JAUS ADVANCE PLANNING BRIEFING

SURVEY RESULTS & QUESTION CARD RESPONSES

This document summarizes and attempts to address all questions presented to the JAUS Staff at the JAUS Advance Planning Briefing (JAPB) of November 15th, 2006. Due to a number of overlapping questions the staff combined responses in many instances. If your question is not represented or you have further questions, please email us at INFO@JAUSWG.COM and we will respond as soon as possible.

A summary of the responses to the Survey conducted at the JAPB is included herein. Of approximately 110 attendees, 29 submitted survey cards and 19 of those requested the results.

The following are the categories in which questions and answers may be found as well as a quick link to the section containing the Survey Results.

JAUS SCOPE

Question: Will AS-4 expand beyond converting JAUS into standards? Will it develop performance standards for robotics, e.g. how to distinguish high grass from a solid wall?

Answer: *AS-4 will expand as necessary to meet the needs for standardization within the unmanned systems community. The primary focus of AS-4 is interoperability of systems, subsystems and nodes (mission payloads and native vehicle/robot computing elements). With regard performance standards, many challenges are not specific to unmanned systems including your examples. JAUS will provide messaging standards that allow for such differentiation; however the means through which the differences are detected are beyond the scope of AS-4.*

Question: What is the definition of "architecture" as in RA?

Answer: *The Reference Architecture defined by JAUS, establishes the framework for the logical communications between unmanned systems elements (Subsystems, Nodes and Components). In the larger picture, the Joint Architecture for Unmanned Systems establishes a framework for the design of unmanned systems—provides domain specific analysis, logical decomposition of system elements, basic data requirements, and high level communications protocol parameters.*

Question: The primary focus of JAUS is on machine-to-machine communications (e.g., control station-to-platform or payload). Has the Committee considered the machine-to-human communications problem including displays and controls? Will the Committee consider expanding out the standards to address the operator interface?

Answer: *There are a number of Human Machine Interface issues that should be addressed by designers of unmanned systems. The majority are not specific to unmanned systems however. The AS-4 Technical Committee has discussed exploring the need for extending the scope of the standard to include the operator interface. No formal effort has been started at this time, and consultations with experts in the field will be required before that decision is made.*

RELATED STANDARDS

Question: What are the plans (if any), to integrate commercial video standards such as evolving MPEG and other similar standards?

Answer: *The proposed architecture allows for the use of existing protocols such as RTSP. Alternately, a wide variety of media formats such as MPEG-II, MPEG-IV etc can also be embedded into JAUS messages as individual frames.*

Question: Are you working standards to accommodate IPV6 transition? DoD is transitioning to IPV6 EOIP (Everything over IP-voice, data, and video) for all networks comprising the Global Information Grid (GIG)

Answer: *Yes. The AS-4B Network Environment (JAUS Transport) Committee will publish its initial transport standard for JAUS in March 2007. This initial version will cover IPv4, IPv6 and serial.*

Question: What relationship exists between JIEDDO & JAUS, JAUS & DISR?

Answer: *No formal relationship at this time between JIEDDO and JAUS. JAUS adopts guidance from the JTA/DISR with respect to use of other related or referenced standards.*

Question: Arch Framework – any standard framework (DoDAF, etc.) being used? When it's "done' will it be available through DoD channels for use in JCIDS architecture?

Answer: *The JAUS Architecture Framework would be useful in the detailed models based on the DoDAF. No direct mapping to the DoDAF has been performed to date. Availability of the Architecture Framework will be via the SAE.*

Question: Has the ASTM F41 work been considered by JAUS Working Group or AS-4 Technical Committee for the UUV unique requirements?

Answer: *Yes, but not in detail as of yet. The intent was to wait until the ASTM 41 efforts became more finalized. NUWC, in addition to other members of the UUV Task Group, has been involved with the ASTM 41 efforts too date. Additionally, AS-4 maintains a liaison between the JAUS/SAE Working Group and ASTM.*

RESOURCES

Question: What resources are available for JAUS in terms of reference implementations and open source examples?

