



Implementing an Open Architecture Approach to Common Systems



*Tracy Barkhimer, CAPT, USN
Air Combat Electronics*

NAVAIR Public Release
2013-800
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PMA209 develops, integrates, and delivers avionics solutions that meet customer requirements, enable interoperability, and maximize affordability.





Open Architecture Approach to Common Systems



- **Delivering common solutions to Better Buying Power 2.0 and Naval Open Architecture requires a product line approach**
- **Encouraging enforceable, consensus built standards to open systems**
- **A more competitive marketplace needs a new business model**



Problem Statement



Avionics costs are showing an unaffordable trend as systems advance, capabilities mature and solutions become more complex.

We are currently developing avionics solutions with common systems, yet paying for software development and integration each time we implement the solution onto a platform.

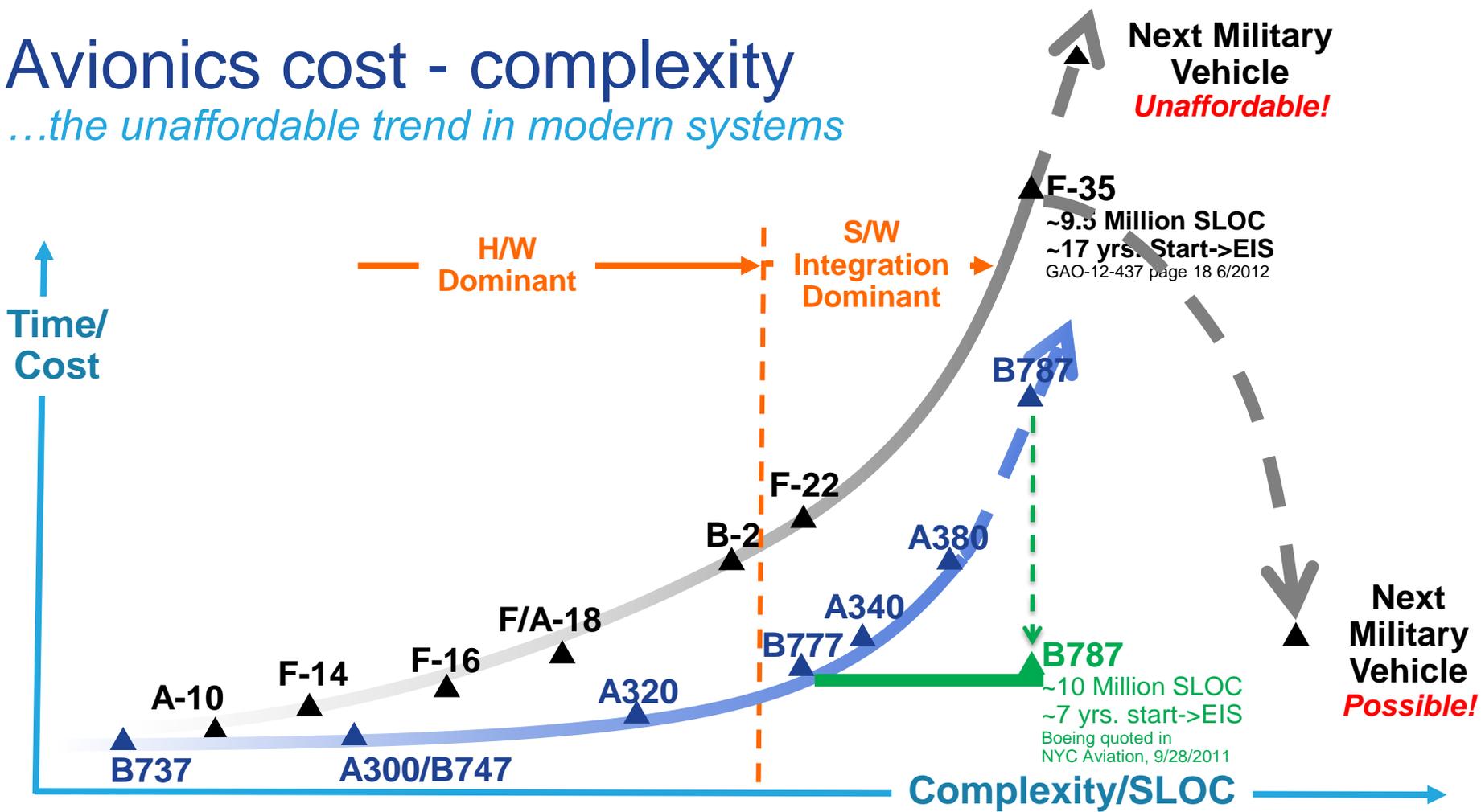
How can we leverage a solution developed for one aircraft on another aircraft? Why can't we reuse software?



