

Ogden Air Logistics Center



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

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Agenda



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



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A-10 BACKGROUND



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Legacy Aircraft The “Green Machine”



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- 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

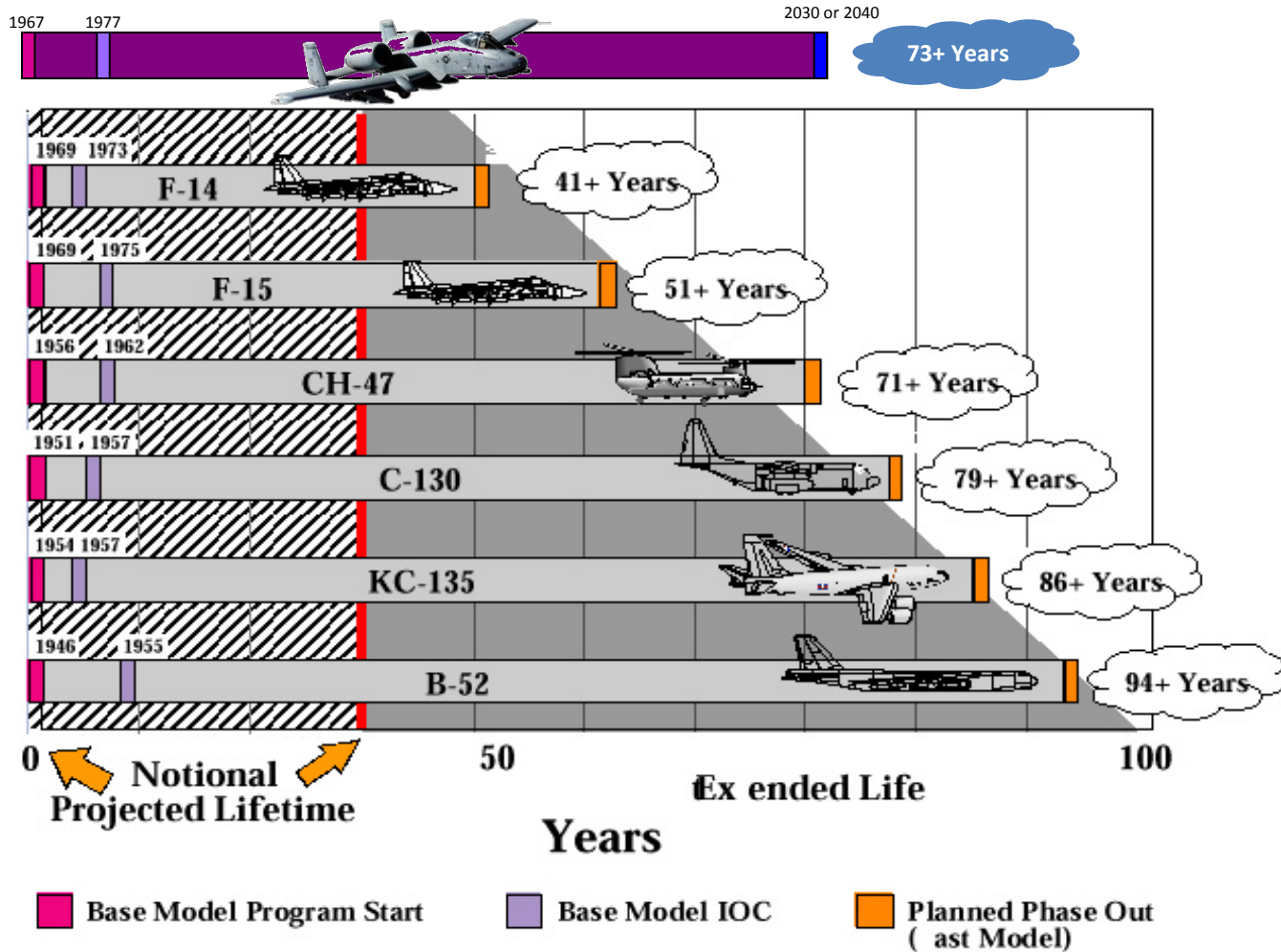




Beyond Design Life



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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





Precision Engagement

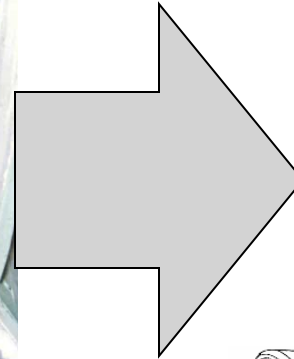
This Ain't Your Daddy's Hog



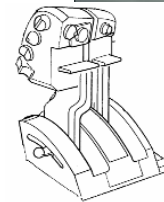
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A-10A



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



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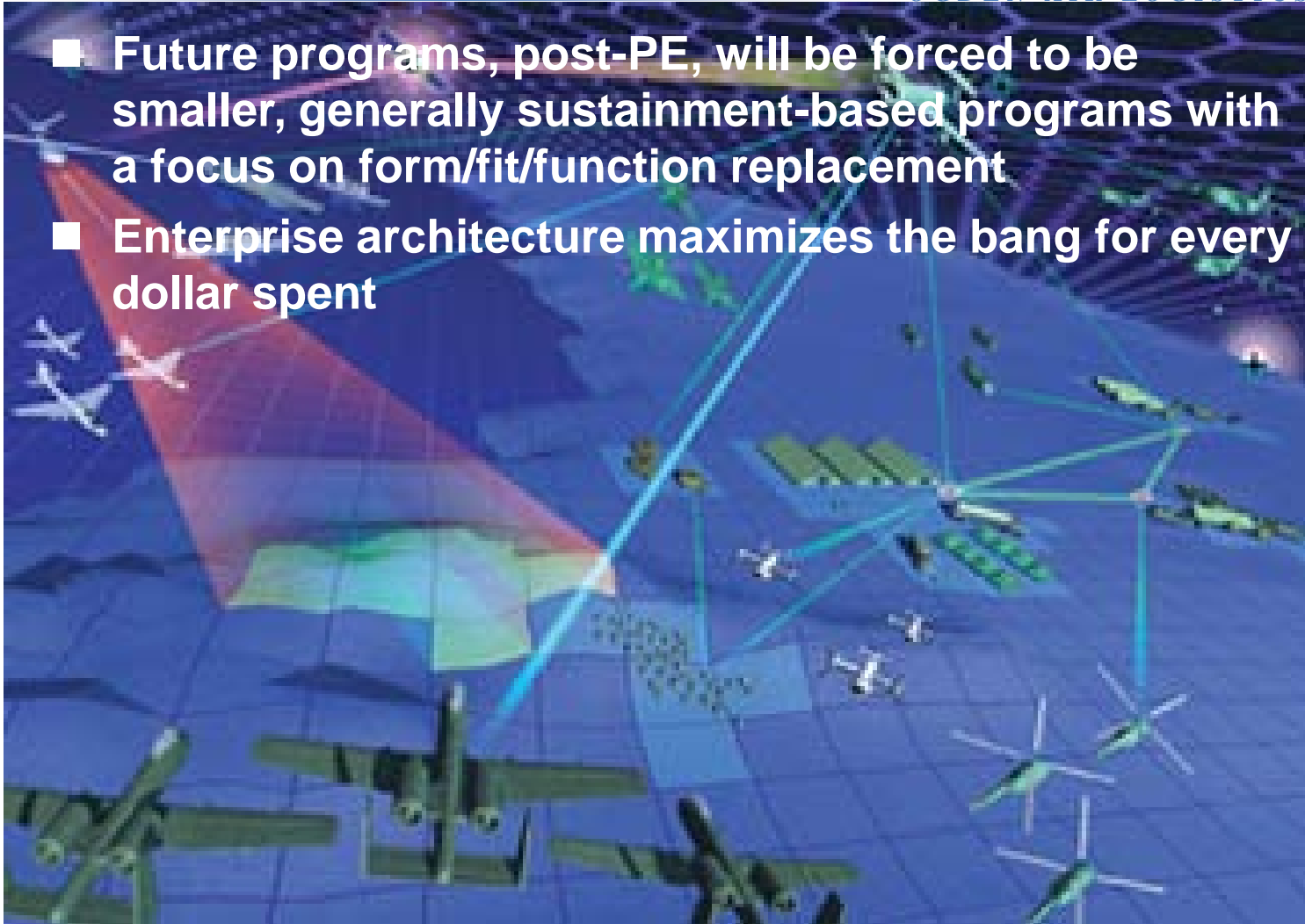
A-10 2030

