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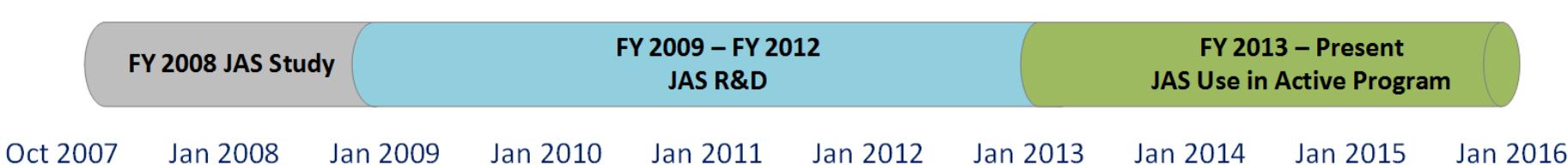
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Joint Architecture Standard Overview

SAND2016-3272 M

JAS Mission Statement & History

- The Joint Architecture Standard (JAS) realizes a reusable set of common hardware and software for space-based processing payloads:
 - Government controlled, open standard, available to all industry, no Proprietary Information (PROPIN) limitations
 - Common infrastructure and processes facilitate significant reuse and rapid development of systems
 - Easily scaled, configured, adapted, interconnected and integrated with industry standards
 - Controlled access to JAS Intellectual Property (IP) providing functionality to support any payload sensor suite
- JAS has been a joint DOE and DoD development effort

