FACE Time:
Capability Innovation Model for Cyber-Physical Systems

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Speed of Capability vs. Sustainment of Fixed Performance

The U.S. DoD is the envy of all nations, but …

- Near-peer competitors are progressing faster than our policies enable
  - e.g., COTS tools & building blocks are available to all
- New threats are vexing in key warfare areas

https://www.theepochtimes.com/7-military-weapons-china-copied-from-the-united-states_1699756.html

- To move faster, we need a different approach
- The environment is ripe with opportunities for new approaches

Which one took 20 or more years to design? Which one took less than 5 years to copy?

The Warfighters Need for Rapid, Joyous Change

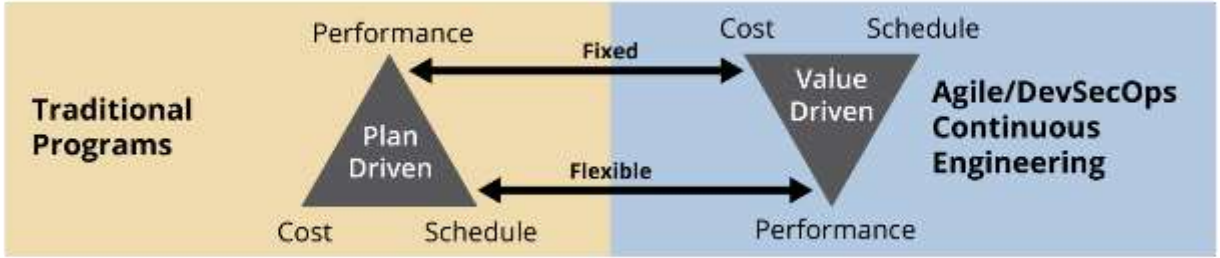
Move to Modularity & All That It Means

Cyber-physical products are never done

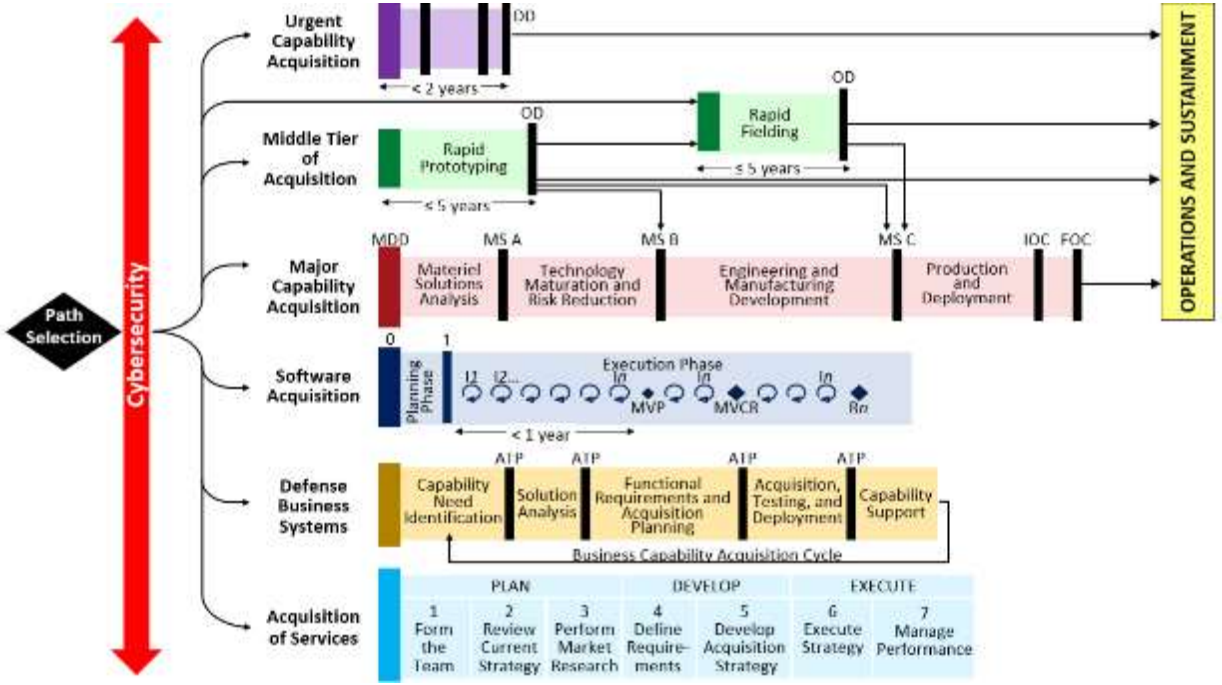
Continuous engineering & development/operations pairing

- “Sustainment” becomes Continuous Engineering
- Everything is improved throughout the lifecycle
- **The new “requirement” is stable –**
  be operationally relevant

