

AS-4 JAUS Overview

- JAUS Background
- Status & Roadmap
- Interaction w/JAUS
- Summary
- Q&A

SAE AS-4 Unmanned Systems Committee
and the
JAUS Working Group

AS-4 JAUS Overview
John Ackley, AS-4A Secretary



18 April 2007
AS-2C
Salt Lake City, UT

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JAUS Background



- Subsystems common to unmanned systems (UMS) have been unique for each system
- Performance gains made by one system cannot be easily leveraged for a different system with a similar requirement

JAUS solves the proprietary “Stovepipe” problem

- Avoid being “locked into” a vendor’s solution
- Avoid being “locked out” of technology advancements
- Support all classifications of control
 - (teleop, semi-autonomous) and all classif. of systems (combat, combat support, combat service support)
- Support the evolution of a system from one classification to another
- Usable under current acquisition guidelines

Exploit existing and future technologies while simultaneously supporting systems evolution to autonomy

- The goal of JAUS is *interoperability* with an emphasis on the *logical communications* between heterogeneous computing systems used for unmanned systems command and control.
- JAUS is a common language enabling internal and external communication between unmanned systems. It incorporates a *component-based, message-passing* architecture specifying data formats that promote stability of *capabilities* by projecting anticipated requirements as well as those currently needed.
- JAUS is *open, scalable, and responsive* to the unmanned systems communities' needs.

A Common Interface Language for Unmanned Systems

- **Purpose:** The primary purpose of JAUS is interoperability: the ability to operate unlike systems with unlike controllers.
- **Product:** A standard messaging set to support the rapid and cost-effective development of unmanned systems.
- **Payoff:**
 - More efficient development
 - Reduced ownership cost
 - An expanded range of vendors
- **Sponsored By:** OSD Joint Ground Robotics Enterprise

