THE Open GROUP

FACE™ Future Airborne Capability Environment

SOSA™ Sensor Open Systems Architecture

U.S. Army FACE™ & SOSA™ Technical Interchange Meeting

SOSA Overview

Huntsville Alabama
September 14, 2021

U.S.ARMY

PROGRAM EXECUTIVE OFFICE AVIATION

The SOSA Approach in a Nutshell*

Who Are We?

- Air Force, Navy, Army, other Government Agencies, and Industry

What Are We Doing?

- **Developing** a unified technical Open Systems Architecture standard
- **Radar, EO/IR, SIGINT, EW, and COMMS**

Why Are We Doing It?

- **Improve** sub-system, system, and platform affordability, re-configurability, upgradability, and hardware/software/firmware re-use
- To shorten cycle times to counter emerging threats

How Are We Doing It?

- **Developing** an OSA via modular decomposition (defining functions and behaviors) and associated interfaces (including physical, protocol, and data structure) between the modules

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* Based on abstract of "Sensor Open System Architecture (SOSA) Evolution for Collaborative Standards Development," SPIE Open Architecture/Open Business Model Net-Centric Systems and Defense Transformation 2017

SOSA Consortium Vision and Goals

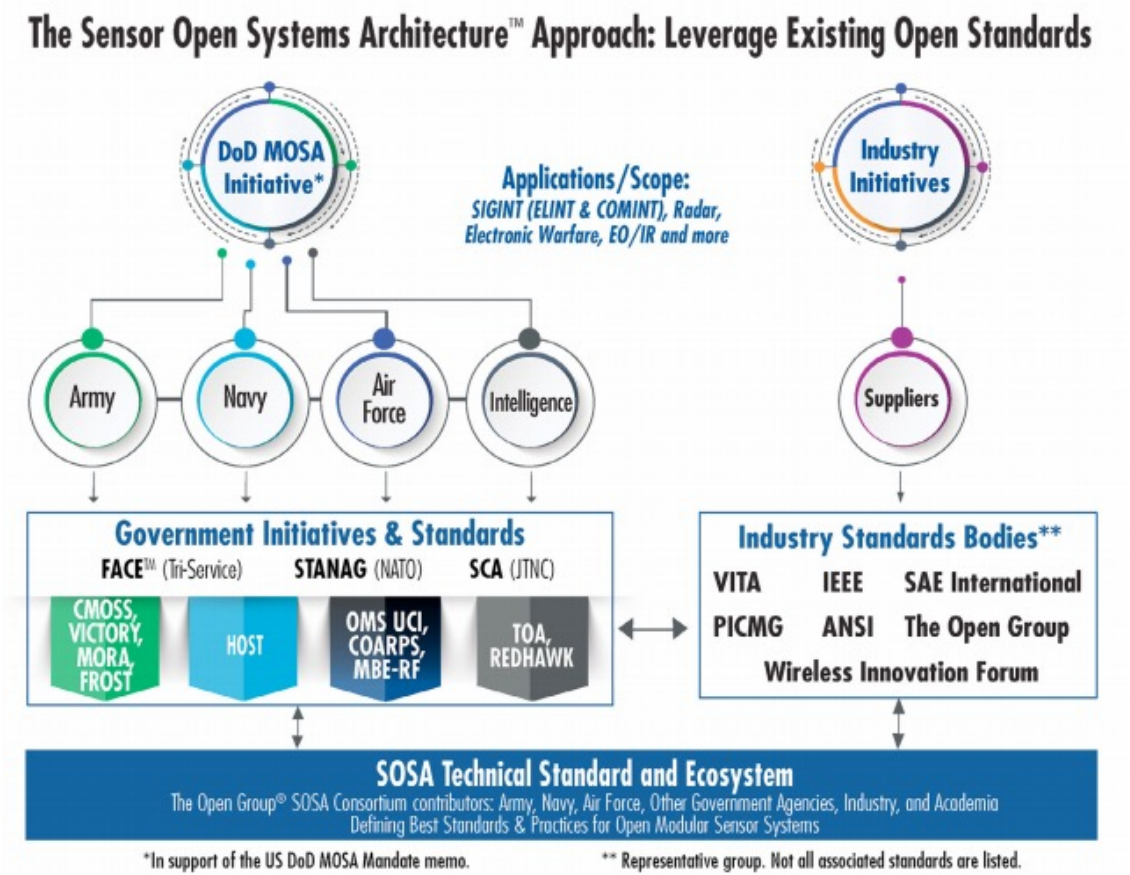
Our Vision

Fosters **innovation**
Industry **engagement**, **competition**
Allow for **rapid fielding** of cost-effective capabilities and platform mission reconfiguration while minimizing logistical requirements

Our Goals

Open	Standardized	Harmonized	Aligned	Cost Effective	Adaptable
Vendor- and platform-agnostic open modular reference architecture and business model	Software, hardware, and electrical-mechanical module interface standards	Leverage existing and emerging open standards	Consistent with DoD acquisition policy guidance	Affordable C4ISR systems including lifecycle costs	Rapidly responsive to changing user requirements

SOSA Approach



Anticipated Benefits with SOSA

Government

- **Faster/more efficient and more cost-effective acquisition**
  - Adherence to the NDAA'17 MOSA mandate
  - Standardized system composition, known interfaces
  - More efficient tech transition
- **Improved Lifecycle and supportability**
  - Commonality and reuse of components across systems
  - Tech insertion (new capability)
  - Tech insertion (obsolescence)
- **Interoperability**
  - Between SOSA systems
  - Within SOSA systems
  - Across DoD deployed Product Families

Industry

- **Reduces development cost, risk, and time**
  - Leverage proven modular decomposition
  - Leverage known interface definitions (no need to invent)
  - Leverage standards-based tooling
- **Creates opportunities for strategic sourcing**
  - COTS Suppliers
  - Small businesses and non-traditionals can integrate components into prime systems
- **Facilitates Product Family Development**
  - Base Product Family Architectures on the SOSA Architecture
  - Leverage inherent composability
  - Tremendous reuse opportunity

Industry/Government Partnership Reflected in Consortium Membership

Sponsor Level Members

- Air Force Life Cycle Management Center
- Boeing
- Collins Aerospace
- Joint Tactical Networking Center
- Lockheed Martin
- NAVAIR
- U.S. Army CCDC C5ISR
- U.S. Army PEO Aviation
- U.S. Army Project Manager Electronic Warfare and Cyber
- U.S. Space Force Space and Missile Systems Center

10 Sponsor Level Members

Principal Level Members

- Advantech Corp
- BAE Systems, Inc.
- Booz Allen Hamilton
- Cubic Corporation
- Elbit Systems of America
- FLIR Systems, Inc.
- GE Aviation Systems
- General Dynamic
- Huber+Suhner Astrolab
- Intel Corporation
- L3Harris
- Mercury Systems
- Northrop Grumman
- Raytheon
- Sierra Nevada Corporation
- SRC Inc.
- VadaTech Inc

