JAUS Compliance and Interoperability Policy

RATIONALE

A guideline is needed for how to select from the suite of SAE AS-4 JAUS standards and use the selected standards together in such a way so as to achieve interoperability between systems that implement them.

FOREWORD / EXECUTIVE SUMMARY

The SAE AS-4 Unmanned Systems Technical Committee defines a set of standards for use in the research, development, design, acquisition and deployment of unmanned systems. These standards provide a robust message set and message exchange protocol to promote interoperability between systems and components.

This Society of Automotive Engineers (SAE) Aerospace Recommended Practice (ARP) provides guidance to acquisition program managers, system specifiers, designers, et al., on the application of SAE JAUS Standards. Guidance is provided through the identification of applicable AS-4 Aerospace Specification (AS) standards documents and how these documents complement one another to achieve JAUS interoperability between systems that implement them.

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1.   INTRODUCTION

The SAE Joint Architecture for Unmanned Systems (JAUS) is a technology enabler for air, ground, water surface, and underwater unmanned systems. SAE JAUS is platform independent and thus provides a standard for interfacing with different types of vehicles, sensors, operator control stations, and payloads.

The SAE AS-4 Unmanned Systems Technical Committee defines a set of standards for use in unmanned systems. While each standard can be used individually, specific guidance is required for combining them. This recommendation provides this guidance and defines the concept of "interoperability profiles" (Section 5). An Interoperability Profile is the result of a strategic application of standards in a layered approach. The desired result is for any two systems that implement the same Interoperability Profile to interoperate in a useful way.

1.1   Scope

This document, the *JAUS Compliance and Interoperability Policy* (ARP6012), recommends an approach to documenting the complete interface of an unmanned system or component in regard to the application of the standard set. While non-SAE AS-4 JAUS documents are referenced in this ARP they are not within the scope of this document and should be viewed as examples only.

1.2   JAUS Compliance and JAUS Interoperability Defined

The phrase "JAUS Compliant" is often used interchangeably with the phrase "JAUS Interoperable". These phrases are not interchangeable and to use them in this manner is incorrect. The following definitions are used throughout the remainder of this document:

  ➢ "JAUS Compliance" is the binary (pass/fail) measure of an implementation's adherence to an individual published SAE JAUS specification.

  ➢ "JAUS Interoperability" is the ability to exchange data in accordance with an identified set of SAE JAUS specifications.

2.   REFERENCES

The following publications for a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of the other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1   SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), Web address: www.sae.org

AIR5665A   Architecture Framework for Unmanned Systems

AS5669A   JAUS Transport Specification

AS5684   JAUS Service Interface Definition Language

AS6009   JAUS Mobility Service Set

2.2   JAUS Technical References

RA33P1   *JAUS Reference Architecture Specification*, Volume II, Part 1, Architecture Framework, Version 3.3, June 22, 2007

RA33P2   *JAUS Reference Architecture Specification*, Volume II, Part 2, Message Definition, Version 3.3, June 22, 2007

RA33P3   *JAUS Reference Architecture Specification*, Volume II, Part 3, Message Set, Version 3.3, June 22, 2007

3.   COMPLIANCE

Compliance is meaningful only within the context of a particular specification, e.g. AS5710. Each specification within SAE JAUS addresses compliance by defining unambiguous, normative language that is appropriate within the scope of the individual document. In cases where options to standards are allowable, the impact on compliance and interoperability are addressed directly by that standard. Measurement of compliance is beyond the scope of the SAE AS-4 Standards body.

4.   INTEROPERABILITY

The SAE Architecture for Unmanned Systems (AFUS) Aerospace Information Report [AIR5665] provides guidance for Standards that enable interoperability at multiple levels. AFUS defines the following four levels (types) of interoperability as a hierarchy:

a.   Physical Interoperability: The ability for two unmanned systems to exchange data at a physical level. At a minimum physical interoperability ensures commonality of wave forms. Where applicable, physical interoperability may also ensure commonality for physical form factors, mount points, electrical connections, et al.

b.   Transport Interoperability: The ability for two unmanned systems to exchange data at a logical level. At a minimum, transport interoperability ensures commonality in addressing and routing of messages. Where applicable, transport interoperability may also ensure commonality for prioritization, quality of service, encryption, compression, et al. Transport Interoperability implies Physical Interoperability.

c.   Messaging Interoperability: The ability for two unmanned systems to interpret exchanged data as well-defined messages. At a minimum, messaging interoperability ensures commonality of message formats (data fields, field semantics, complex structures, and optional elements). Where applicable, messaging interoperability may also ensure commonality for message-exchange rules, protocol, et al. Messaging Interoperability implies Transport Interoperability.

d.   Mission Interoperability: The successful use of protocol and messages (Message Interoperability) in the application of an unmanned system to a tactical or strategic goal.

In most cases, end users are only interested in Mission Interoperability. This leads to plug-and-play compatibility, coordination between multiple systems, and other behaviors. Mission Interoperability (4) requires interoperability at all lower levels, as shown in Figure 1.
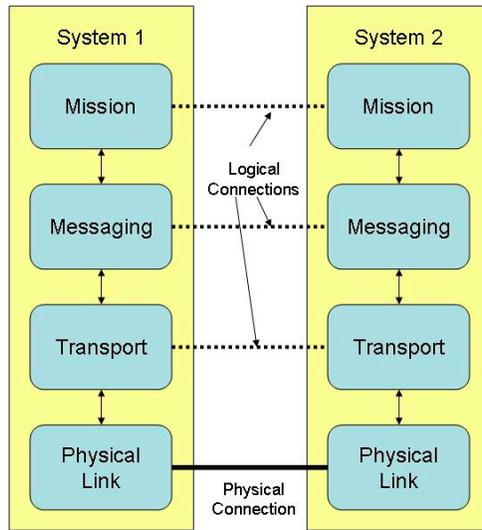
FIGURE 1 - 'HIERARCHY OF INTEROPERABILITY'

5.   INTEROPERABILITY PROFILES

This section provides guidance on selecting configurations of SAE JAUS standards that can be integrated to form a cohesive, interoperable solution.   This ARP only applies to SAE AS-4 documents, however interoperability profiles may incorporate references to external standards as applicable, e.g. IEEE 802.11, as shown by example in Figure 2.

5.1   Overview of Interoperability Profiles

Interoperability requires compliance with a common set of standards.   An "Interoperability Profile" can therefore be defined by specifying appropriate standards and additional constraints that satisfies the project requirements for each level of interoperability.   The hierarchical nature of achieving interoperability through the SAE JAUS standards is illustrated in Figure 2.

FIGURE 2 - 'ILLUSTRATION OF HIERARCHY IN JAUS SPECIFICATIONS'

Since some Messaging Level specifications do not integrate fully with all Transport Level specifications, the next section describes common templates that have been shown to achieve interoperability.   It is recommended that system specifiers, designers and architects make use of these templates whenever possible.