

JOINT ARCHITECTURE FOR UNMANNED SYSTEMS

January 29, 2011

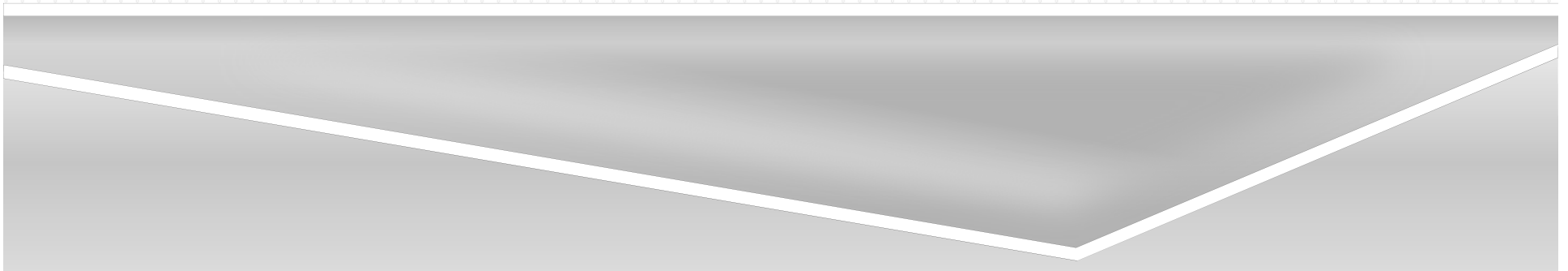
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Based on Slides by Bo Sun



