Ogden Air Logistics Center

U.S. AIR FORCE

A-10 Avionics System Architecture Trade Analysis (AVSATA) Program

Jerry Coates
A-10 OSS&E Integrator
OO-ALC/538 ACSG/EN

Richard Sorensen
KIHOMAC Staff Systems Engineer

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Agenda

- A-10 Background
- Architecture & Requirements Overview
- A-10 Architecture Development
- Example
- Path Forward
- Results

A-10 BACKGROUND

Legacy Aircraft
The "Green Machine"

- A-10 designed as a tank buster, low-technology, easy to maintain ground attack fighter
  - A-10 upgrades limited in scope and capability.
  - Sustainment programs
    - Largely form/fit/function replacements.
  - Lack of funding and a master plan (architecture roadmap) resulted in stovepipe sustainment/capabilities modifications without considerations for:
    - Systems Engineering
    - Distribution of functions
    - Growth of capabilities
    - Interoperability

Beyond Design Life

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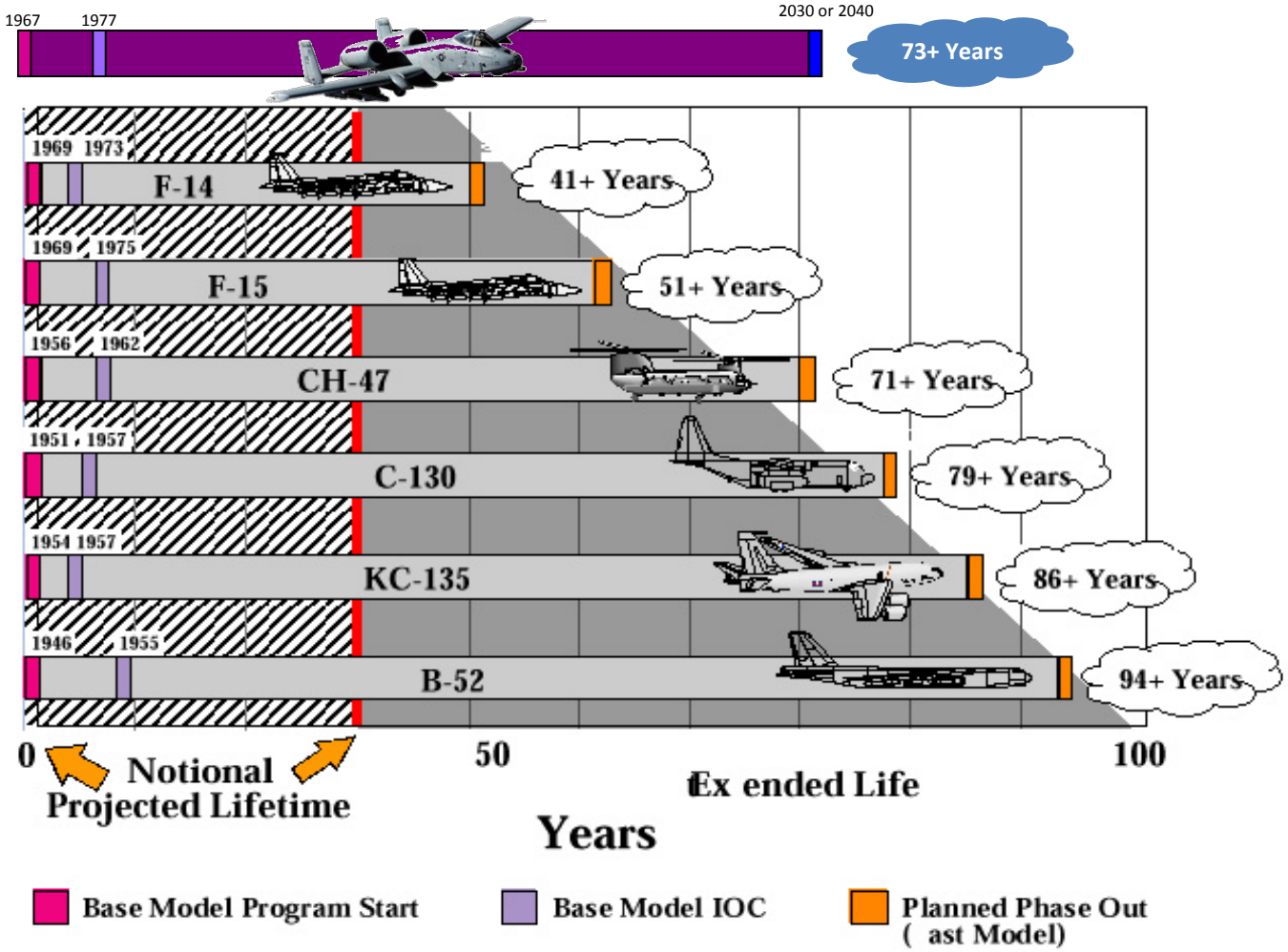

Baseline Graph extracted from *USAF Viable Combat Avionics Initiative Implementation*, Mr. Doug Ebersole; AFMC Aeronautical Enterprise Program Office; 22 Oct 02; pg 5

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Precision Engagement

This Ain't Your Daddy's Hog

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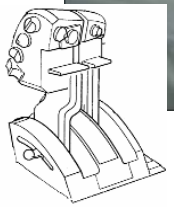
A-10A

A-10C



New Right Throttle Grip

- Precision Engagement is the largest upgrade in the history of A-10
  - Significantly upgraded and changed the platform, providing an integrated avionics suite with a considerable number of functions moved into software
  - New aircraft baseline provides a point of departure for many new operational and sustainment capabilities

A-10 2030

"To Infinity and Beyond…"

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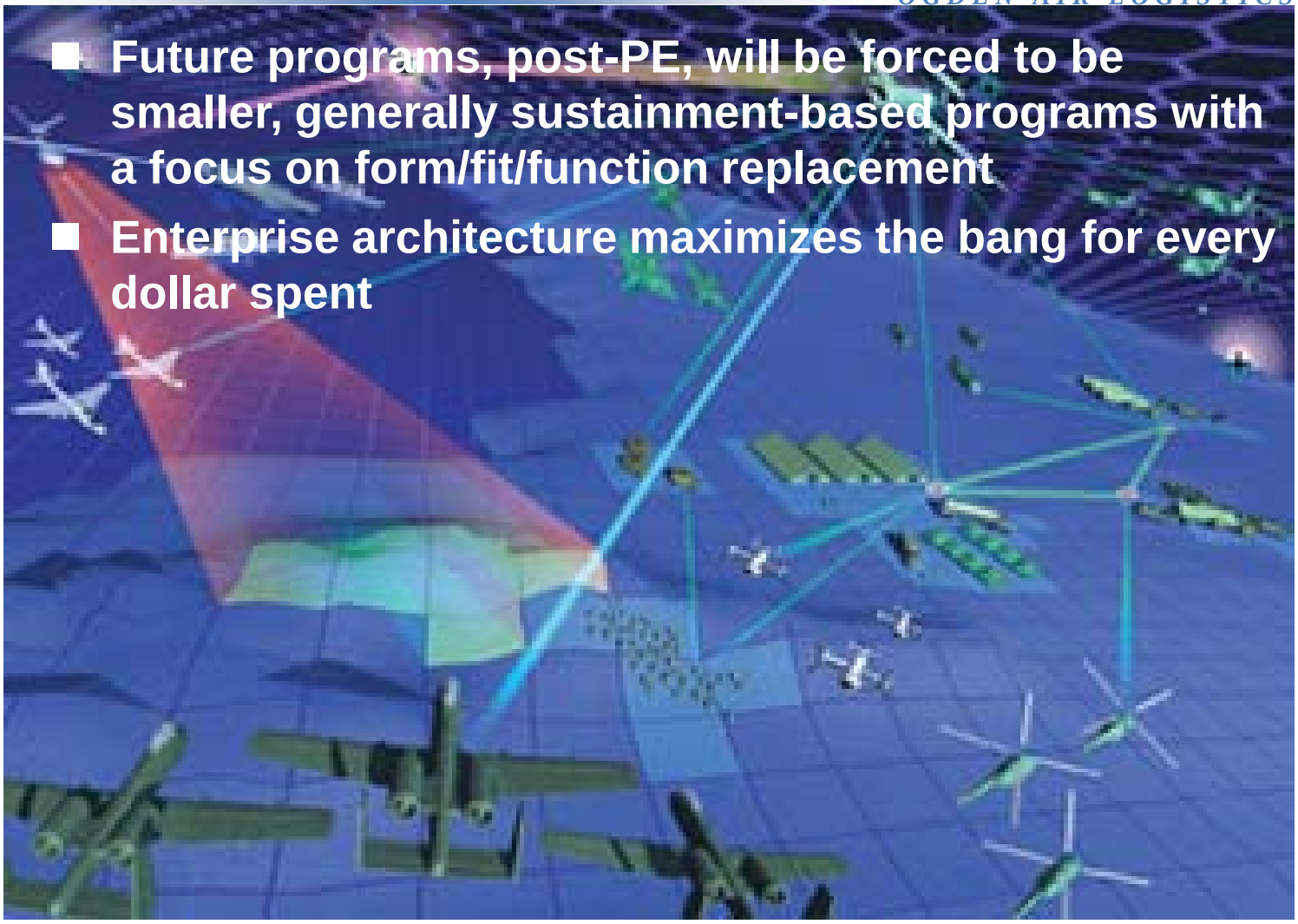
- Future programs, post-PE, will be forced to be smaller, generally sustainment-based programs with a focus on form/fit/function replacement
- Enterprise architecture maximizes the bang for every dollar spent



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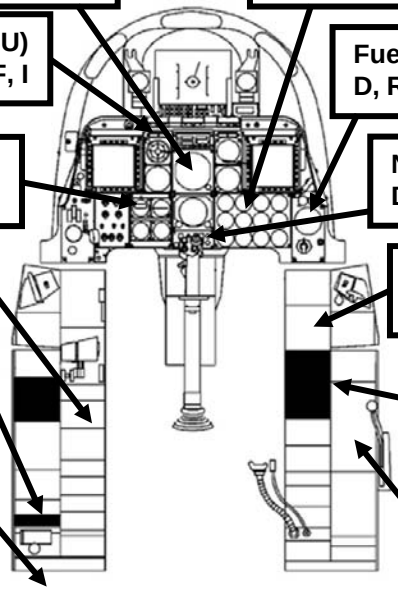
Avionics Sustainment Program (ASP) (Wish List)