“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

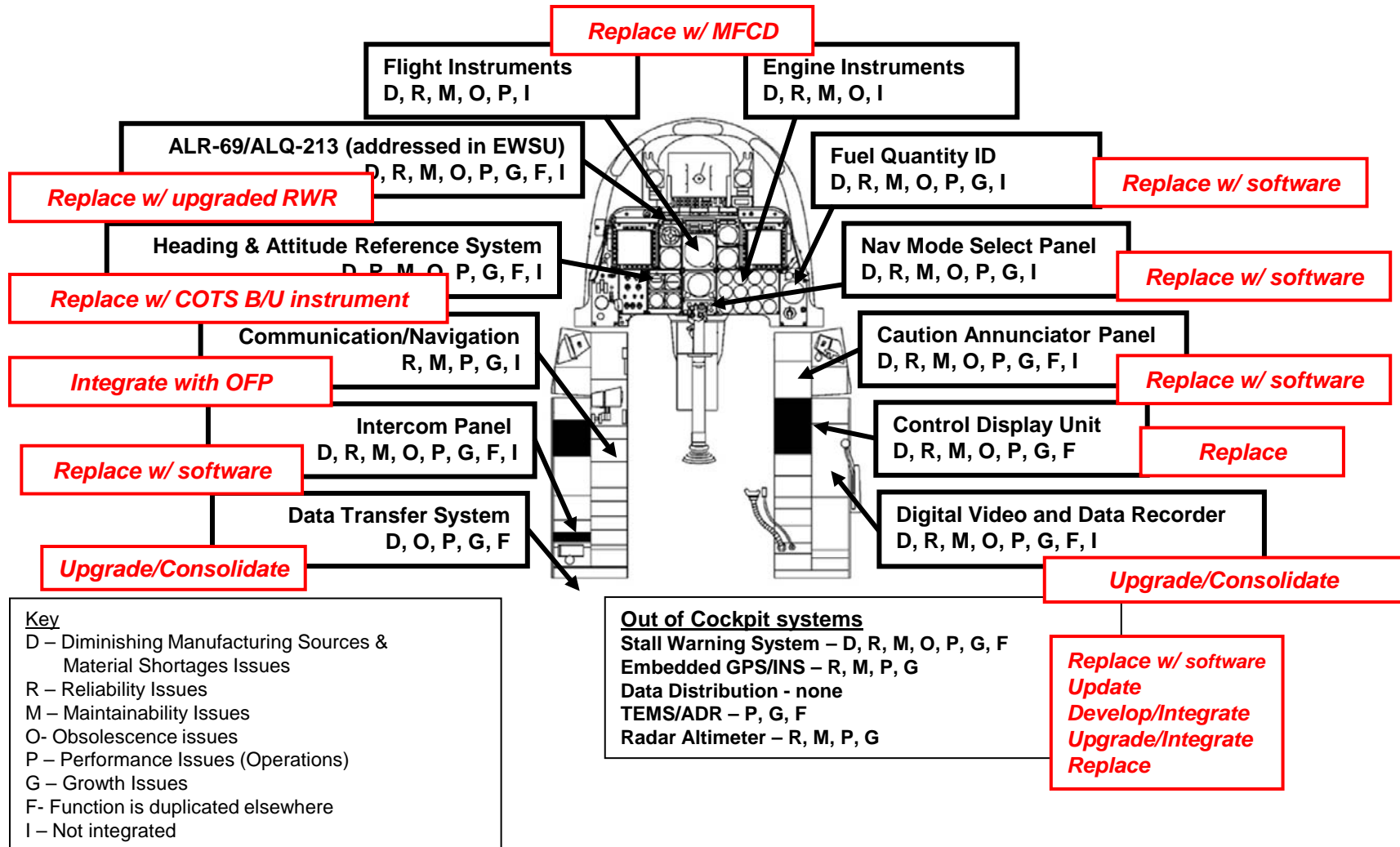




Avionics Sustainment Program (ASP) (Wish List)



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A-10 AVSATA Vision



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A-10 Integrated Lifecycle Management Process A-10 Weapon System Roadmap

Requirements

37s, 1067s, ASRRC, CDD:
Connectivity, PUP, EW

Obsolescence

DMS & Spares Retention

Direction

PMD, SEP, FVB Report

SLAs with ALCs and DMS
& Spares Retention

Reliability

RCM & RMS&S Program
MECSIP, AVSIP, etc.

Aircraft Structural
Integrity Program (ASIP)

IMP/IMS - LCMP

AVSATA FY07 – FY12-13: Avionics Architecture/Roadmap

Analysis >>> Multiple OAs >>> Permanent Mods >>> ASP

3400 POM

594, 592, 583, 540, MSD

PEM POM

30XX 3600

Sustainment and Modernization Modifications

SLEP, Wing Replacement, PE, Suite Updates, Consolidated Mod, etc



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A-10 Integrated Architecture



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- 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.



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ARCHITECTURE & REQUIREMENTS OVERVIEW



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Integrated Architecture Overview



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- **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**



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Fundamental Linkages Between Views



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Operational View
Identifies What Needs to be Accomplished and Who Does It

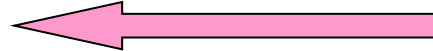
What needs to be done
Who does it
Information Exchanges
Required to Get it Done

Systems that Support the
Activities and Information
Exchanges

Operational Requirements &
Capabilities

Basic Technology Supportability
New Technical Capabilities

Technical Standards Criteria Governing
Interoperable
Implementation/Procurement of the
Selected System Capabilities