In 2008, PMA209 recognized that the current business model was unsustainable which drove the team to seek change.

Avionics cost - complexity

...the unaffordable trend in modern systems



GE's CCS, "open" IMA computing and tools reset "the curve" for the Boeing 787

".... Paradoxically, some of the most complex areas—such as the software-intensive common core system [CCS] at the heart of the 787's avionics and systems architecture— have proved robust and stable ... The CCS has been rock solid for us."

Scott Fancher, Boeing 787 vice president and general manager, 02/15/2010 Aviation Week & Space Technology

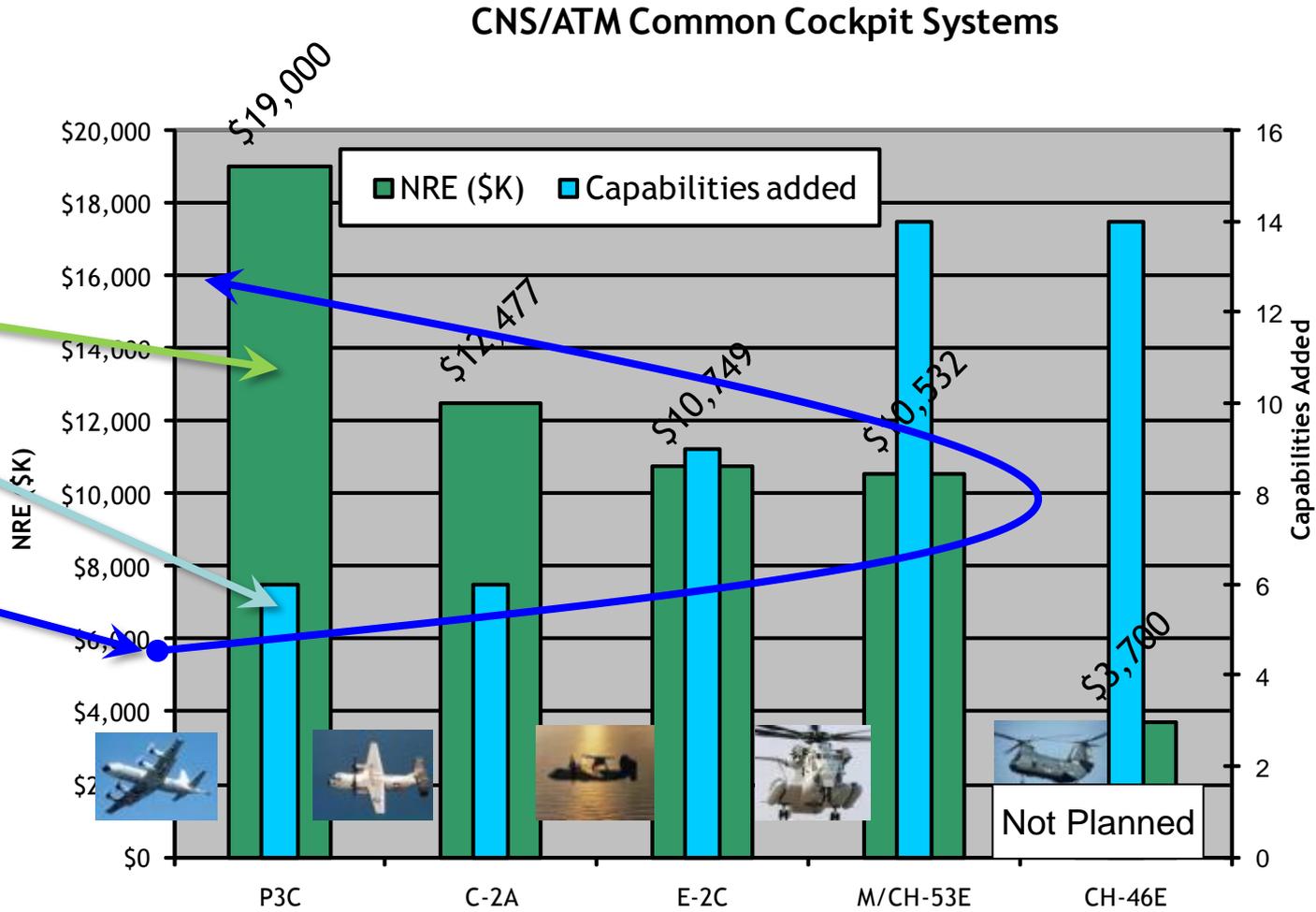




Software Reuse Business Case



- Highly successful CNS/ATM Acquisition Strategy to reuse S/W across multiple platforms
- Achieved cost savings as capability increased
- Capabilities spiraled back into previous integrations
- Lack of Open Standards required sole source
- Rockwell Collins H/W solution

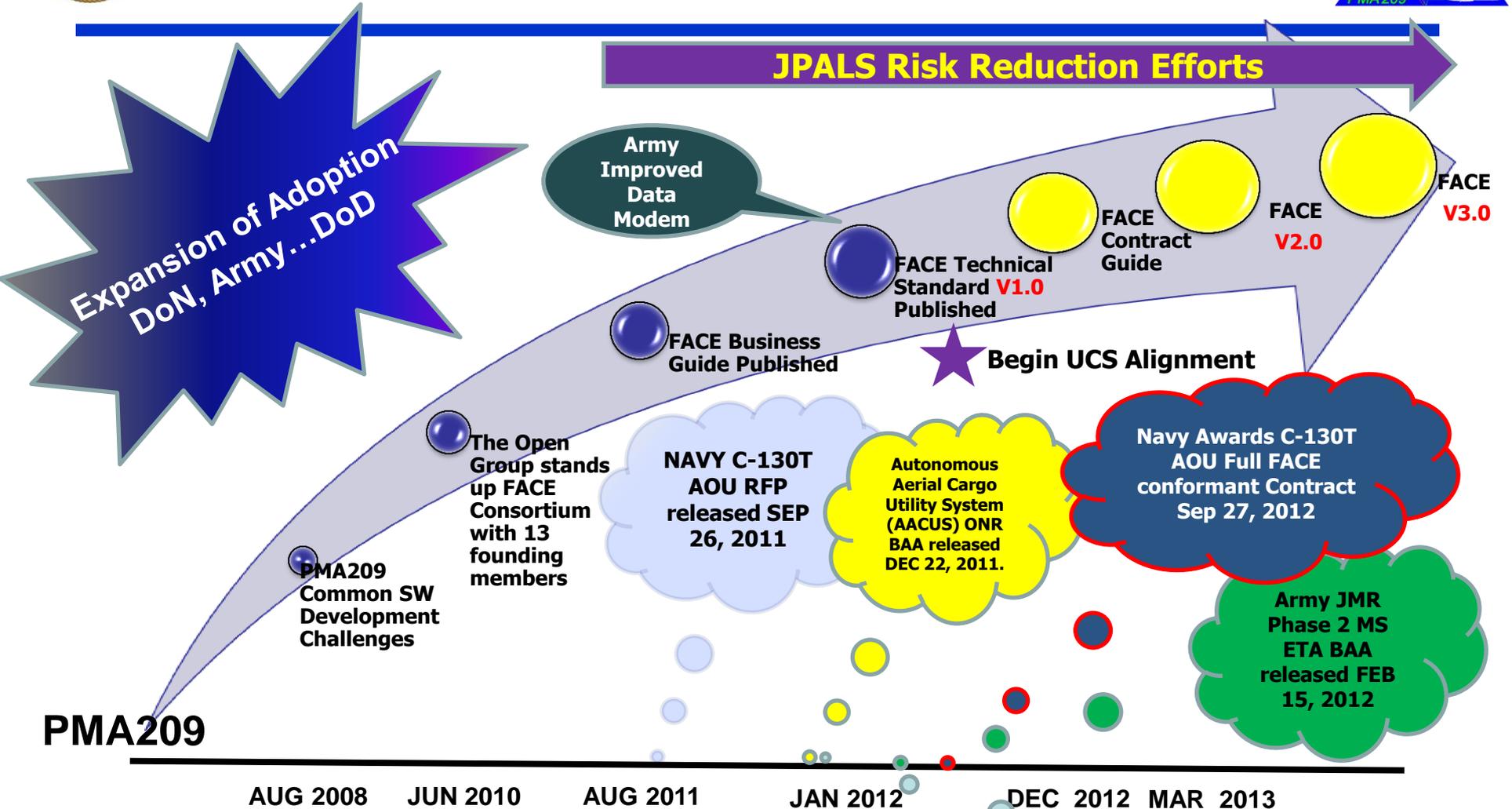




FACE Initiative is Born!