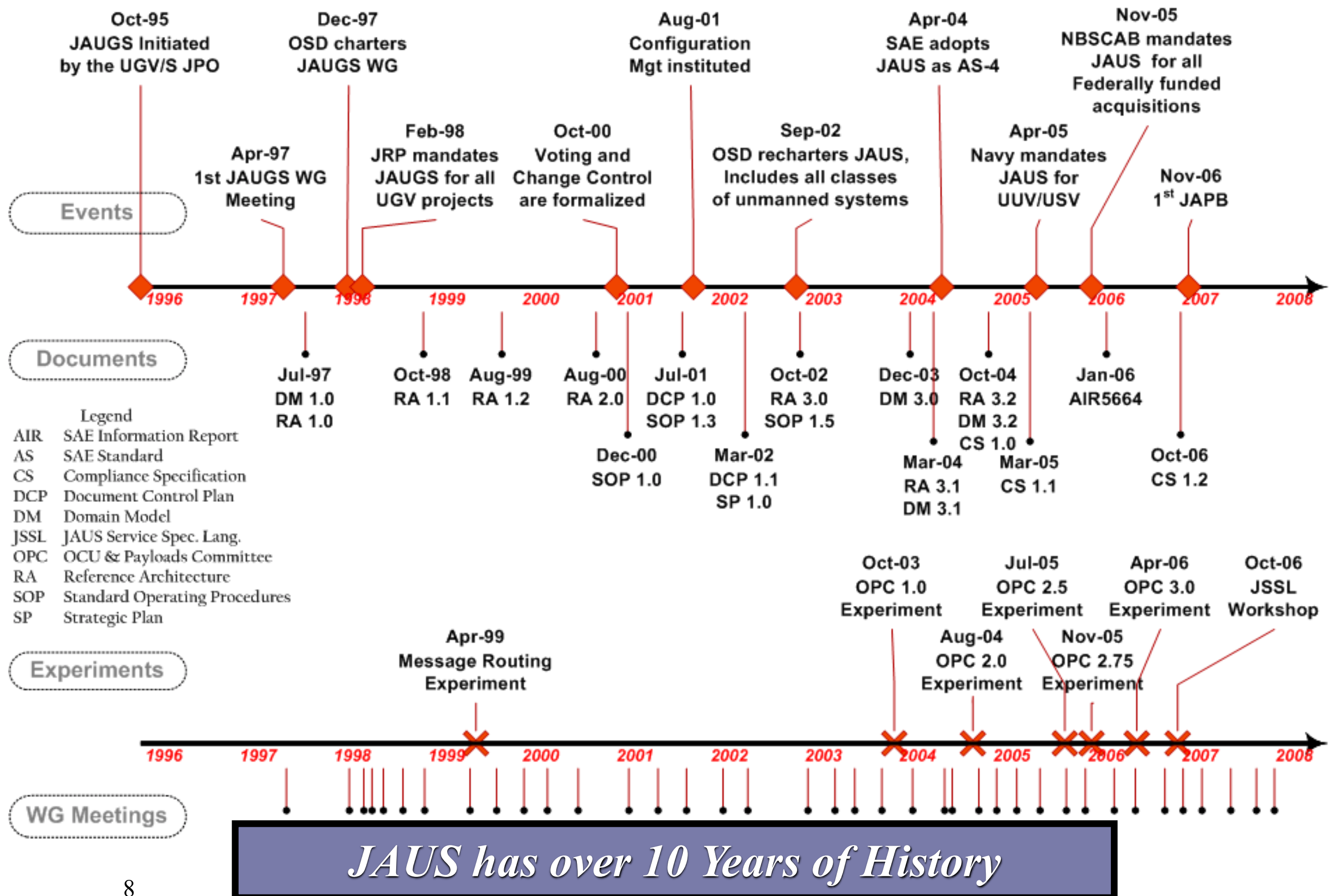
JAUS is chartered by OSD

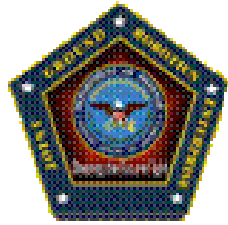
- Platform Independence
 - Supports Interoperability on any platform
- Mission Isolation
 - Supports configurable payloads
- Computer Hardware Independence
 - Not based on dated technology
- Technology Independence
 - Supports technology insertion
- Operation Independence
 - Allows the user to determine the operation
- Communications Independence
 - No requirement for specific data link

JAUS remains flexible and independent

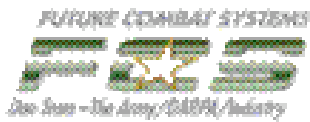
AS-4 JAUS Overview

Timeline





- **OSD Joint Ground Robotics Enterprise** – Mandated for use by all Joint Ground Robotics Enterprise (JGRE) programs.



- **Army Future Combat System** – Operational Requirements Document required capability.



- **Navy Littoral & Mine Warfare** – Directed for incorporation in unmanned ground systems, unmanned surface vehicle and unmanned underwater vehicle.



- **National Bomb Squad Commanders Advisory Board** – Requires JAUS compliance for use by all federally funded robotic programs FY08 and beyond.

*JAUS is evolving into the
Unmanned Systems Messaging Standard*

JAUS Supports Interoperability with Unmanned Systems

- Focus on message and service specification
- Supports any network or communication system
- Services/messages are independent of
 - Computing hardware and software
 - System configurations
 - Technologies
 - Communication mediums

JAUS Supports an Expanded Market for Unmanned System Developers

- Standard is open and available for any vendor
 - International standards body with open processes
- Standard focuses on interface definition
- Standard can be expanded using a consensus based open process
- Standard avoids technology or system implementation details
 - Allows vendors to protect intellectual property
 - Allows vendors to design different configurations

JAUS Reduces Risk for an Unmanned System Buyer

- Open consensus standards allow for multiple vendors
- Open consensus standards have the largest group of people examining the product
- Open consensus standards are maintained by well defined processes
- Numerous systems and projects are already incorporating JAUS
 - Army Future Combat System
 - Navy Littoral Combat Ship
 - Navy Unmanned Sea Surface Vehicle
 - ...
- Supported by the Department of Defense

JAUS is Supported by Numerous Others

- DoD Programs
 - Numerous
- Suppliers
 - Commercial products are becoming available
- Open, International standards bodies
 - Society of Automotive Engineers
 - MOAs between SAE and others

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Status and Roadmap



- Current Status
 - **Membership**
 - Organization
 - Meetings
 - Documents/
Publications
 - Migration to SAE
- Roadmap
 - Current
Developments
- Schedule

- Committee (as of April 2006)
 - 119 Members to Date
 - 52 Organizations
 - 71 Voting members
 - 16 Associate Members
- Distribution
 - User \approx 35%
 - Supplier \approx 55%
 - Other \approx 10% (including Academia & National Labs)
- Average 2-6 New members each meeting
- Membership is open
 - AS-4 Membership Controlled by Chairs
 - Requires Regular Attendance
- Work Focus on Needs Determined by Members