Answer: *Many examples of JAUS implementations and source code can be obtained via members of the JAUS AS-4 Technical Committee. It is beyond the scope of the Technical Committee to promote, advertise or otherwise involve itself in commercial or open source products directly.*

Question: Is there an inventory of user reported JAUS implementations?

Answer: *No. All insight to implementations of JAUS in various programs comes from the personnel involved in those programs that participate in JAUS development. At this time no formal inventory of JAUS implementations exists and any future report of such may not be verifiable or complete.*

Question: What current Non-DoD applications are using JAUS?

Answer: *A listing of non-DoD unmanned systems using JAUS is not available at this time and it is unlikely that one will be available in the future.*

REFERENCE ARCHITECTURE UPDATE

Question: I would love to see the Spartan "Property" fields & messages added. The ability for a developer to be able to set, read, and modify system variables remotely is extremely useful for debug/development.

Answer: *We are happy to accept recommendations to enhance messages that already exist or to include new messages with features that are not already available in the current message set. We encourage everyone to submit recommended changes/updates to the appropriate committee.*

COMPLIANCE

Question: Who will validate JAUS compliant systems?

Answer: *Verification of compliance to JAUS is currently in the realm of the contracting agency.*

Question: For existing/deployed systems that are not currently JAUS-compliant, are there lessons learned on becoming JAUS-compliant or a guidance document to get to JAUS-compliance?

Answer: *A guidance document or a set of "lessons learned" has not been formally undertaken by the Technical Committee. However, numerous members of the Committee have been involved in legacy system upgrades and can offer insight to the challenges and possible solutions.*

Question: What are the minimum set of services all components must implement?

Answer: *At present the JAUS Compliance Specification requires that any JAUS subsystem or component have at least one JAUS message as defined by the Reference Architecture. The use of User Defined messages is acceptable.*

Question: Is there a Compliance Test suite. How does a vendor or a user verify compliance without one?

Answer: *There exists at least one JAUS Compliance Test Suite. This tool is not a product of the AS-4 Technical Committee. Use of available testing tools must be coordinated with the tool vendor/supplier.*

PAYLOADS

Question: How are unique payloads (those with motions of their own) addressed within the standard?

Answer: *Currently, payloads are not specifically addressed within the standard.*

Question: Given that most UAV missions focus on ISR, why is there little emphasis on sensor payloads, even though you consider weapons?

Answer: *There is ongoing discussion of how JAUS will address sensor payloads. The experimentation Task Group is proposing a "generic" payload interface for incorporation to the Reference Architecture update. This proposal is available via the JAUS Working Group.*

UNMANNED ARIAL VEHICLES

Question What is the status of JAUS/STANAG convergence?

Answer: *Although no formal convergence is currently in progress, it is clear to the JAUS/AS-4 committee that there is a need to review the possible blending of unmanned systems standards. This convergence is viewed as beneficial to the continued evolvement of collaborative behaviors and control amongst the UMS domains (UAV, UGV, UUV, USV, etc). As a first step, the JAUS and STANAG organizations are in communications with regard to formalizing a relationship and establishing possible interoperability between the two standards.*

Question: What are the issues in the minds of the UAV community that affect their decisions to participate or not in JAUS/AS-4 initiatives? There does not seem to be any traction for JAUS in UAVs? Would you say this is because of competing standards, because UAV autopilot manufacturers are not stepping forward, or some third reason?

Answer: *Although, JAUS originated from the unmanned ground vehicle (UGV) community, the scope of JAUGS, as it was known, was expanded to include all unmanned vehicle systems and renamed JAUS. The JAUS/AS-4 has worked with an expanding representation from other UMS domains (UUV, USV, etc) and we have achieved some*

"traction" with the UAV community. We anticipate that as more requirements for UAVs to use JAUS expand (as has the Army's FCS Program), the interaction with that community will also expand. We have initiated dialog with the Army's Future Combat Systems (FCS) UAV IPT to examine standing up a focused working group similar to that already established for the UUV community.

Question: Has the USAF Global Hawk bought into JAUS Protocol?

Answer: *No. There is no record of the Global Hawk program using JAUS know to the AS-4 Executive Committee.*

UNMANNED SURFACE VEHICLES

Question: Have any of the experiments conducted to date included USV or UUVs?