Replace w/ MFCD

Flight Instruments
D, R, M, O, P, I

Engine Instruments
D, R, M, O, I

ALR-69/ALQ-213 (addressed in EWSU)
D, R, M, O, P, G, F, I

Replace w/ upgraded RWR

Fuel Quantity ID
D, R, M, O, P, G, I

Replace w/ software

Heading & Attitude Reference System
D, R, M, O, P, G, F, I

Replace w/ COTS B/U instrument

Nav Mode Select Panel
D, R, M, O, P, G, I

Replace w/ software

Communication/Navigation
R, M, P, G, I

Integrate with OFP

Caution Annunciator Panel
D, R, M, O, P, G, F, I

Replace w/ software

Intercom Panel
D, R, M, O, P, G, F, I

Replace w/ software

Control Display Unit
D, R, M, O, P, G, F

Replace

Data Transfer System
D, O, P, G, F

Upgrade/Consolidate

Digital Video and Data Recorder
D, R, M, O, P, G, F, I

Upgrade/Consolidate

Key
D – Diminishing Manufacturing Sources & Material Shortages Issues
R – Reliability Issues
M – Maintainability Issues
O- Obsolescence issues
P – Performance Issues (Operations)
G – Growth Issues
F- Function is duplicated elsewhere
I – Not integrated

Out of Cockpit systems
Stall Warning System – D, R, M, O, P, G, F
Embedded GPS/INS – R, M, P, G
Data Distribution - none
TEMS/ADR – P, G, F
Radar Altimeter – R, M, P, G

Replace w/ software Update
Develop/Integrate
Upgrade/Integrate
Replace

A-10 AVSATA Vision

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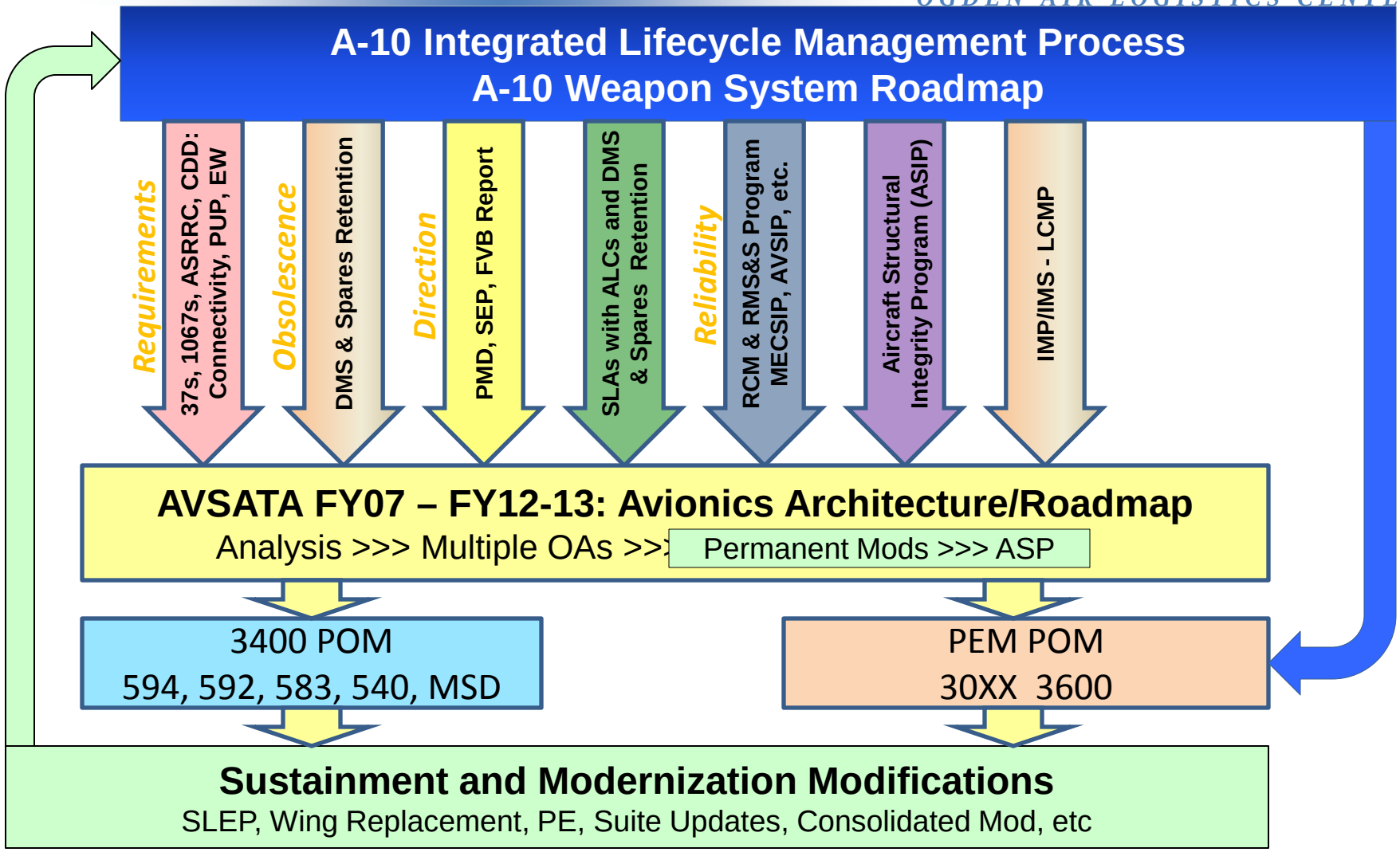

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A-10 Integrated Architecture

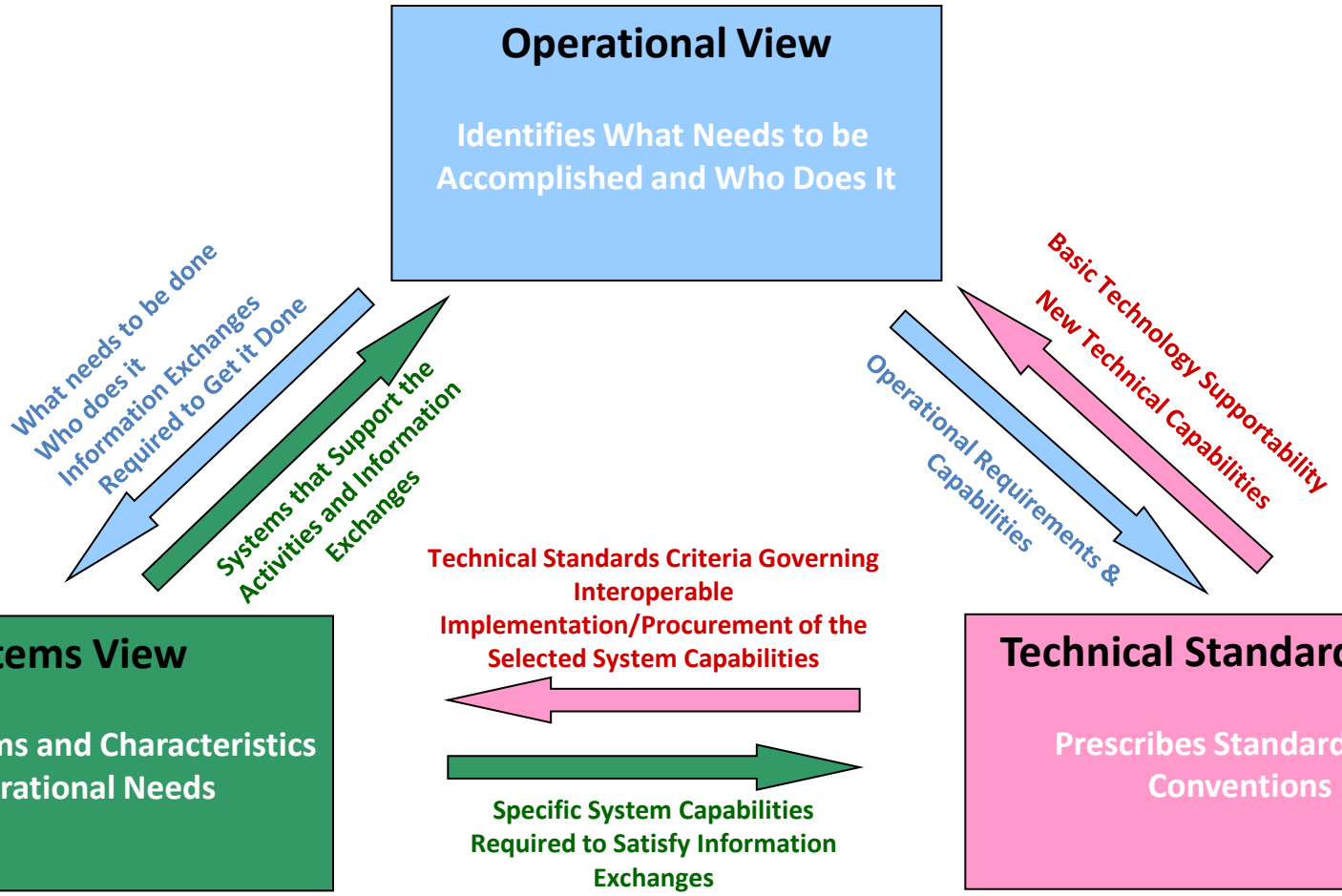
- AVSATA provides the framework to help make the most of the resource limited sustainment programs
- Integrated architecture provides a comprehensive plan for the operational and technical capabilities and interconnections required by the aircraft lifecycle sustainment
  - Defines a roadmap to show smaller programs how they can fit into the overall plan
  - Defines a way to leverage small sustainment investments into significant increased platform sustainment and capability
- ***Path Finding*** process applied to legacy sustainment
  - Keep A-10 relevant in our nations conflict and at the forefront of the force throughout its lifecycle.