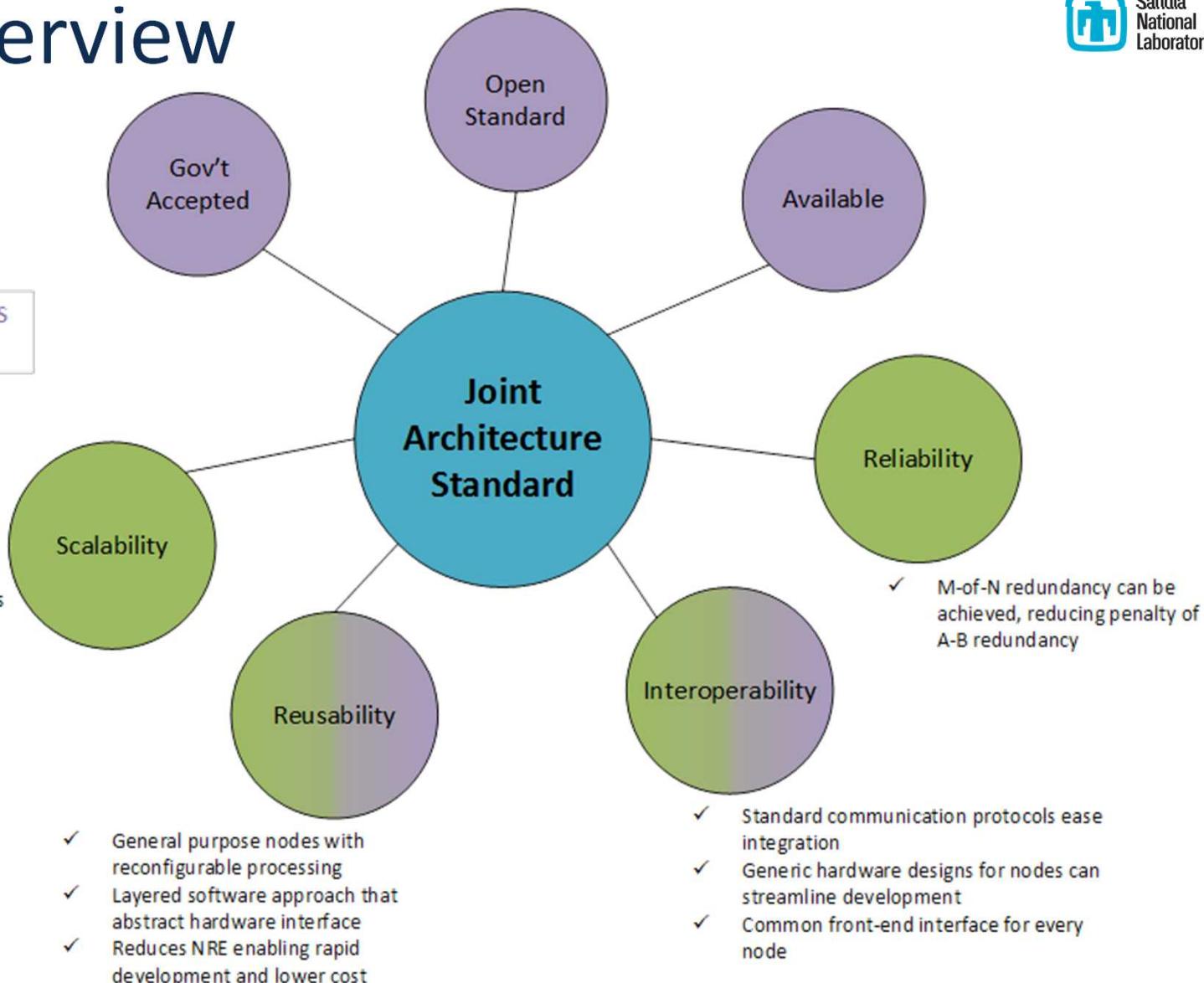


JAS provides capability to meet new emerging mission requirements at reduced NRE

JAS Overview

Programmatic Benefits
Technical Benefits

- ✓ Add nodes for scaling processing capability
- ✓ Expansion capabilities accommodate specific needs
- ✓ Adaptable mechanical designs



JAS emphasizes methodology without specifying instance

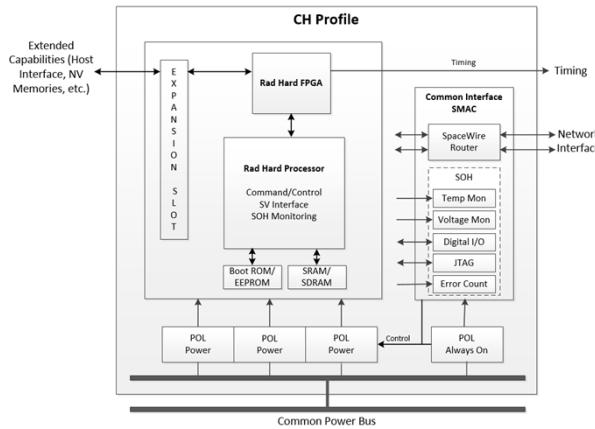
JAS Essential Elements

- Mission requirements drive the selection of JAS elements to include within a system instance
- The following essential elements must be included:
 - Communication Interfaces (physical, preferably serial)
 - Protocols to communicate over the physical interface
 - Network-connected nodes that implement the communication interface and protocols
 - Network routing and addressing scheme(s)
- Realization of these elements can be achieved through instances of hardware profiles in the JT
 - Standard node types (e.g., CH, RP, PS)
 - Expansion modules (e.g. mezzanines and rear transition modules)
 - System Monitoring and Communications (SMAC) functions

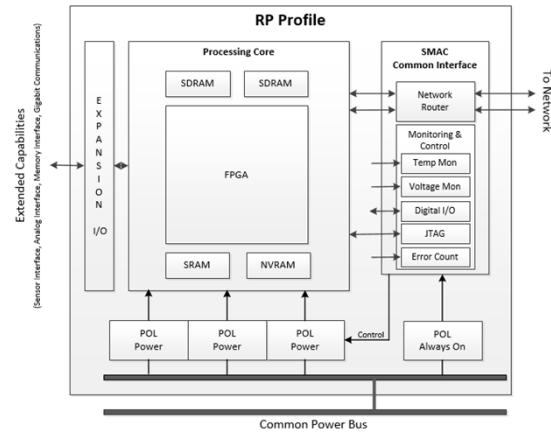
*Common Communications is the key to Interoperability,
Networking allows Scalability*