17 Principal Level Members

Industry/Government Partnership Reflected in Consortium Membership

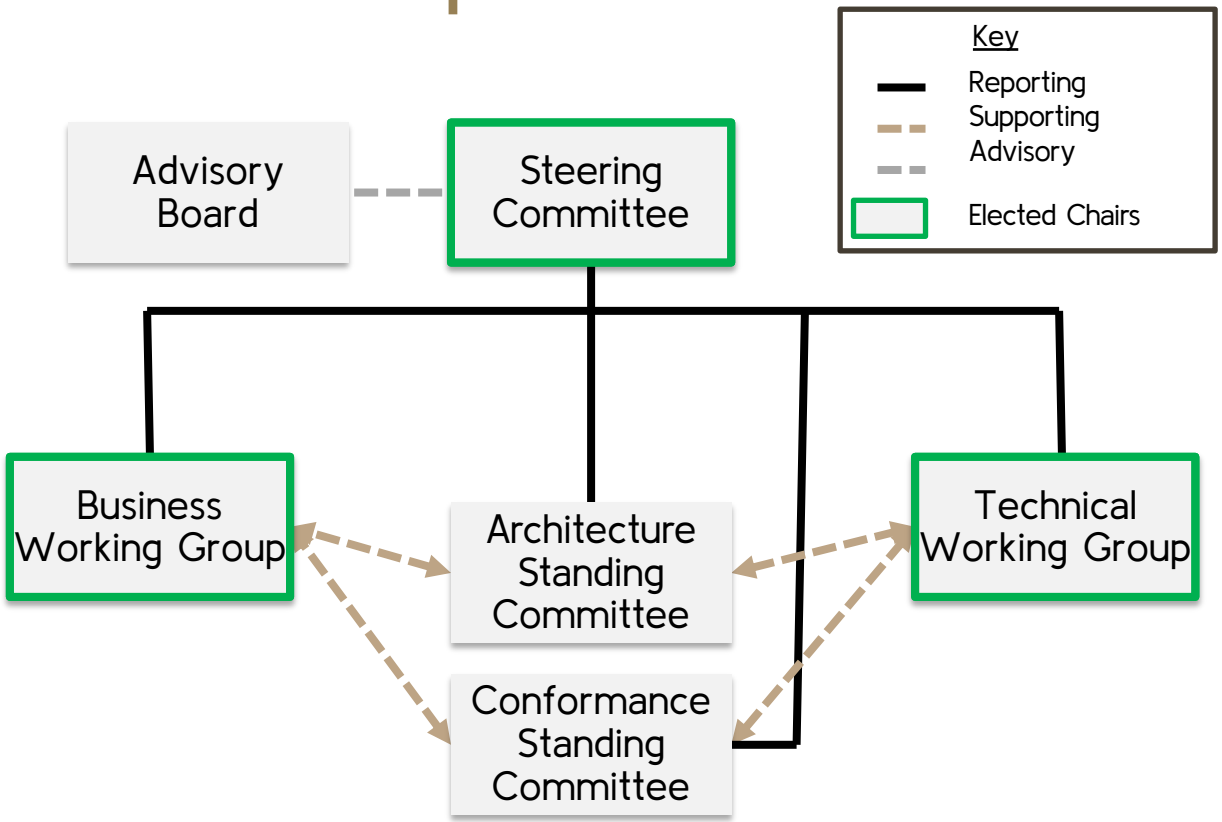
Associate Level Members

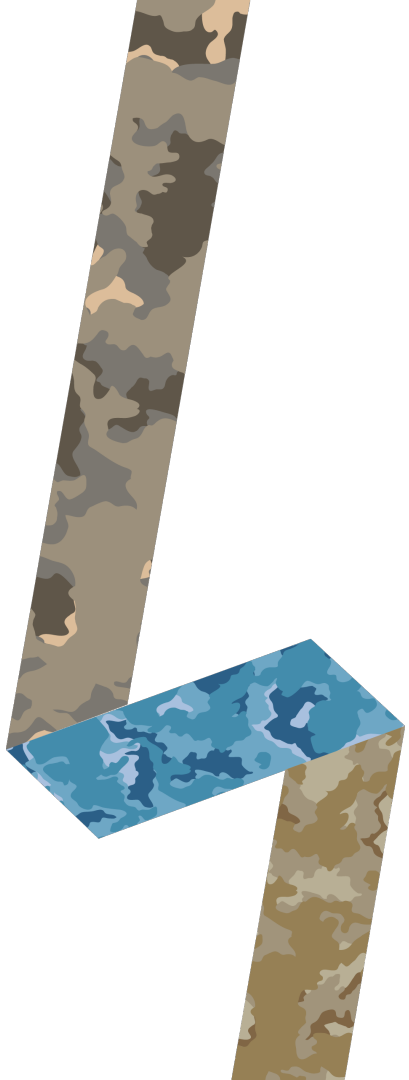
Abaco Systems
Acromag, Inc.
Aegis Power Systems
Aitech
AirBorn, Inc.
Ampro ADLINK Technology, Inc.
Anduril Industries, Inc.
Annapolis Micro Systems, Inc.
AREA-I, INC
Ascendant Engineering Solutions, LLC
Atrenne, A Celestica Company
Ball Aerospace
Behlman Electronics, Inc.
Booz Allen Hamilton
CACI International, Inc.
Chameleon Consulting Group, L.L.C.
Cobham Advanced Electronic Solutions Inc
CodeMettle, LLC
Comtel Electronics, Inc.
Concurrent Technologies
CoreAVI
COTSWORKS, LLC
CRFS, Inc.
Critical Frequency Design
Crossfield Technology
Curtiss-Wright Defense Solutions
Cynosure, Inc.
Dawn VME Products
Delta Information Systems
DornerWorks
DRS Signal Solutions
DRTI
EIZO Rugged Solutions, Inc.
Elma Electronic Inc.
ENSCO Avionics Inc.
Epiq Solutions
FEI-Elcom Tech, Inc.
FiberQA
Freedom Power Systems, Inc.
Georgia Tech Research Institute
GORE
Herrick Technology Laboratories, Inc.
IDEAS Engineering and Technology, LLC
iRF Solutions
ITZ, LLC
Jacobs
Jovian Software Consulting LLC
Kontron America

