Headquarters U.S. Air Force

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USAF Work on Weapon System Government Reference Architectures

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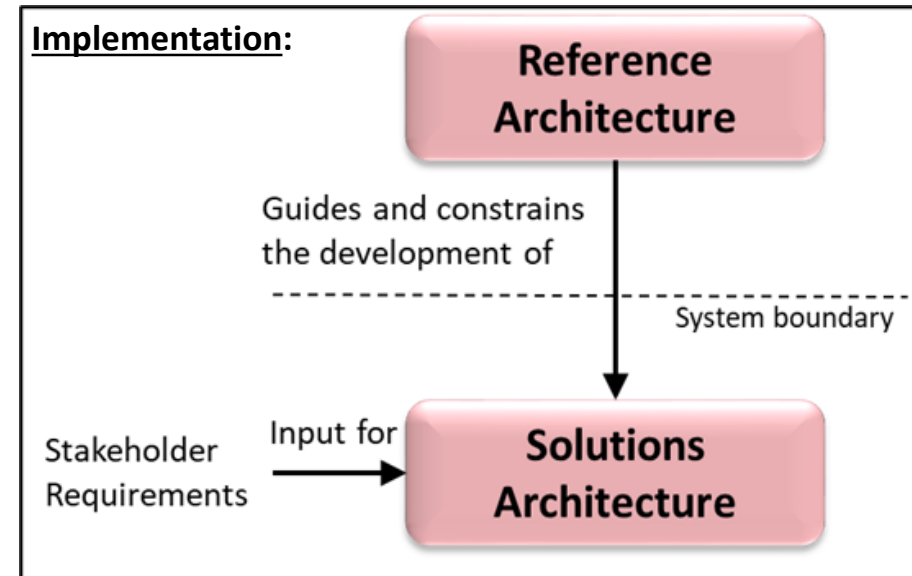AFMC/ENS
December 2021

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BLUF: The AF is working to develop a Weapon System Government Reference Architecture (GRA) Strategy to reduce waste from duplicative efforts

- **High Level Definitions - Difference Between Reference & Solution Architectures**

- **Example of Multiple Reference Architectures Working Together**

- **How Standards Relate to Reference Architectures**

- **USAF GRA & Standards Catalog**

- **How Models Relate to Architectures**

- **Future Work for Air Force GRA Governance**

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- **RA: An authoritative source of information about a specific subject area that <u>guides and constrains</u> the instantiations of <u>multiple architectures</u> and solutions[1,2]**

- **GRA: Government-owned, authoritative source of information about a specific subject area that <u>guides and constrains</u> the instantiations of capability architectures and solutions[2]**

- **Per the Mission Eng Guide a GRA: integrates the data, information, boundary conditions and rules that describe the mission capability needed by the warfighter in sufficient detail to allow for transition of technology-based solutions**

Implementation:

Reference Architecture Purpose[3]

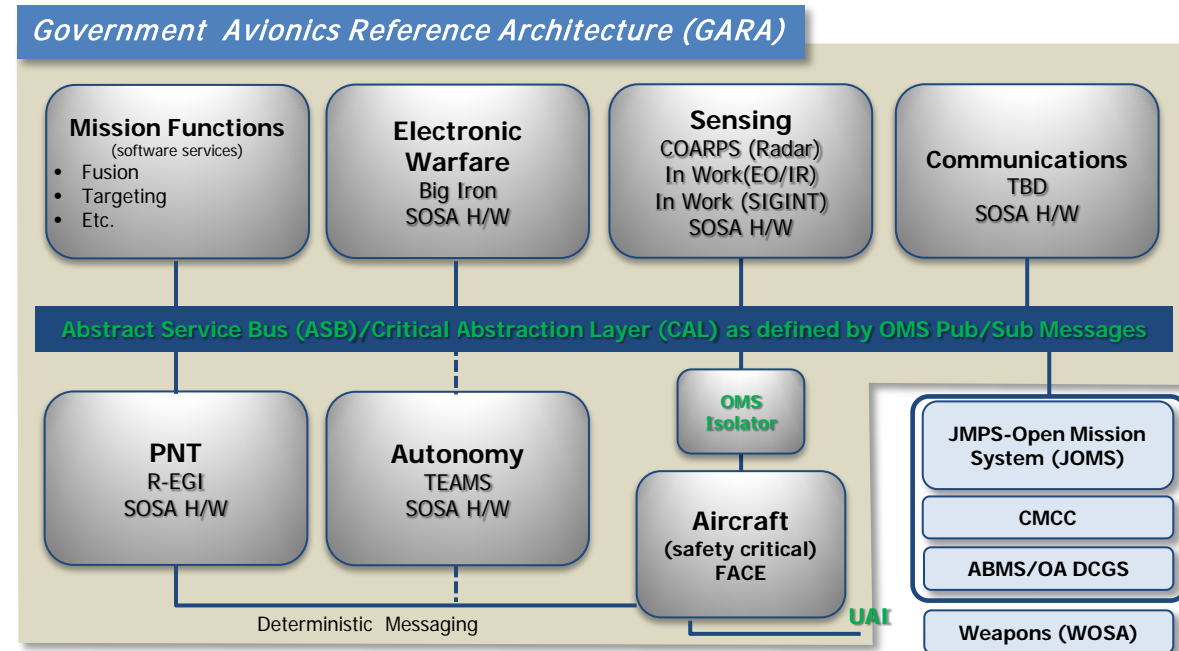**[1]DoD Reference Architecture Description, June 2010**   **[2]Mission Engineering Guide, November 2020**