Capability Evolution and Delivery Constantly In Motion



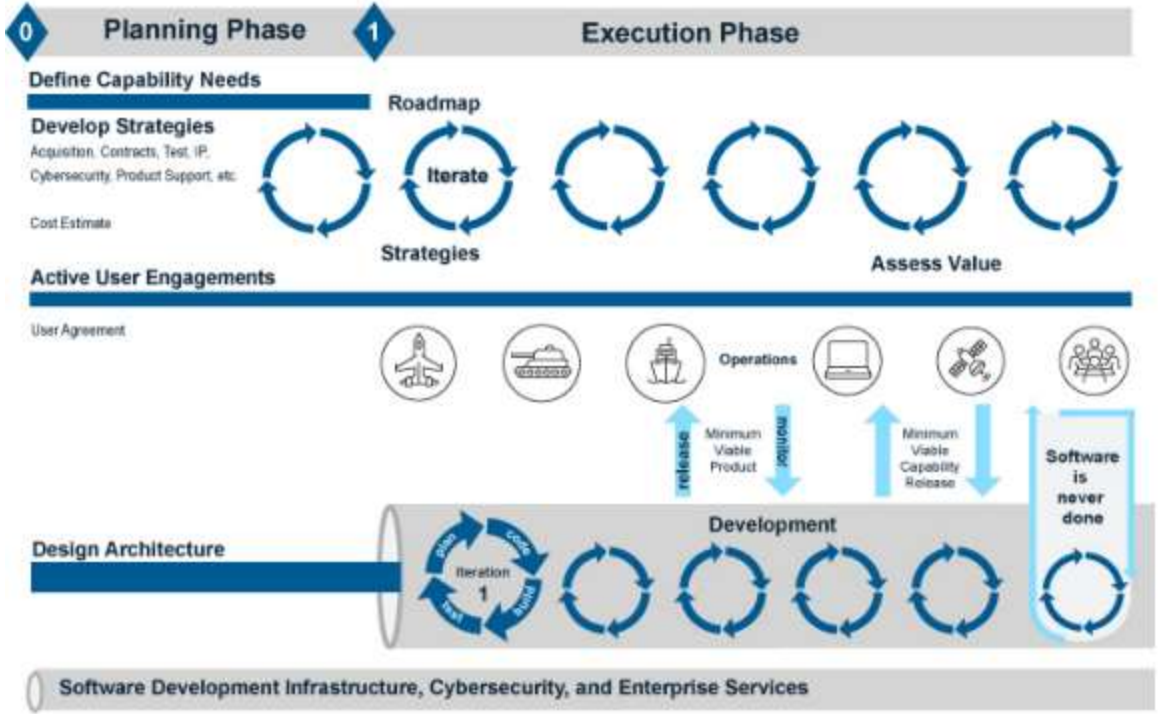
The Adaptive Acquisition Framework
A New Sustainment Model for Software



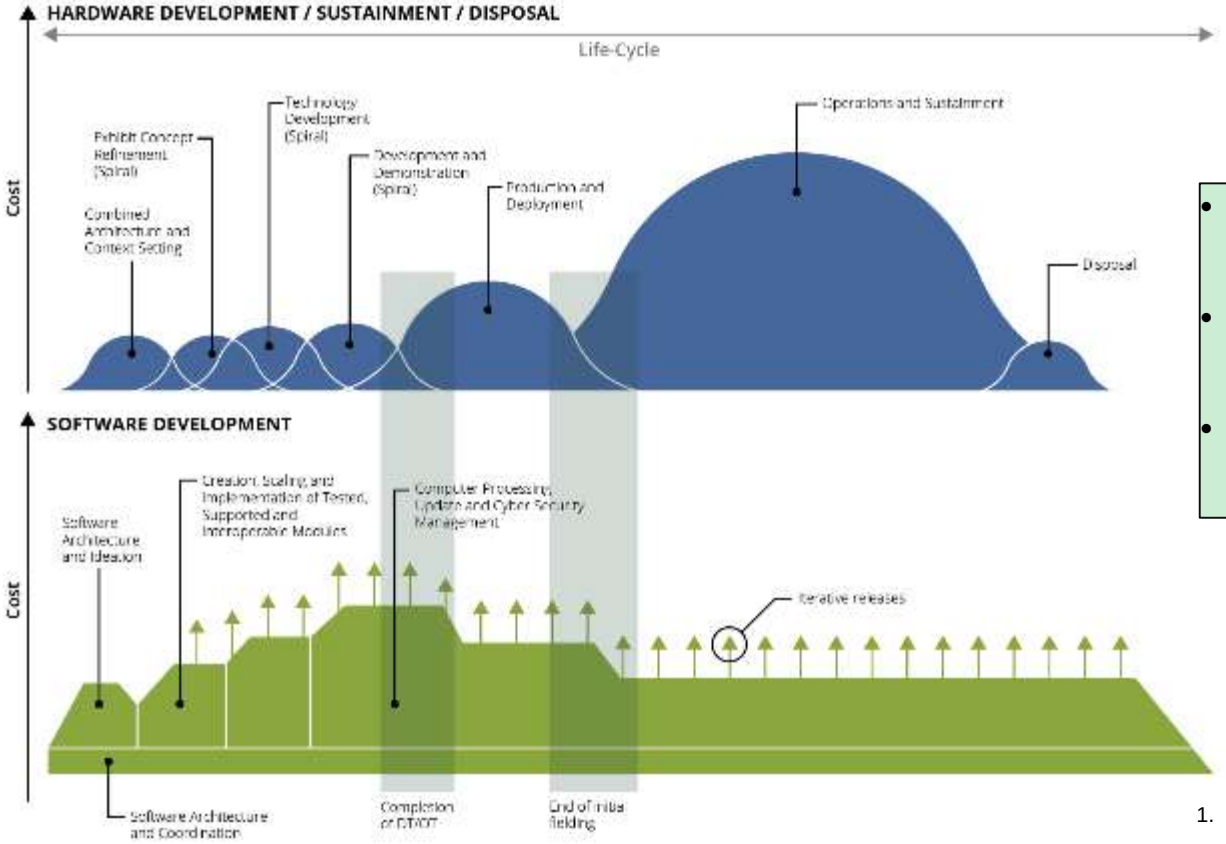
https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/500087p.PDF?ver=virAfQj4v_LgN1JxpB_dpA%3d%3d

Software Pathway

"There are two paths within the software acquisition pathway: applications and embedded software. Except where specifically noted, the guidance in this issuance applies to both paths equally."