Answer: *No AS-4 Experimentation Task Group (formally Operator Control Units and Payloads Committee of the JAUS Working Group) have included USVs or UUVs. The U.S. Navy has implemented JAUS on various research vessels (USVs) and conducted interoperability demonstrations with them.*

Question: Will the UUV Task Group also address USVs?

Answer: *No. It is the intent of the JAUS Working Group to address USVs separately from UUVs. However, any overlap in the requirements space between UUVs and USVs will most certainly be worked to ensure the maximum compatibility between them.*

OTHER UNMANNED VEHICLES

Question: What integration of standards from space UVS have you/will you include(d) in JAUS/AS-4 to date? Participation by 'near-space" UVS providers/endusers yet?

Answer: *The JAUS Working Group has engaged representative from NASA in the past. At present there is not a formal relationship or "work in progress" to address the unique needs of space UVS.*

SERVICES

Question: Did the committee look at other design languages before creating JSIDL? If so, which ones?

Answer: *Yes. UPnP, Web Services: WSDL, BPEL, CORBA, Microsoft Robotics Studio.*

Question: What commonality, if any, is there with the architecture design language AADL?

Answer: *Commonalities between JSIDL and AADL: Both are specification languages that model component hierarchies and provide interfaces to name spaced components.*

Question: Are there application profiles (e.g. small, non-weaponized UUV) that define a common subset of services that all components conforming to that profile must implement.

Answer: *There are no formal JAUS requirements defining application profiles at this time.*

Question: On slide 143, AS5710 Overview, should 'server interface' be 'Service Interface'? If not, what is meant by 'server' in this context?

Answer: *The slide was correct in using the term server. The point of reference of a service interface can be considered to be either the client or the server, where the client consumes a functionality provided by the server. AS5710 will only define the interface from the perspective of the server, i.e., it will not define the clients of a particular service. This gives the greatest amount of flexibility in designing a system without compromising interoperability.*

Question: If AS-4C succeeds in their "Formal Methods" task, will there be anything other than performance issues for the Experimentation Task Group to focus on?

Answer: *Once formal methods are fully implemented, we still anticipate that the ETG will have a significant role and function. One aspect of this role would be to ensure that the services which are developed are sufficient to fulfill its role once implemented. While the service development methods will help ensure that services are "correct", and can be validated, they do not speak to the actual practical utility of developed services. The ETG will help in this regard through actual service testing and experimentation.*

Question: Please explain difference between message-based and service-based architectures. Give example of each. How is a mission task (e.g. establish on observation post) decomposed into services?

Answer:

Message Based Architecture:

Typically, message based architectures specify only an informal description of a component's application or function, and its message interface (message vocabulary and message encoding).

Example: (Access Control Component)
Description: The Access Control component allows at most one user to be logged into a system.

Message Interface:

Name: LOGIN Code: 0001h Type: Input

Field #	Name	Type	Units	Interpretation
1	User Name	String	N/A	Fixed length string: size 15 bytes
2	Password	String	N/A	Fixed length string: size 15 bytes

Name: LOGOUT Code: 0002h Type: Input

Field #	Name	Type	Units	Interpretation

Name: LOGIN_ERROR Code: 0001h Type: Output

Field #	Name	Type	Units	Interpretation
1	Error Code	byte	N/A	0 =Invalid user name 1=Invalid password 2=Another user is currently logged in

Service Based Architecture:

Typically, a service based architecture specifies not just the informal description of a service (or component) and its message interface, but also the assumptions made about the messaging environment by the service and its communication protocol.

Example: (Access Control Service)

Description: The Access Control component allows at most one user to be logged into a system.

Assumptions: This service is assumed to work with unreliable communication links where messages may be lost or re-ordered.