JAS Nodes

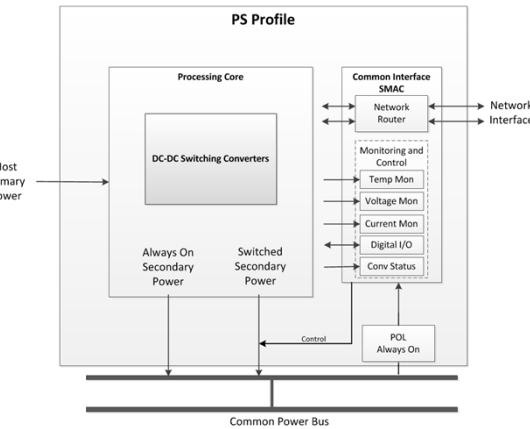
Configuration and Host (CH) *Microprocessor-based processing*



Reconfigurable Processing (RP) *FPGA-based processing*



Power Supply (PS)

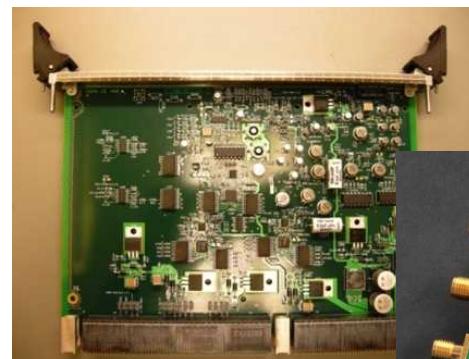
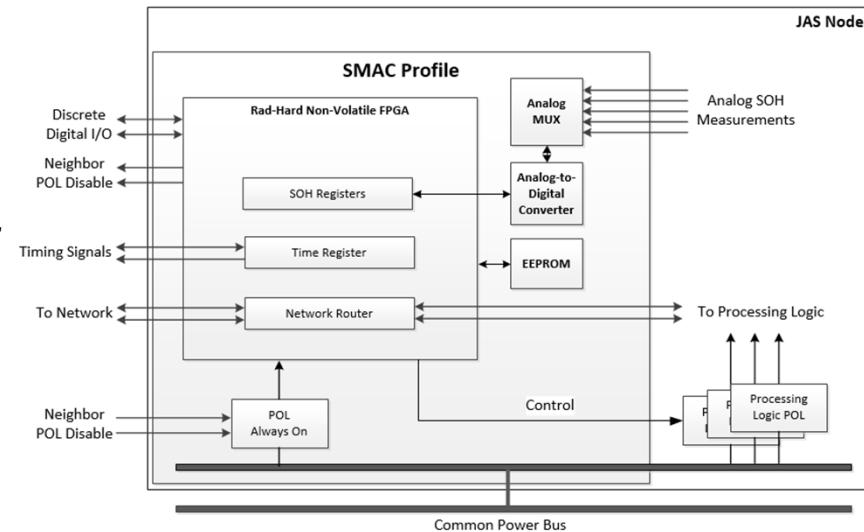


Note: The example nodes shown here utilize the VPX standard, but any interconnect standard may be used.

Nodes and expansion capabilities are the building blocks for any JAS-based system

JAS SMAC and Expansion Capabilities

- The System Monitoring and Communications (SMAC) functions are implemented on every node
 - Provides network connectivity between processing elements, controls node power and discrete signals, and provides state of health for node hardware
 - Having a common SMAC design on every node provides a consistent front-end interface that reduces software complexity
 - SMAC functions can be implemented in either hardware or software
- Expansion capabilities provide mission-specific hardware and interfaces to standard nodes
 - Expansion boards may take the form of mezzanines, Rear Transition Modules (RTMs)¹, backplane-integrated cards, etc.
- Systems can be instantiated using two or three node types and expansion capabilities for specialized functions