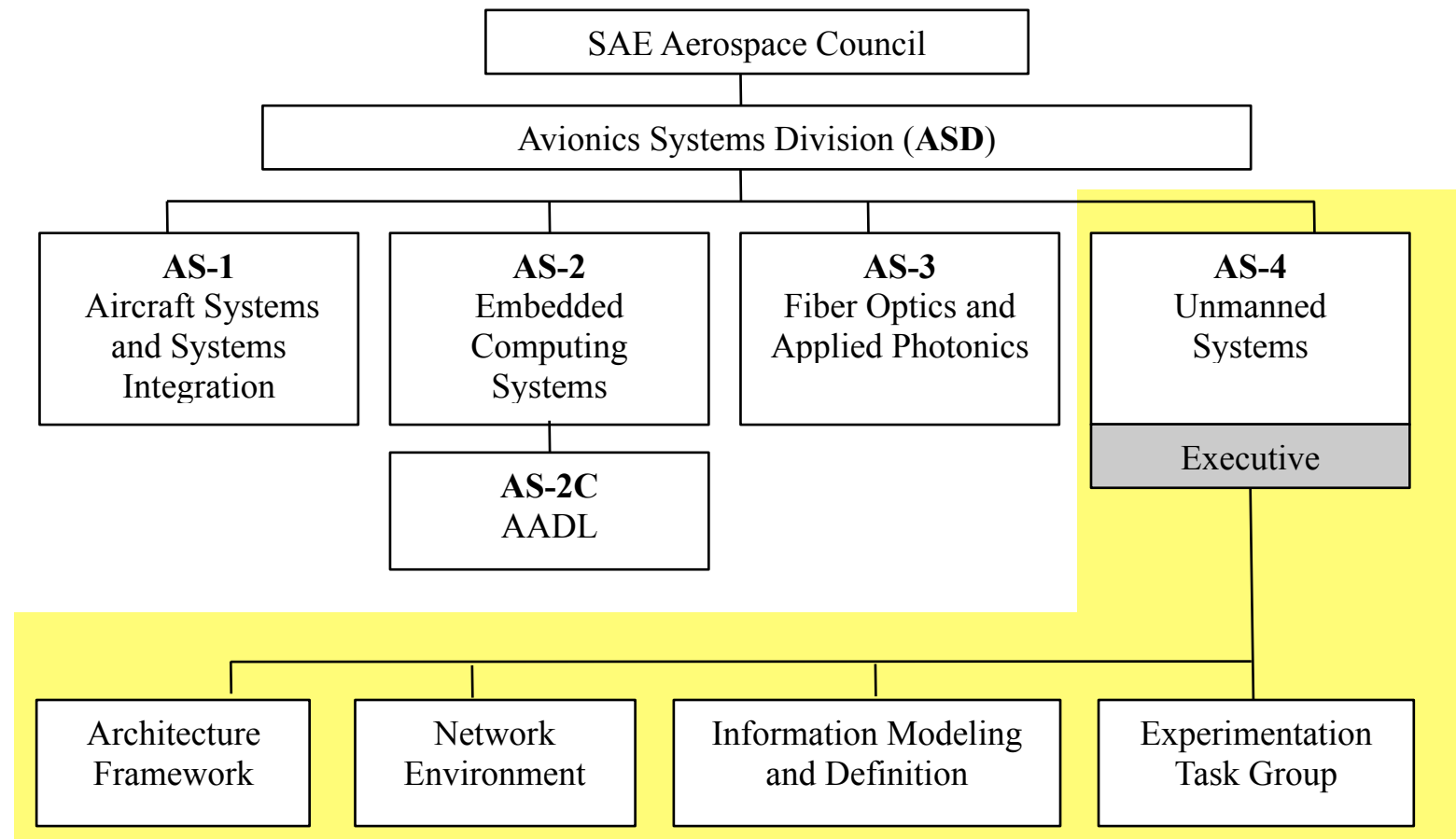
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Organizations