A Blended Approach – Mixing Spiral and DevSecOps

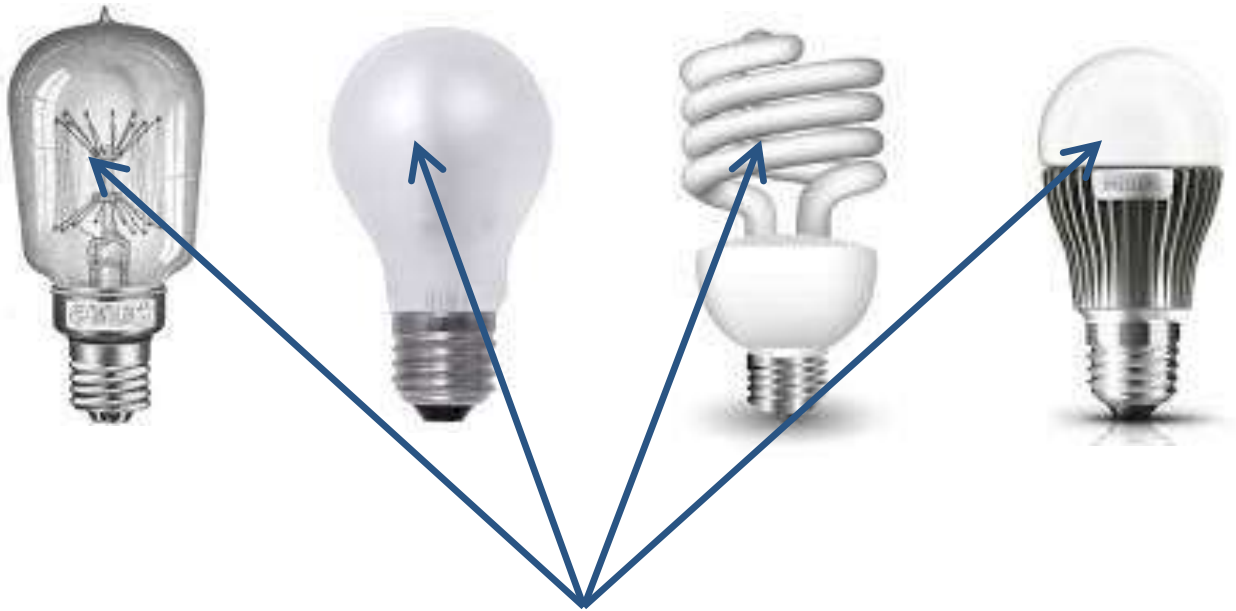


- Software is Different than Hardware,
- Not All Software is the Same, Software is Never Done[1]
- Architect from the beginning to support continuous change

1. Defense Innovation Board, Software Acquisition Practices Study, March 2019

FACE: A Brilliant Concept!

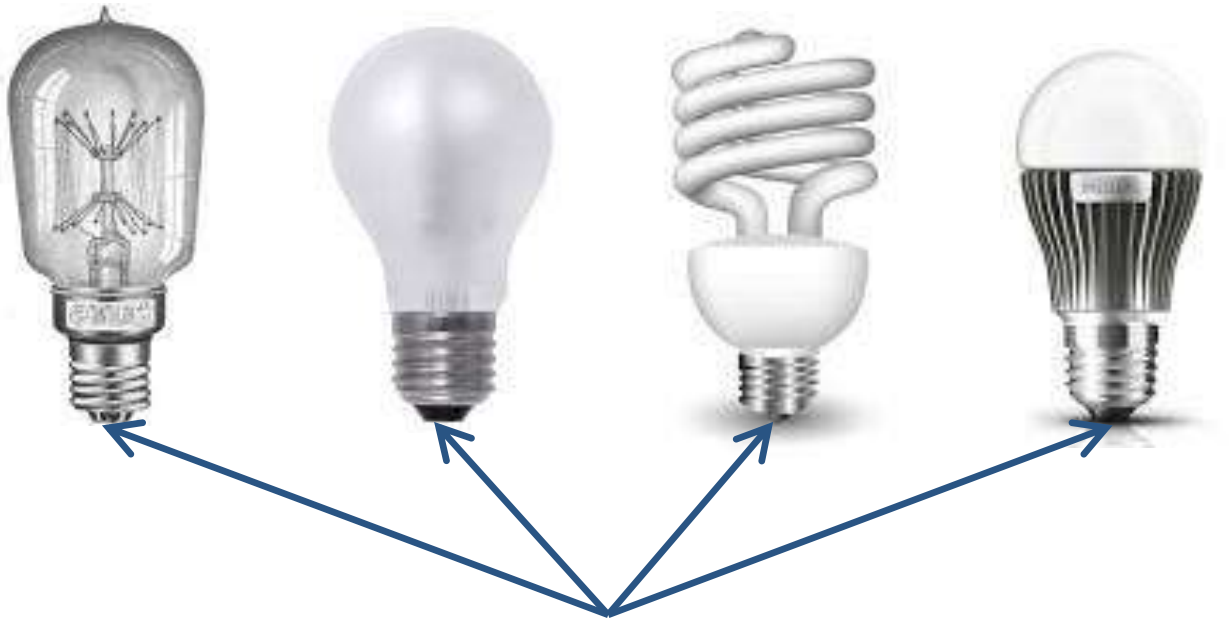
What is competitive about all of these devices?



The Application Design!

FACE: A Brilliant Concept!

