JOINT ARCHITECTURE FOR UNMANNED SYSTEMS

January 29, 2011
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Based on Slides by Bo Sun
JAUS

Standard for Unmanned Systems originally initiated by the U.S. DoD

- Open and scalable service-based architecture
- Designed to be:
  - Vehicle platform independent
  - Mission isolated
  - Hardware and technology independent
JAUS

- Defines “Services” and the interfaces to them
- In essence, a description of a vocabulary to access capabilities
  - Between and within Unmanned Systems
  - Between Unmanned Systems and the Operator Control Unit (OCU)
  - Described by the JAUS Service Interface Definition Language (JSIDL)
WHY JAUS?

- To provide
  - A basis for logical interoperability
  - A foundation for achieving automated architectures
SIGNIFICANCE OF JAUS

- Allows
  - Interoperability
  - Reduction in cost of support
  - Reduction in cost of development
  - Ease of unmanned system modeling
HISTORY OF JAUS

Spearheaded by the DoD under the Joint Robotics Program

JAUS Reference Architecture published by JAUS Working Group

SAE JAUS Standard Documents maintained by the AS4 Unmanned Systems Technical Committee
JAUS RA VS. SAE-JAUS

- JAUS Reference Architecture (RA) was the original version of the standard, which is no longer maintained after version 3.3, and is a component based message passing architecture.
- SAE-JAUS is the current version of the standard and contains more formal documentation and clearer guidelines to support implementation. It is a service-based architecture. The current standards documents are:
  - AS5669 - JAUS Transport Standard – Defines packet construction and addressing for TCP, UDP, and Serial links
  - AS5710 – JAUS Core Service Set – Establishes common set of services for distributed systems communication and coordinate
  - AS6009 – JAUS Mobility Service Set – Migrates mobility related components from JAUS RA to SAE standard (e.g. Primitive Driver, Waypoint Drivers)
# OPEN SOURCE JAUS IMPLEMENTATIONS

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JAUS TOPOLOGY

System

Subsystem

Node

Component

System

UGV

OCU

Sensor PC

Navigation PC

Control PC

AV Sensor

Navigator

AV Display

Omni Sensor
COMPONENT AND SERVICES

- A Component is a part of or a complete software application running on a Node and is composed of Services.
- A Service is a defined capability with a formal interface to access or manipulate that capability.
- For example, consider a car radio as a Component with two Services (clock and music). The clock as buttons and display to change the time and show you the current reading. The music service has a knob and speaker which manipulate the volume of the sound and allow you to hear it.
- Services can inherit from other services in order to extend capabilities defined.
JAUS COMPONENTS AND SERVICES

Physical Transport Layer (e.g. JUDP)

Subsystem

Node

Component

Transport Service

Service X

Service Y

Service Z

Subsystem

Node

Component

Transport Service

Service X

Service Y

Service Z
JAUS SERVICE MESSAGES

Three types of messages to interface with a Service

- Query
- Report
- Command (need control)
CORE SERVICE SET AND TOPOLOGY

- Transport
- Events
  - Liveness
  - Discovery
  - Access Control
    - Time
    - Management
TRANSPORT SERVICE

- Defines
  - TCP (JTCP), UDP (JUDP), and Serial (JSerial) links
  - General packet header and payload format
    - Message type
    - Source/destination addressing
  - Software Defined Protocol
EVENTS SERVICE

- Create Event (periodic or on change)
- Confirm Event Request
- Cancel Event
- Query Events
- Report Events

Dogbot, tell me when you move!

OK!
ACCESS CONTROL SERVICE

- Request Control
- Confirm Control
- Query Authority
- Report Authority

Dogbot, grant me control of your services!

OK!
LIVELINESS SERVICE

- Query Heartbeat Pulse
- Report Heartbeat Pulse

Dogbot, are you there?

Still kicking!
TIME SERVICE

- Query Time
- Report Time
- Set Time

Dogbot, What time is it?

4:19pm
DISCOVERY SERVICE

- Provides topology of Subsystem Configuration
- Provides list of services available per component

I wonder who is there!? Dogbot is here!
Tell me what you can do?
I can tell time and be driven
MANAGEMENT SERVICE

- Provides component States: Ready, Standby, Emergency
- Shutdown, Reset controlled components
MOBILITY SERVICE SET AND TOPOLOGY

Access Control

Management

Global Pose Sensor

Local Pose Sensor

Velocity State Sensor

Primitive Driver

Global Waypoint Driver

Local Waypoint Driver

Pose Sensor

State Sensor

Velocity State Sensor
PRIMITIVE DRIVER SERVICE

- Provides mechanism to directly manipulate actuators/motors on a platform
- Uses “Wrench Efforts” which are percent of effort along or around the vehicles coordinate frame

Dogbot, move at 50% effort on the X Axis

Driving Forward at 50% Max Effort
GLOBAL POSE SERVICE

- Provides position and attitude information: Latitude, Longitude, Roll, Pitch, Yaw, etc.

Dogbot, tell me when your Global Pose Changes

Confirm Event Request

Report Event – Global Pose
QUESTIONS?