[3]DoD Reference Architecture Purpose June 2010

Example Case of a GRA for USAF Avionics

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Government Avionics Reference Architecture (GARA)

Standards
OMS/UCI
Universal Armament Interface (UAI)
Sensor Open Systems Architecture (SOSA)
Common Open Architecture Radar Program Specification (COARPS)
Resilient – Embedded GPS/INS (R-EGI)
Big Iron
Teaming-Enabled Arch for Manned-Unmanned Systems (TEAMS)
Future Airborne Capabilities Environment (FACE)

Mission Functions (software services)
- Fusion
- Targeting
- Etc.

Electronic Warfare
Big Iron
SOSA H/W

Sensing
COARPS (Radar)
In Work(EO/IR)
In Work (SIGINT)
SOSA H/W

Communications
TBD
SOSA H/W

Abstract Service Bus (ASB)/Critical Abstraction Layer (CAL) as defined by OMS Pub/Sub Messages

PNT
R-EGI
SOSA H/W

Autonomy
TEAMS
SOSA H/W

OMS Isolator

Aircraft (safety critical) FACE

JMPS-Open Mission System (JOMS)

CMCC

ABMS/OA DCGS

Weapons (WOSA)

Deterministic Messaging

UAI

- **GRAs are not full implementations; they help _guide and constrain_ designs**

- **Multiple Standards are combined in this GRA to create a holistic Avionics Picture**

- **Program Offices can take advantage of parts or all of a GRA to suit their specific needs**

- **Models of the GRA enable clearer industry-government communications**

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Standards & Architectures

Interface Management:
The functional and physical characteristics required to exist at a common boundary or connection between persons, between systems, or between persons and systems. A system external to the system being analyzed that provides a common boundary or service that is necessary for the other system to perform its mission in an undegraded mode, e.g., a system that supplies power, cooling, heating, air services, or input signals – DAU Glossary

Standards:
Standards documents can serve as Interface Management Reference Architecture elements

Open Architecture Standards:
Help provide common interface management techniques for certain architectural areas (usually targeted to specific domains and/or functional areas

Standards are elements included in Reference Architectures

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USAF GRA & Standards Catalog

- **The Air Force has developed an initial Catalog of Standards and Reference Architectures on the "Digital Guide" website.**
  https://wss.apan.org/af/aflcmc/default.aspx

- **We track GRA's, Standards Containing Interface Management Elements, and Standards Containing Reference Architecture and Interface Management Elements**