- | | |
|--------------------------------|-------------------------------|
| • Lockheed Martin | • BAE |
| • L-3 Com | • Rockwell |
| • Boeing | • Northrop Grumman |
| • Cybernet | • European Aeronautic Defence |
| • Autonomous Solutions | • PSU |
| • DDC | • Carnegie Mellon |
| • Applied Perception | • EG&G |
| • John Deere | • Univ. of Florida |
| • FAA | • QinetiQ |
| • Interoptek | • Jacobs |
| • ARA | • Augusta Systems |
| • Torch | • iRobot |
| • Navcom | • U.S. Army |
| • Caterpillar | • Defense Technologies |
| • Radiance Tech | • Interoptek |
| • Virginia Tech | • U.S. Navy |
| • Foster Miller | • Nomadio |
| • Applied Systems Intelligence | • Textron |
| • Harris | • U.S. Air Force |
| • Re ² | • Draper Labs |
| • AeroVironment | • Coroware |
| • OSD | • EADS |
| • Battelle | • WINTEC |
| • DOC NIST | • Intelligent Innovations |
| • AAI | • Azimuth |
| • General Dynamics | • SAIC |
| • Kairos Autonomi | • DeVivo AST |

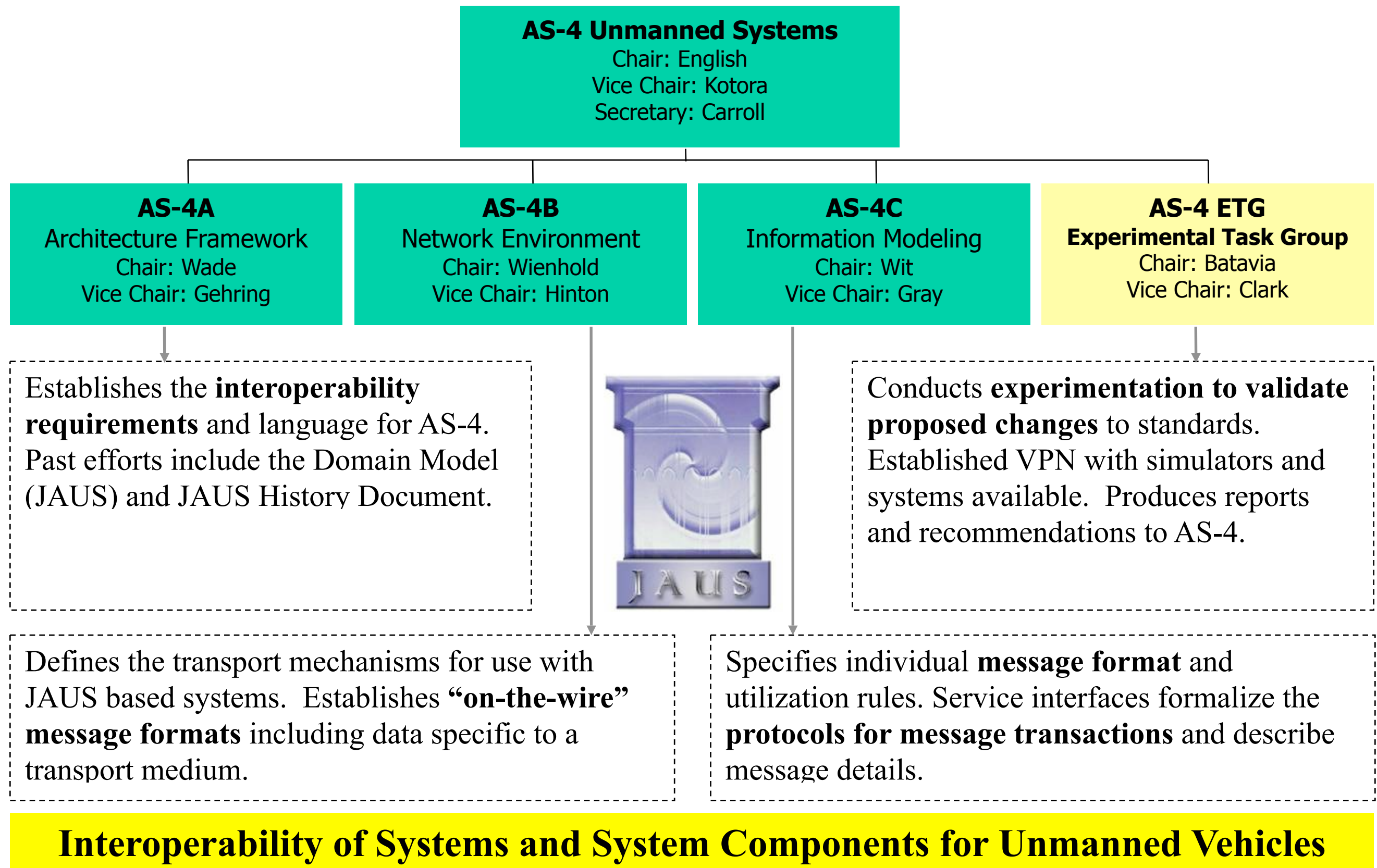
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- SAE / Aerospace Council / ASD /
- Unmanned Systems Committee (AS-4)