Specific System Capabilities
Required to Satisfy Information
Exchanges

Systems View
Relates Systems and Characteristics
to Operational Needs

Technical Standards View
Prescribes Standards and
Conventions





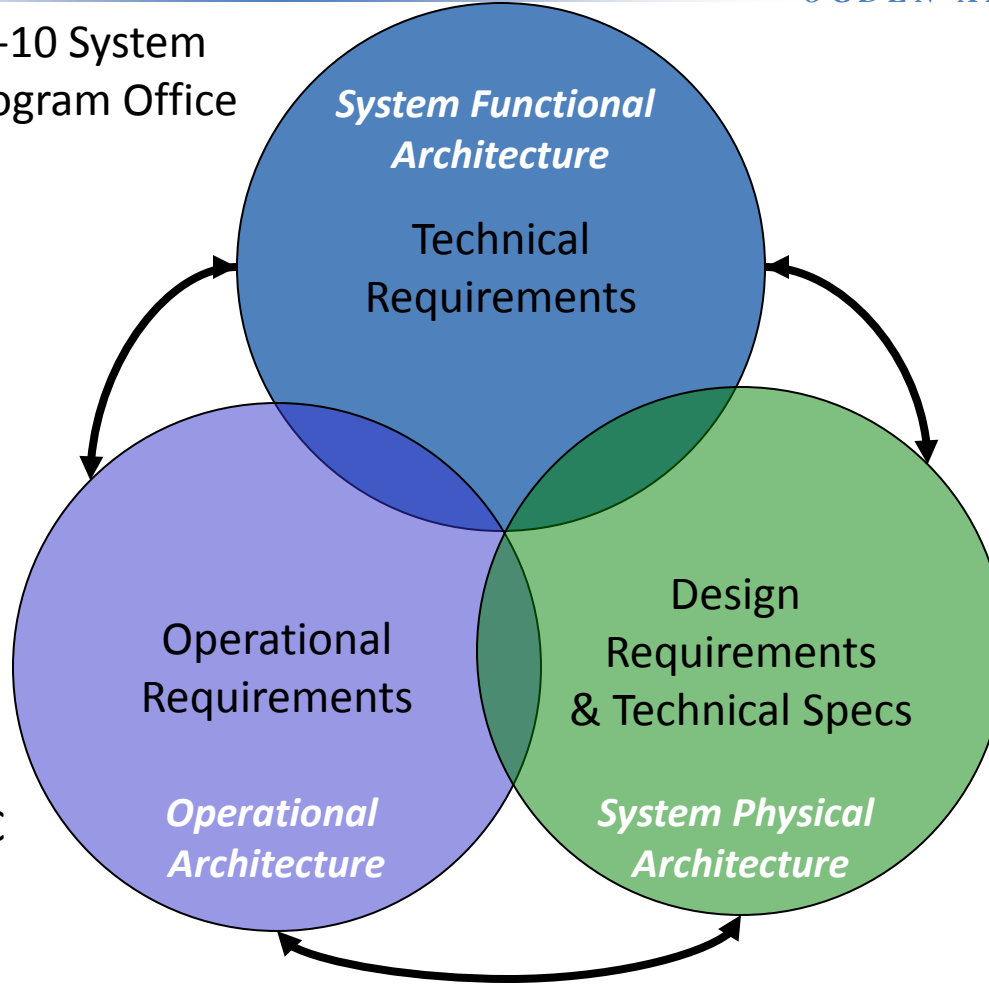
Traceability of Requirements

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



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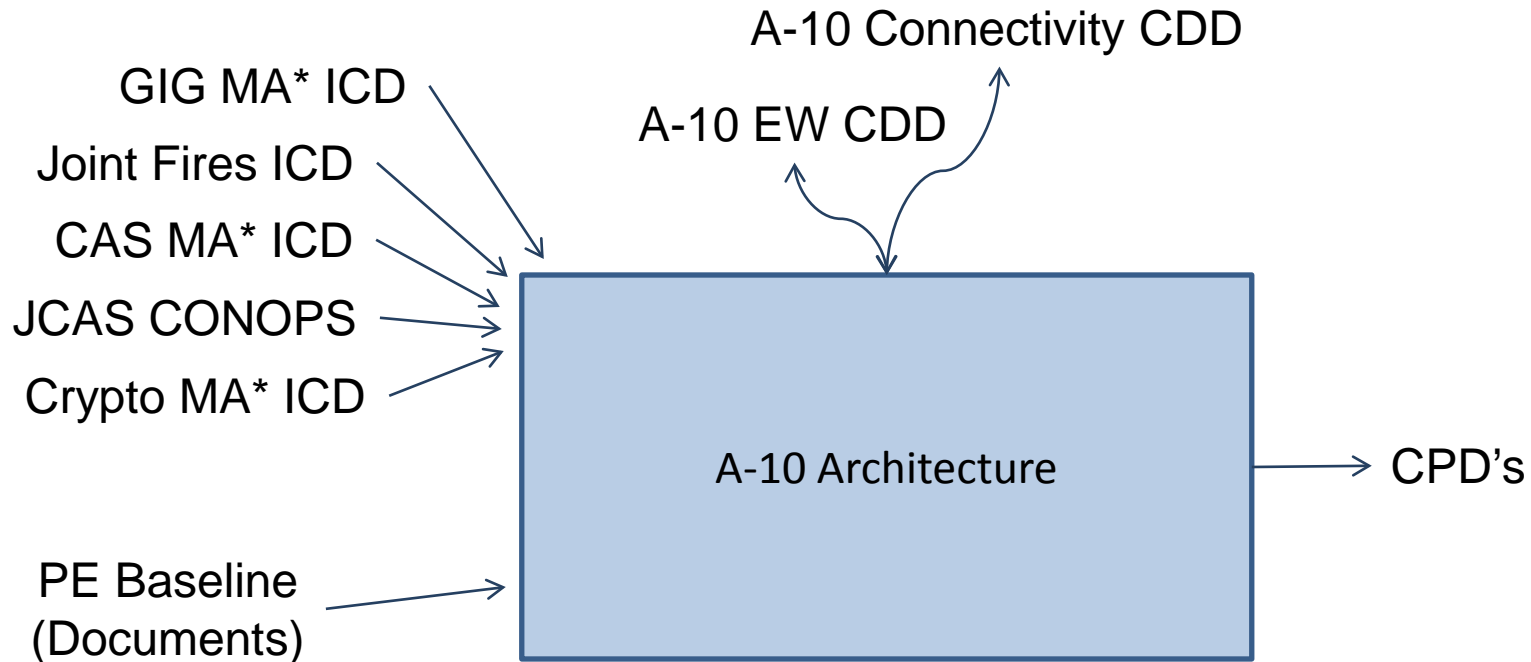
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A-10 Architecture and External Docs



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





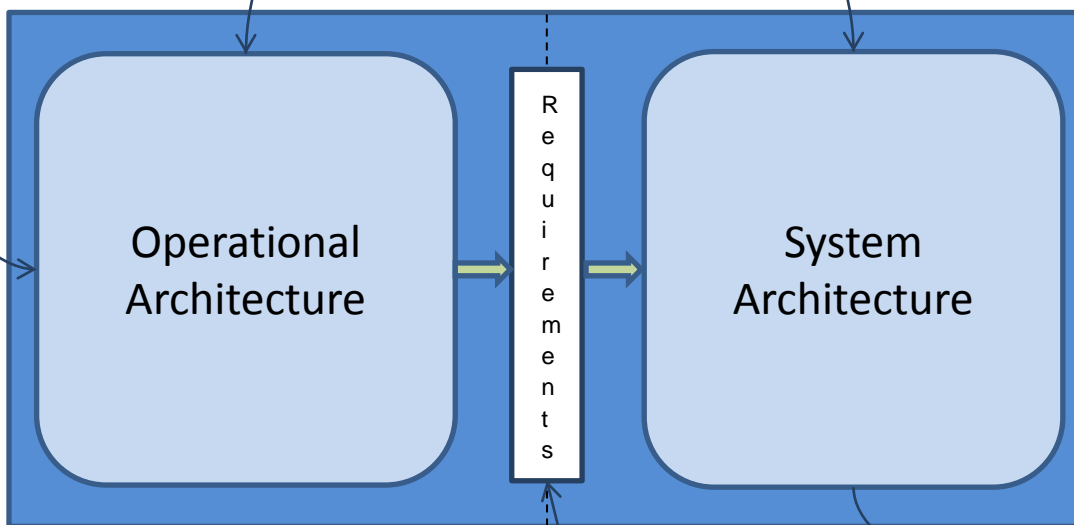
Architecture -Top-Level View



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ICD's &
CONOPS
(guidance)

CDD's



A-10 PE Baseline
(A-10 WSS, A-10 PIDS)

CPD's



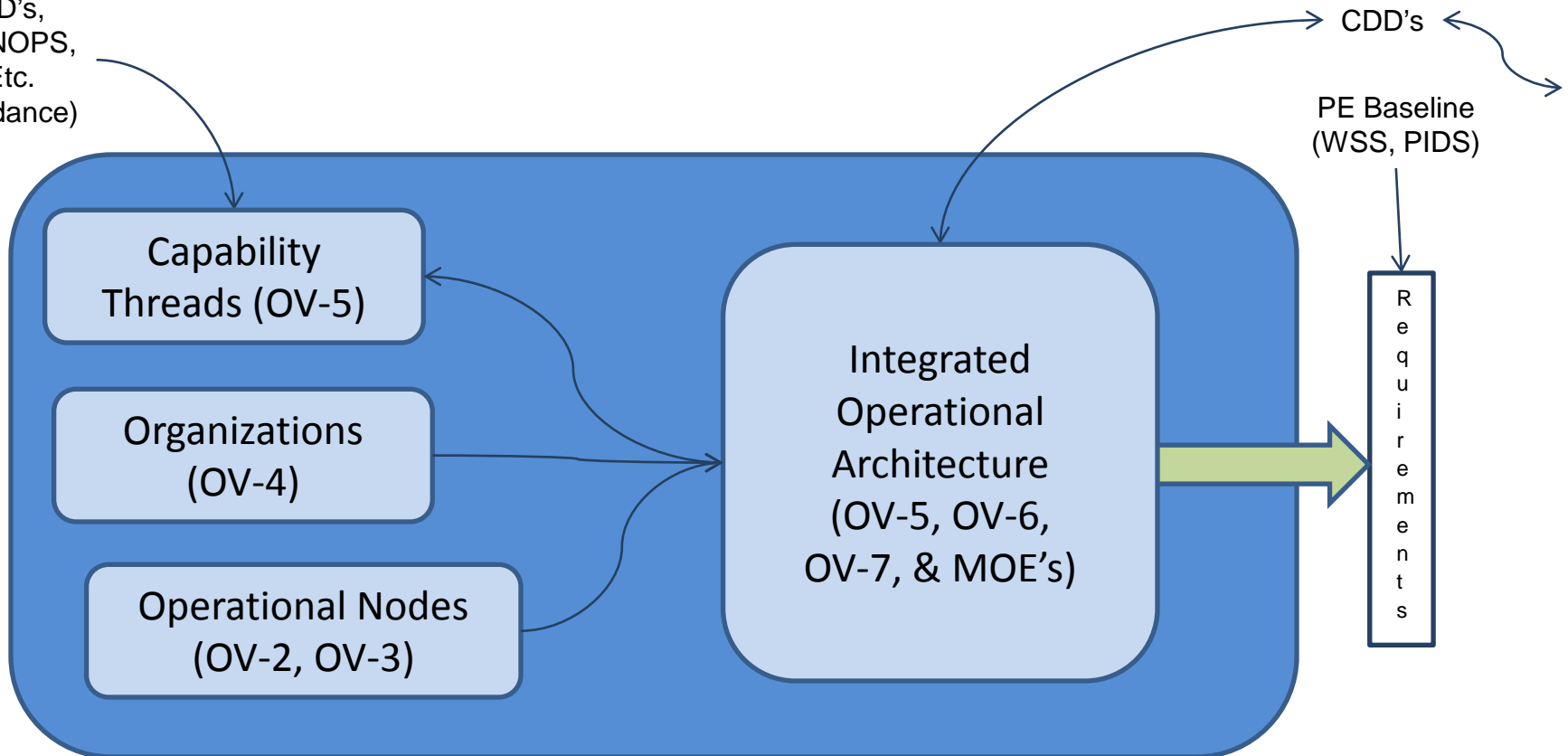


Operational Architecture



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ICD's,
CONOPS,
Etc.
(guidance)

