

# **J AUS Interface Control Document For Intelligent Ground Vehicle Competition 2007**

Version 2.1

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RECORD OF REVISIONS			
Revision	Date	Pages Involved	Change Number
Initial	25 Oct 2005	Initial Release	
2.0	12 Mar 2007	Updated for 2007 IGVC	
2.1	18 May 2007	Updated Section 2 to include JCTS distribution restrictions and non-US team award structure.	

## 1 EXECUTIVE SUMMARY

### INTELLIGENT GROUND VEHICLE COMPETITION 2007 JOINT ARCHITECTURE FOR UNMANNED SYSTEMS (JAUS) IMPLEMENTATION

#### 1.1 Objective

JAUS is a set of standardized messages suitable for controlling all types of unmanned systems, and is soon to become an Aerospace Standard of the Society of Automotive Engineers (SAE). IGVC officials and sponsors believe that it would be valuable for student teams to become exposed to and familiar with JAUS. The intent is to start at a very simple level and increase the complexity in an incremental manner at successive IGVCs.

#### 1.2 Voluntary Participation

Participation in the JAUS portion of IGVC by a student team is voluntary.

#### 1.3 The Challenge

There are two aspects to IGVC JAUS Challenge: (1) a written/oral presentation and, (2) a practical demonstration.

##### 1.3.1 Written/Oral Presentation

The written/oral presentation shall include a description of the student team's implementation of JAUS in their design report. If a student team participates in the IGVC JAUS Challenge, they will be allotted one extra page in their report and two extra minutes during their oral presentation. The items to be addressed in the design report and presentation are:

1. Student team's process for learning about JAUS.
2. How the JAUS messages were integrated into the design.
3. Challenges to implementation that were encountered.

##### 1.3.2 Practical Demonstration

The practical demonstration will consist of JAUS messages being sent to the vehicle from an IGVC developed operator control unit (OCU) via an RF data link. Within the practical demonstration, there are two levels of performance:

Level 1: This level will consist of messages to start the vehicle moving forward in the autonomous mode, stop the vehicle from moving in the autonomous mode, and activate a warning device (horn/light).

Level 2: This level will be to demonstrate vehicles only accept messages intended for them and provide the Navigation Challenge waypoints upon request.

#### **1.4 Judging**

Because IGVC JAUS Challenge is voluntary, there shall be no negative implications assigned or implied if a student team does not participate. Successful IGVC JAUS Challenge is on a pass-fail basis and consists of the vehicle performing the JAUS commands on the course during qualification and the student team's JAUS Implementation in the Design Competition. The judging for the JAUS challenge will be conducted by members of the JAUS Working Group who are developing the JAUS standards.

#### **1.5 Award**

Schools that complete either level of the IGVC JAUS Challenge shall receive an award of \$500. Teams can elect to compete in both challenges (except as noted below) and will be awarded one prize of \$500. Teams that participated in and successfully completed the JAUS Challenge during the 2006 IGVC are not eligible to participate in the Level 1 competition again. Multiple teams from a school can compete in the JAUS challenge; however, there will only be one monetary prize per school.

All schools and teams participating in the JAUS Challenge will be individually recognized on the IGVC website.

## 2 TECHNICAL APPROACH

Student teams are required to implement the messages defined in this section as defined in the JAUS Reference Architecture version 3.2 Part 3 and the JAUS Header as described in the JAUS RA V3.2 Part 2. All other messages within the JAUS Reference Architecture document may be ignored for this competition. The IGVC OCU will not transmit JAUS messages that are not defined within this section. Teams are not required to develop an OCU for this competition, but are free to develop one that may help in testing. The JAVA based JAUS Compliance Tool Suite (JCTS) that will be used for testing during the competition is available to participants from the United States. A copy of JCTS can be requested from Mr. Dan Gehring (daniel.g.gehring@us.army.mil). A testing station will be available for non-US teams in the evenings prior to the JAUS Challenge day. All non-US teams can earn half the JAUS Challenge award based on the completeness and quality of their Oral/Written Presentation. Upon successful completion of the Practical Demonstration, the non-US teams will receive the final half of the JAUS Challenge award. US teams are only eligible to receive the full JAUS Challenge award upon successful completion of both the Oral/Written Presentation and Practical Demonstration, no partial award will be granted to a US team.

The current JAUS RA documents can be found at:

<http://www.jauswg.org/baseline/refarch.html>.

### 2.1 Network Based

The Radio Frequency will adhere to the 802.11g specification. The protocol will be carried using a Direct Sequence Spread Spectrum (DSSS) carrier that is prevalent in commercially available wireless Ethernet systems.

JAUS communication will be accomplished using UDP (User Datagram Protocol) over Ethernet. The UDP header, in addition to the JAUS header information and the standard UDP header information will include eight bytes containing the ASCII equivalent of "JAUS01.0". Only one JAUS message per UDP packet is allowed.

### 2.2 UDP Port Allocation

The following TCP/UDP ports shall be used for data transfer via Ethernet during the challenge:

Command and Control	3794
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### 2.3 IP Address Assignment

Communications: Internal (subsystem) traffic shall not leave the subsystem.

The IP address for the OCU shall be: 192.168.128.1

The IP addresses for the student unmanned vehicles shall be selected from the following range: 192.168.128.2-254

The unmanned vehicle must be developed such that the 802.11g radio is powered off while the unmanned system is not performing in the JAUS competition.

## **2.4 JAUS IDs**

The following values will be used for the JAUS IDs:

The last octet of the IP address will be the Subsystem ID.

The Node ID will always be 1.

The Component ID for the unmanned system will be as defined below.

The Component ID for the OCU will be the System Commander ID (40).

The Instance ID will always be 1.

## **2.5 Level 1 Challenge**

The Component ID for the Level 1 Challenge will be the Primitive Driver ID (33).

### **2.5.1 Mobility**

The vehicle will start moving in its autonomous mode upon receipt of the JAUS Resume message (Cmd Code = 0004h).

The vehicle will stop moving upon receipt of the JAUS Standby message (Cmd Code = 0003h)

### **2.5.2 Warning Device Activation**

A horn or light will be activated using the JAUS Set Discrete Devices message (Cmd Code = 0406h) using bit 1 of field #3 (Horn On/Off bit).

## **2.6 Level 2 Challenge**

The Component ID for the Level 2 Challenge will be the Global Waypoint Driver (ID 45).

### **2.6.1 JAUS Header Fields**

The vehicle shall not respond to messages that have an improperly formed JAUS Header. The following is what constitutes a properly formed JAUS Header.

1. JAUS Message Properties
  - a. Version must be set for 3.2
  - b. User Defined Message bit must be set to JAUS
  - c. Service Connection bit must be set to Not
  - d. Ack/Nak must be set to None
  - e. Priority must be set to Default
2. Command Code
3. JAUS Destination ID (as specified above for the vehicle)
4. JAUS Source ID (as specified above for the OCU)
5. JAUS Data Control (bytes)
6. Sequence Number set to zero

To pass this part of the challenge, the vehicle shall not respond to any JAUS message that has an improperly formed Header.

### **2.6.2 Waypoints**

The vehicle shall accept queries for waypoint information using the JAUS Query Global Waypoint (Code = 240Ch). The vehicle shall respond using the JAUS Report Global Waypoint (Code = 440Ch). To pass this part of the challenge the waypoint information returned must match the waypoint data provided by the Navigation Challenge organizers.