ARCHITECTURE & REQUIREMENTS OVERVIEW

Integrated Architecture Overview

- **What is an architecture?**
  - "The structure of components, their relationships, and the principles and guidelines governing their design and evolution over time" – DoD Integrated Architecture Panel
- **What is an "integrated" architecture?**
  - Architecture is an integrated architecture when products and their constituent architecture data elements are developed such that architecture data elements defined in one view are the same (i.e., same names, definitions, and values) as architecture data elements referenced in another view.
- **What are the advantages of integrated architectures?**
  - Facilitate an organized and consistent standardized design process
  - Facilitate the clear definition and implementation of new operational, system & technical requirements
  - Promote interoperability
  - *Required* by Joint Capabilities Integration & Development System (JCIDS)!
  - Provide for traceability of system requirements back to the originating joint concepts (facilitates successful POM inputs, i.e., getting program funding)
  - **Facilitate systems and systems sustainment engineering**

Fundamental Linkages Between Views



Traceability of Requirements

from Users to Acquirers to Contractors

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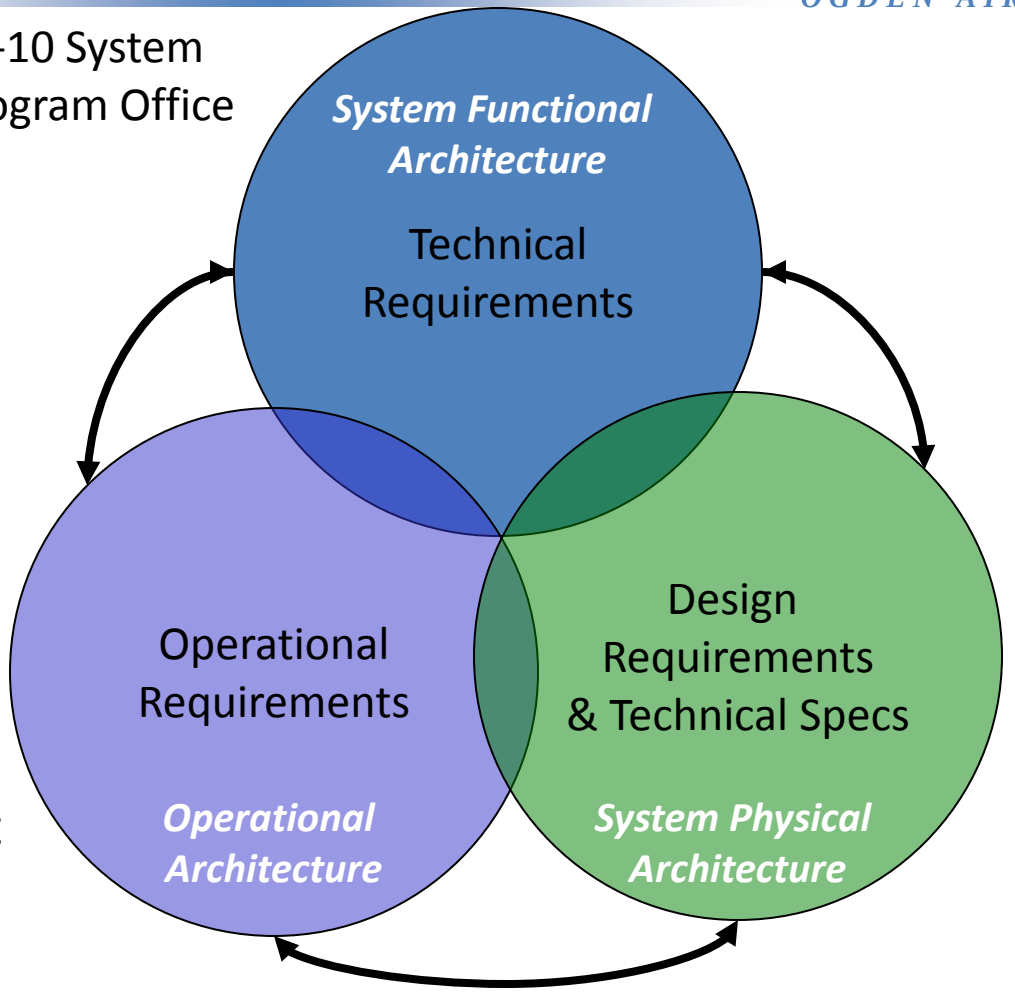
A-10 System Program Office



ACC/ANG/AFRC

A-10 TLPS Contractors

Requirements are tightly coupled to Architectures

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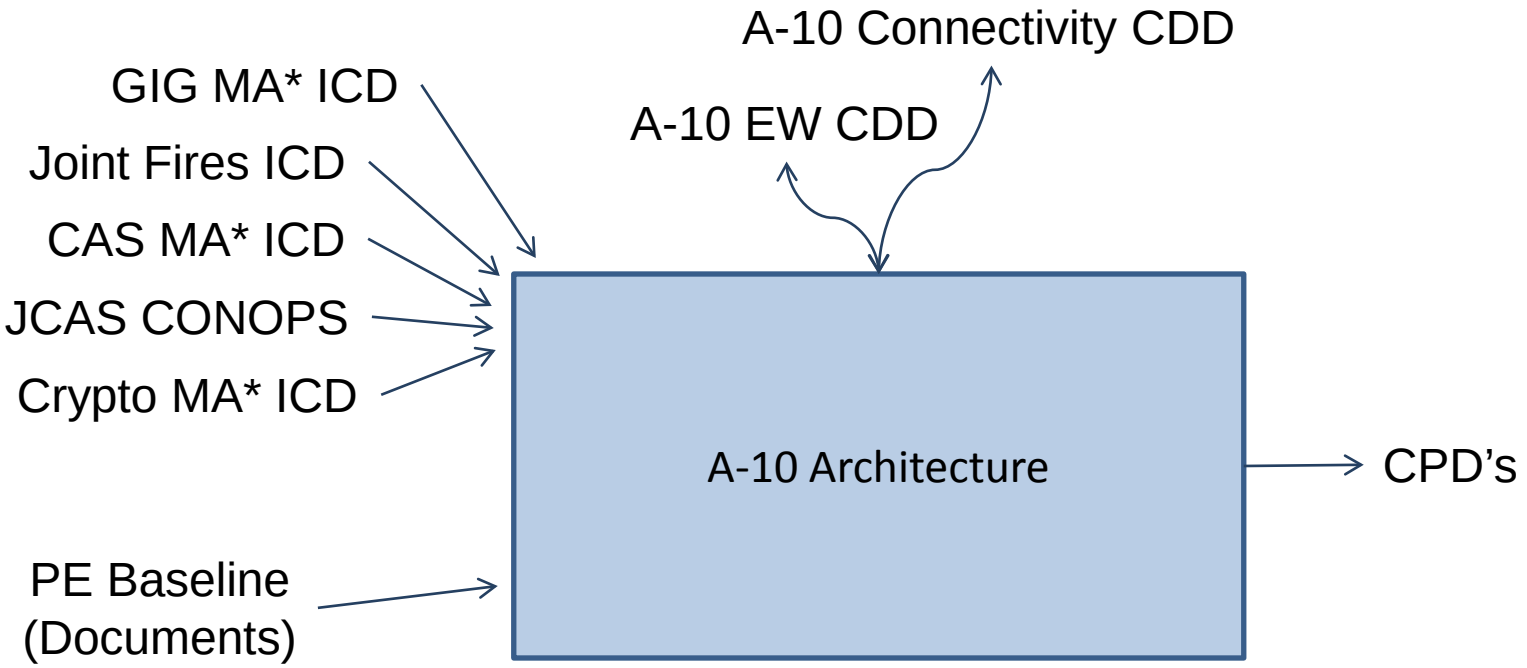
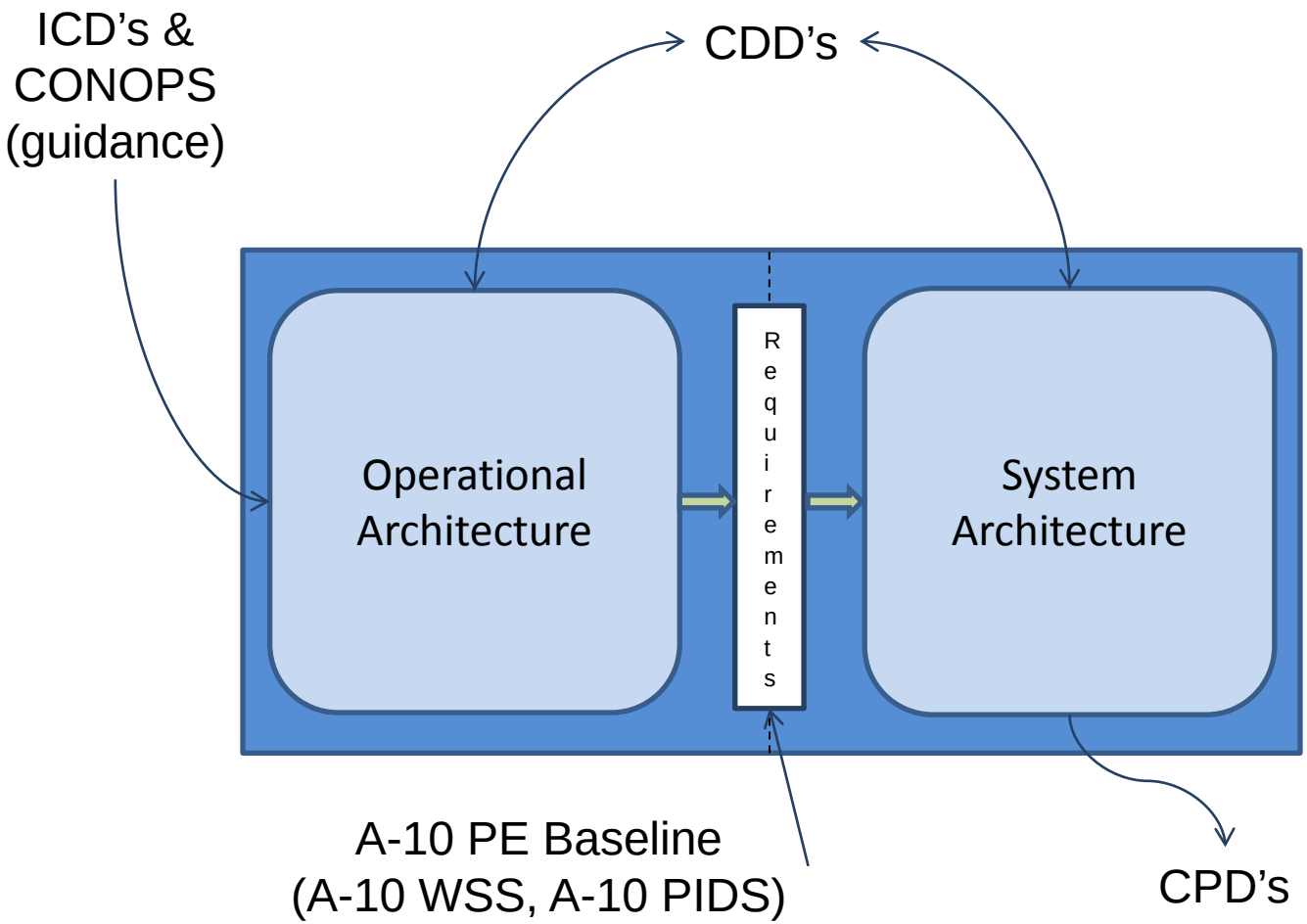
A-10 ARCHITECTURE DEVELOPMENT