Alignment with Technical Committees Pursuing Similar Goals

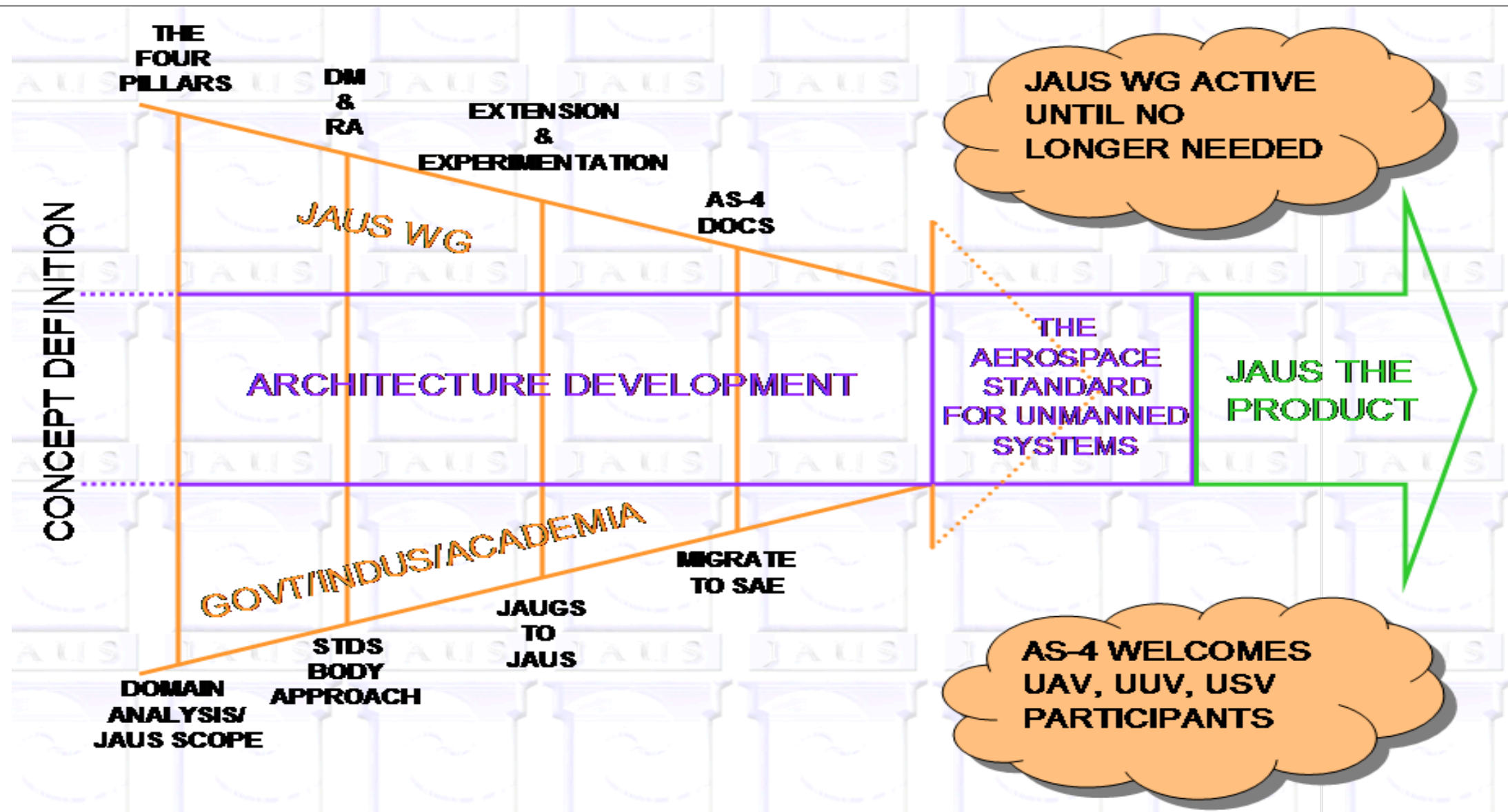
- MIL-STD-1553, MIL-STD 1773, MIL-STD-1760
- GOA (AS-4893), AADL (AS-5506)
- Protocol Standards for Specialty Niches (Weapons)
- Emphasis on System Integration Standards/Guidelines
- Plug and Play Standards