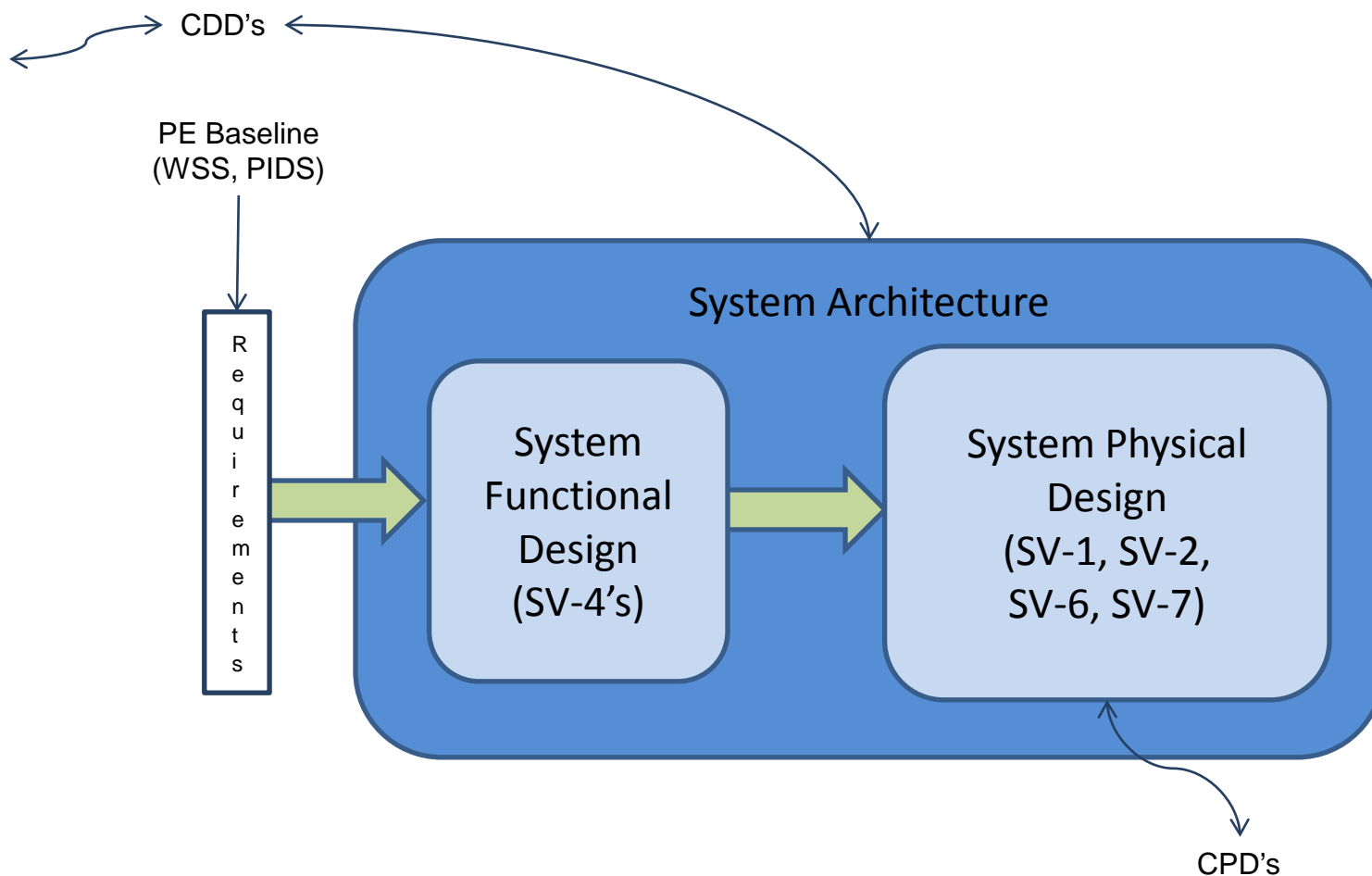




System Architecture



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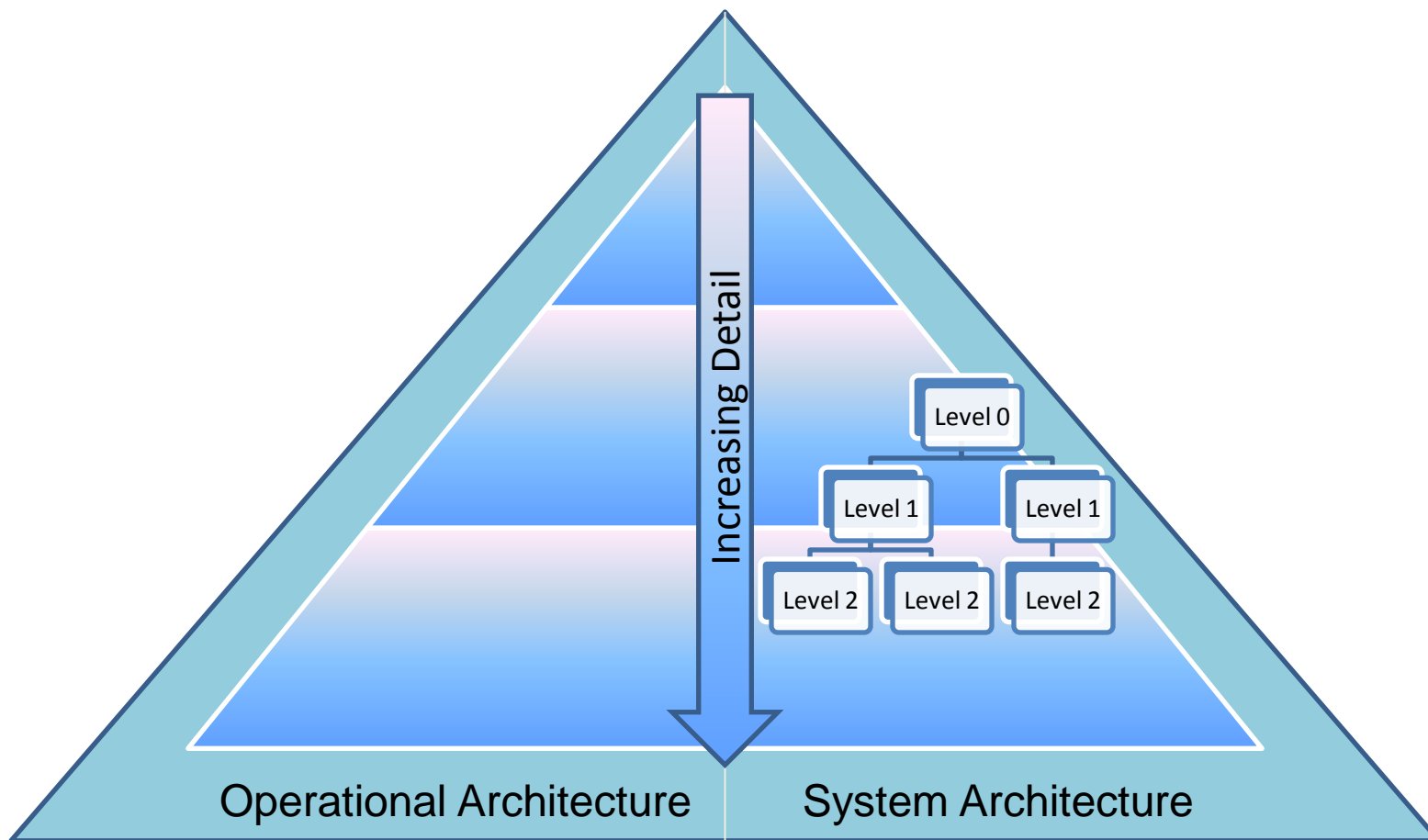




Architecture Layering



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EXAMPLE

From JCAS CONOPS:

- Establish & Maintain Battlespace Awareness



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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.