Message Interface:

Name: LOGIN Code: 0001h Type: Input

Field #	Name	Type	Units	Interpretation
1	User Name	String	N/A	Fixed length string: size 15 bytes
2	Password	String	N/A	Fixed length string: size 15 bytes

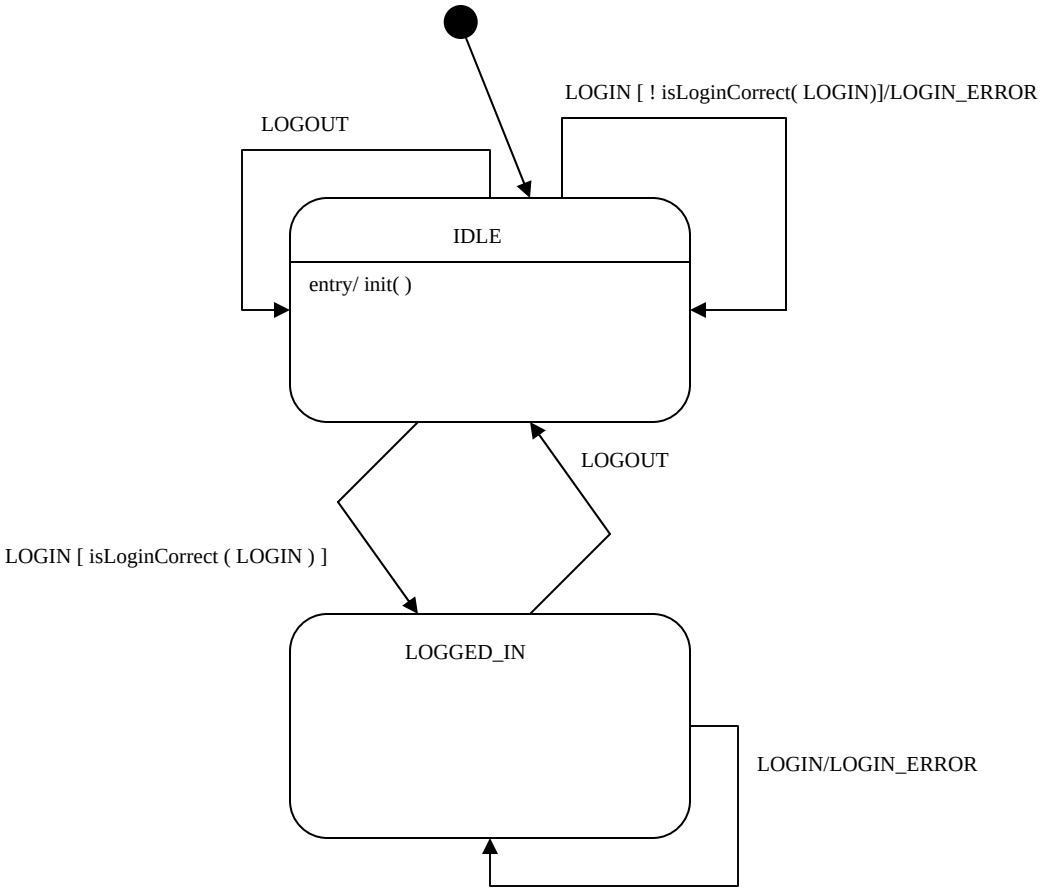
Name: LOGOUT Code: 0002h Type: Input

Field #	Name	Type	Units	Interpretation

Name: LOGIN_ERROR Code: 0001h Type: Output

Field #	Name	Type	Units	Interpretation
1	Error Code	byte	N/A	0 =Invalid user name 1=Invalid password 2=Another user is currently logged in