- **This Body of Knowledge allows Programs to understand the various efforts available across the Department of the Air Force**
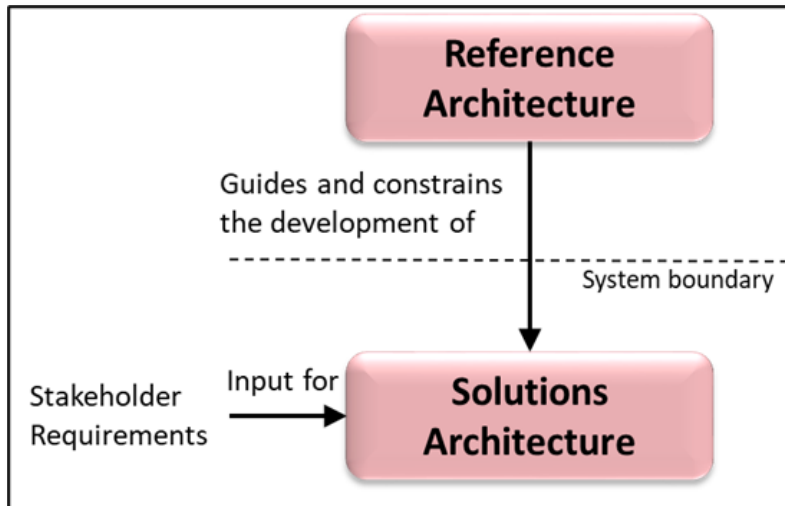
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- **Models are defined as "A representation of an actual or conceptual system that involves mathematics, logical expressions, or computer simulations that can be used to predict how the system might perform or survive under various conditions or in a range of hostile environments" – DAU Glossary**

- **Architectures can be represented by models (and that is the desired end state as part of the USAF and USSF Digital Transformation)**

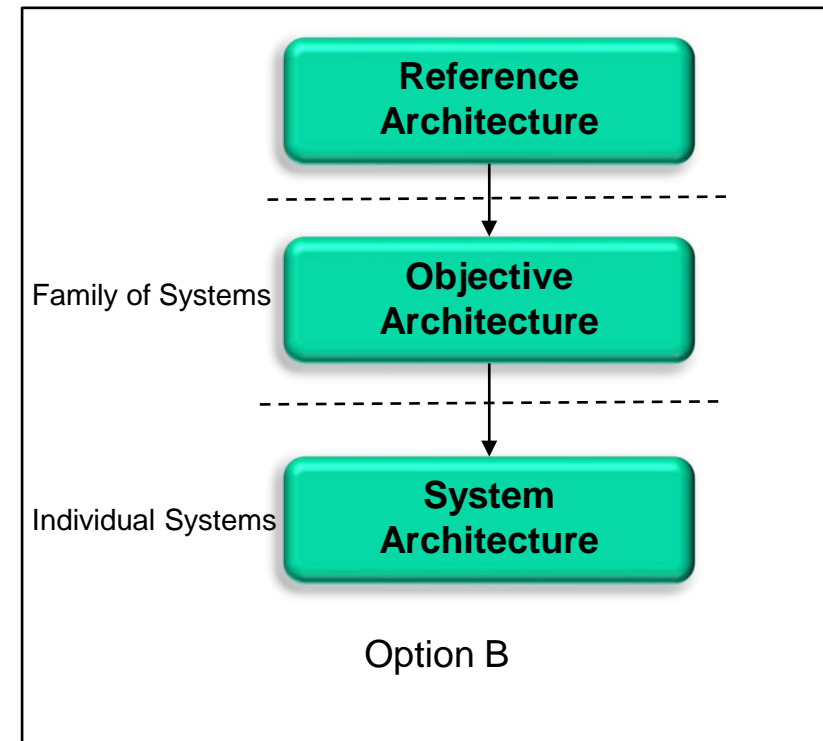- **A Government Reference Model is a GRA provided as an output of a Modeling Tool. At this point the terms become synonymous**