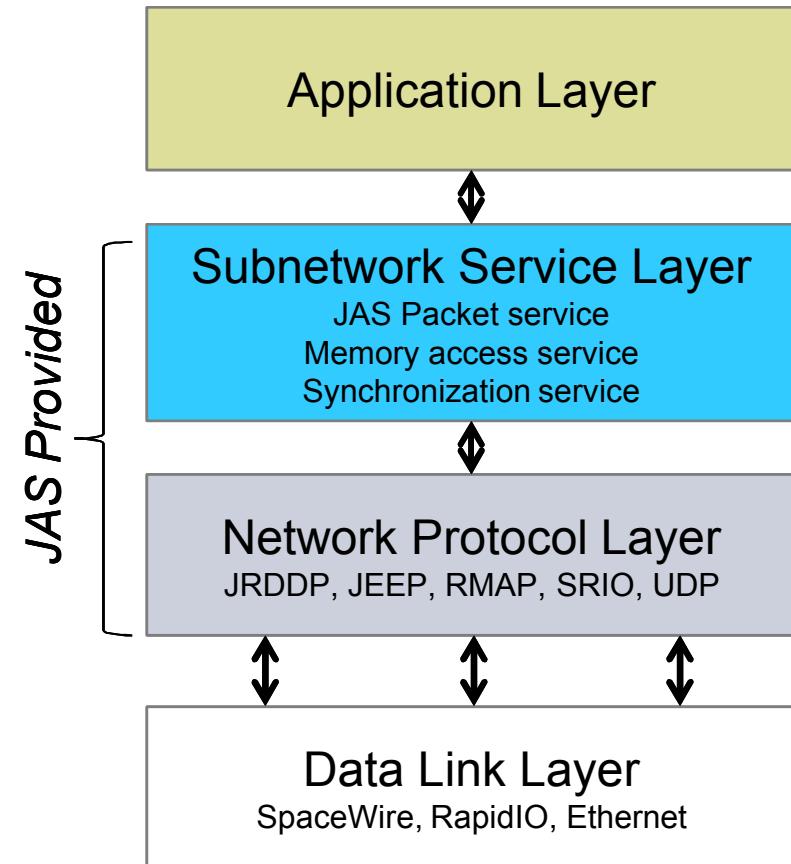


***SMAC is the common front end interface;
Expansion enables enhanced functionality***

¹ Note: The example expansion modules shown here utilize VITA standards, but any standard may be used.

JAS Software and Communications

- JAS provides a standard set of software and communication services to applications
- A layered architecture abstracts applications from data links, making them more reusable
- Software services interface to network protocols based on communication needs
 - JAS packet service for sending messages between applications
 - Memory access service for remote access to hardware
 - Synchronization service for broadcasting events such as time



JAS supports layered architecture that facilitates Reusability of software

JAS Toolbox

JAS Dashboard Joint Architecture Standard v. 1.0

Select the desired System, Profile, and Specification options from the listings below and press "Submit" to view their content:

Systems

JAS Overview

Satellite System Description

Profiles

CH COMM EXP PS RP SMAC

Hover over a Profile for its full name.

ALL NONE

Select a Profile, Specification, or both.

Click a document to select it. Clicking All selects all of them.