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- **JAUS Is Comprised Of Several Documents**
 - Domain Model
 - Reference Architecture
 - Standard Operating Procedures
 - Document Control Plan
 - Transport Layer Plan (Pending)
 - Strategic Plan
 - Compliance Specification
- **SAE Published Documents**
 - AIR5664 JAUS History and Domain Model
- **Near Term SAE Documents**
 - AIR5665 Architecture Framework for Unmanned Systems
 - AIR5645 JAUS Transport Considerations
 - AS5669 JAUS Transport Specification
 - AS5684 JAUS Service Interface Definition Language
 - AS5710 JAUS Service Set

AS-4, Unmanned Systems is the name of the Technical Committee established by the Society of Automotive Engineers to host continued JAUS development. The JAUS and AS-4 efforts will execute in parallel until such time that products converge. Legacy JAUS standards will be ultimately superseded by SAE standards.



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- AS-4 Technical Committee

- JAUS Service Set
- Transport Specification
- Architecture Framework

- JAUS Working Group

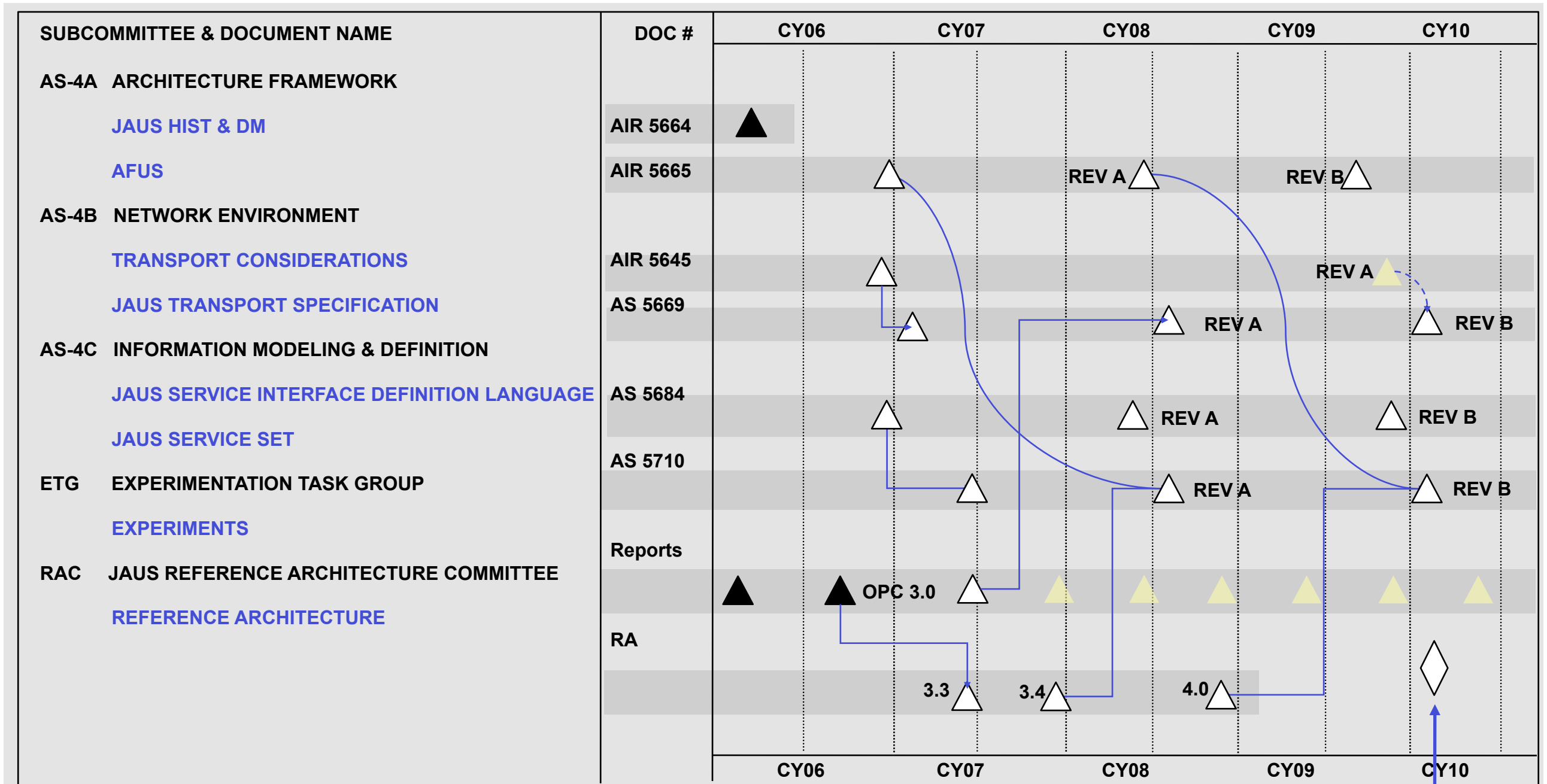
- JAUS Reference Architecture (RA)
- Compliance Specification

