP RNAV algorithms

**OA facilitates cost avoidance in this case**
Response From Industry

- **Previous History**
  - Initial RFI released in 2012
  - Previous platform RNP RNAV FACE™ Conformant software efforts (earlier discussed Lessons Learned)
  - Original Equipment Manufacturers asked for estimates to integrate a Government RNP RNAV application

- **Most recent RFI release in 2016**
  - Released RFI for FMF and 11 responses received and reviewed (4Q FY16)
  - Conducted FMF Industry day with 7 briefs from 8 companies (4Q FY16)

- **Pre-solicitation released December 2016**
  - Contained a draft Statement of Work and Specification
  - 12 requests for the draft Specification
  - 8 responses from industry

- **Sources Sought April 2017**
  - 5 responses received (2 from small business)

- **RFP released July 2017**

*Industry appears ready to support the FMF Application*
IV&V Lab

- **Desire to build and utilize a Government IV&V lab to support the procurement process and gain Government experience**
  - FMF app procurement contracting will ensure the vendor conducts IV&V
  - Government IV&V lab testing to demonstrate/ensure portability of the application

- **Actively planning with multiple competencies at NAVAIR**
  - Software enterprise wide attention and effort
  - Finishing a Work Breakdown Structure to lay a functional foundation

- **Exploring plan to convert un-used Government owned equipment and test benches to build OA IV&V lab**
  - Re-use and convert existing hardware
  - Other spaces and support facilities possible
Multi-Use laboratory Environment (MULE)

FACE Application Integration Support Lab (AIR 4.5)
- OA Software IV&V and Product Support
- FMF FACE App Project

Avionics Product Support Lab (AIR 4.5)
- Hardware IV&V
- MCA Project

Avionics SIL/SSA (AIR 4.5)
- Avionics Hardware and Software Rehost and Integration
- OFP/FMF/MCA Rehosting

ASTARS (USNTPS)
- NTTPS Flying OA Test Environment
- Possibility to collect actual in flight data

Multiple efforts leveraging shared resources
Wrap-Up/Final Thoughts

- **PMA-209 is pushing forward on OA**
  - Stovepipe system development is unaffordable

- **Risk factors**
  - Capturing FMF application requirements/functionality at the correct level
  - Weighing contracting options with offerer's software capabilities

- **Opportunities for additional participants in FMF application**
  - Expect multiple vendors with supporting products

- **Using this effort to refine process for how OA software will be developed**
  - What skill sets are needed (i.e. software logistics, functional architects)
  - What organizational structures are needed
  - What lab facilities are needed for Government Independent Verification & Validation
    - **MULE:**
      - Avionics Product Support Lab; FACE Application Integration Support Lab; Avionics Software Integration Lab (SIL)
      - Working with United States Navy Test Pilot School to develop a flying SIL

Don’t think out of the box, make the box bigger
CNS/ATM POCs

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