FACE Timeline



FACE Technical Standard:
V1.0 = Framework
V2.0 = Common Data Model, Health Monitoring, Implementation Guide
V3.0 = Security System

UNCLAS:
 Brief: IC
 Date: 11 JUL 13
 Configuration Manager: Hannah Roberson

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AMRDEC released RFI for FACE Reference COE FEB 22, 2012



Initial Barriers to the FACE Initiative



- **Risk Aversion/Maintain the Status Quo**
- **Acquisition Rules and Regulations**
- **Open Architecture Requirements**
- **Funding/Program of Record Did Not Exist**
- **Lack of Understanding about SW Acquisition/Industry**
- **Classic *Change Management* in a large organization**
- **Industry Buy-in – why should they play?**
- **Government Acceptance**
- **Just another OA Initiative**
 - What makes this different?
- **External Barriers**
- **Internal Barriers**



Open Architecture Requirements

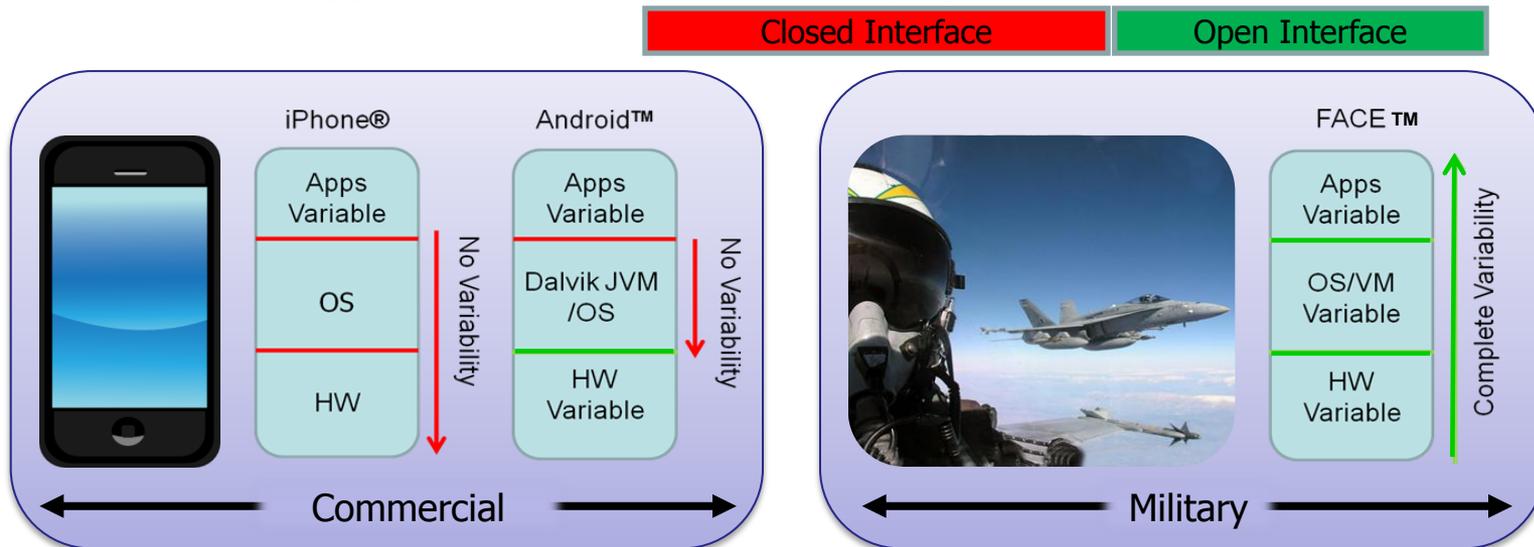
- **DoD Directive 5000.1**
 - “E1.1.27. Systems Engineering. Acquisition programs shall be managed through the application of a systems engineering approach that optimizes total system performance and minimizes total ownership costs. A modular, open-systems approach shall be employed, where feasible.”
- **N6/N7 Naval Open Architecture (NOA) Requirements Letter 9010, Ser N6N7/5U916276, 23 Dec 05**
 - This letter establishes the requirement to implement Open Architecture (OA) principles across the Navy Enterprise. Warfare systems include hardware, software and people.
- **SECNAVINST 5000.2E**
 - “Naval open architecture precepts shall be applied across the Naval Enterprise as an integrated technical and business approach and shall be used for all systems, including support systems, when developing an Acquisition Strategy per ASN(RD&A) memorandum of 5 Aug 04 and CNO (N6/N7) memorandum of 23 Dec 05 with enclosure (1).”
- **FACE is a rigorous and enforceable definition of OA**
 - FACE is a standard, not a program or product
 - Single, open interpretation of existing industry standards and software best practices
 - Established collaboratively between services and industry
 - Initiated to achieve the goals of OA by explicitly addressing the business and technical issues which plagued other OA attempts