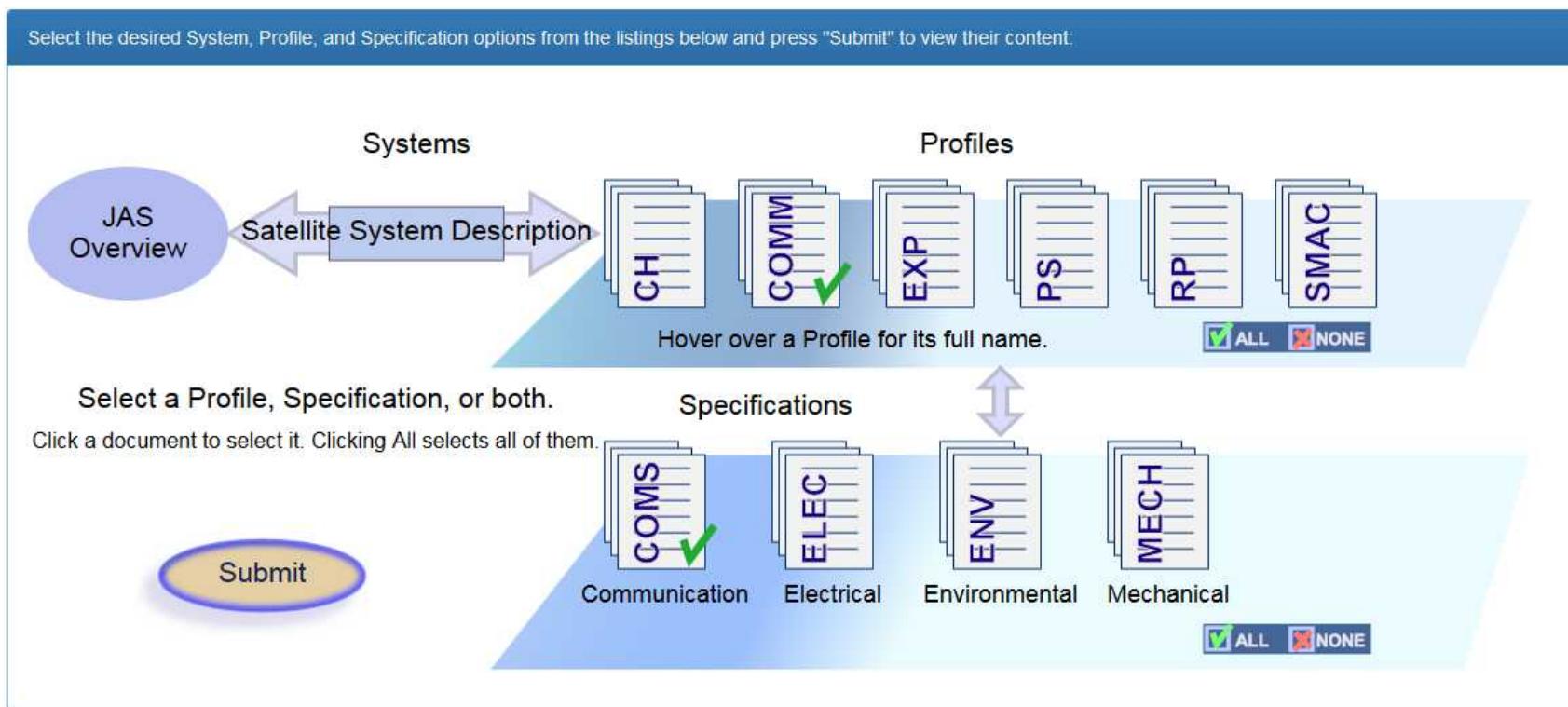
Specifications

COMS ELEC ENV MECH

Communication Electrical Environmental Mechanical

ALL NONE

Submit



Selected Contents

- JAS Overview

System Description

- Satellite System Description

Profile

- Communication Profile
 - Functional Description

Comm Profile Example

Profiles ▾ Specs ▾ Dashboard

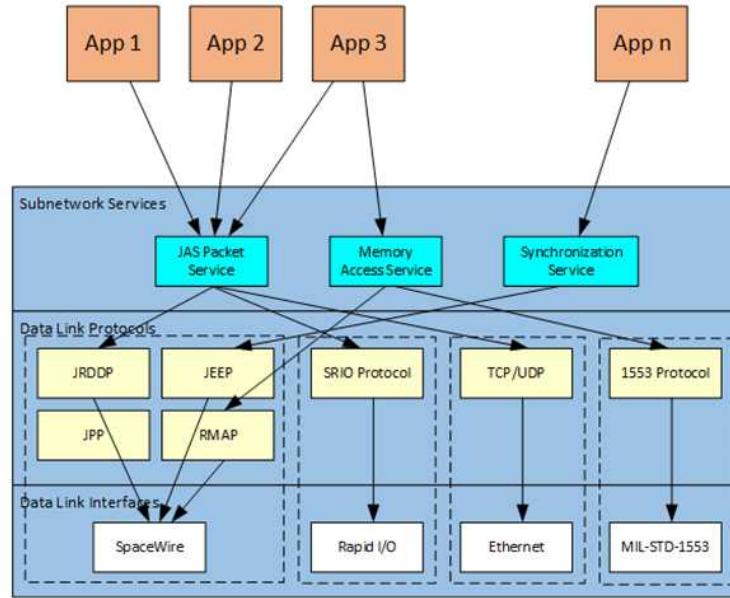
Selected Contents

- System
- Profile
 - Communication Profile
 - Functional Description
 - JAS CCSDS SOIS
 - SOIS Applied to JAS**
 - Interconnect Technologies
 - SpaceWire Interconnect
 - SpaceWire Logical
 - Remote Memory Access Pr
 - JAS Reliable Data Delivery
 - JAS Efficient Exchange Prot
 - JAS Packet Protocol
 - SpaceWire Transport
 - Packets
 - Networks
 - Addressing
 - Routing
 - Network Discovery
 - Multicast/Broadcast
 - SpaceWire Physical
 - RapidIO Interconnect
 - RapidIO Logical
 - RapidIO Transport
 - RapidIO Physical
 - Subnetwork Services
 - Packet Service
 - Memory Access Service
 - Synchronization Service
- Specification