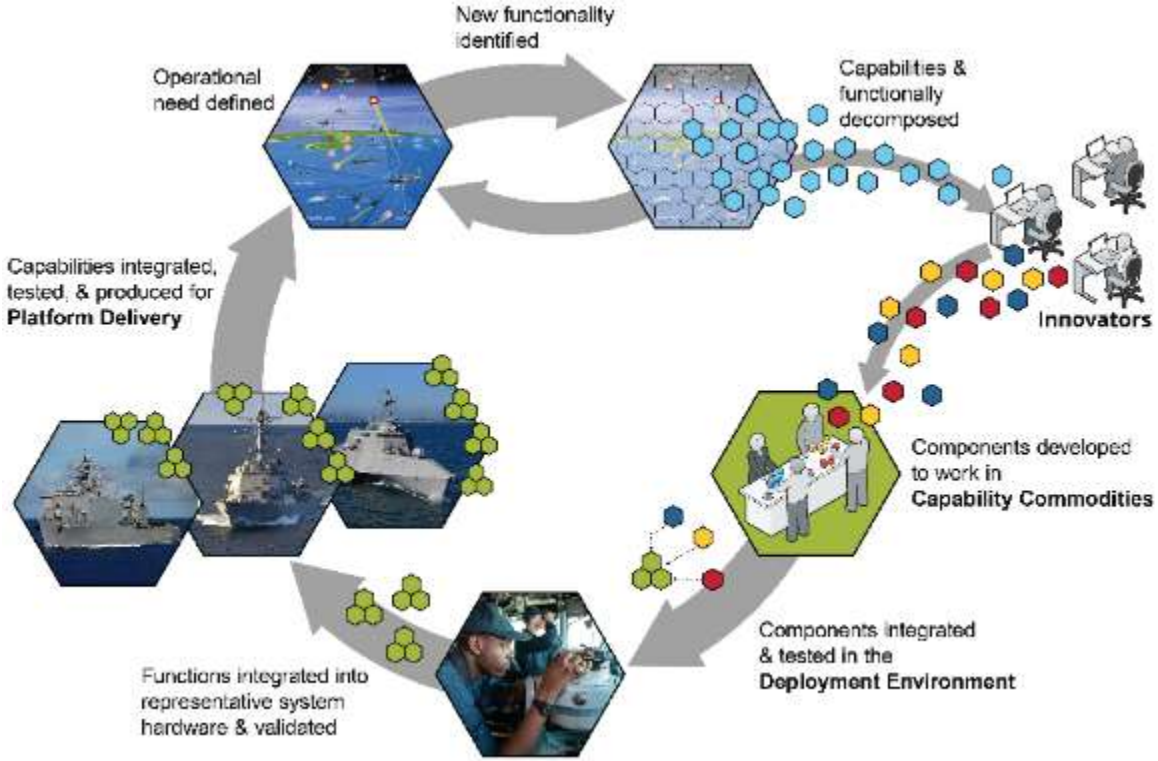
What is standardized on all of these devices?



The Interface!

ANSI standard C81.67 and IEC standard 60061-1

Business and Organizational Impacts for Modularity



MOSA

A **Modular Open Systems Approach (MOSA)**

- A technical and business strategy of an affordable and adaptable system.

The Five Principles of MOSA

1. Establish an Enabling Environment
2. Employ Modular Design
3. Designate Key Interfaces
4. Use Open Standards
5. Certify Conformance

New Development and Operations Approaches

The Most Secure Software is updated regularly

- *DevSecOps* **Methods are Best Practice for Security**

From System-of-Systems to *Capability Composition*

- Modular Capability Composition is Main Stream

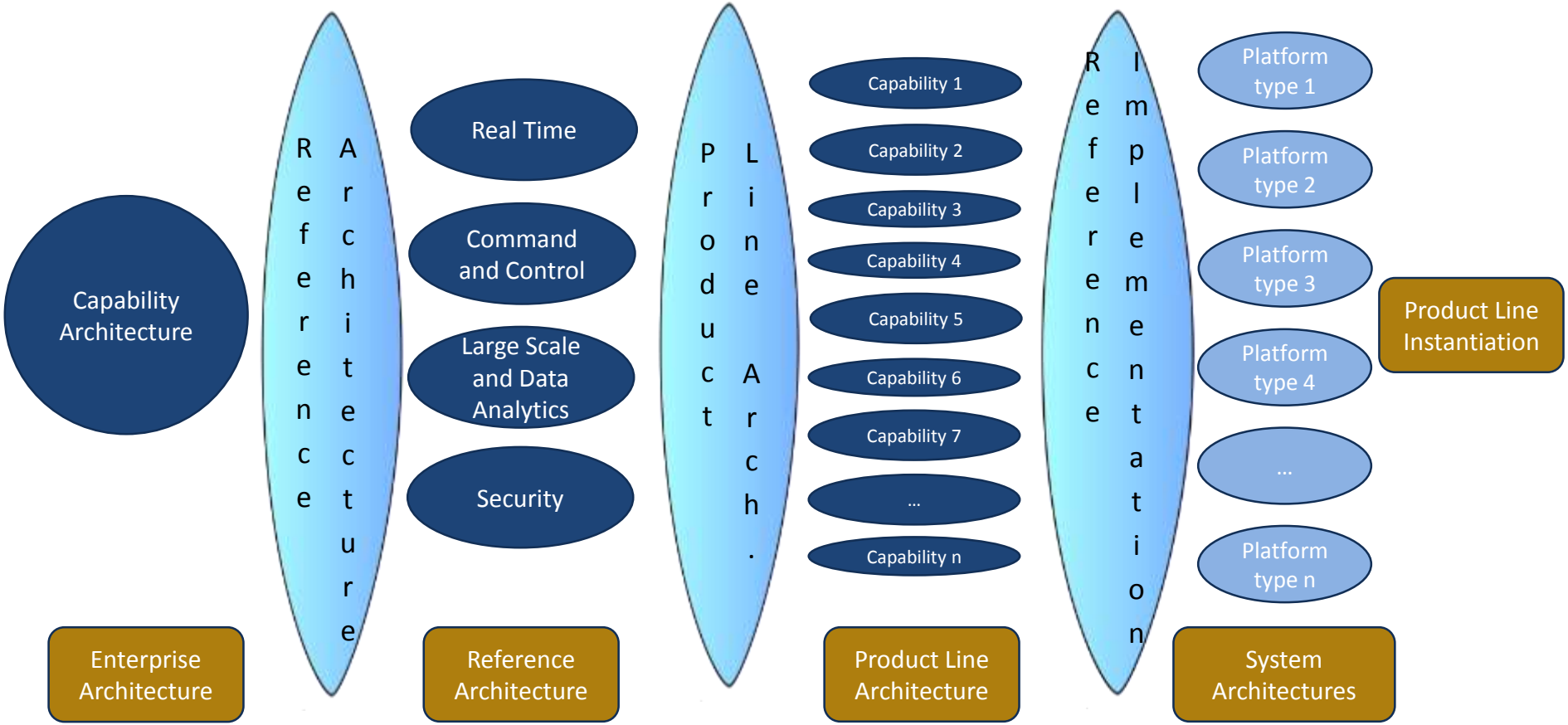
Wholesale Hardware Swap-outs No Longer Needed