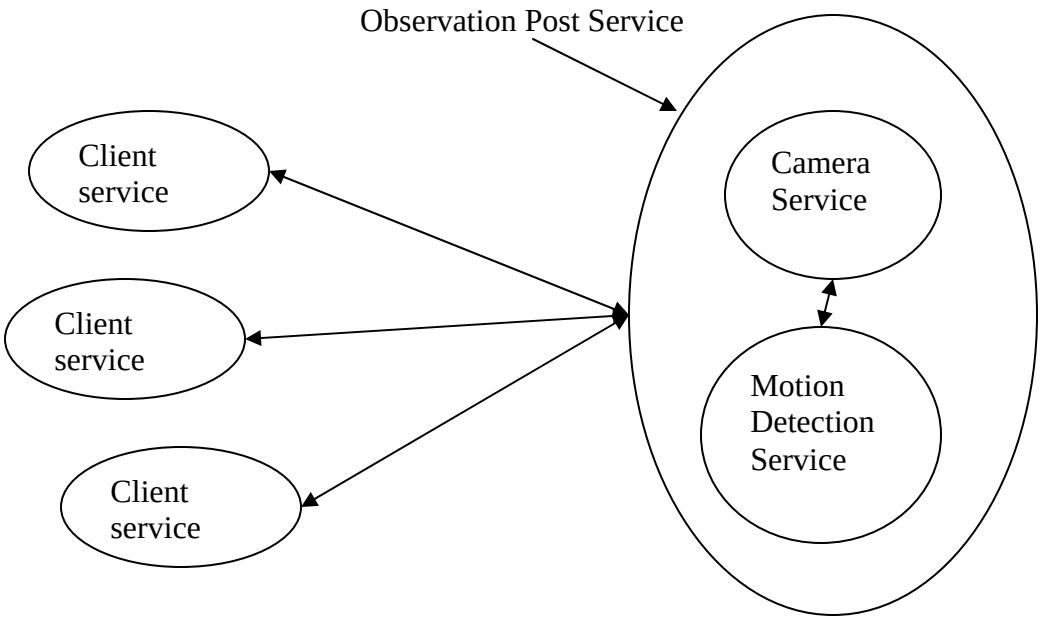
Protocol Behavior: Formally described as a finite state machine.



Observation Post Example

As an example, in its simplest form, an observation post service is composed of two lower level services: motion detection and a camera service. All services can be tied up asynchronously. Each service defines its message interface and protocol behavior. When motion is detected, the motion detection service sends a message to the camera, possibly with coordinates of the location of the motion. The camera takes a picture and sends it to services that have registered with it for image notification. In this case, it would be the higher level observation post service that registers for notification of images from the camera service.

The observation post service combines the functions of the motion detection service and the camera service to provide a conceptually new function of notifying clients with images of mobile activity in its physical environment. This new function is created by the composition of the protocol finite state machines of the lower level services. Client services (typically but not limited to operator control units) communicate with the observation post using its message interface and protocol definition.



Question: DoD (and industry) emphasis on net-centricity is making Service-Oriented Architectures very widely used. Will this have an impact on JAUS RA? You said yes after I wrote this. If so, can you indicate how?

Answer: *The emphasis on net-centricity does not have an impact on the JAUS RA, but the adoption of Service-Oriented Architecture (SOA) principles does. A SOA defines a system made of up distributed capabilities that are self-contained, loosely coupled, and have well defined interfaces. In order to achieve a well-defined interface, the procedural rules for the messages defined in the RA must also be specified, i.e., the RA will be modified to include message protocol.*

Question/Comment: Have you considered incorporating Microsoft Robotics Studio definition of services and XML messaging into your JAUS services definition?

Answer: *Technically, it is possible to do this via a separate namespace. But, it may not lead to an elegant solution. It may be better to maintain their separation and provide services that allow the two separate entities to interact or communicate transparently. This is true not only for MRS, but also for Web Services and all other types of service definitions.*

JOINT ROBOTICS GROUND ENTERPRISE

The following questions were directed to the OSD Joint Ground Robotics Enterprise Director during the JAUS Advance Planning Briefing. Responses presented are from the JGRE Director.

Question/Comment: Is JAUS going to be a real and meaningful standard (as is 1553) or a standard like Ada that is more honored in the breach than in the compliance?

Answer: *I understand the concern that underlies your question: is JAUS just a "flash-in-the-pan" standard, or will it become widely used and continue for the long term. We in OSD have supported and stood behind JAUS for almost ten years, because we believe it is the right thing to do. Our opinion is that JAUS is viable now and will continue on the upslope to increasingly widespread use. Let me cite just a few examples. First, the U.S. Army is mandating JAUS for its biggest and most technologically advanced program – Future Combat Systems (FCS). Second, JAUS is beginning to be used and taught in universities around the country. Lastly, we are told that commercial companies overseas are adopting JAUS because they made a good business case for its use. So, we see the JAUS standard as being a very positive initiative for the entire unmanned systems community that will be long term.*

Question/Comment: Does JAUS apply to UAVs? If not, is there a comparable standard being developed for UAV? Why does OSD allow two uncoordinated standards efforts for unmanned systems?