99

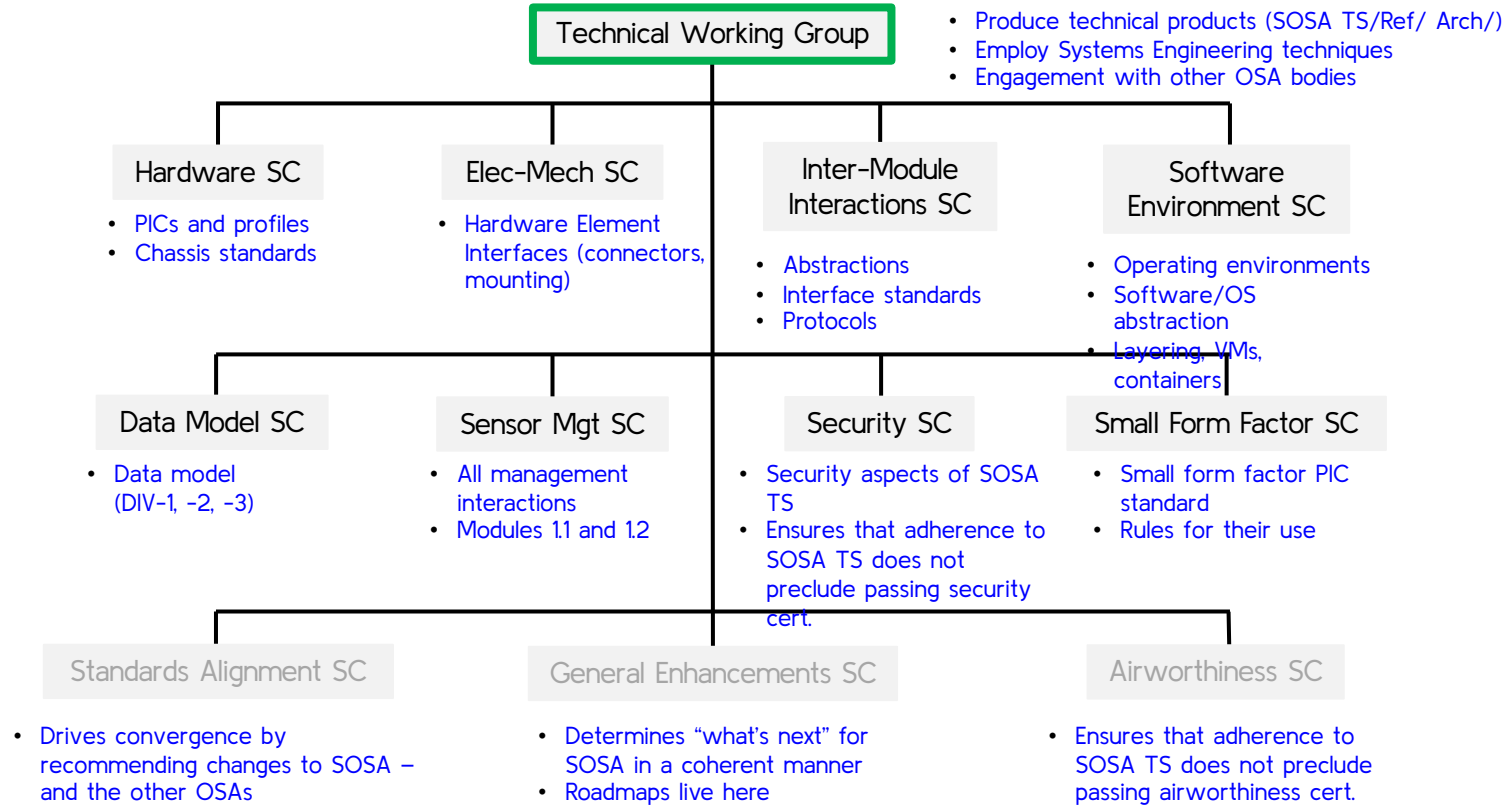
LCR Embedded Systems, Inc.
Lead Dog Technologies, LLC
Leidos
LGS Innovations
Meritec
Micro Focus (US), Inc.
Micropac
Midwest Microwave Solutions Inc
Milpower Source
Motorola Solutions
New Wave Design and Verification, LLC
NVIDIA Corporation
North Atlantic Industries, Inc.
Orion Technologies, LLC
Orolia Defense & Security, LLC
PacStar
Parry Labs, LLC
Pentek, Inc.
Perspecta Labs Inc.
Pixus Technologies USA Corp.
QRC Technologies, LLC
RADA Technologies, LLC (RADA USA)
Radiall USA, Inc.
Rantec Power Systems, Inc.
Real-Time Innovations
Red Rock Technologies
Reflex Photonics Corp.
Riverside Research
RTD Embedded Technologies, Inc.
Saab, Inc.
Samtec
ScioTeq LLC
Sciens Innovations
Sealevel Systems, Inc.
Selex Galileo Inc.
Skayl LLC
Southwest Research Institute
Spectranetix, Inc.
Spirent Federal Systems
SR Technologies, Inc.
StreamDSP LLC
SV Microwave
TE Connectivity
Technology Service Corporation
Tektronix, Inc.
Telephonics
Tomahawk Robotics
Tucson Embedded Systems
University of Dayton Research Institute
VITA
Wolf Advanced Technology Inc.

SOSA Consortium Organization and Makeup





SOSA Consortium Organization: TWG



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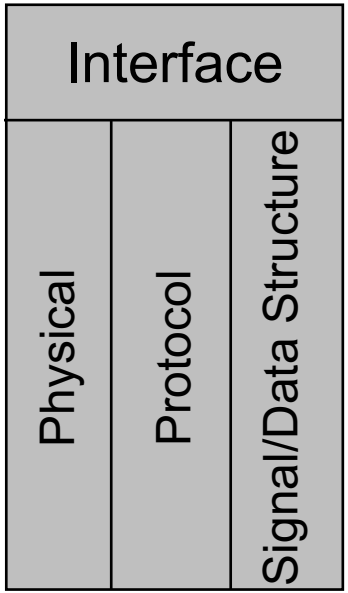
SOSA Overview

SOSA Building Blocks

SOSA Module Interfaces

- Physical: Medium (wire, fiber, etc.) and connector
- Protocol: The method used to exchange the signal or data
- Signal/Data Structure: The "payload" being delivered



SOSA Consortium approach:

- **Top-down** architectural approach, based on DoDAF best practices
  - Conceptual Data Model (DIV-1) documents at a high-level the type and nature of the data to be exchanged
  - Logical Data Model (DIV-2) captures – in detail -- the data content
  - Physical Data Model (DIV-3) documents the physical manifestation of the data (exact format; bits per field, formats, schemas, structures)
- The protocols used to carry the data are defined separately from the Data Model itself
  - a decoupling that ensures that the same data (in the same format) can be carried between source and destination by different means (and as necessary)
- Messages define how those data items are conveyed; messages are constructed by marrying the "payload" with the protocol