Product = JAUS

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- NATO Standards
 - Established Working Relationship with STANAG 4586
 - Coordination with Research Task Group (RTG) on Military Applications for Multi-Robot Systems
- National Institute for Standards & Technology (NIST)
 - Autonomy Levels For Unmanned Systems (ALFUS)
 - Intelligent Systems Ontology (new)
- Weapons
 - AS-1B (Mil-Std-1760)
 - WSTAWG
- US Navy Program Executive Office Littoral and Mine Warfare (USN PEO (LMW)) Unmanned Systems Community of Interest (US COI)
 - JAUS Established as Standard for USV, UUV, UGV
 - STANAG 4586 for UAV

Planned Development of JAUS Documents



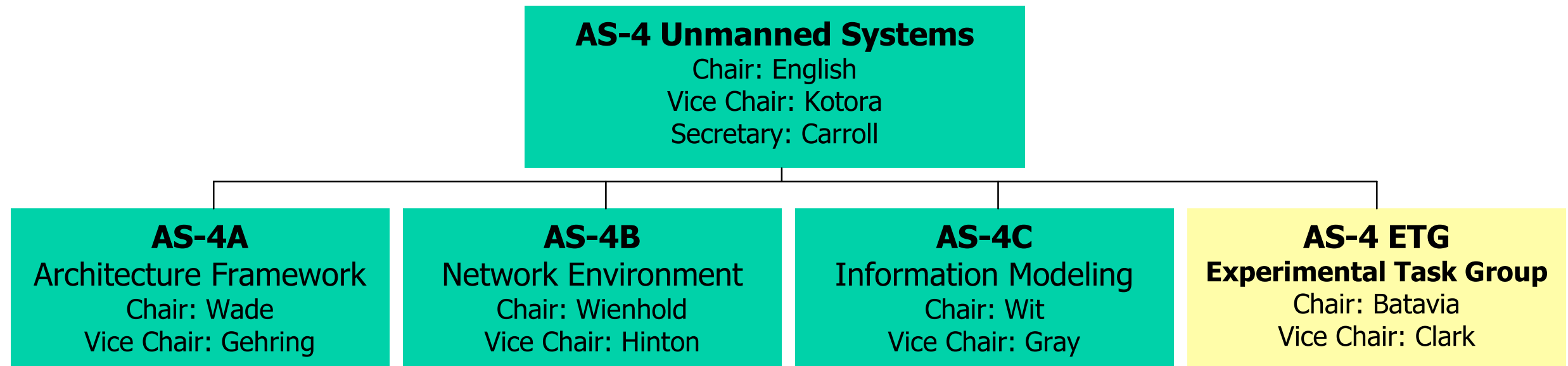
JAUS documents are all managed within AS-4

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Interacting with the JAUS WG and the AS-4 Unmanned Systems Committee





- **Members**
 - **Participate in Development of Standards**
 - **Review Documents**
 - **Attend Meetings**
 - **Vote on Documents**
- **Consultants**
 - **Subject Matter Expertise**
- **Liaisons**
 - **Coordination w/other related groups**
- **Mailing List**
 - **Receive email notification of meetings**

- Organization
- **Charters**
- Contacts

AS-4 Charter

The charter of the AS-4, Unmanned Systems, Committee is to address **standards in Unmanned Systems with emphasis on architecture and systems integration**. The AS-4 Committee shall respond to the guidance and direction of the Executive Board of the SAE Aerospace Avionic Systems Division (ASD) and to the guidance of the SAE Aerospace Council.