What is FACE Initiative?



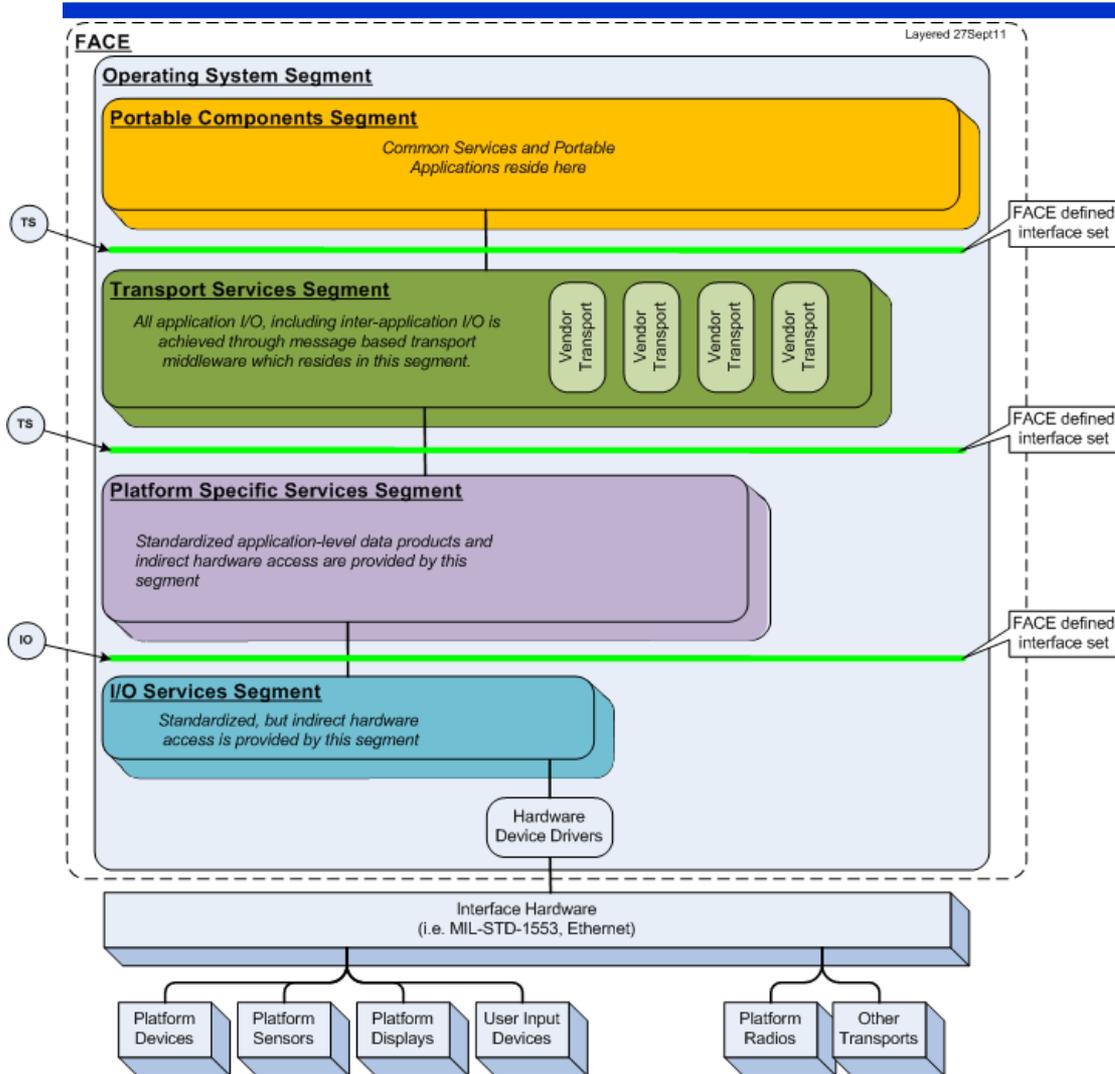
- **First and foremost, the FACE Technical Standard is a standard of standards with a business strategy that is set to completely re-architect the acquisition of aircraft software systems**
- **FACE Conformance Program provides testable requirements to Modular Open System Architecture (MOSA) principles**
- **FACE initiative aligns with and/or supports other Open Architecture (OA) initiatives**
- **FACE initiative is addressing business and technical requirements in developing the ecosystem**
- **FACE initiative applies the tenets of Better Buying Power Initiatives**