SOSA Module Definition Process

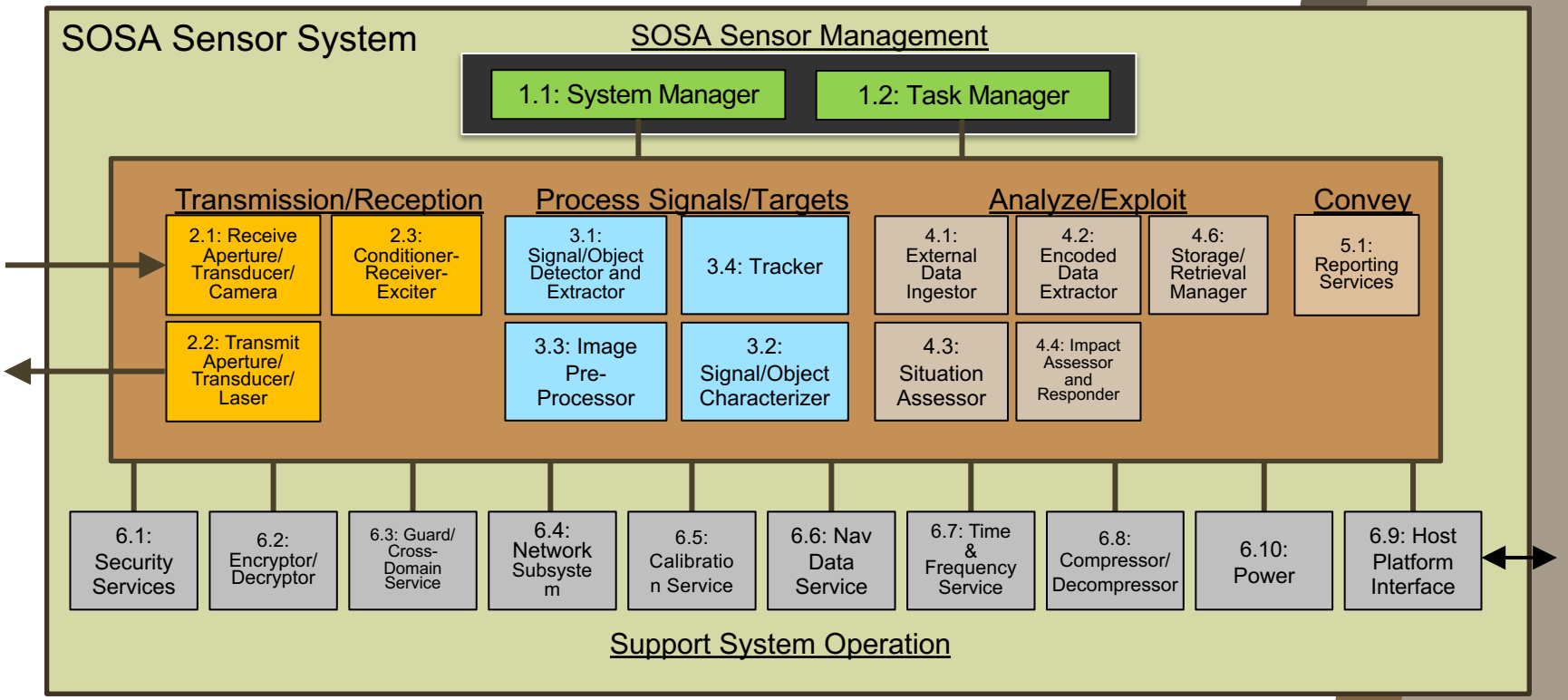
- Identified functions performed within radar, EO/IR, SIGINT, EW, and communications systems
- Aggregated these functions into logical groups, SOSA Modules, based on the following criteria

1. Severable (can be separated and used elsewhere; a SOSA Module can be removed from one system and used in another without needing to be modified) – based on business needs, timing requirements, or other drivers
2. Has minimal complexity interfaces (minimum interdependencies)
3. Can operate as stand-alone or be operated via function/process/system manager; it can be operated independently of the rest of the SOSA sensor
4. Is independently testable
5. Does not expose IP
6. Facilitates competitive procurement
7. Encapsulates rapid change

- For each function within a SOSA Module, we identified
  - What is required for input (not provided by another function inside that SOSA Module) ,and
  - What it produced for an output that is used outside the SOSA Module

The SOSA Technical Standard specifies what the modules do, but not how they do it (IP and innovation are preserved)

SOSA Modules – Logical Building Blocks



Hardware Approach: "Chassis Level" Hardware Building Blocks

Applicable

- To a variety of sensor/avionics platforms

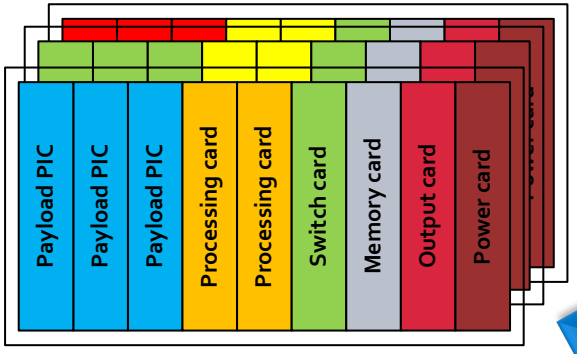
The Plug-in Card

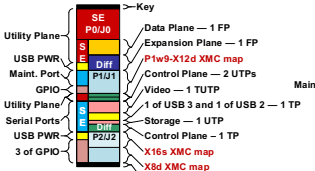
- Is an individual card that fits into a standard chassis.
  - The Plug-In Cards are essentially hardware level building blocks

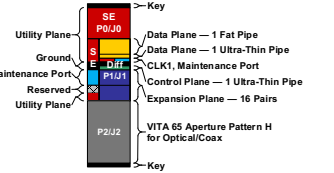
The System

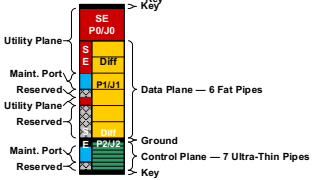
- Is inherently interoperable, and compatible with non-Conformant hardware via a set of standard bridge interfaces that are
  - Portable
  - Upgradeable (evolvable)
  - Securable
  - Scalable through adaptation of technology and Host Platform evolution