Answer: *Other than the UASs in FCS, JAUS is not mandated for unmanned air vehicles. The STANAG 4586 standard does have a message set contained in it that is similar to that of JAUS. The SAE AS-4 Unmanned Systems Technical Committee is engaging in initial discussions with the STANAG 4586 sponsors to begin to seek ground for commonality among the standards.*

Question/Comment: Please provide info on how MDARS is represented as the FIRRE vehicle.

Answer: *At one time, Mobile Detection Assessment Response System – Expeditionary (MDARS-E) was the name of the UGV component of FIRRE. However, the MDARS – Exterior platform shown in the chart has never been part of FIRRE. We regret the confusion and will update the briefing. Thank you for pointing this out.*

Question/Comment: What is being done to coordinate standards between ground and air vehicles? It appears overlap may exist.

Answer: *Please see my answer to question 2 above. Additionally, within the Office of the Undersecretary of Defense, Acquisition, Technology, and Logistics (AT&L), we are writing the first ever integrated Unmanned Systems Roadmap. As part of this process, we (air, ground, and maritime) will be identifying areas of commonality to examine for potential standardization, horizontal integration, and convergence. We are also concerned that overlap may exist and will be analyzing these areas.*

Question/Comment: Do you have any interest in supporting and/or co-sponsoring a joint (Army, Navy, Marine Corps) program to deploy a hostile-fire detection and counter-fire mission payload module for unmanned platforms that is JAUS compliant and interoperable?

Answer: *The portfolio that I was recently charged with overseeing for the Department is Joint Ground Robotics. As such, we are instituting a Technology Advisory Board process that will look at selected prioritized Mission Areas (by the Combatant Commanders) and Most Pressing Military Issues (MA/MPMI) for technology gaps as they pertain to ground robotics. If there is a need for a hostile-fire detection and counter-fire mission payload module for unmanned platforms identified, then we will contact you.*

Question/Comment: How is the Congressional FY07 Report Language regarding unmanned systems planned to be implemented both at the OSD and Service levels? How and when will this language be implemented in unmanned systems acquisition programs?

Answer: *The report to Congress in response to the FY2007 Language is currently in draft. As it is pre-decisional, we are not yet at liberty to discuss implementation details.*

Question/Comment: Great brief! Questions are: 1) Who is the 'gatekeeper' for 'good ideas' for TAB or 0-6 council consideration? What is the process for industry to bring in their ideas? 2) Industry cannot efficiently apply their resources to help the JGRE if they do not have visibility on capability gaps/needs. Where can industry access these to understand "What warfighters need?" INVOKE INDUSTRY CREATIVITY, AND FOCUS THEIR EFFORTS – GET INDUSTRY WORKING FOR YOU (JGRE)

Answer: *Thank you. 1) The entry point for industry to bring 'good ideas' to the JGRE is a Technology Advisory Board (TAB) member. Industry can and should request meetings/demos with TAB members to present their ideas and concepts. 2) To help answer the question "What do warfighters need?" industry should continue to use standard market research methods – conferences, symposia, briefings, etc. In particular, be involved with the activities conducted by NDIA, NCDR and AUVSI. The Department of Defense will also be publishing the first Integrated Unmanned Systems Roadmap. The*

Roadmap will include prioritized lists of Mission Areas and Most Pressing Military Issues, and well as the direction the Department will be heading with regard to unmanned systems. In addition, we will encourage TAB and O-6 Council members to promulgate appropriate information regarding capability needs associated with ground robotics.

Question/Comment: How does JGRE matrix through Reliance, where multiple DTO/DTAPs, address (uncoordinated) unmanned "systems"?

Answer: *While the JGRE has not in the past matrixed through Reliance, we do provide guidance and suggested S&T investments for ground robotics related technologies. We also participate in the Technology Area Reviews and Assessments (TARA), which places emphasis on relevance of programs' (portfolios') to Defense Technology Objectives and the Defense Technology Area Plan (DTO/DTAP). As part of the recently established Technology Advisory Board and O-6 Council, investment priorities will be established across the range of technology level maturities, from S&T efforts up to programs of record. DDR&E will be a very active member of the TAB.*

JAPB SURVEY RESULTS

A summary of the responses to the Survey conducted at the JAPB is included herein. Of approximately 110 attendees, 29 submitted survey cards and 19 of those requested the results.