FACE is a bold new step in establishing greater Open System Architecture benefits in Defense Acquisition



FACE Reference Architecture



- **FACE Portable Components Segment**
 - Portable Applications
 - Portable Common Services
- **Transport Services Segment**
- **Platform Specific Services Segment**
 - Platform Device Services
 - Platform Common Services
 - Graphics Services
- **I/O Services Segment**
- **Drivers**
- **Operating System Segment**



FACE Consortium Members



Sponsors:

- Lockheed Martin
- Naval Air Systems Command (NAVAIR)
- US Army PEO Aviation
- Rockwell Collins

Principals:

- ATK
- BAE Systems
- Bell Helicopter
- Boeing
- Elbit Systems of America
- GE Aviation Systems
- General Dynamics
- Green Hills Software
- Harris Corporation
- Honeywell Aerospace
- IBM
- Northrop Grumman
- Raytheon
- Sierra Nevada Corp.
- Sikorsky Aircraft
- Textron Systems
- US Army AMRDEC
- UTC Aerospace Systems
- Wind River

Associates:

- AdaCore
- Aitech Defense Systems, Inc.
- Avalex Technologies
- Barco Federal Systems
- Brockwell Technologies
- CALCULEX
- Carnegie Mellon Univ. – Software Engineering Institute
- Chesapeake Technology Int'l.
- CMC Electronics
- Cobham Aerospace Communications
- Core Avionics & Industrial Inc.
- CTSi
- Curtiss-Wright Controls Defense Solutions
- DDC-I
- DornerWorks
- Draper Laboratory
- Enea Software & Services, Inc.
- ENSCO Avionics Inc.
- Esterel Technologies
- Exelis Inc.
- Fairchild Controls
- GE Intelligent Platforms
- Johns Hopkins Applied Physics Lab
- Kutta Technologies
- L-3 Communications
- LDRA Technology
- LynuxWorks
- Physical Optics Corp.
- Presagis
- QinetiQ North America
- Real-Time Innovations
- Richland Technologies
- Stauder Technologies
- Support Systems Associates
- Symetrics Industries
- Thomas Production Company
- Tresys Technology
- TTTech North America, Inc.
- Tucson Embedded Systems
- US Army Electronic Proving Ground
- Verocel
- Zodiac Data Systems



Challenges Along the Way



- **Educating the Chain of Command**
- **Educating other Services**
- **Educating PEOs, Program Managers, etc, etc, etc.**
- **PMA209 is a program office/FACE isn't necessarily in our swim lane**
- **Fiscal Realities**
- **Getting Industry Buy-In**
- **Business Case Development**
- **Contracting Challenges**
- **Program Manager Challenges**



Overcoming the Challenges



- **Succeeded in convincing industry to move toward new software product line business models through:**
 - Attaining dedication from both above (the organization) and below (people)
 - Leadership support from AIR-00 and other competency leaders
 - Dedication of the whole team to ensuring success
 - Building consensus through over 60 company Consortium has been key in gaining support for the FACE documents, policies and procedures
 - Leveraging existing, proven technologies to create a common, enforceable Technical Standard



Where are we Today?