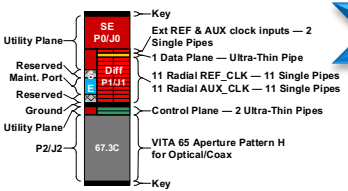
SOSA Hardware Building Blocks

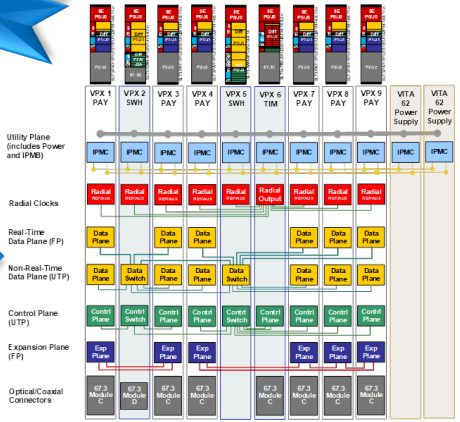


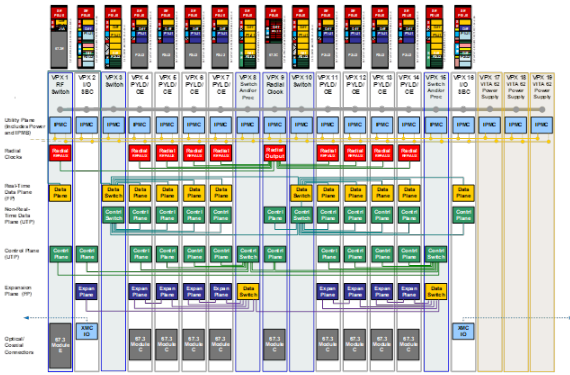












Software and Interaction Building Blocks

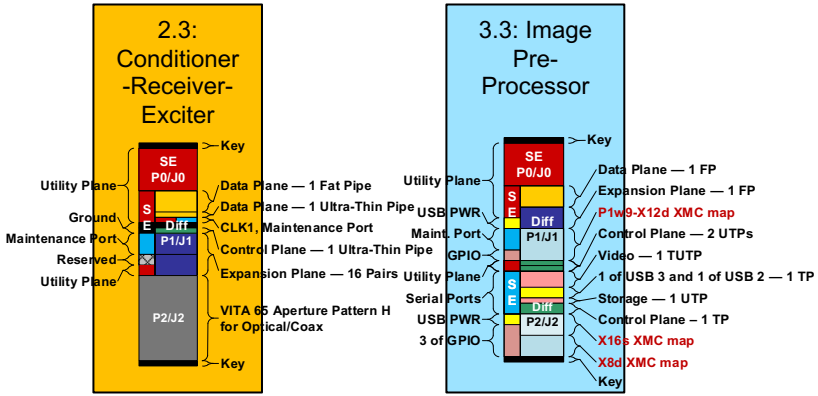
Software Runtime Environment (RTE)

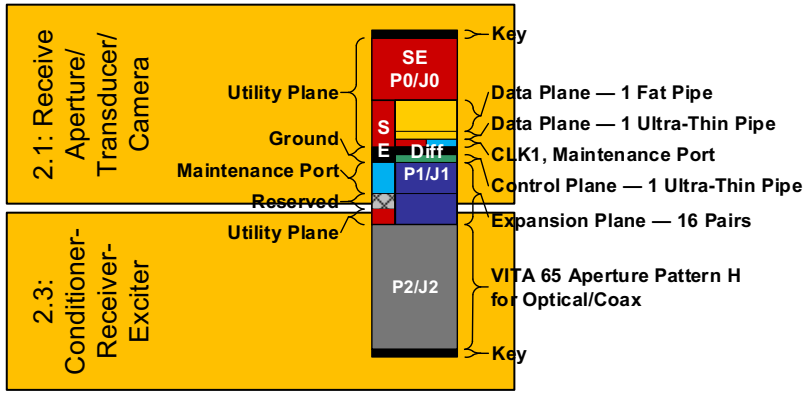
- Building blocks for each type of RTE
- SOSA will make use of FACE as an example
- Others are available

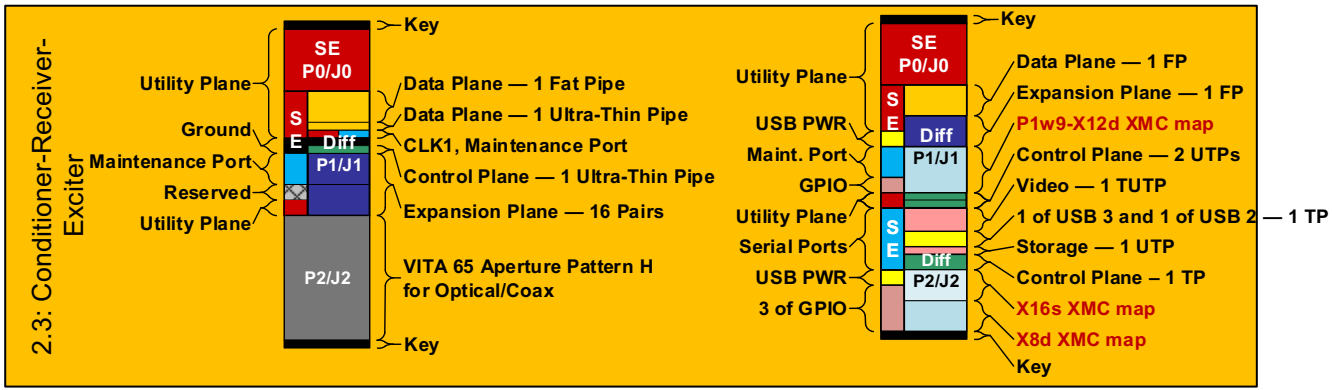
Inter Module Interactions

- SOSA has leveraged a set of interaction bindings to facilitate communication between SOSA Modules