A-10 Architecture and External Docs

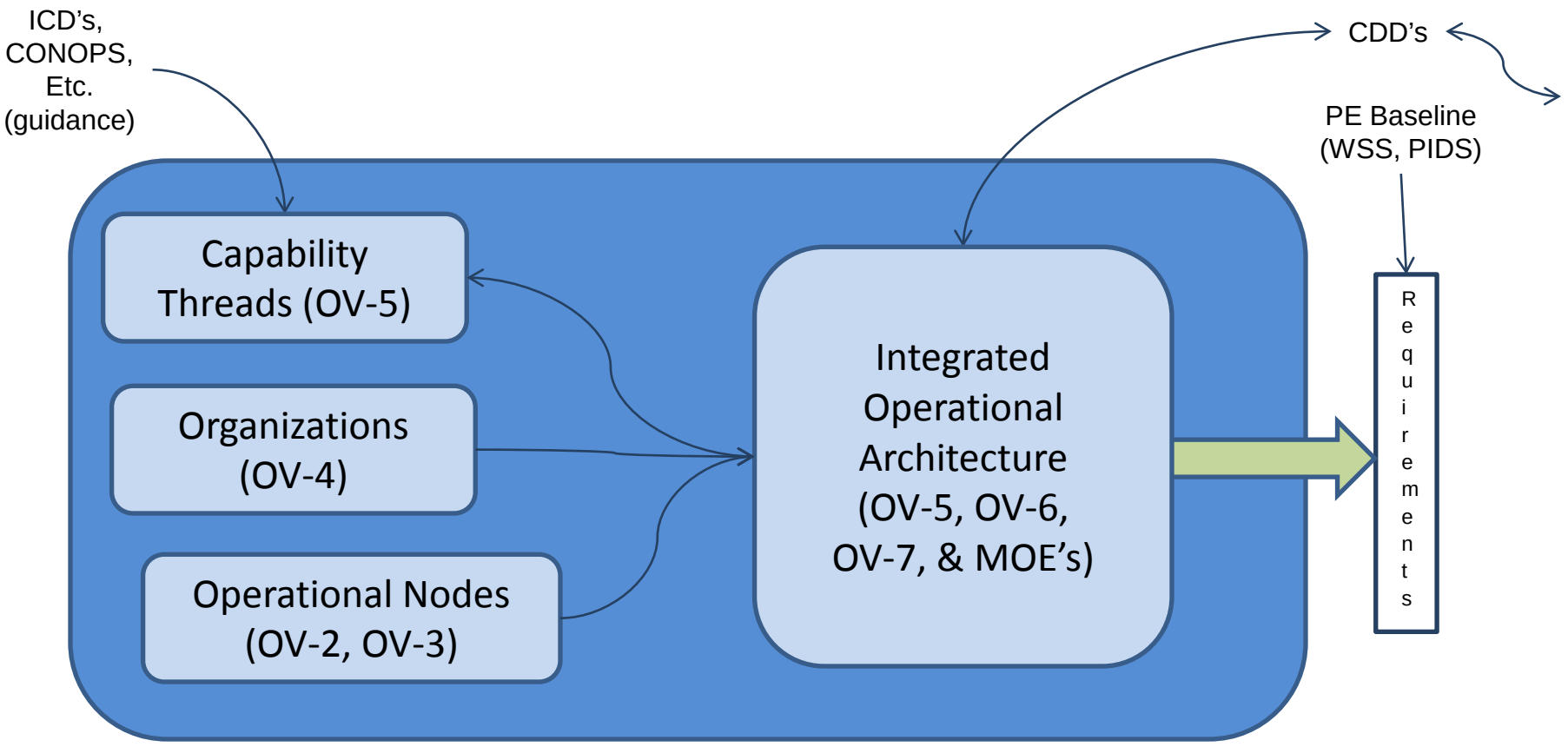


* MA ICD's were directed to be converted or they were rescinded effective June 2008

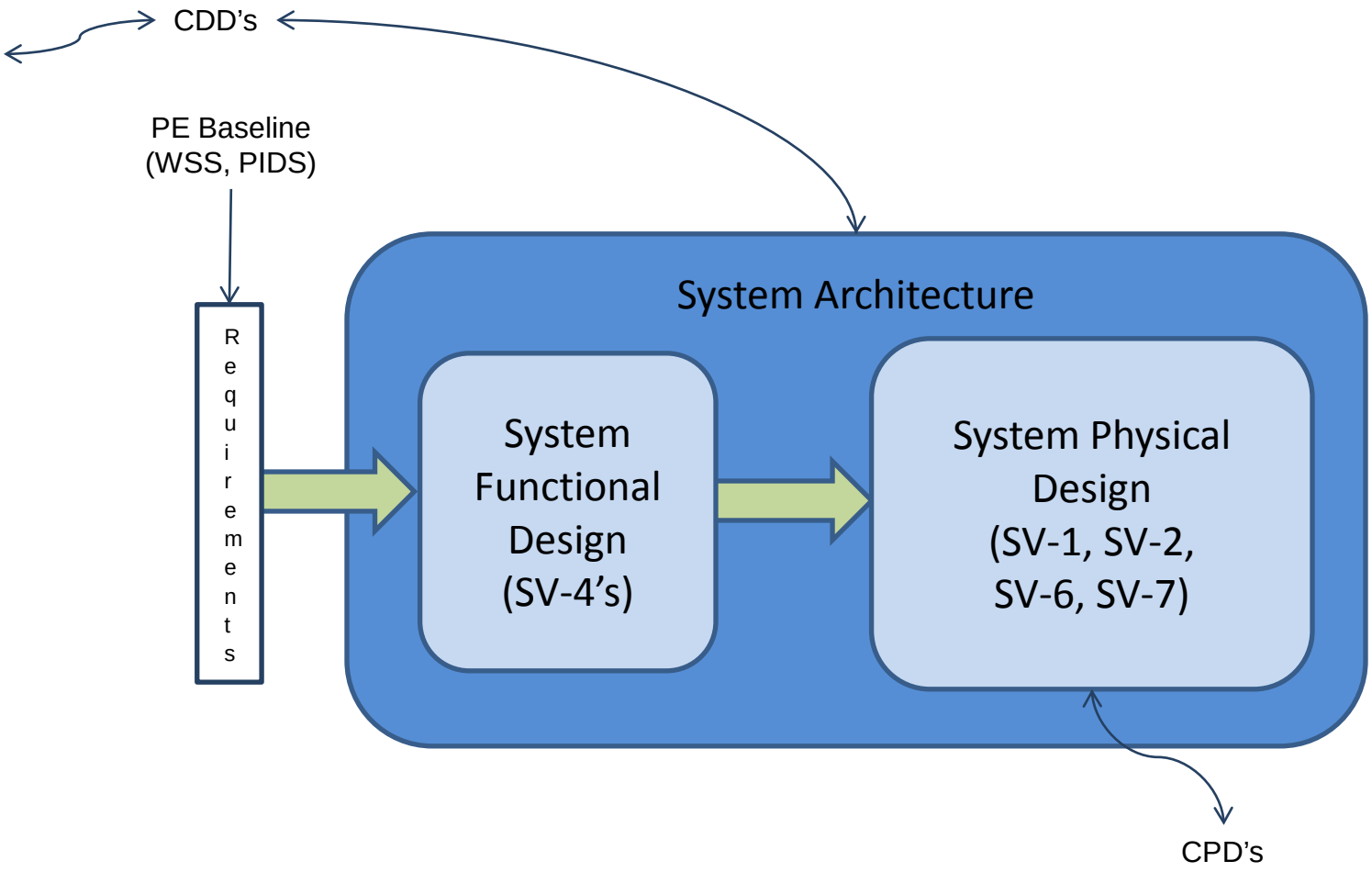
Architecture
-Top-Level View



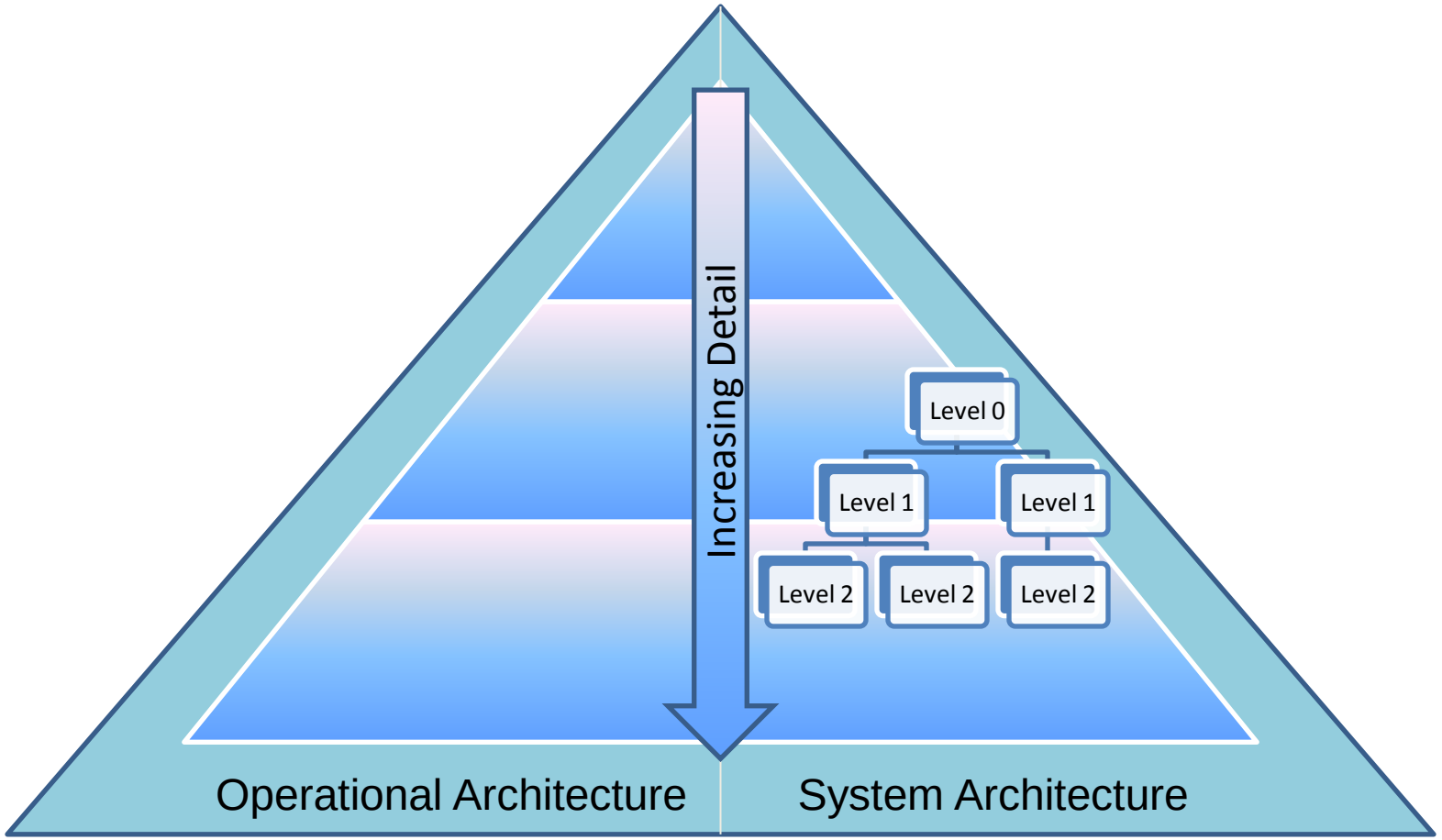
Operational Architecture



System Architecture



Architecture Layering



EXAMPLE

From JCAS CONOPS:

- Establish & Maintain Battlespace Awareness

JCAS CONOPS in DOORS

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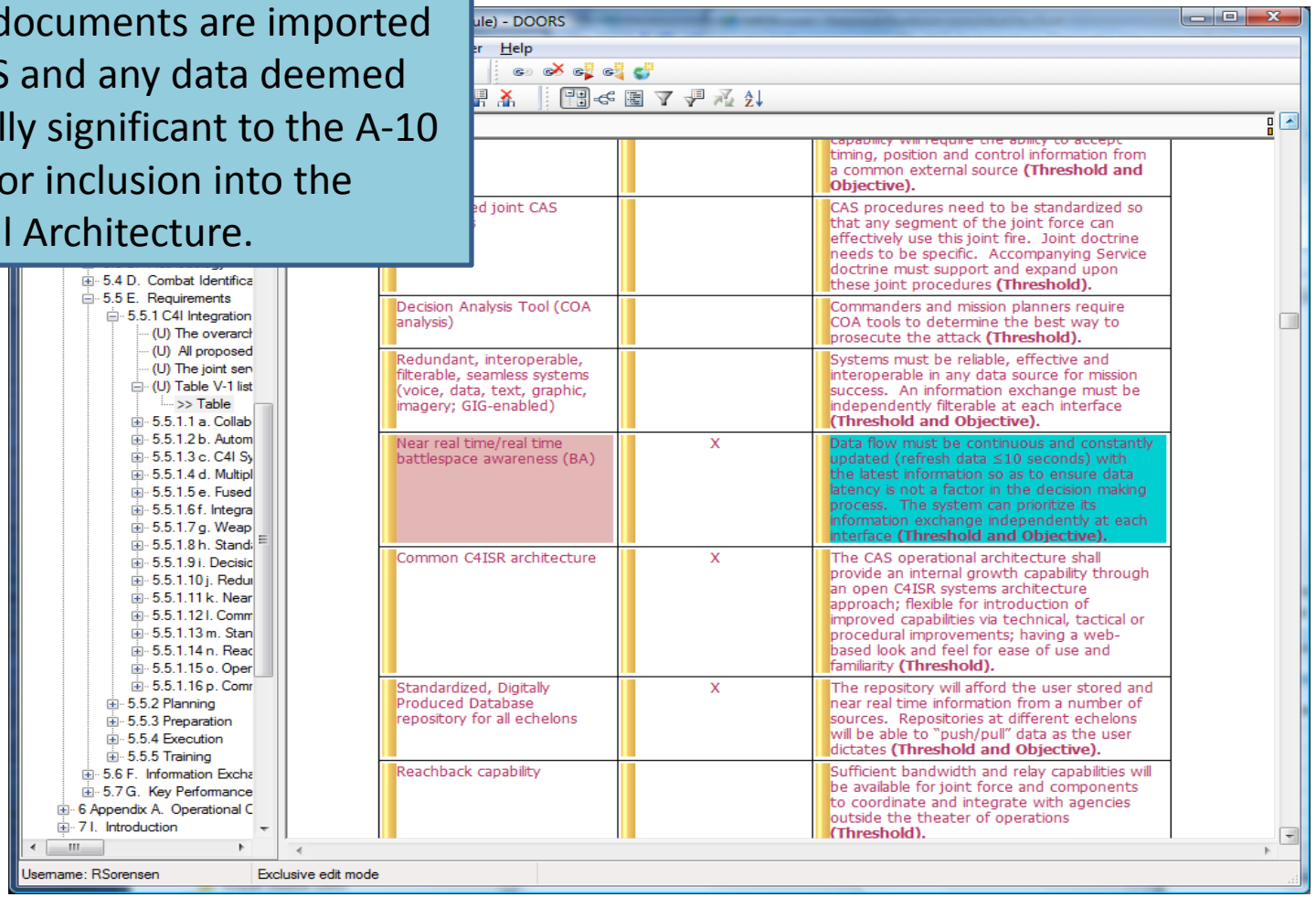
Joint level documents are imported into DOORS and any data deemed operationally significant to the A-10 is marked for inclusion into the Operational Architecture.



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Operational Architecture Hierarchy

- Establish & Maintain Battlespace Awareness

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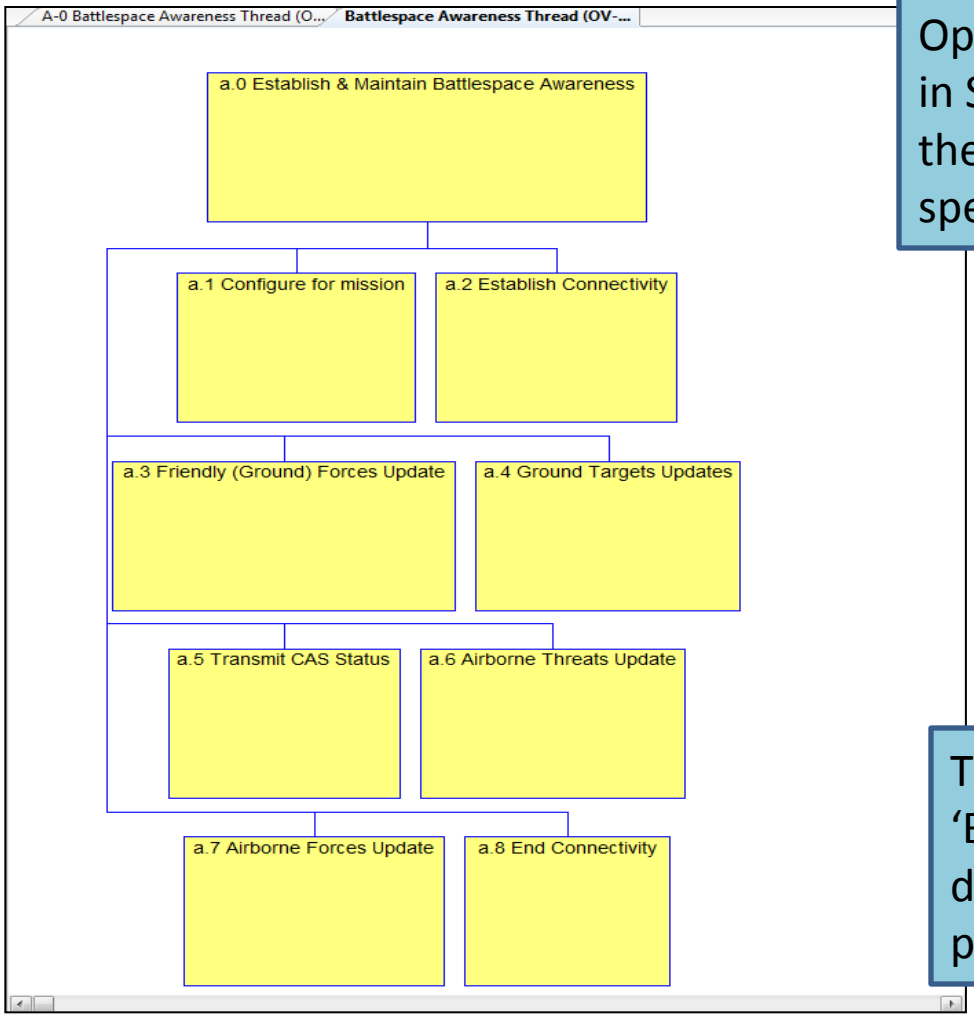

Operational Architectures are created in System Architect and linked both to the Joint Level capabilities and the A-10 specific system requirements.

This example shows the JCAS CONOPS 'Battlespace Awareness' capability decomposed into the components that provide the capability.

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Operational Architecture Thread

- Establish & Maintain Battlespace Awareness

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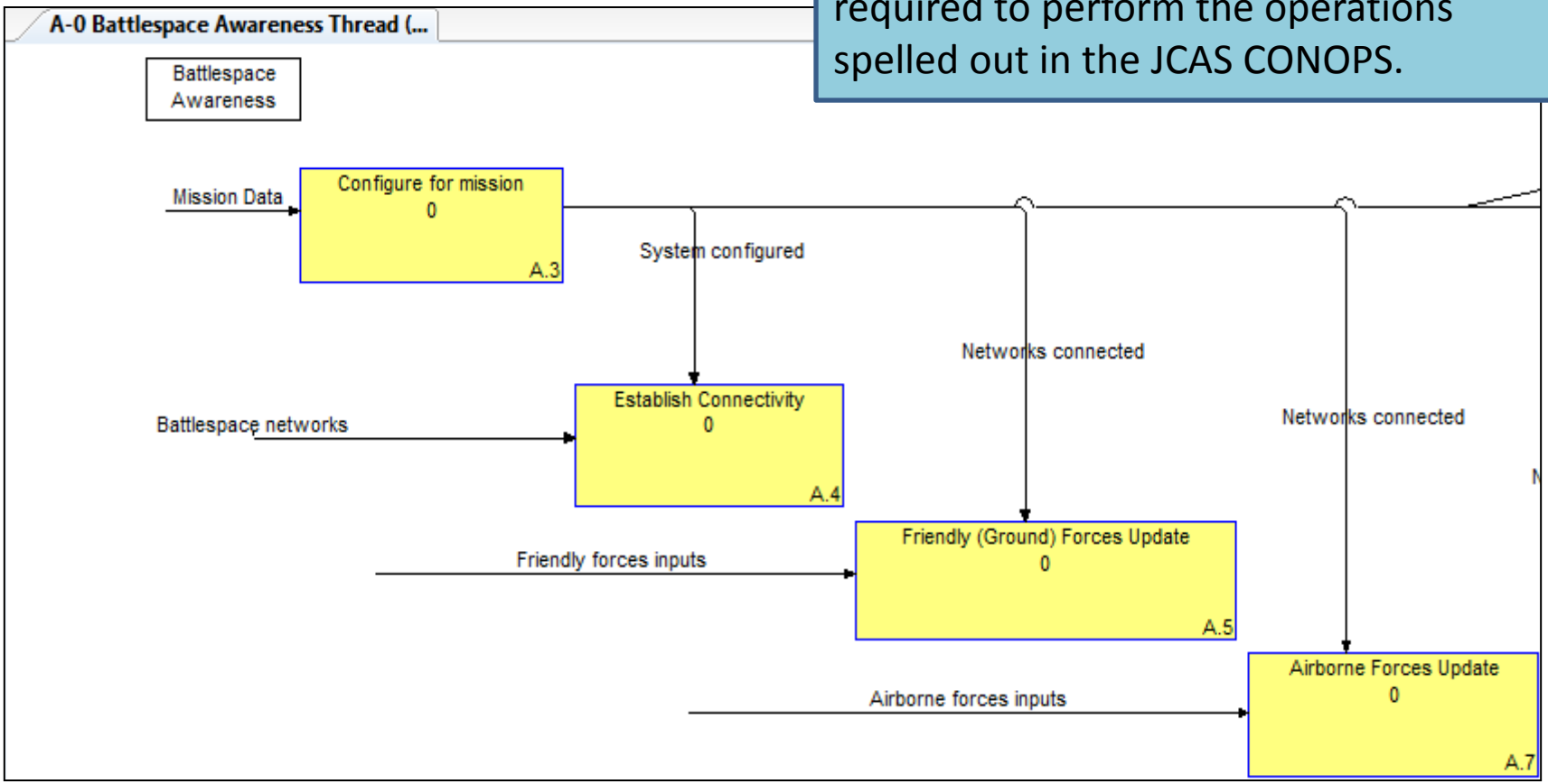
This view (OV-5) details the general data required to perform the operations spelled out in the JCAS CONOPS.