The screenshot shows the DOORS software interface. On the left is a tree view of requirements, and on the right is a table of requirements with columns for description, status, and notes.

Requirement ID	Description	Status	Notes
5.5.1 C4I Integration	Decision Analysis Tool (COA analysis)		Commanders and mission planners require COA tools to determine the best way to prosecute the attack (Threshold).
5.5.1.1 a. Collab	Redundant, interoperable, filterable, seamless systems (voice, data, text, graphic, imagery; GIG-enabled)		Systems must be reliable, effective and interoperable in any data source for mission success. An information exchange must be independently filterable at each interface (Threshold and Objective).
5.5.1.2 b. Autom	Near real time/real time battlespace awareness (BA)	X	Data flow must be continuous and constantly updated (refresh data ≤10 seconds) with the latest information so as to ensure data latency is not a factor in the decision making process. The system can prioritize its information exchange independently at each interface (Threshold and Objective).
5.5.1.10 j. Redu	Common C4ISR architecture	X	The CAS operational architecture shall provide an internal growth capability through an open C4ISR systems architecture approach; flexible for introduction of improved capabilities via technical, tactical or procedural improvements; having a web-based look and feel for ease of use and familiarity (Threshold).
5.5.2 Planning	Standardized, Digitally Produced Database repository for all echelons	X	The repository will afford the user stored and near real time information from a number of sources. Repositories at different echelons will be able to "push/pull" data as the user dictates (Threshold and Objective).
5.5.5 Training	Reachback capability		Sufficient bandwidth and relay capabilities will be available for joint force and components to coordinate and integrate with agencies outside the theater of operations (Threshold).



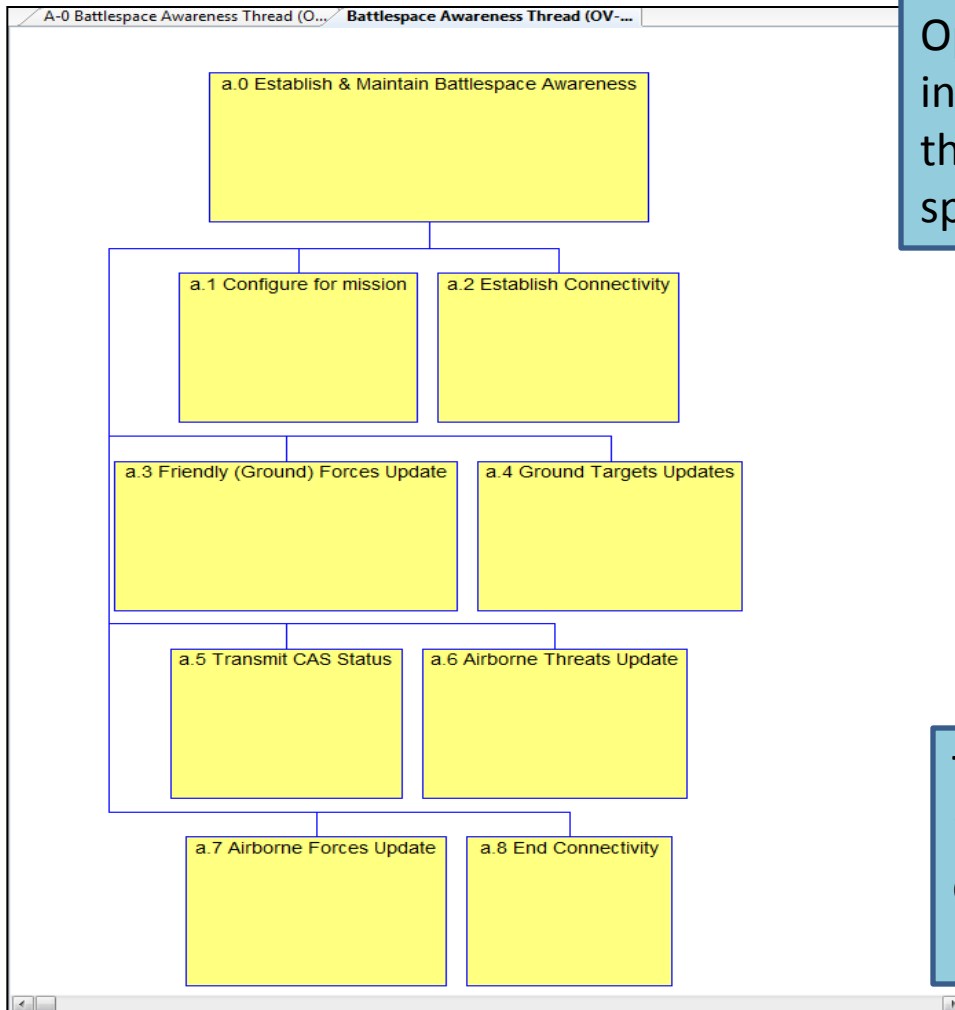


Operational Architecture Hierarchy

- 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.