Let Put It All Together

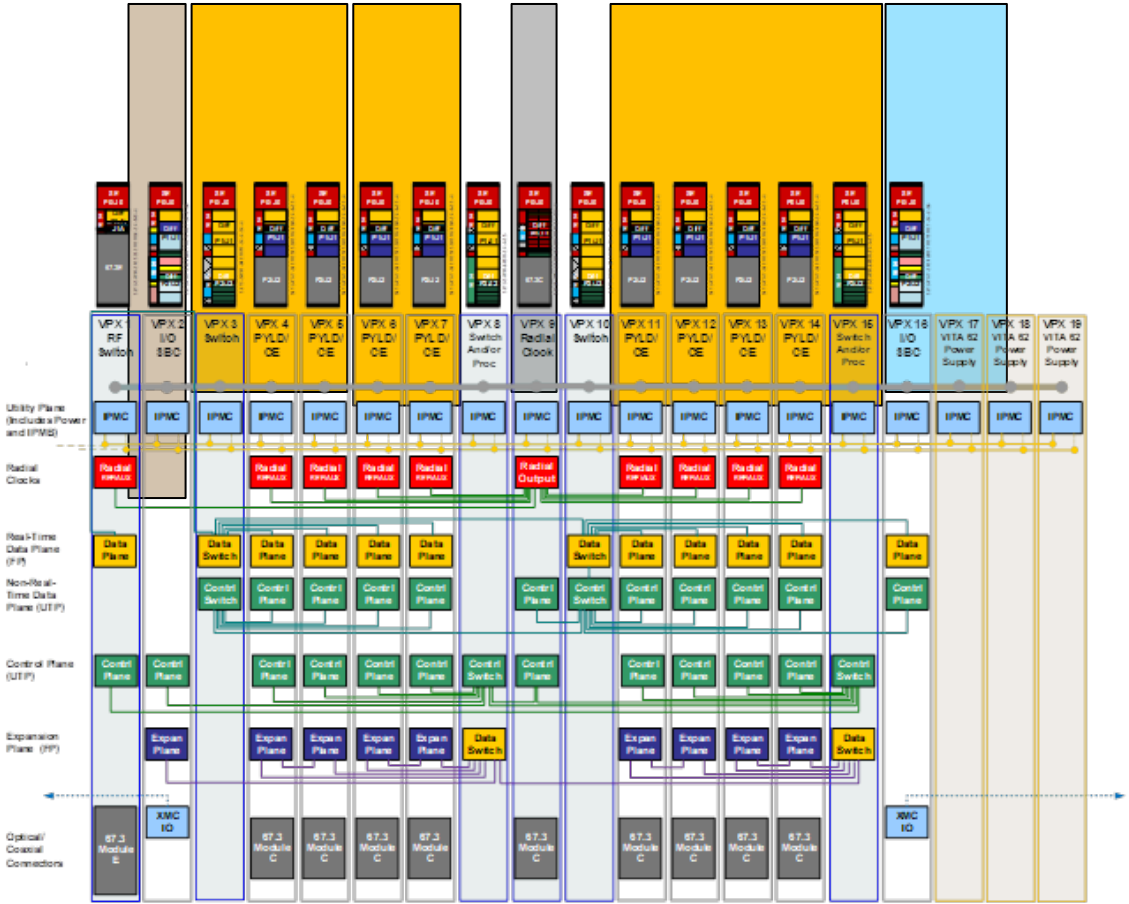






Let Put It All Together

SOSA Modules



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SOSA Overview

SOSA Products

SOSA (Draft) Technical Standard

http://opengroup.org/sosa

- Documents the SOSA Reference Architecture
- Contains normative and non-normative content
- Major Sections – Subset
  - Architecture Overview
  - Architecture Definition
  - StdV-1 (Applicable Standards)
  - AV-2 (Integrated Dictionary)
  - DIV-2 (Logical Data Model) and Data Dictionary
  - Host Platform / Sensor Connector Details
  - Plug-In Card Profiles
  - Backplane Examples

Published and Planned Documentation/Products

Business

- Business Guide (draft v0.8 published)
- Procurement Guide
- Contracting Guide
- Supplier Guide
- Publications Guide
- Instructions to Authors (internal)
- Sample Outreach Material
- Tri-Fold

Technical

- Technical Standard
  - Snapshots 1 (published)
  - Snapshots 2 (published)
  - Snapshot 3 (published)
  - Version 1 (planned for early-2021)
- Reference Implementation Guide (RIG) (to accompany the SOSA Technical Standard)
  - RIG Snapshot 1 (planned concurrent with Version 1)
- Digital Model of the SOSA Reference Architecture

Published and Planned Documentation/Products

Conformance

- Conformance Certification Policy – Awaiting Publication
- Conformance Certification Guide – Awaiting Publication
- Conformance Certification Agreement
- Conformance Statement – Published DRAFT
- Certification Register
- Certification Website
- PC/CR Tool
- Trademark License Agreement
- Verification Matrix Guide
- Conformance Requirements Template – In Process

Key Take-Aways

SOSA Consortium is

- Developing a unified **modular** open reference **architecture** – and associated business model – for radar, EO/IR, SIGINT, EW, and communications
  - Structured, top-down approach: Quality Attributes, Architecture Principles, use of DoDAF
  - Structured with an Infrastructure to provide reusable building blocks for the architecture
- Using a consensus standards-body approach to balance interests of all parties, based on five Working Groups
- A set of products include the SOSA Technical Standard, the Business Guide, and an Operational Conformance Program.
  - Initial "Snapshots" have been released for both

“Do

Or do not,

There is no try.”

- Yoda

FACE™
Future Airborne Capability Environment

Thank You

Any questions?

You can find me at
patrick.collier@aspenconsultinggroup.com

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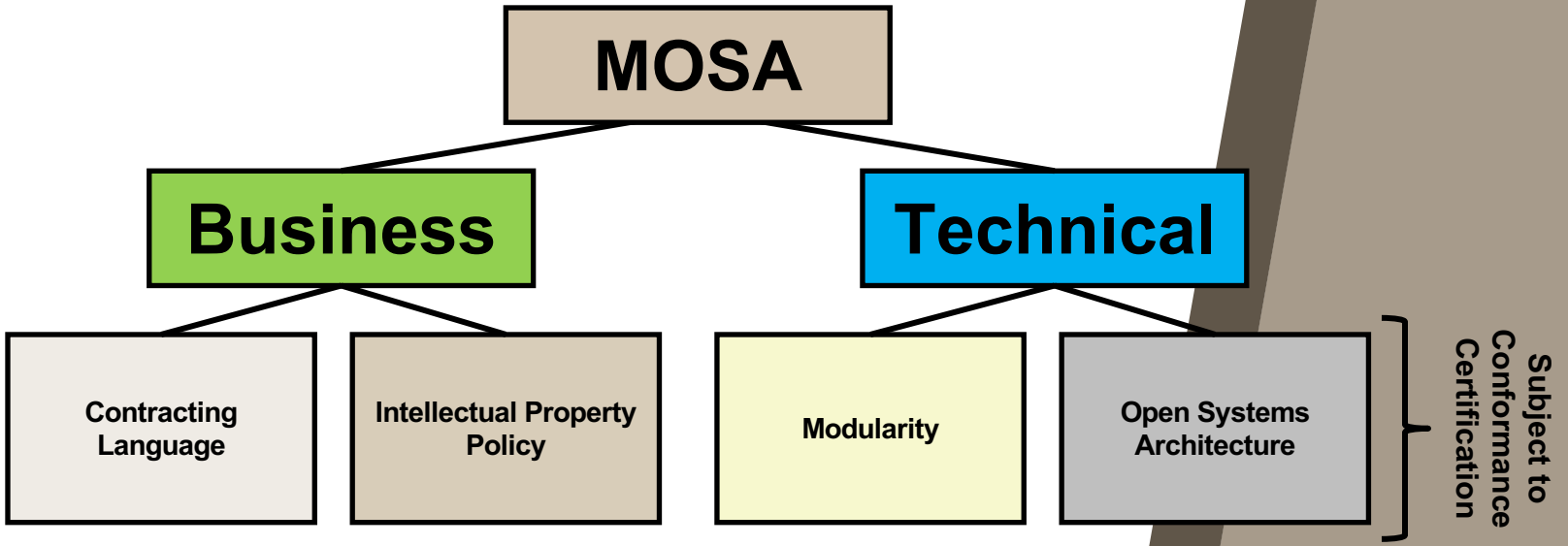
SOSA Overview