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Operational Requirements

- Derived from Operational Architecture

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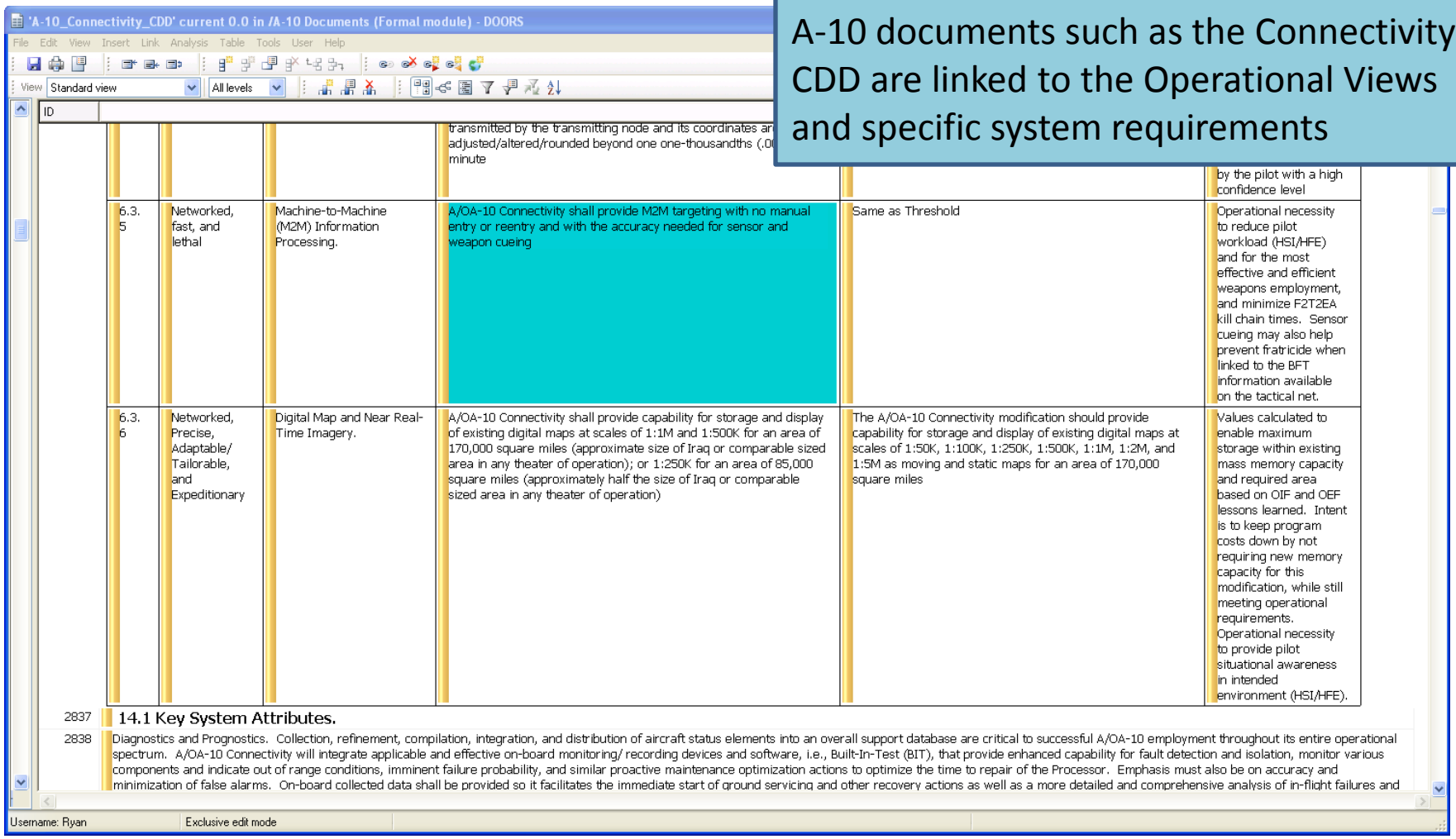
A-10 documents such as the Connectivity CDD are linked to the Operational Views and specific system requirements



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System Requirements

- Derived from Operational Requirements

The A-10 system requirements are stored in DOORS and are traced to the Operational Views, System Views, as well as documents such as the Connectivity CDD and PIDS.

'SADL_EPLRS_Example' current 0.0 in / A-10 System Requirements/A-10 Baseline Requirements (Formal module) - DOORS

File Edit View Insert Link Analysis Table Tools User Help

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ID		Function	Subfunction	Threshold Requirement	
119	COMM-003	Comm	General Interoperability Platforms	The A-10 shall be capable of providing digital data and voice co the Tactical Air Control System (TACS) that include, but not be platforms: - A-10 - F-16 - Joint Terminal Attack Controllers (JTAC) - Tactical Air Control Parties (TACPs) - Air Support Operation Center - Air Operations Center, - Forward Air Controller Airborne (FAC(A)) aircraft - Command and Control (C2) aircraft (e.g., E-3 AWACS, E-8 JSTARS,).	- UK Tornado - UK Harrier
120	COMM-004	Comm	General Data Link	The A-10 shall support a selected DoD standard digital data link communication capability.	Same as Threshold.
121	COMM-005	Comm	General Data Link Interoperability	The A-10 data link system must fully support execution of joint critical operational activities identified in the applicable joint and system integrated architectures and the system must satisfy the technical requirements for transition to Net-Centric military operations to include: 1) DISR mandated GIG IT standards and profiles identified in the A/OA-10 Technical Standards View (TV-1), 2) DISR mandated GIG KIPs identified in the Key Interface Profiles (KIP) declaration table, 3) Net Centric Operations and Warfare Reference Model (NCOW-RM) Enterprise Services 4) Information assurance requirements including availability, integrity, authentication, confidentiality, and nonrepudiation, and issuance of an Interim Approval to Operate (IATO) by the Designated Approval Authority (DAA) 5) Operationally effective information exchanges; and mission critical performance and information assurance attributes, data correctness, data availability, and consistent data processing specified in the applicable joint and system integrated architecture views.	The A-10 data link system should fully support execution of all operational activities identified in the applicable joint and system integrated architectures and the system must satisfy the technical requirements for Net-Centric military operations to include: 1) DISR mandated GIG IT standards and profiles identified in the TV-1, 2) DISR mandated GIG KIPs identified in the KIP declaration table, 3) NCOW RM Enterprise Services 4) Information assurance requirements including availability, integrity, authentication, confidentiality, and nonrepudiation, and issuance of an Interim Approval to Operate (IATO) by the Designated Approval Authority (DAA)

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System Functional Architecture

- Developed from System Requirements

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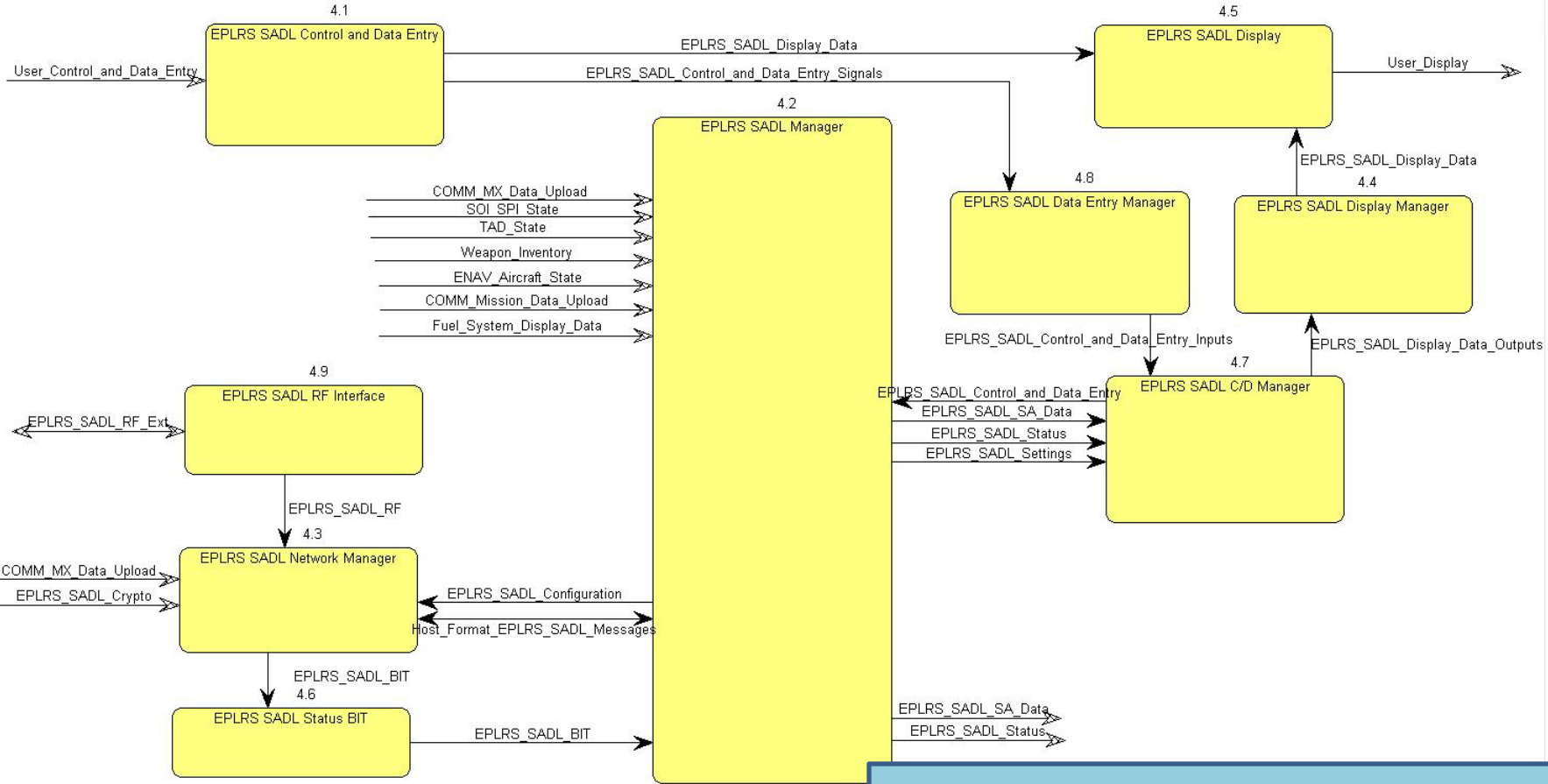

The functions are traced from the system requirements which they fulfill as well as any associated Operational Views.