- Virtualization and *Containerization* Alternatives

A New Architecture is Needed to Make This Happen

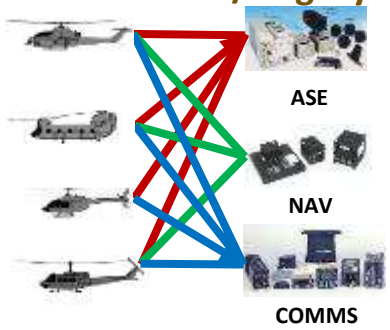
- Discoverable and Interoperable Modular Capabilities

Why FACE for the Other Services?



The FACE Approach Reduces Integration Effort for SW Reuse

Traditional / Legacy



- Unique software capabilities per platform
- Platform maintains only their product
- Long integration cycle per software block

FACE

- Re-use capabilities across multiple platforms
- Optimize investment for the same capability

Software reuse via the FACE approach allows you to **do more with what you have!**

Software Reuse Means More Capabilities for Warfighters

FACE Consortium Members

Sponsor Level Member Organizations

- US Air Force Life Cycle Management Center
- US Army PEO Aviation
- US Army CCDC C5IS
- US Navy NAVAIR
- Boeing
- Collins Aerospace
- Lockheed Martin
- Joint Tactical Networking Center

Principal Level Member Organizations

- AdaCore
- AeroVironment, Inc.
- Bell
- Elbit Systems of America
- Flir
- Sikorsky Aircraft
- GE Aviation Systems
- General Dynamics
- Green Hills Software
- Harris Corporation
- Honeywell Aerospace
- IBM
- Leonardo DRS
- Northrop Grumman
- Parry Labs
- Raytheon
- Sierra Nevada Corp.
- Textron Systems
- US Army CCDC AvMC
- Wind River

Associate Level Member Organizations

- Abaco Systems
- ADLINK Technology, Inc.
- Adventium Labs
- ANSYS
- Arizona State University
- Avalex Technologies
- Avilution, LLC
- BAE Systems Inc.
- Brockwell Technologies
- Carnegie Mellon Univ. – Software Engineering Institute
- CAST Navigation
- CERTON Software, Inc.
- CMC Electronics
- Cognoscenti Systems
- Core Avionics & Industrial Inc.
- CS Communication & Systems, Inc.
- CTSi
- Curtiss-Wright Defense Solutions
- DDC-I
- DornerWorks
- ENSCO Avionics
- Esterline AVISTA
- EuroAvionics USA LLC
- EXB Solutions
- Garmin International, Inc.
- GECO Inc.
- IEE
- Infinite Dimensions
- Inter-Coastal Electronics, Inc.
- IS4S
- Johns Hopkins Univ. - APL
- Joint Tactical Networking Center
- Jovian Software Consulting
- Kearfott Corporation
- KIHOMAC
- L3 Technologies, Inc.
- LDRA Technology
- Leidos Inc.
- Lynx Software Technologies
- Mercury Systems
- Micro Focus (US) Inc.
- North Atlantic Industries, Inc.
- OAR Corporation
- Performance Software
- Physical Optics Corp.
- Presagis USA, Inc.
- Pyrrhus Software
- Rapida Systems, Inc.
- Rapid Imaging Software
- RDRtech, Inc.
- Real-Time Innovations (RTI)
- Riverside Research
- Rogerson Kratos
- SAIC
- Selex Galileo Inc..
- SimVentions
- Skayl LLC
- SwRI
- Terma North America
- TES-SAVI
- Thales USA, Inc.
- Trideum
- TTTech North America, Inc.
- Twin Oaks Computing
- University of Dayton Research Institute
- Vector Software, Inc.
- Verocel
- VIStology
- WolfSSL
- Woodward
- Zodiac Data Systems

>100 Government, Academia and Industry Members

FACE Certified Conformant Products Available Now

Now 20 FACE Certified Conformant Products from 12 Different Suppliers in the FACE Registry

FACE Recent Solicitations, Procurements, Guidance*

Army RFI – CCDC C5ISR Center Air Launch Effects (ALE)

Nat'l Academy of Sciences – Advancing Aerial Mobility; A National Blueprint

Navy SBIR – Fusion-Aided Sensor Resource Management

Army RFI – for the UH-60V Black Hawk Wide Area Augmentation System (WAAS) Support

Army RFI - Revolutionary Technology and Strategies for the HSA-DM Program

Army BAA – Innovative Integration Trades Analysis

Navy Draft RFI – NAWCAD-Wolf-Rapid MAC

Army RFI – Air To Ground Network Integration Digital Clone (or Twin) White Paper

Army Solicitation - Cargo Helicopter C3 CTES IV Avionics and Avionics Architecture

Army RFI - UH-60 FLIGHT CONTROL COMPUTER (FCC)

Navy RFI - H-60 RFI for Circuit Card Assembly

Tri-Service Memorandum – FACE mentioned in memo signed by Secretaries of Army, Navy and Air Force.