1. Satisfaction with Briefing

Category (Very Satisfied – Very Dissatisfied)	5	4	3	2	1
Briefing Content	14	8	4	0	1
Registration Process	23	1	2	1	1
Venue	12	12	3	0	1

2. "What was the most beneficial topic of the briefing?" (also # 8 "What was the most beneficial aspect of the briefing?"

Topic	# 2	# 8	Total
Status & Roadmap	4	3	7
Mrs Ellen Purdy	4	1	5
UUV	4	1	5
AS4 B / Networking	3	2	5
SAE Process	1	2	3
JAUS Background	1	2	3
Migration Strategy	1	1	2
ETG	1	1	2
Current JAUS issues	1	1	2
RA	1	0	1
AS4C	1	0	1
Interaction w/ JAUS	1	0	1

2. How did you hear or learn about this briefing?

[3] FBO
[10] Referral
[4] AS-4 or JAUS WG Membership
[12] Other *(Several comments were "AUVSI")*

4. Did the briefing fulfill your reason for attending?

[17] Yes - Absolutely
[8] Yes – But not to my full extent
[2] No Comments included: "more technical details needed" and "Surprised at lack of UAV participation"

5. Please specify the main reason for attending this briefing (check all that apply):

[6] Program/Project office has a JAUS Requirement
[3] JAUS Product Vendor
[12] Unmanned Systems Vendor
[5] Standards Developer
[8] Other

R&D of unmanned Systems
Developing ASTM- related standards on autonomy
New UGV Initiative
Technical information regarding message set
Determine JAUS application to target drones
Potential JAUS product
Business Development
Army War College Curriculum
ONR – S&T / transition

6. Would you recommend this briefing to others?

[25] Yes [3] Maybe [0] No

7. "What other topics in this domain interest you?" (22 topics)

Details on JAUS messages & practical applications
How is JAUS compliance verified?
Details on JAUS material distribution
Comparison of JAUS to other approved standards
World modeling, Ontology, knowledge representation
JAUS & DoD Range Target Control Systems
How to raise USAF/UAV awareness
Greater definition of benefits to autonomous vehicles
Comparison & understanding different UxVs
Standardization GIG/Forcenet compliance
Compliance message content with UAVs
More details
STANAG 4586 (2)
More info on migration to SOA
UUV working group
Intra vehicle communications
Unmanned Aviation
SOA
AADL
JSIDL
Application to UAV
User communities/meeting implementers

8. "What was the most beneficial aspect of the briefing?" (22 topics)

Seeing faces in communities, points of contact (2)
Why & who plans to adopt JAUS
Overview by Purdy
Bringing me up to speed on what's going on
Learning about JAUS and where it's going
AS4B – Networking (2)
Good description of purpose and content of JAUS
JAUS process overview
There is an International standard out there
List of current issues
Schedules, Roadmaps, Q&A session
Depth of Briefing
Timeliness & progress of ETG
The history of development
Seeing the high level picture of JAUS
SAE process
Migration Plans
Plan & where & when (2)
JAUS overview and status (2)
Application discussions
UUV
AUVSI meeting

9. "What other topics are of interest to you for another Advance Planning Briefing?"

Message Specific workshops for new adopters
Assistance in migrating JAUS
Technical content of messages
Case study of the implementation & use (videos, etc)
Technical "How to", downloads, user groups, urls,…
Specific examples, white papers, migration strategies
More on ETG, UAV, & UGS examples
Should have drafts for everyone
Level of international partnership for allied/NATO use
Hybrid JAUS & STANAG specification
Success Stories
Design Language for UxVs
Interfaces with other standard organizations
Payload Interoperability and testing
UUVs
USV
UAV Interoperability
UAV focus
More info on mission planning
More in-depth roadmap-future challenges
IED solutions with regards to robots
Levels of compliance L1, L2, L3
Maybe a JAUS theme song