SOSA BackUp Slides

Modular Open Systems Approach Decomposed



"… an integrated business and technical strategy to achieve competitive and affordable acquisition and sustainment over the system life cycle"

SOSA Follows an Enterprise Architecture Approach

Driven by business needs

- Balancing interests and concerns of the Government and Industry

Top-down, fundamentals basis

- Based on agreed-upon drivers grounded in how the Business and Technical Architectures will be used

Following DoD MOSA model

- Widely available and published
- Consensus-based in creation and governance
- Verification processes assessing conformance to the Technical Standard

SOSA Quality Attributes (1

Name	Description
Interoperability	The ability of the system to provide data/information to – and accept the same from – other systems, and to use the data/information so exchanged to enable them to operate effectively together. In the context of the SOSA architecture, this quality attribute refers to the ability of SOSA systems to be able to exchange information during operation, and (possibly with adaptation) be able to interoperate with other systems not designed to align with the SOSA Reference Architecture.
Securability	The property of a system such that its design renders it largely protected/inviolable against acts designed to alter functionality or capabilities, or reverse engineer capabilities and/or critical program information — or impair its effectiveness and prevents unauthorized persons or systems from having access to data/information contained within. In the context of the SOSA architecture, this quality attribute ensures that the fundamental architecture is one that has minimal attack surfaces and effective authentication enforcement, and SOSA systems can be designed so that they can adapt to an evolving threat environment.
Modularity	The degree to which a system or element is composed of individually distinct physical and functional units that are loosely-coupled with well-defined interface boundaries. In the context of the SOSA architecture, this quality attribute enforces the establishment of well-defined, well-understood, standardized system modules that can be created and tested individually for function and conformance.
Compatibility	The ability of a system to coexist with other systems without conflict or impairment or be integrated or used with another system of its type. In the context of the SOSA architecture, this quality attribute refers to the ability of SOSA systems to be used or integrated with systems not designed to align with the SOSA Reference Architecture, or with systems designed with earlier versions of the SOSA standard (backwards-compatible).
Portability	An attribute that describes the reuse of existing hardware or software elements (as opposed to the creation of new) when moving hardware or software elements from one environment (physical or computing) to another. In the context of the SOSA architecture, this quality attribute refers to the ability of SOSA based hardware and software to be used, without modification, in other SOSA based environments (e.g., different operational domains, different systems, and different sensor modalities), but does not necessarily imply the porting to vastly different physical environments (e.g., operating temperature, shock, vibration – which are design, not architectural, features).

SOSA Quality Attributes (2

Name	Description
Plug-and-playability	The capability of a system to recognize that a hardware component has been introduced or replaced -- and subsequently use it without the need for manual device configuration or operator intervention. In the context of the SOSA architecture, this quality attribute refers to the ability of a SOSA conformant system to recognize the introduction or replacement of SOSA modules, and through an information exchange, to understand and use the capabilities and services that the module offers – thereby reducing the cost and schedule impact of adding a new SOSA Module, but does not to eliminate the need for integration and test.
Upgradeability	The ability of a system to be improved, enhanced, or evolved without fundamental physical, logical, or architectural changes. In the context of the SOSA architecture, this quality attribute refers to the ability of a SOSA system to have specific Hardware Elements, or Software Components replaced with more modern or more capable equivalents, while maintaining SOSA Conformance, and without (significant) change to the rest of the system.
Scalability: Sensor Multiplicity	The capability of a system to cope and perform well under an increased or expanding workload or increased demands, and to function well when there is a change in scope or environment – and still meet the mission needs. In the context of the SOSA architecture, this quality attribute refers to the ability of the SOSA architecture to accommodate a multiplicity of sensors, constrained only by design-specific limitations.
Scalability: Host Platform Size	The capability of a system to cope and perform well under an increased or expanding workload, increased demands, and to function well when there is a change in scope of environment and still meet the mission needs. In the context of the SOSA architecture, this quality attribute refers to the ability of the SOSA architecture to be applied to platforms that range from the small (e.g., Class I UAS) to large surveillance aircraft – and possibly even spacecraft.
Resiliency	The ability of a system to continue or return to normal operations in the event of some disruption or over-capacity (system saturation), natural or man-made, inadvertent or deliberate, and to be effective with graceful and detectable degradation of function. In the context of the SOSA architecture, this quality attribute refers to the ability of SOSA systems to be able to maintain operations while under “duress” caused by physical damage, electronic interference, or cybersecurity attack.

SOSA Architecture Principle's Names

Business-oriented

- ✓ The SOSA business and technical architectures are vendor-agnostic
- ✓ SOSA Consortium products are provided royalty-free
- ✓ SOSA products and processes protect the intellectual property of vendors