SOIS Applied to JAS
JAS-1.1-PR-COMM-SOApptoJA

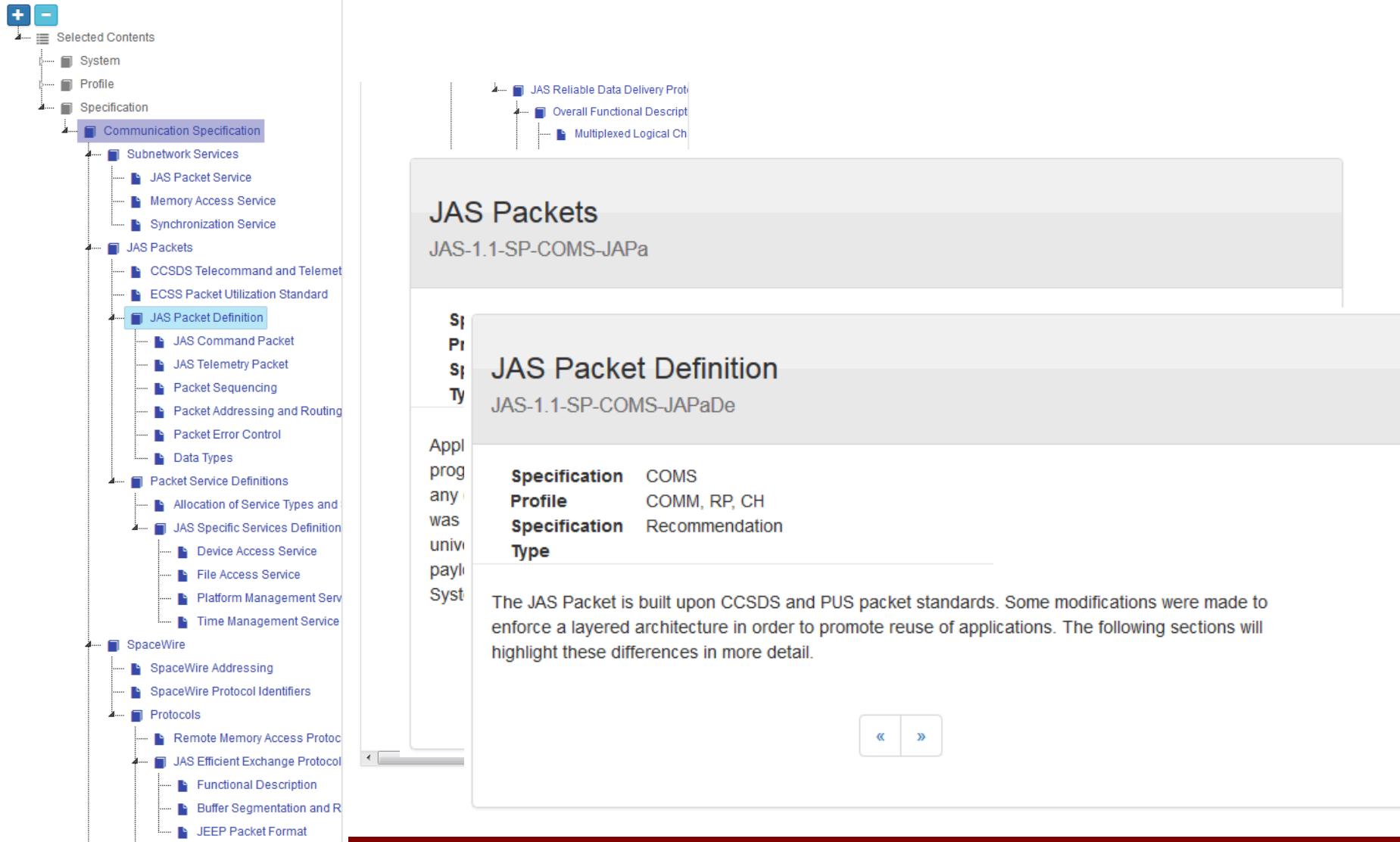
Profile **COMM**

A simplified version of the SOIS architecture as applied to JAS is shown in the figure below. The subnetwork services are used by applications to encapsulate and describe the data that needs to be communicated regardless of the underlying physical layer. The subnetwork services are JAS-specific implementations of the respective SOIS services, which bridge the application interfaces to the underlying JAS protocols.