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System Physical Architecture

- Implements System Functional Architecture

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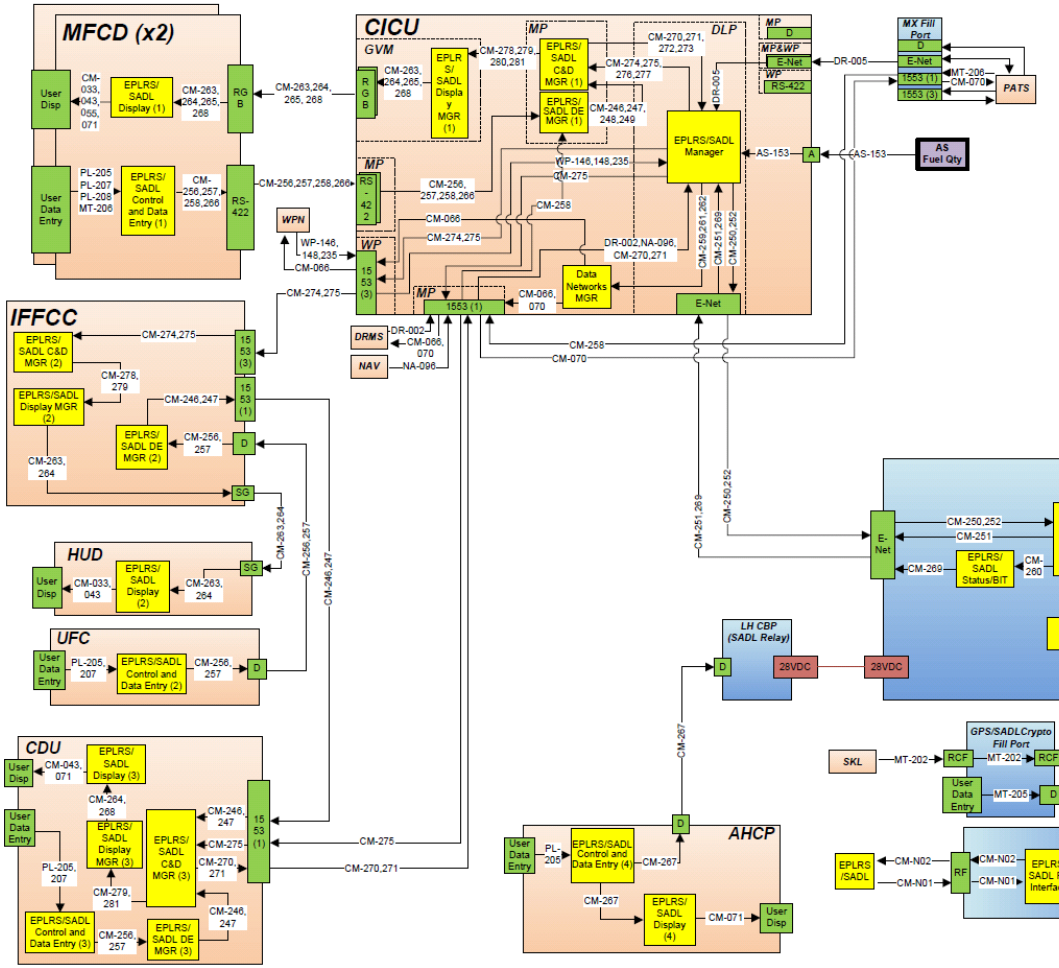

Data Networks
– EPLRS/SADL

The functions are then linked to the actual systems in the physical architecture.

Ref: A-10 System Architecture Plan Rev A, Vol II

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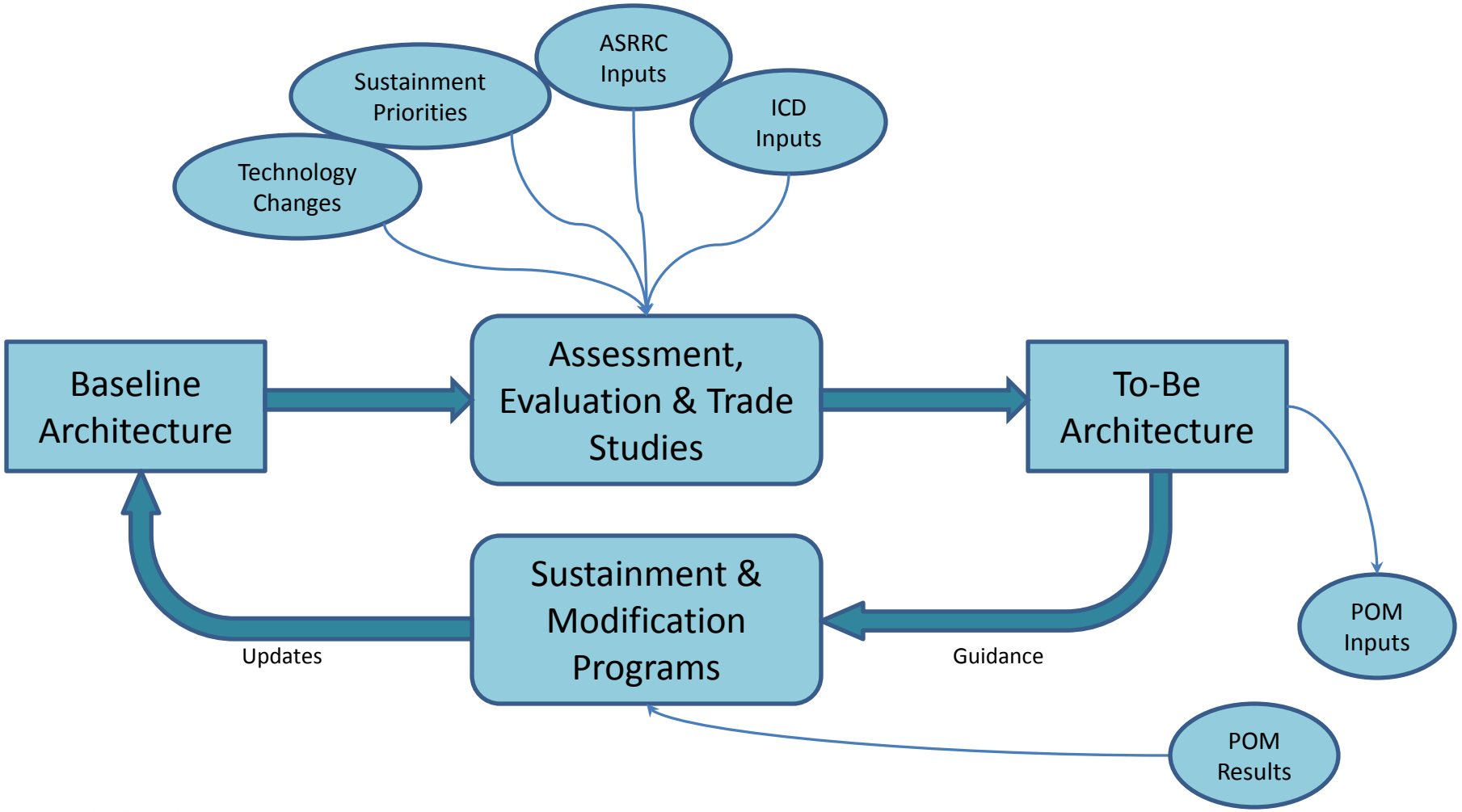
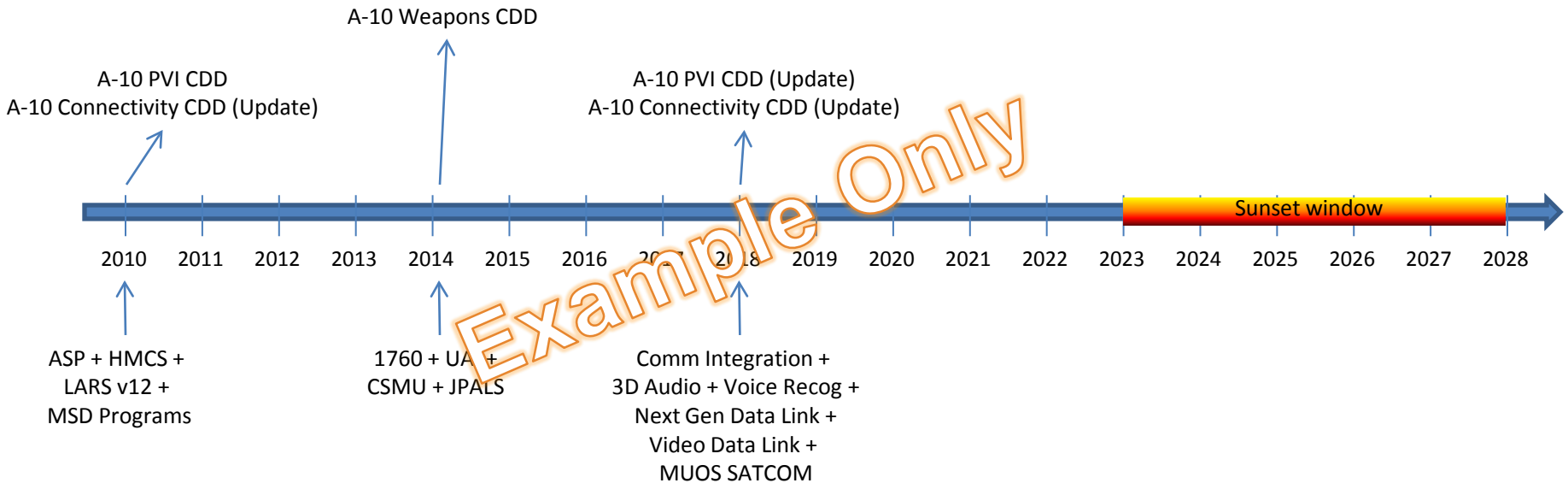
PATH FORWARD