Army SBIR - Secure Avionics Mobile and Windshield Display Technologies

Army SBIR - Weather Situational Awareness in the Cockpit

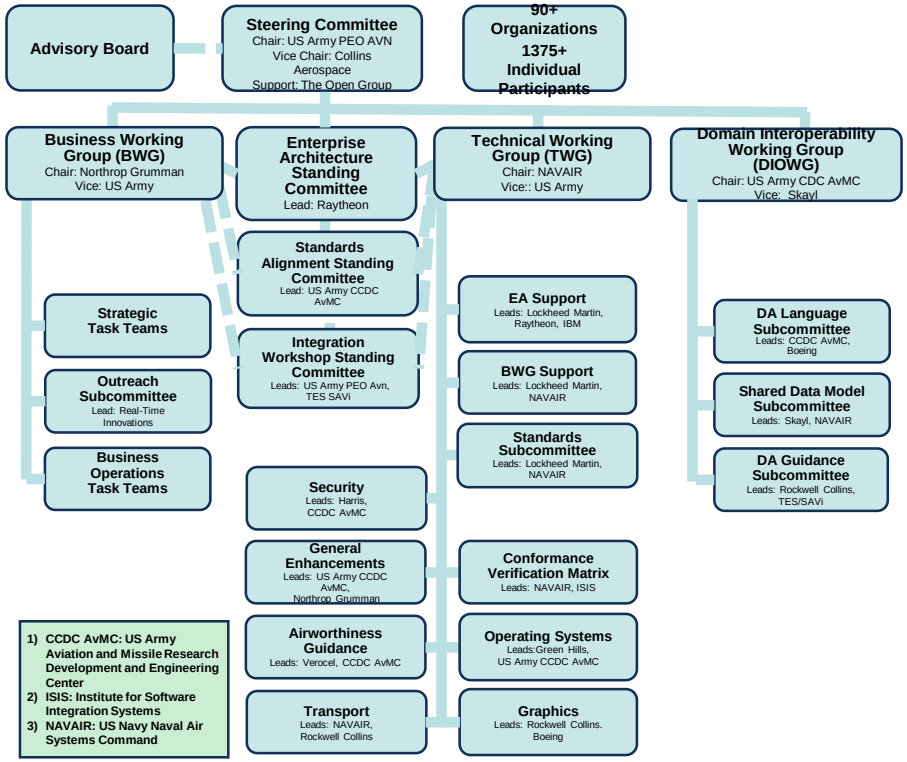
Note: FedBizOpps.gov is now Beta.SAM.gov (definitely *beta* from 1st observation)

*Find the full list at www.opengroup.org/face/procurements

*Reverse chronological order.

The FACE Consortium Org

17-September-2019



A consortium formed under the auspices of The Open Group is a "Voluntary Consensus Standards Body" as defined by the Nat'l Tech. Transfer Act and OMB Circular A-119 with the following attributes:

- Openness
- Balance of interest
- Due process
- An appeals process
- Consensus
- Enabler for consortium participation by US agencies
- Foundation of consortium status under National Cooperative Research and Production Act (NCRPA)

Voluntary Consensus Body

Four Characteristics of FACE

The FACE Approach has four very powerful characteristics:

1. **Affordability.** FACE open architecture foundation drives down costs for both industry and government
2. **Speed.** The FACE Technical Standard directly enables greater speed by using and expanding upon standards that have been proven in commercial and military platforms
3. **Agility.** FACE uses a common data architecture and characterizes data according to best known practices, achieving higher interoperability across domains, systems and capabilities
4. **Excellence**. The FACE robust software architecture drives excellence into software design, acquisition, and deployment

FACE Maturity & Adoption

Conformance Process is <u>Operational</u>

Technical and Business FACE <u>Expertise available</u>

<u>Industry utilizing SPLs</u> with FACE requirements

- Multiple Primes and Suppliers
- Saving time and money

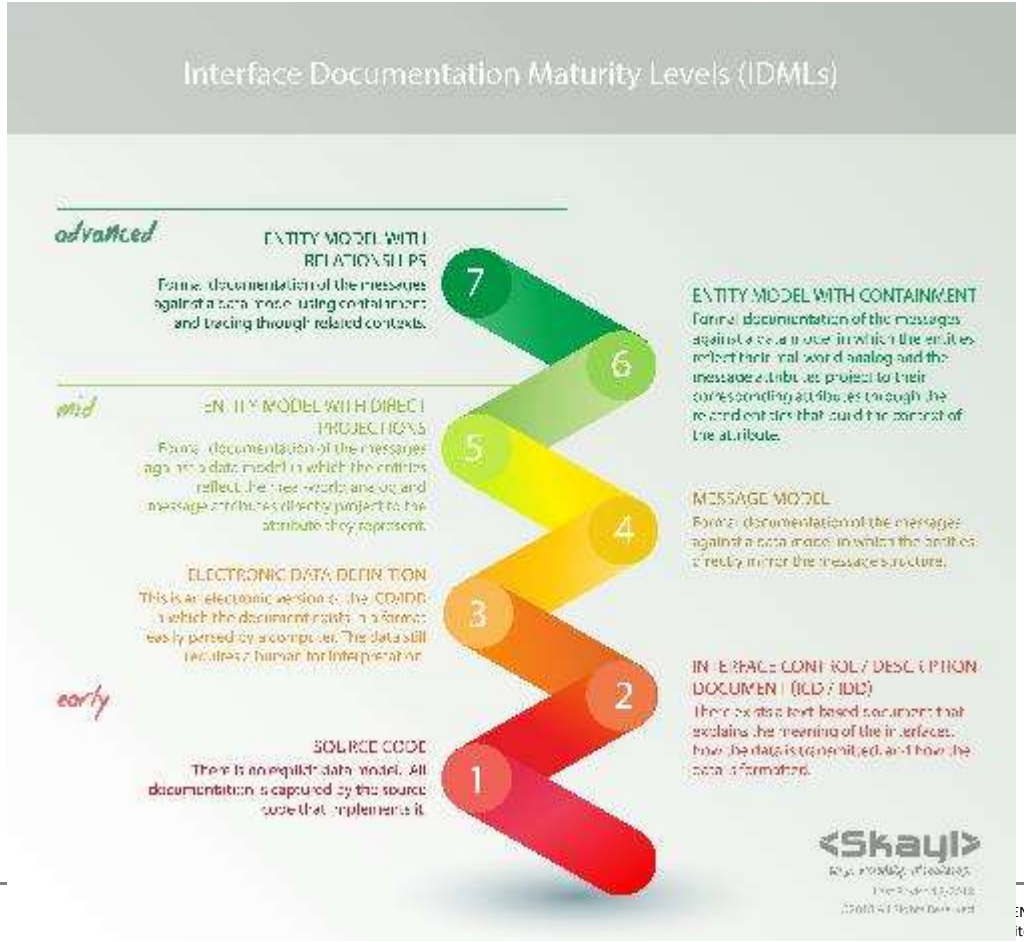
Capabilities are Available

- **22 UoCs** in FACE Registry
- **19** known in FACE VA/CA
- Dozens more ready for VA/CA

Major Improvements in FACE 3.0

FACE Approach is ready and in use now!