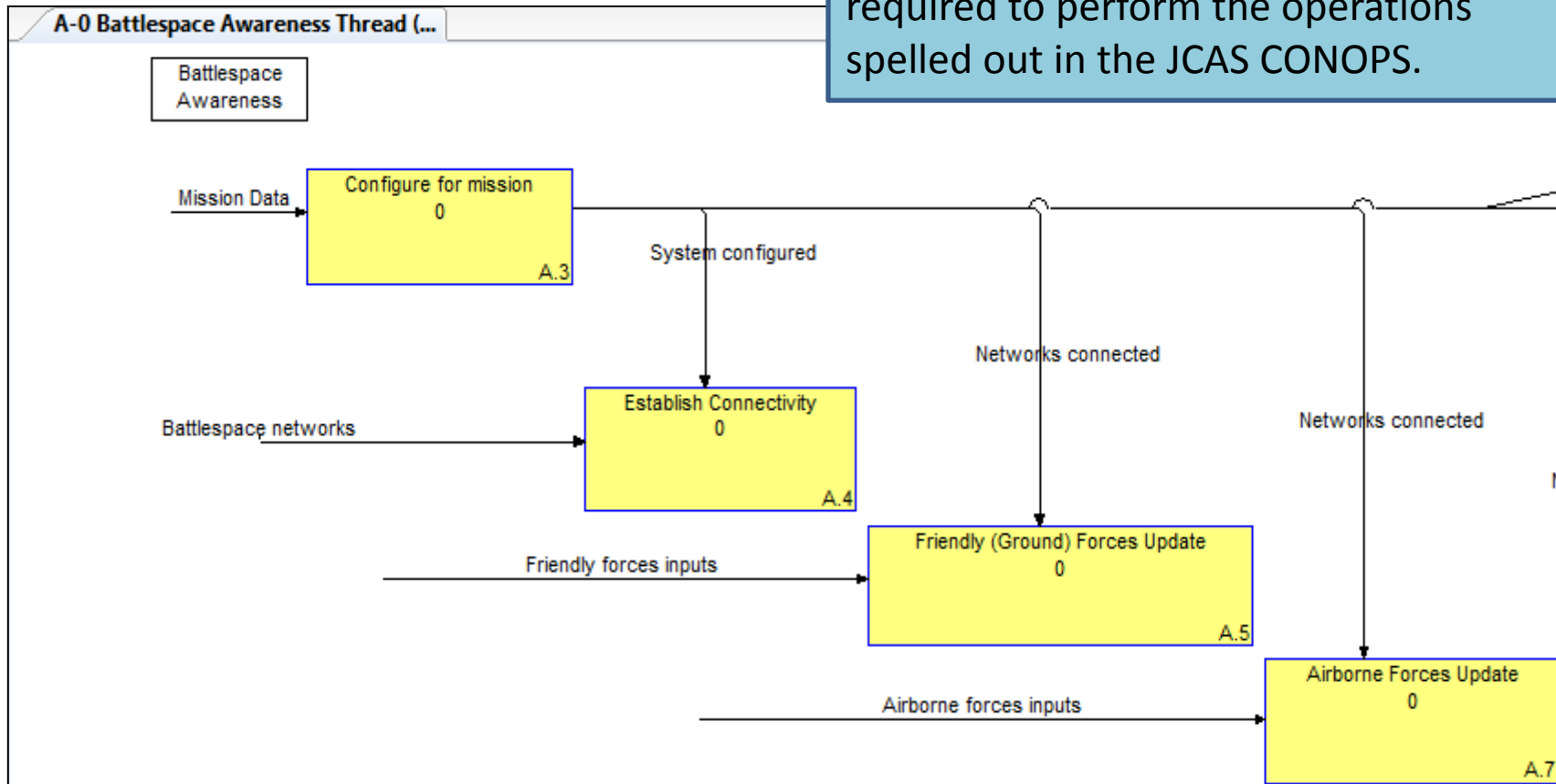
Operational Architecture Thread

- 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

ID						
				transmitted by the transmitting node and its coordinates are adjusted/rounded beyond one one-thousandths (.001) minute		
6.3.5	Networked, fast, and lethal	Machine-to-Machine (M2M) Information Processing.	A/OA-10 Connectivity shall provide M2M targeting with no manual entry or reentry and with the accuracy needed for sensor and weapon cueing	Same as Threshold		by the pilot with a high confidence level Operational necessity to reduce pilot workload (HSI/HFE) and for the most effective and efficient weapons employment, and minimize F2T2EA kill chain times. Sensor cueing may also help prevent fratricide when linked to the BFT information available on the tactical net.
6.3.6	Networked, Precise, Adaptable/Tailorable, and Expeditionary	Digital Map and Near Real-Time Imagery.	A/OA-10 Connectivity shall provide capability for storage and display of existing digital maps at scales of 1:1M and 1:500K for an area of 170,000 square miles (approximate size of Iraq or comparable sized area in any theater of operation); or 1:250K for an area of 85,000 square miles (approximately half the size of Iraq or comparable sized area in any theater of operation)	The A/OA-10 Connectivity modification should provide capability for storage and display of existing digital maps at scales of 1:50K, 1:100K, 1:250K, 1:500K, 1:1M, 1:2M, and 1:5M as moving and static maps for an area of 170,000 square miles		Values calculated to enable maximum storage within existing mass memory capacity and required area based on OIF and OEF lessons learned. Intent is to keep program costs down by not requiring new memory capacity for this modification, while still meeting operational requirements. Operational necessity to provide pilot situational awareness in intended environment (HSI/HFE).
2837	14.1 Key System Attributes.					
2838	Diagnostics and Prognostics. Collection, refinement, compilation, integration, and distribution of aircraft status elements into an overall support database are critical to successful A/OA-10 employment throughout its entire operational spectrum. A/OA-10 Connectivity will integrate applicable and effective on-board monitoring/ recording devices and software, i.e., Built-In-Test (BIT), that provide enhanced capability for fault detection and isolation, monitor various components and indicate out of range conditions, imminent failure probability, and similar proactive maintenance optimization actions to optimize the time to repair of the Processor. Emphasis must also be on accuracy and minimization of false alarms. On-board collected data shall be provided so it facilitates the immediate start of ground servicing and other recovery actions as well as a more detailed and comprehensive analysis of in-flight failures and					





System Requirements

- Derived from Operational Requirements



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

ID	Function	Subfunction	Threshold Requirement
119	COMM-003	Comm General Interoperability Platforms	<p>The A-10 shall be capable of providing digital data and voice to the Tactical Air Control System (TACS) that include, but not be limited to the following platforms:</p> <ul style="list-style-type: none"> - 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,).
120	COMM-004	Comm General Data Link	<p>The A-10 shall support a selected DoD standard digital data link communication capability.</p>
121	COMM-005	Comm General Data Link Interoperability	<p>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:</p> <ol style="list-style-type: none"> 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 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.

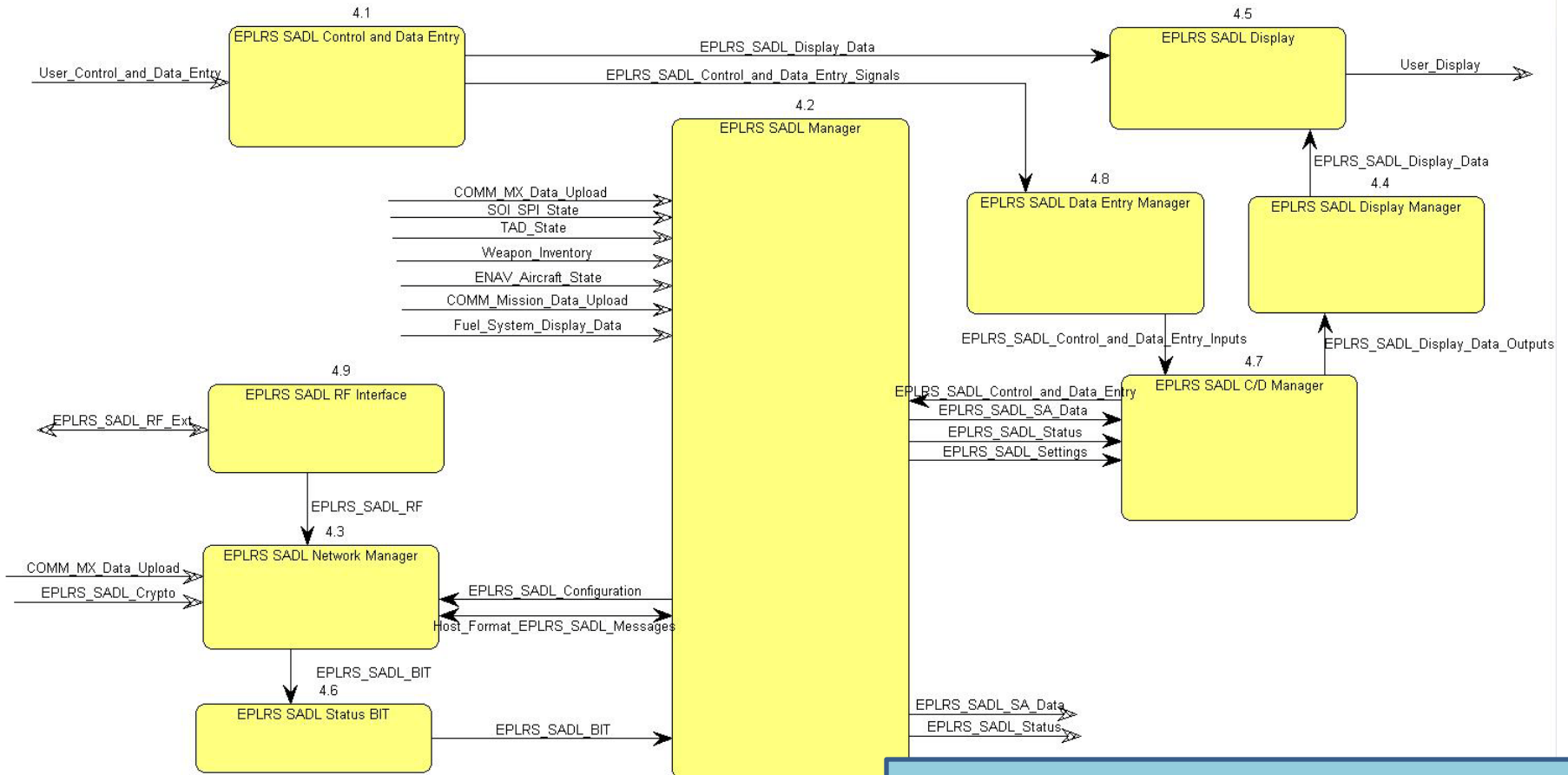


System Functional Architecture

- 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.