- **First FACE conformant RFP/Award C-130T**
- **AIR-00 Challenge – Lab Prototype**
- **AV-8B RNP/RNAV Certification**
- **Fiscal Realities**



Wins for the Program



- **Innovative Thinkers**
- **Environment for Change**
- **Hard Working, Dedicated Team Members with Industry Experience**
- **Senior Leadership Advocacy**
- **Resource Sponsor Advocacy**
- **Army Advocacy**



Barriers Yet to Overcome



- **Program managers fear cost, schedule and performance impact**
 - How do we incentivize PMs to take risk? How do we recognize and reward innovative thinking or calculated risk taking?
 - Someone has to be first...
- **How do we meet the goals of Better Buying Power 2.0?**
 - FACE initiative is creating ways to promote affordability, control lifecycle costs, promote productivity, innovation and effective competition
 - How do we measure success?
- **Determining how to incentivize government and industry to shift to a new business model**
 - Must be willing to take risks and partner with outside organizations to accomplish change
 - Incentivize cost reduction by thinking across enterprise and utilizing SPL approach



Barriers Yet to Overcome



- **How do we protect funding and how do we sustain FACE initiative in FY14 and out?**
- **How do we recognize/reward Program Managers?**
- **How do we address security requirements?**
- **Who has configuration control of OA initiatives?**
- **Must determine how to incentivize government and industry to shift to a new business model**
 - Must be willing to take risks and partner with outside organizations to accomplish change
 - Incentivize cost reduction by thinking across enterprise and utilizing Software Product Line approach



Strategies to Overcome Remaining Barriers



- **Cultural Change is Key**
 - DoD and NAVAIR must lead change on the government side
 - Industry must be willing to lead change in their organizations
- **Continue Implementation/Risk Reduction Efforts**
 - AIR-00 FACE Prototyping Integration Lab Environment
 - FACE Conformant C-130T Avionics Obsolescence Upgrade
- **Determine Strategies for Rewarding Government and Industry Program Managers**
- **Leverage Challenges and Benefits of the Current Fiscal Environment**



Summary



- **FACE initiative is a business strategy that can change the landscape of software acquisition**
- **FACE initiative already aligns to NAVAIR Commander's Intent**
- **FACE team has risk reduction and proof of concept efforts underway for AIR-00 focused specifically on track fusion**
- **NAWCAD/WD and Industry involvement to help focus maturation of FACE labs to meet future platform requirements**



Questions?



Backup



FACE Objectives



- **Establish a COE to support portability of software across DoD airborne electronics platforms**
 - Determine a strict set of Open Standards for the environment
 - Builds upon tenants of Open Architecture (OA), Integrated Modular Avionics (IMA) and Modular Open Systems Approach (MOSA)
 - Portable, Modular, Partitioned, Scalable, Extendable, Secure
- **Reduce life cycle costs and time to field**
- **Obtain Industry and DoD Program Management endorsement**
- **Foster competitive avionics marketplace**
- **Facilitate adoption and conformance to maximize reuse and interoperability**



Better Buying Power 2.0 Alignment



- **Achieve Affordability & Control Life Cycle Costs**
- **Incentivize Productivity and Innovation in Industry and Government**
 - Development of capability vice platform unique infrastructure
- **Promotes Effective Competition** 
 - Provides a consistent competitive environment to vendors regardless of size
 - Open Systems Architecture and set rules for acquisition of technical data rights
- **FACE Reduces Barriers for Small Businesses to Compete for Aircraft Platform Software**
- **Reduces Software Development Times**
 - Modularization and portability



FACE will change the business model and competitive landscape for DoD aviation software acquisition



Published FACE Standards



- **FACE Edition 1.0**
 - Baseline Technical Standard and Business Guide
 - Proof of concepts prove or disprove viability/functionality of proposed reference architecture
 - Initial software, integrator and conformance toolkits and reference applications
- **FACE Edition 1.1**
 - Clarified requirements language
- **FACE Edition 2.0**
 - Includes all updates from FACE Ed. 1.X series plus new functionality
 - Adds Data Model
 - Adds Ada IDLs
 - Adds Frameworks, Run-Times
 - Adds Device Protocol Mediation Services and Streaming Media Services
 - Adds Units of Portability (UoP) Packages



Future FACE Standards



- **FACE Edition 2.1**

- Enhanced Data Model functionality
- Object Oriented Language Standard for TSS and I/O binding
- Consistent use of terminology
- Header files examples moved to the Reference Implementation Guide (RIG)

- **FACE Edition 3.0**

- Updates from FACE Ed. 2.X series
- Configuration Services update (Centralized and Local)
- Extension of I/O Service message types
- Extension of OS API Set
- Extension to Multi-Core and Hypervisor
- Data Model refinements
- DM/TSS harmonization
- Extension of Graphics Services