JAS Implementation of SOIS

Comm Specification



Selected Contents

- System
- Profile
- Specification
- Communication Specification
 - Subnetwork Services
 - JAS Packet Service
 - Memory Access Service
 - Synchronization Service
 - JAS Packets
 - CCSDS Telecommand and Telemetry
 - ECSS Packet Utilization Standard
 - JAS Packet Definition
 - JAS Command Packet
 - JAS Telemetry Packet
 - Packet Sequencing
 - Packet Addressing and Routing
 - Packet Error Control
 - Data Types
 - Packet Service Definitions
 - Allocation of Service Types and...
 - JAS Specific Services Definition
 - Device Access Service
 - File Access Service
 - Platform Management Service
 - Time Management Service
 - SpaceWire
 - SpaceWire Addressing
 - SpaceWire Protocol Identifiers
 - Protocols
 - Remote Memory Access Protocol
 - JAS Efficient Exchange Protocol
 - Functional Description
 - Buffer Segmentation and Reassembly
 - JEEP Packet Format

JAS vs. PROPIN

Advantage	Budget	Schedule	Performance
Scalable processing systems	✓	✓✓✓	✓✓✓
Standard processing elements	✓✓✓	✓✓✓	✓
Standard communication interfaces	✓✓✓	✓✓✓	✓
Reduce SWaP	✓✓	✓	✓✓✓
M-of-N redundancy	✓✓✓	✓	✓
Utilizing industry standards	✓✓✓	✓✓✓	✓
Future-Proof	✓✓✓	✓✓✓	✓✓✓

There is no disadvantage of utilizing JAS versus PROPIN approach

Optical Payload Trade: Legacy PROPIN vs. JAS Solution

Item	PROPIN	JAS	Savings	Notes
Processing Elements	40	19	52%	JAS – 3 nodes, 16 MEZ/RTM designs PROPIN – 40 unique board designs
Communication Interfaces	14	7	50%	JAS – SpaceWire & SRIO network, external interfaces PROPIN – All internal interfaces custom
Communication Protocols	20	5	75%	JAS – 5, significant reuse of flight software PROPIN – 20 custom communication links
Flight Boxes	17	7	59%	JAS – 7 boxes (3 node stacks w/ common electronics) PROPIN - 17 unique boxes
Flight Cables	132	65	51%	JAS – ~65 (45 Electrical, 20 Fiber) PROPIN - +132 (+122 Electrical, 10 Fiber)
Payload Weight	750lbs	500lbs	33%	JAS – Optimized electro-mechanical design PROPIN – Large number of independent designs
Payload Budget (Equivalent Year)	~\$500M	~\$350M	30%	JAS – significant REC in electro-mechanical design PROPIN – Large NRE cost
Payload Schedule	84 mo.	48 mo.	42%	JAS – significant reuse of hardware and software IP PROPIN – Fully custom due to mission requirements

Significant programmatic savings between PROPIN custom and JAS-based solutions

Available Resources

- Utilize the JAS Toolbox to implement your mission requirements into a JAS-based instance
<https://jastoolbox.sandia.gov>
- Contact for access, questions, and/or feedback:
 - JASToolboxContact@sandia.gov

Web-based JAS resources are available for education and development

Summary

- JAS is a scalable, interoperable, reliable, and reusable architecture
- General-purpose node designs minimize unique hardware
 - Reduces NRE and maximizes reuse both system-to-system and within a given system instance
 - Common interfaces achieved by standardized communications infrastructure
- Efficiently supports external interfaces and node expansion capabilities
 - Facilitates customization to specific instantiations
 - Enables rapid prototyping and path to flight
- Several current programs developing JAS