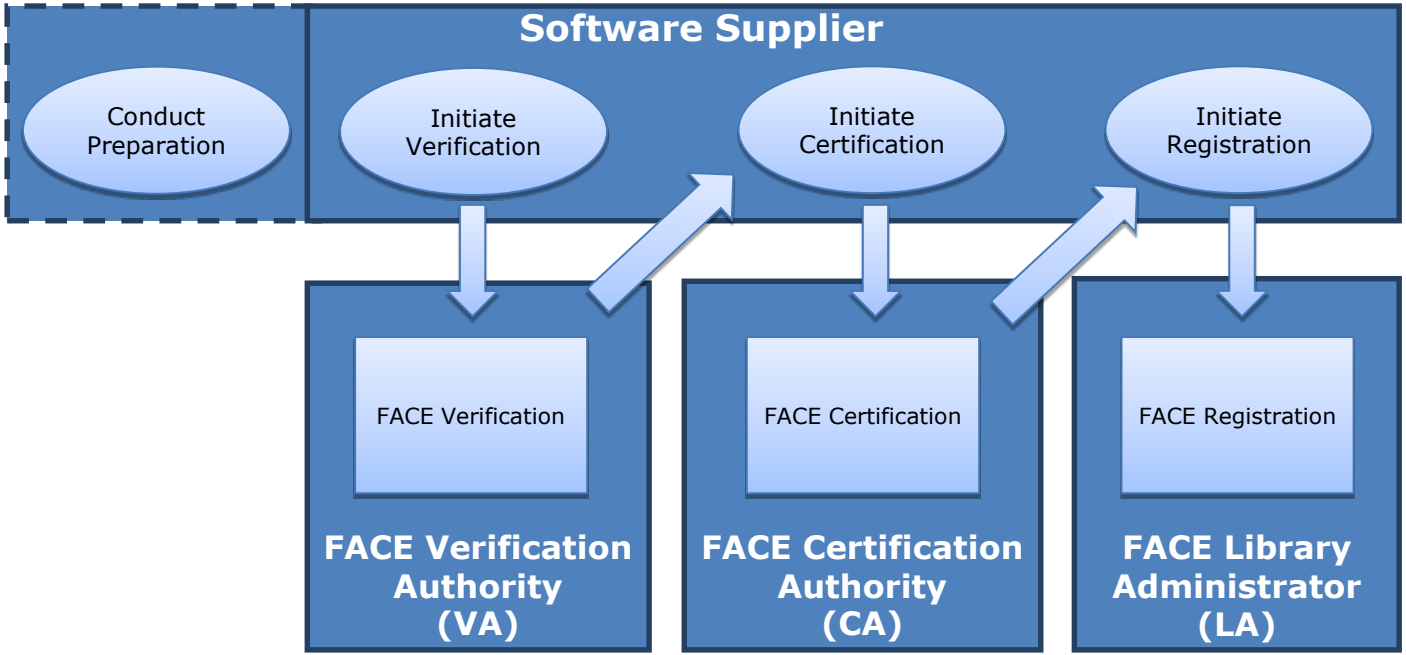
Interoperability of Data is the Key to Modular Change



What is FACE Conformance?

An assessment of a Software Item or Domain Specific Data Model, known as a Unit of Conformance (UoC), to the applicable Conformance Requirements contained in the FACE Technical Standard

FACE Conformance Program, Steps and Processes



FACE Verification

The process of determining the conformance of an implementation to specification requirements. The VA consist of technical expert(s) on the FACE Technical Standard and Verification process and approved by the FACE Consortium Steering Committee

FACE Certification

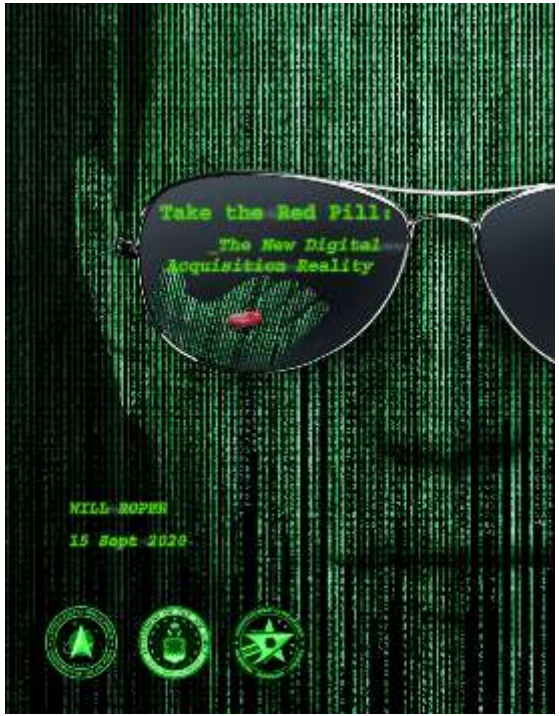
The process of applying for a FACE Conformance Certificate once verification has successfully been completed. Certification is processed through the FACE CA