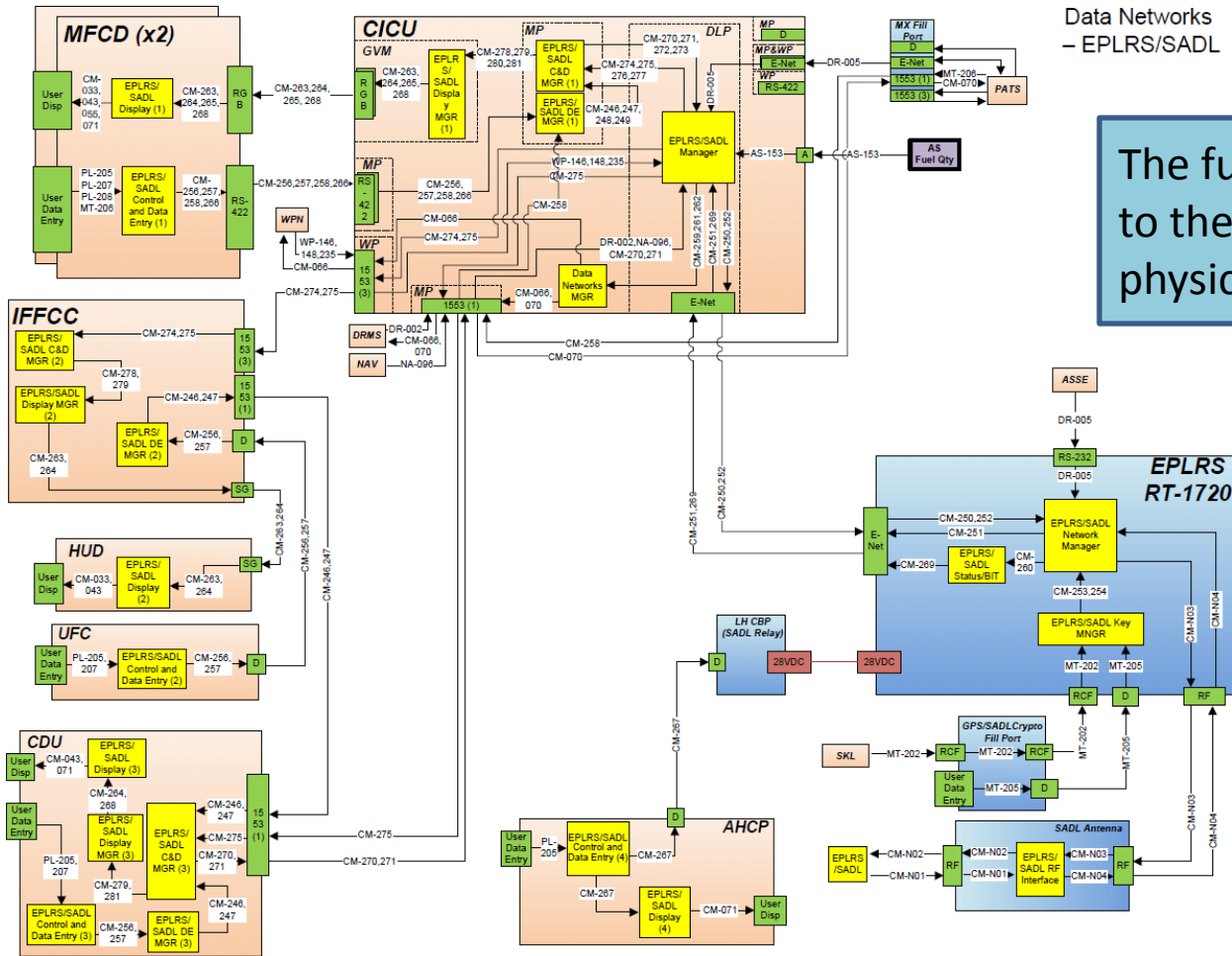


System Physical Architecture

- 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.



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PATH FORWARD



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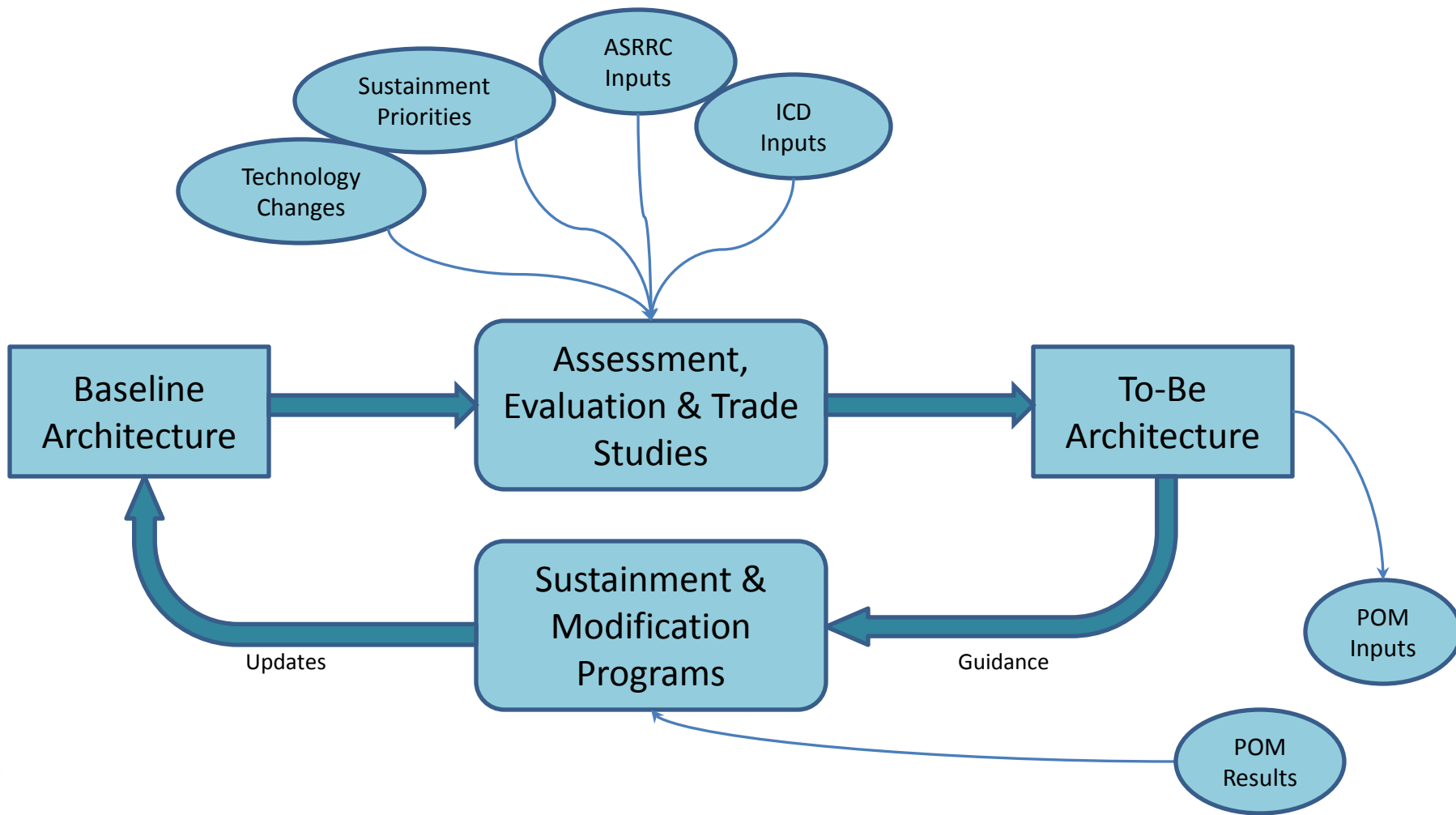
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Roadmap Process



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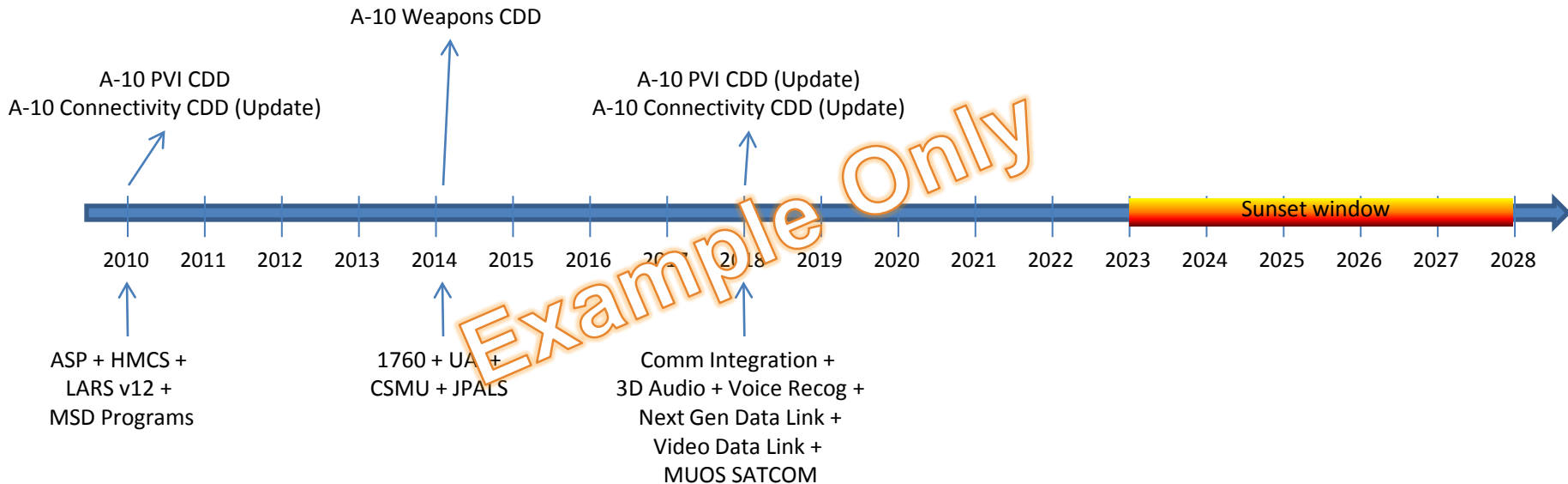