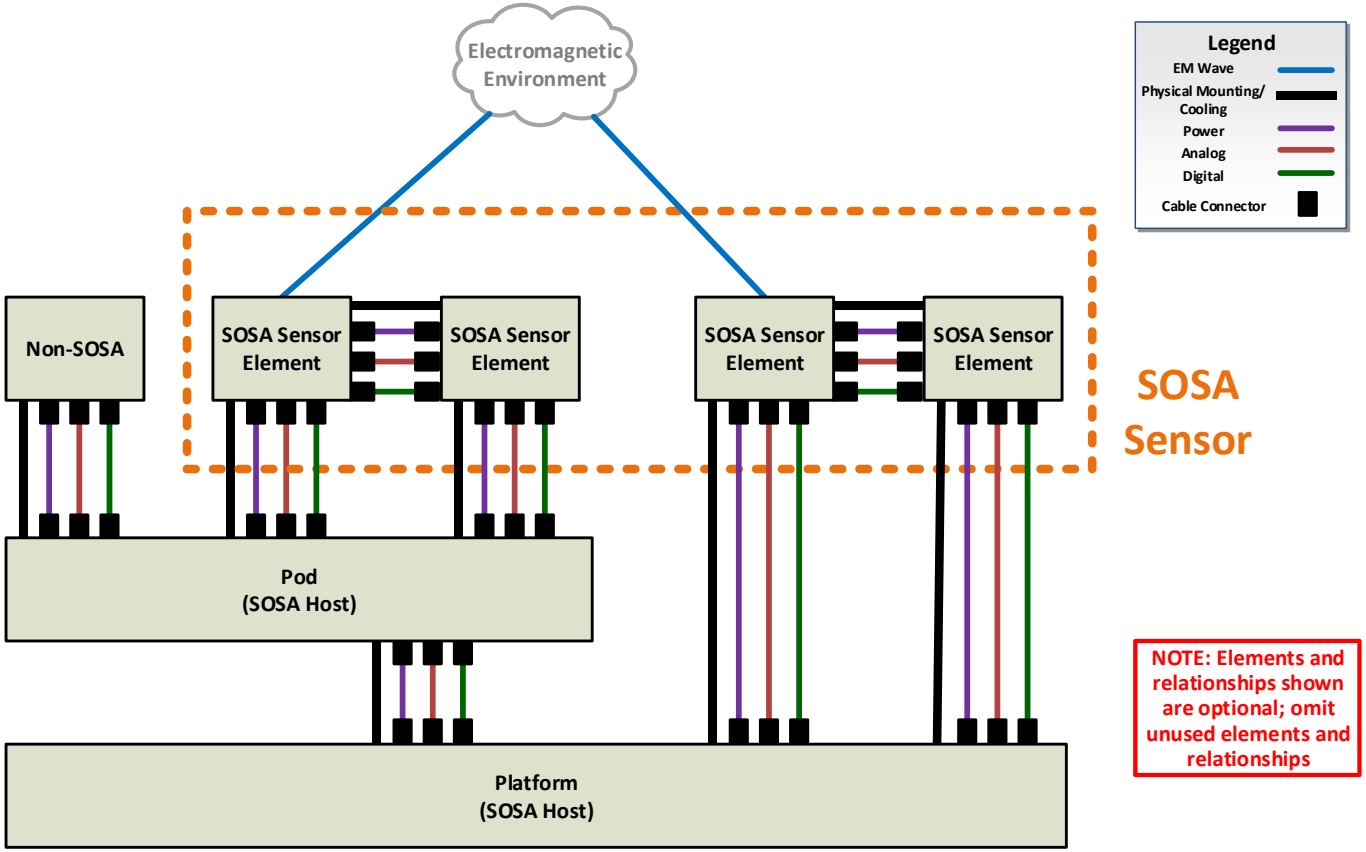
Technically-oriented

- ✓ The SOSA Technical Standard is extensible and evolvable
- ✓ The SOSA architecture maximally leverages/incorporates existing industry and government standards
- ✓ Resilience (including cybersecurity) is enabled by the architecture
- ✓ The SOSA architecture is agnostic with respect to host platform
- ✓ The SOSA architecture is agnostic with respect to processing environment
- ✓ Every SOSA Module has defined logical interfaces
- ✓ Every SOSA hardware element has defined physical interfaces
- ✓ The SOSA architecture accommodates simple through complicated systems
- ✓ The SOSA architecture accommodates small through large host platforms
- ✓ Modularity is fundamental to the SOSA architecture – physical and logical
- ✓ Interchangeability is fundamental to the SOSA architecture
- ✓ Reuse is fundamental to the SOSA architecture

For Architecture Principle:

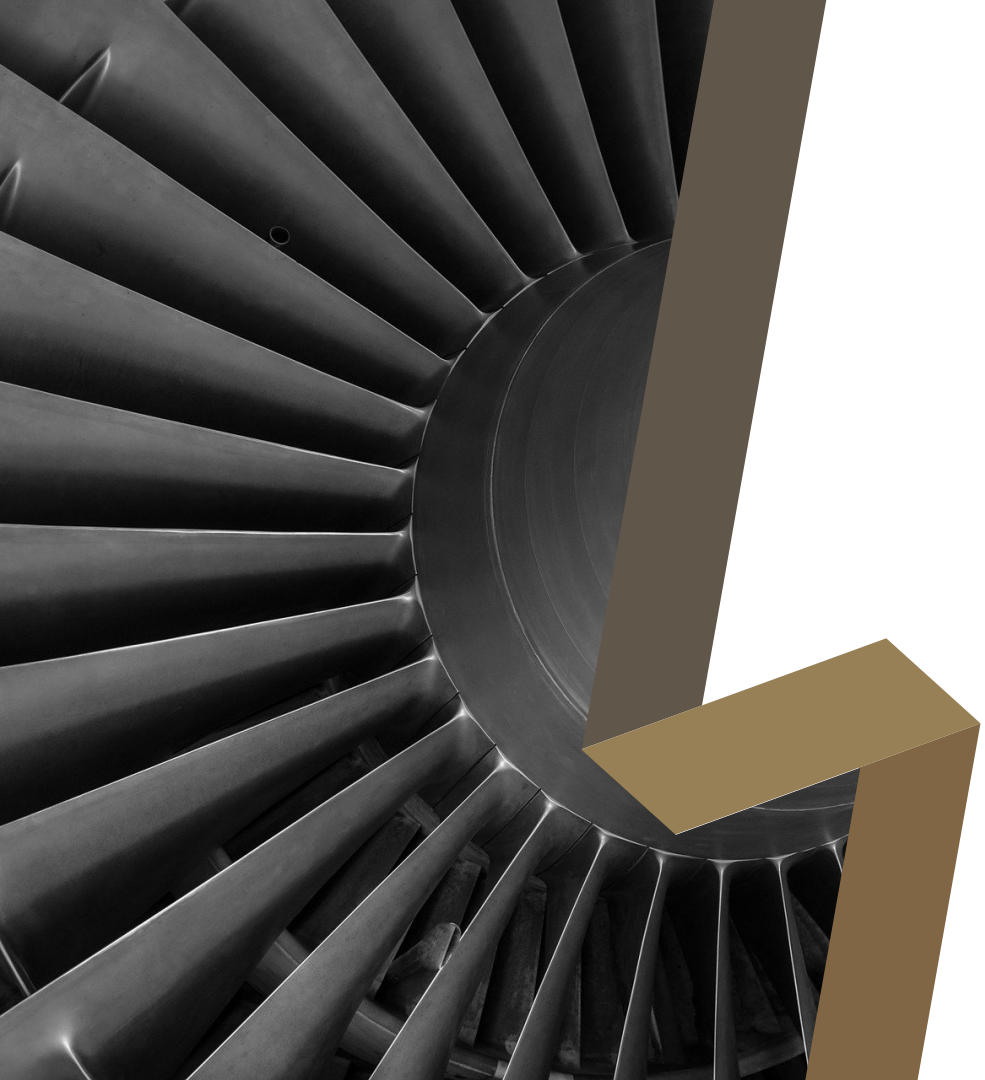
- Statement/Description
- Rationale
- Implications for SOSA

SV-1 ("Context Diagram") for the Nominal Case



Architecture Approach: Maximize Commonality

- Create a superset reference architecture that can be used for the full range of target sensor systems
  - Not all sensors have to incorporate every module (e.g., processing *may* be done in a large sensor, or off-board for a small sensor)
- Leverage commonality between sensor types as much as the physics will permit
  - Both SAR and EO/IR images leverage geo-registration
  - The apertures for EO/IR sensors are different from the others, and they have and no REX



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