Roadmap Process



Notional SV-8

Systems/Services Evolution



Notional SV-9

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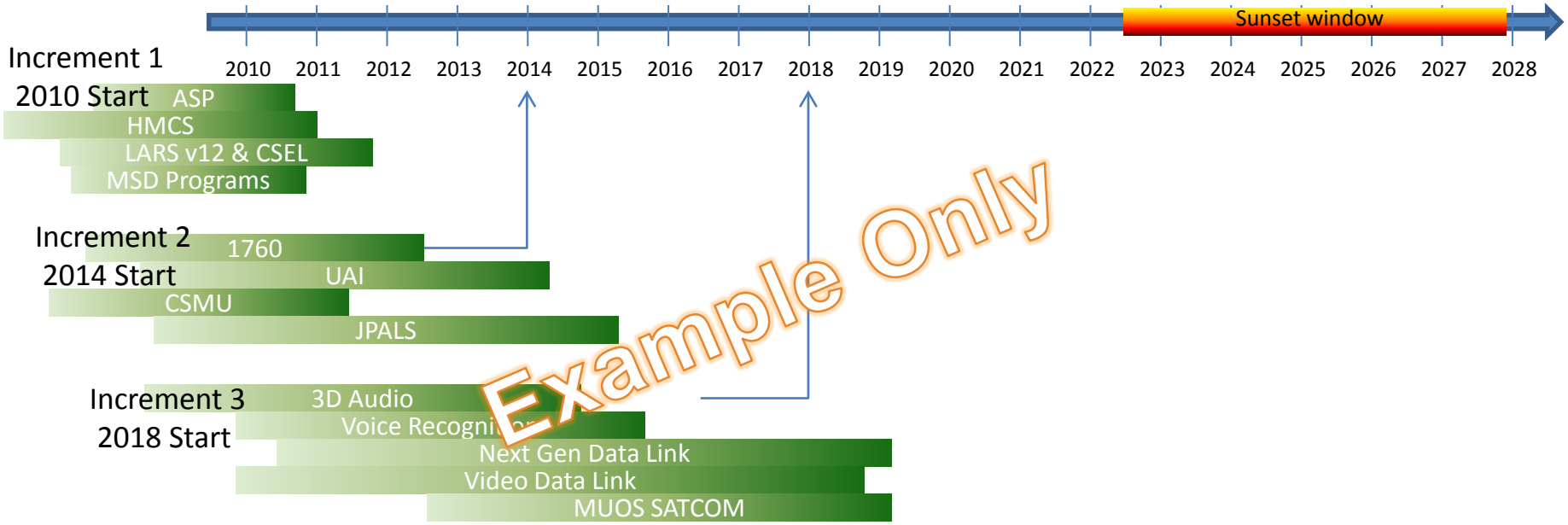
Technology Forecast



Key

Technical Maturity Level

Low High

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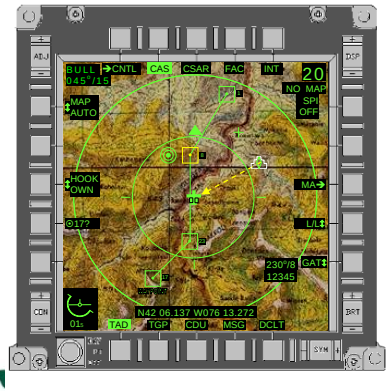
RESULTS

AVSATA Results

- **AVSATA already resulted in integrated system on A-10**
  - **Distributed mass memory (greater map and data storage),**
  - **Helmet mounted cueing,**
  - **LARS V12, Integrated personnel recovery systems for use during CSAR,**
  - **Expanded bus infrastructure to support future high speed devices (12 Port 1GB Ethernet switch)**



Tying Requirements to Funding Requests

(U) A- 10Avionics Sustainment Program (ASP)

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BACKGROUND:

(U) A-10 avionics system has aging Line Replaceable Units (LRU) that have exceeded their design lives. The reliability, sustainment, and obsolescence issues are decreasing aircraft availability, increasing maintenance costs, and limiting growth, mission readiness and capability.

ADJUSTMENT:

(U) Develop, procure, and install 344 ASP kits on A-10 fleet (replace 26 aging LRUs inclu[illegible] displays, high maintenance drivers with obsolescence issues with 5 new LRUs per [illegible]aft)

$M: XXXXXXXXXX	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17
ADJUSTMENT			18.25	[illegible]	39.78	48.51	48.92	26.43
REV PGM TOTAL			[illegible]	[illegible]	39.78	48.51	48.92	26.43

PROCUREMENT	FY10	FY11	FY12	FY[illegible]	[illegible]14	[illegible]15	[illegible]	FY17
ASP			18	69	10[illegible]	1[illegible]		50
ADJ			[illegible]8.2[illegible]	40.83	48.51	48.93		26.43
REV								

MPWR	FY12	FY13	FY14	FY15	FY16	FY17
OFF	0	0	0	0	0	0
ENL	0	0	0	0	0	0
CIV	0	0	0	0	0	0

IMPACTS:

-(U) RQMT[illegible] ORD, Dec 04; A-10 EW CDD, A-10 Connectivity CDD, Mar 07, JCAS MA ICD, Jun 04, JCAS CONOPS, Jun 08, Joint Fires ICD, Nov 02, GIG MA Nov 02

- (U) If not funded, Continued decrease in Aircraft Availability
- (U) If not funded, Grounding of aircraft due to unsupportable CDU, HARS, and displays in FY14-FY17
-(U) If not funded, Mission non capable -no (processing) growth path as processors are maxed out, FY17
-(U) If not funded, Projections lead to capability gaps, FY17 through FY28

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Systems and Systems Sustaining Engineering

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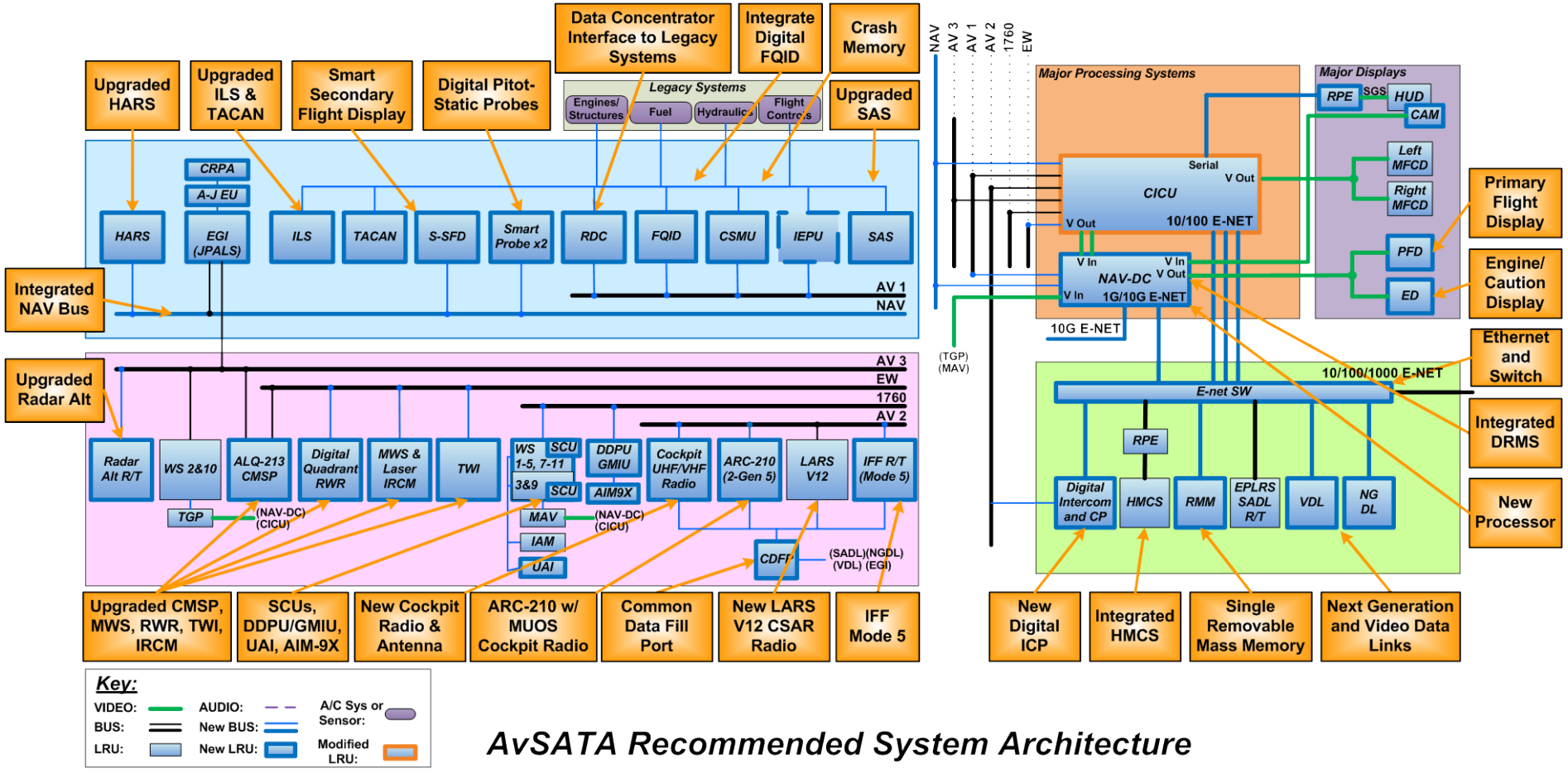

AvSATA Recommended System Architecture

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Biographies

Richard L. Sorensen is a Staff Systems Engineer at KIHOMAC Inc. He has over twenty eight years experience in systems engineering and systems architecture in both military and civil applications.

Adam Grimm is Director for Strategic Programs at KIHOMAC Inc. He has over eight years working logistics, engineering and requirements for U.S. Air Force aircraft and net-centric and command and control systems.

Jerry L. Coates, M. E. E. E., is the A-10 OSS&E Integrator for the A-10 System Program Office (OO-ALC/ 538th ACSG/EN). He has 21 years of experience with the USAF at OO-ALC including 2 years as an AF Exchange Engineer in Manching, Germany at the German Airworthiness Certification Airbase WTD 61, and 11 years of experience in industry (Boeing, SSAI, Robert Bosch and as an independent consultant)