Notional SV-8



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Systems/Services Evolution



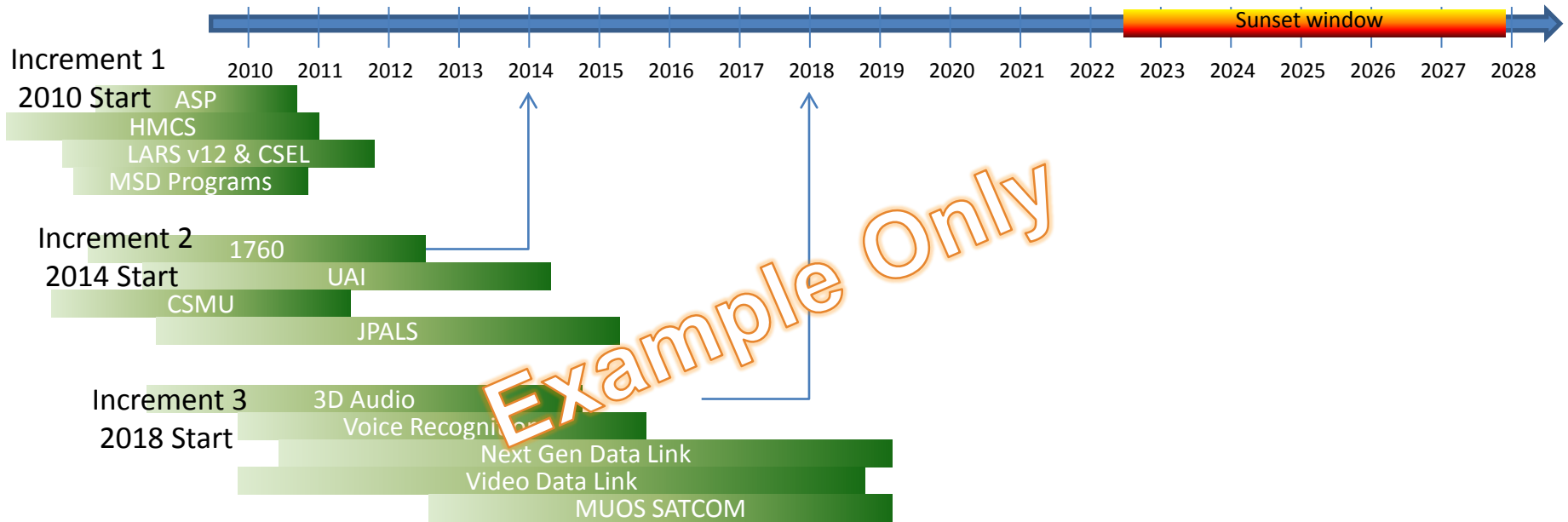


Notional SV-9



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Technology Forecast



Key

Technical Maturity Level

Low High





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RESULTS



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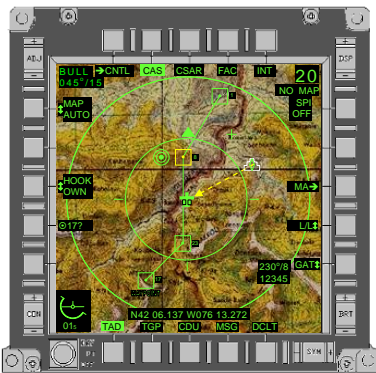


AVSATA Results



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- 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-10 Avionics 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 including aging displays, high maintenance drivers with obsolescence issues with 5 new LRUs per aircraft)

SM: <u>XXXXXXXXXX</u>	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17
ADJUSTMENT			18.25	16.4	39.78	48.51	48.92	26.43
REV PGM TOTAL			18.25	16.4	39.78	48.51	48.92	26.43

PROCUREMENT	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17
ASP	18.25	16.4	10.1	11.5	50			
ADJ	3.2	40.85	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

Example Only

IMPACTS:

- (U) RQMT, *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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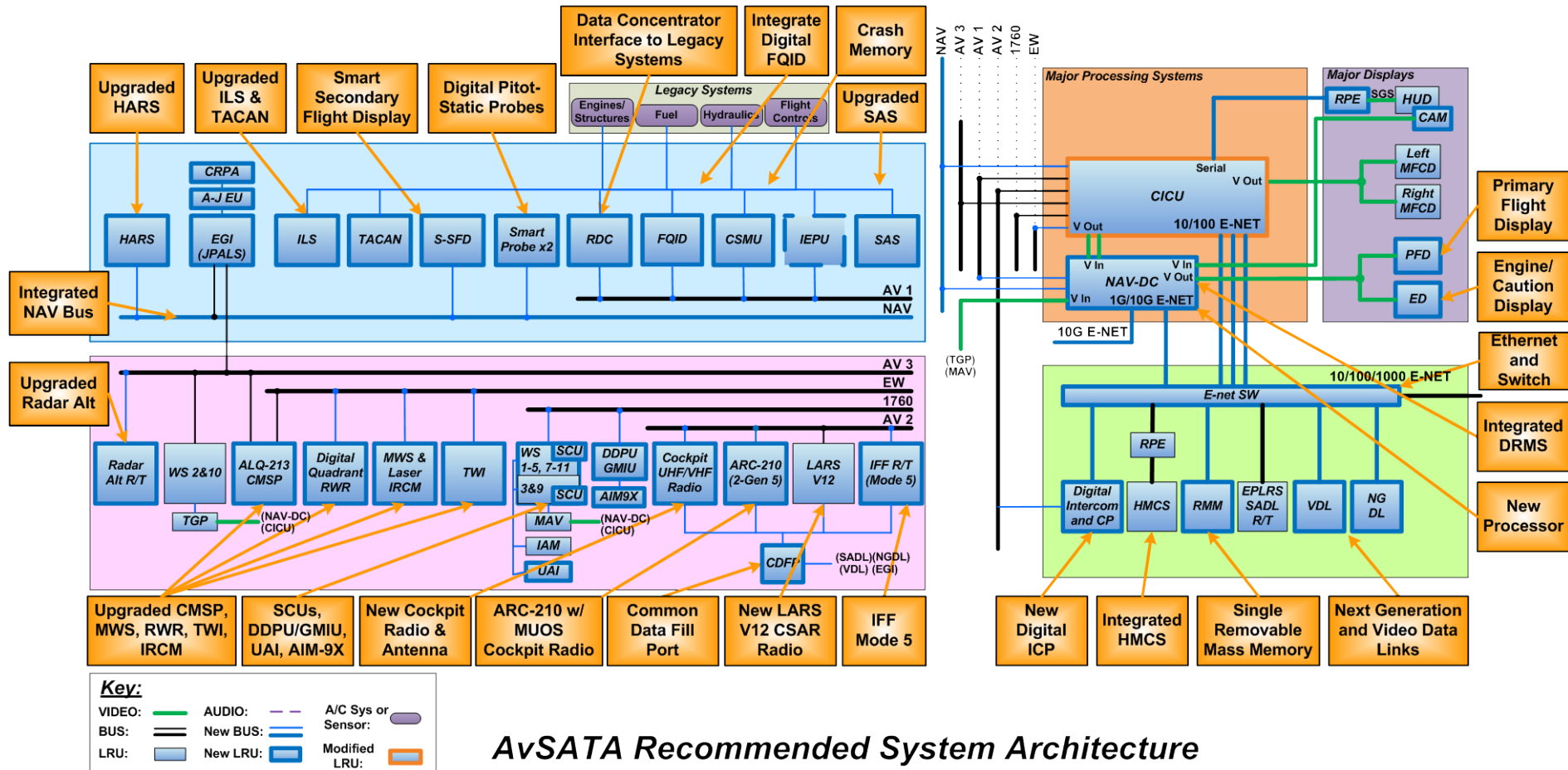
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Systems and Systems Sustaining Engineering



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AvSATA Recommended System Architecture





Biographies



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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)



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