FACE Registration

The process of listing FACE Certified UoCs in a public listing of FACE Certified UoCs known as the FACE Registry. The FACE Registry is accessed from the FACE Landing Page

*The FACE Landing Page can be accessed at http://opengroup.org/face

Why FACE for Air Force:
An Easier Way to Take the Red Pill



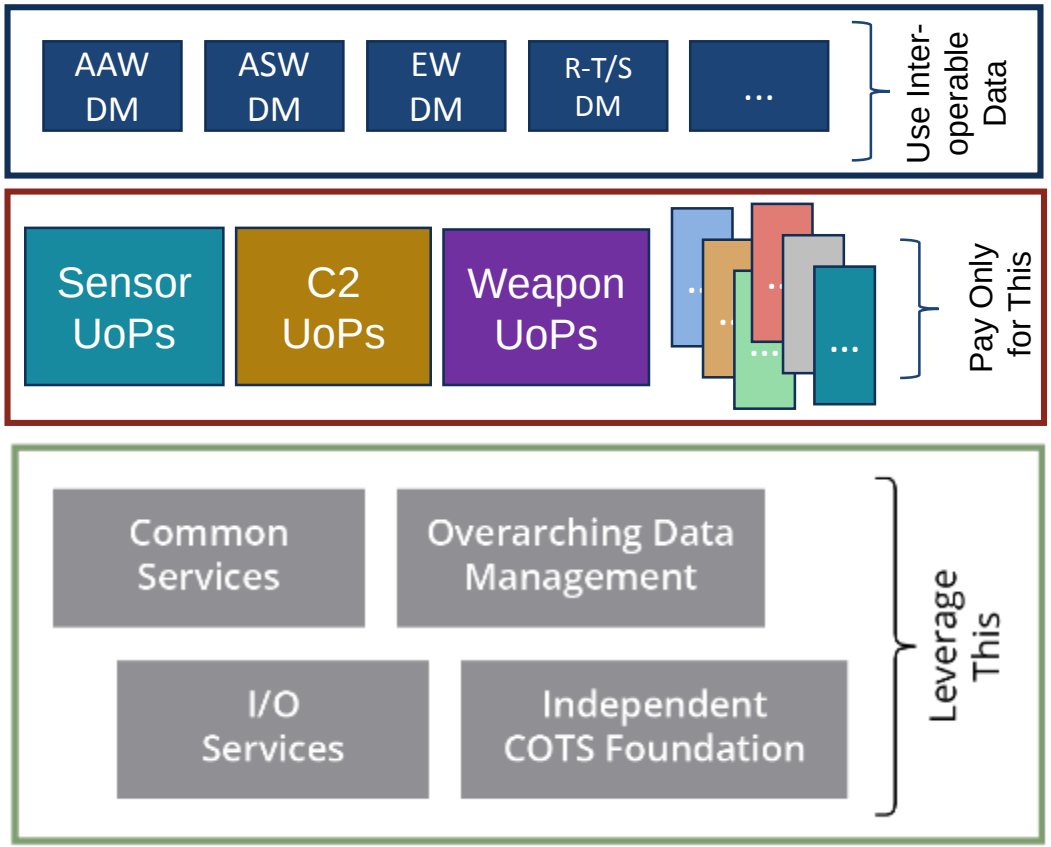
The Digital Trinity:

- Digital Engineering and Management
- Agile Software Practices
- Open Architecture

1. Own, Share, Furnish the Tech Stack
2. Push to the Edge Effortlessly
3. eCreate Before you Aviate
4. Digital Century Series
   (continuous delivery, lower cost/time, derisk integration, increase commonality

https://aflink.usaf.afpims.mil/Portals/1/documents/2020SAF/There_Is_No_Spoon-Digital_Acquisition-23Sept20.pdf

Business and Organizational Impacts for Interoperable Modules



Architecture as an Enterprise Asset

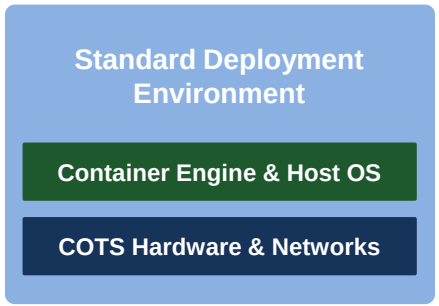
Focus on the things that create unique value

1. Business Architecture
2. Integration/Interoperability Behaviors
3. Deployment/Integration Environments – Critical Corporate Assets
4. Managed by the Market Owner (lots of collaborative input)
5. Cross-Functional (not platform dependent)
6. Address the Hard Problems for Safety, Cyber, and other certifications for aperiodic and rapid updates

Backup

Interoperability at the Module Level, at Scale

Platform and Infrastructure Services
Based on Reference System Architecture



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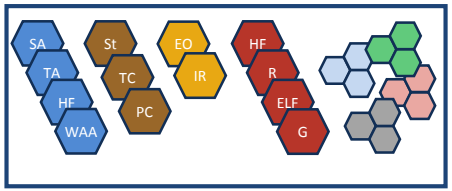
Capability Commodities



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Inter and Intra-Platform Data Inter-operability

=

Fast, Adaptable, Reliable, Capability

Meta-model Architecture

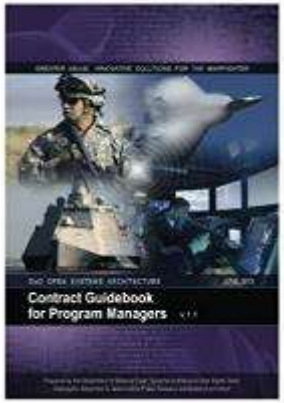
Integration Environment and Test Architectures

Data Architectures Capability Evolution Impacts

Open Acquisition Strategy

Government is the “business integrator”

- Frameworks/Data Architectures
- Platforms
- Integration
- Capabilities



21st-Century IP strategy: Targeted rights to share

- Facilitate and reward innovation
- Modules can be replaced risk- prudently