Specific activities of the committee shall include:

1. Developing and maintaining SAE Aerospace Standards (AS), Aerospace Material Specifications (AMS), Aerospace Information Reports (AIR), Aerospace Resource Documents (ARD) and Aerospace Recommended Practices (ARP) within the scope of Unmanned Systems,
2. Supporting government defense organizations (including NATO nations) in the development and maintenance of standards and standards-related documents through the formal submission of written recommendations,
3. Providing standards user groups relative to Unmanned Systems architecture and systems integration,
4. Providing advice to government and industry on specific Unmanned Systems standards-related questions,
5. Providing guidelines and education to government and industry through papers, articles and tutorials, and
6. Cooperating and teaming with other standards organizations as required.

- Organization
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AS-4A: Architecture Framework Subcommittee

The charter of the AS-4A Architecture Framework Subcommittee is to support the charter of the AS-4 Unmanned Systems Committee by addressing standards and standards-related documents in:

1. **Applications and system requirements** for Unmanned Systems,
2. **Functional architectures and frameworks** for Unmanned Systems designs,
3. Reference architecture components for Unmanned Systems, and
4. Other issues relating to the Architecture Framework of Unmanned Systems.

The AS-4A Subcommittee shall respond to the guidance and direction of the Executive Subcommittee of the AS-4 Committee.

AS-4B: Network Environment Subcommittee

The charter of the AS-4B Network Environment Subcommittee is to support the charter of the AS-4 Unmanned Systems Committee by addressing standards and standards-related documents in:

1. **Network protocol adoption and specification** for Unmanned Systems,
2. Ad-Hoc network discovery, registration and configuration for Unmanned Systems,
3. Specification of Unmanned System specific transport and addressing protocols, and
4. Other issues relating to the Network Environment of Unmanned Systems.

The AS-4B Subcommittee shall respond to the guidance and direction of the Executive Subcommittee of the AS-4 Committee.

- Organization
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AS-4C: Information Modeling & Definition Subcommittee

The charter of the AS-4C Information Modeling and Definition Subcommittee is to support the charter of the AS-4 Unmanned Systems Committee by addressing standards and standards-related documents in:


1. Application and domain specific **message composition**,
2. **Information transfer protocols** and control for Unmanned Systems,
3. **Models and schema** for Unmanned Systems support equipment and systems, and
4. Other issues relating to the Information Modeling of Unmanned Systems.

The AS-4C Subcommittee shall respond to the guidance and direction of the Executive Subcommittee of the AS-4 Committee.

AS-4 ETG: Experimentation Task Group

The charter of the AS-4 ETG, Experimentation Task Group is to **plan, coordinate and execute interoperability experiments** that directly support the advancement of the Architecture Framework, Network Environment and Information Modeling and Definition Subcommittees within AS-4. Experimentation will **result in the recommendation to AS-4** via the appropriate Subcommittee and/or Task Group of standards and practices for use in the development and integration of Unmanned Systems.

The AS-4 ETG shall respond to the guidance and direction of the Executive Subcommittee of the AS-4 Committee.

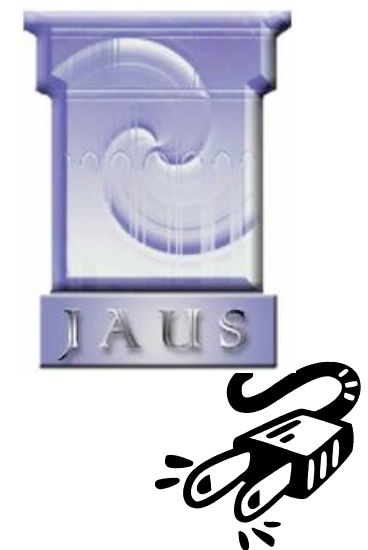
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For more information go to our website

- Presentation Slides
- JAUS Tutorial
- JAUS FAQ
- Current JAUS documents
- Announcements for future meetings

www.jauswg.org



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