Side by Side Architecture Decomposition

■ **The Digital Campaign has not settled on one architectural decomposition technique. Currently Program Offices are using the Terms, Program Architecture, or System Architecture in place of the term Solution Architecture**
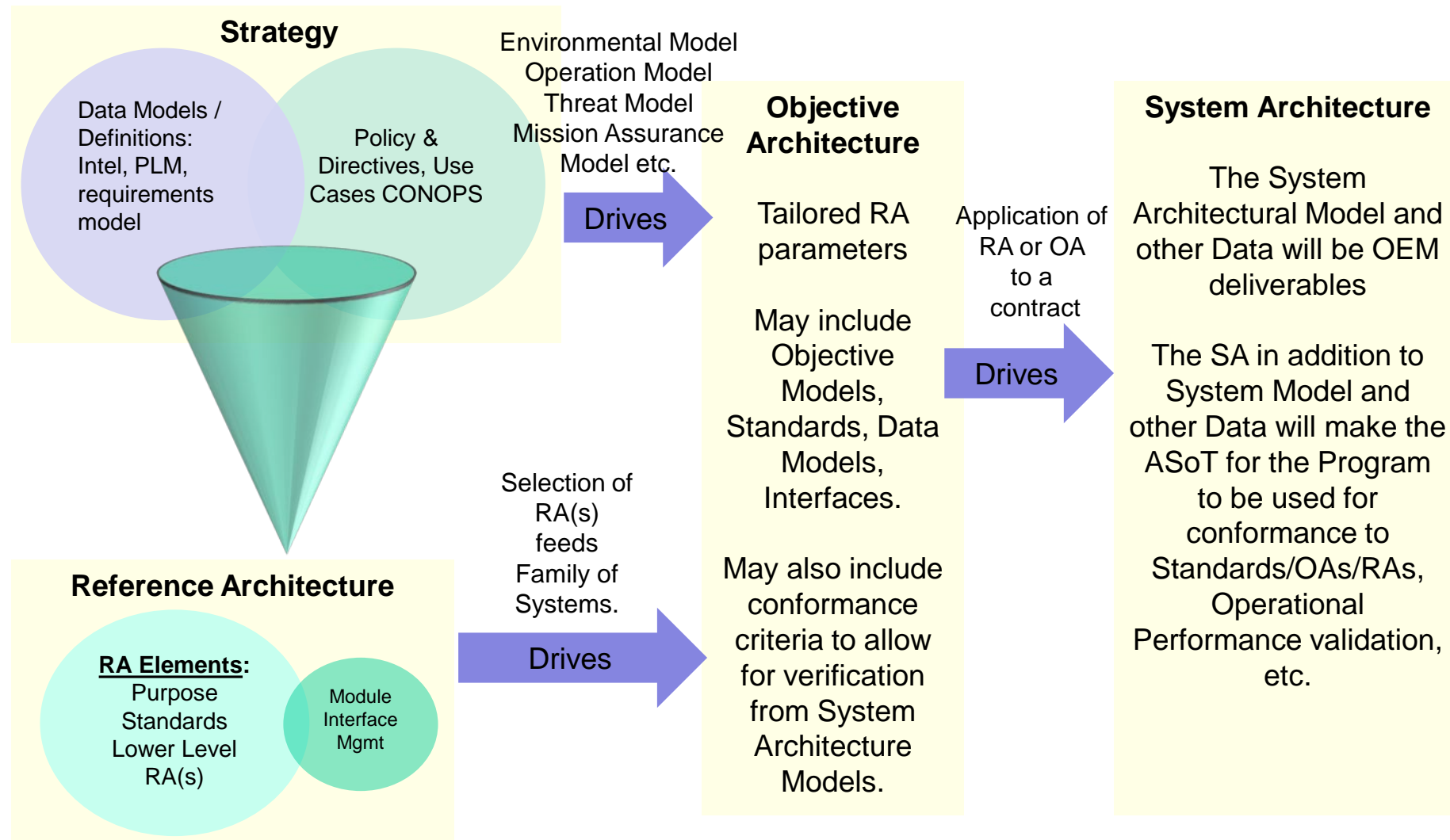

Option A

Option B

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Strategy

Data Models / Definitions: Intel, PLM, requirements model

Policy & Directives, Use Cases CONOPS

Environmental Model
Operation Model
Threat Model
Mission Assurance Model etc.

Drives

Reference Architecture

RA Elements:
Purpose
Standards
Lower Level
RA(s)

Module Interface Mgmt

Selection of RA(s) feeds Family of Systems.

Drives

Objective Architecture

Tailored RA parameters

May include Objective Models, Standards, Data Models, Interfaces.

May also include conformance criteria to allow for verification from System Architecture Models.

Application of RA or OA to a contract

Drives

System Architecture

The System Architectural Model and other Data will be OEM deliverables

The SA in addition to System Model and other Data will make the ASoT for the Program to be used for conformance to Standards/OAs/RAs, Operational Performance validation, etc.

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Future Work for GRA Governance

- **GRA development in the AF has been bottoms up, so governance structures are being explored**

- **Possible Courses of Action for improving GRA governance:**
  - **An Architecture Review Board Structure**
  - **Engineering Senior Leadership works in conjunction with the Directors of Engineering and execution organizations like the Open Architecture Management Office**
  - **Air Force Materiel Command Centers, and Space Program Executive Agents act as GRA Governance Board**
  - **Formal governance board established in conjunction with Digital Transformation Office**

Questions?

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