J AUS

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

J AUS

- ▶ 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

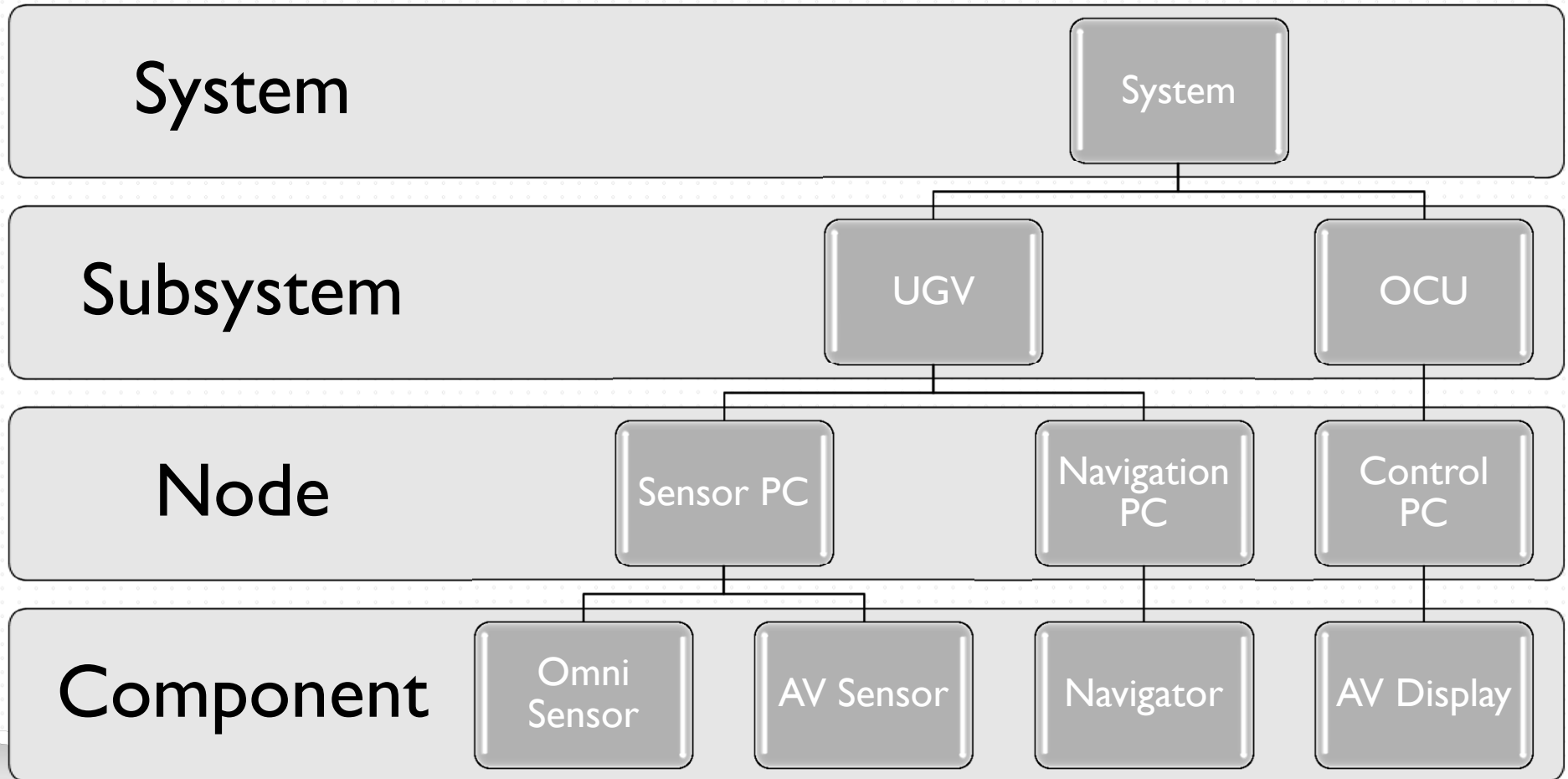
J AUS RA VS. SAE-JAUS

- ▶ J AUS Reference Architecture (RA) was the original version of the standard, which is no longer maintained after version 3.3, and is a component based message passing architecture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 - J AUS Transport Standard – Defines packet construction and addressing for TCP, UDP, and Serial links
 - ▶ AS5710 – J AUS Core Service Set – Establishes common set of services for distributed systems communication and coordinate
 - ▶ AS6009 – J AUS Mobility Service Set – Migrates mobility related components from J AUS RA to SAE standard (e.g. Primitive Driver, Waypoint Drivers)

OPEN SOURCE JAUS IMPLEMENTATIONS

Name	JAUS Version
JAUS Tool Set	SAE JAUS
OpenJAUS	JAUS RA 3.3
Junior Middleware	SAE JAUS - AS5669A Only
JAUS++	JAUS RA 3.3 (v1.X) SAE-JAUS (v2.X)
RI-JAUS	JAUS RA 3.3

J AUS TOPOLOGY

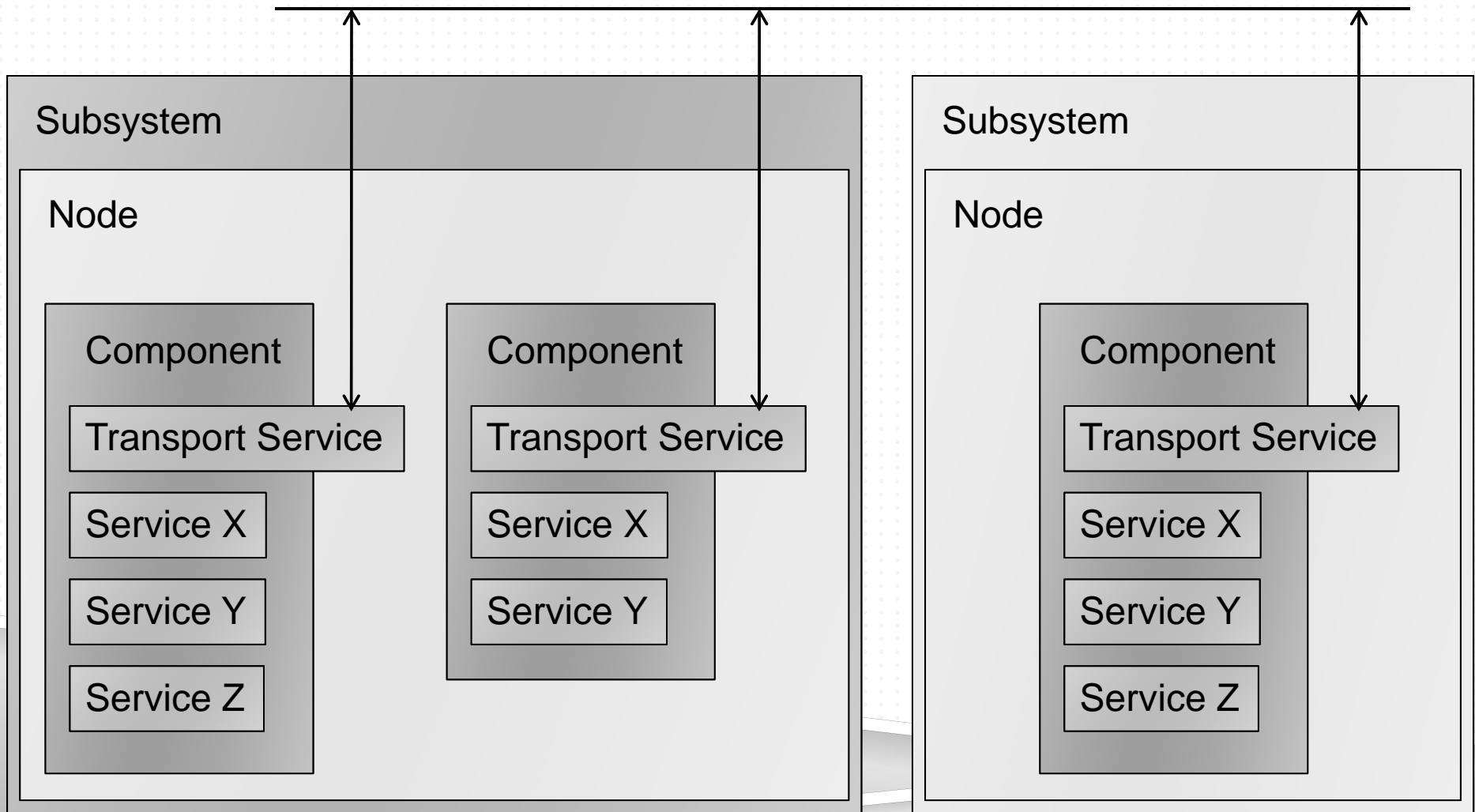


COMPONENT AND SERVICES

- ▶ 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

J AUS COMPONENTS AND SERVICES

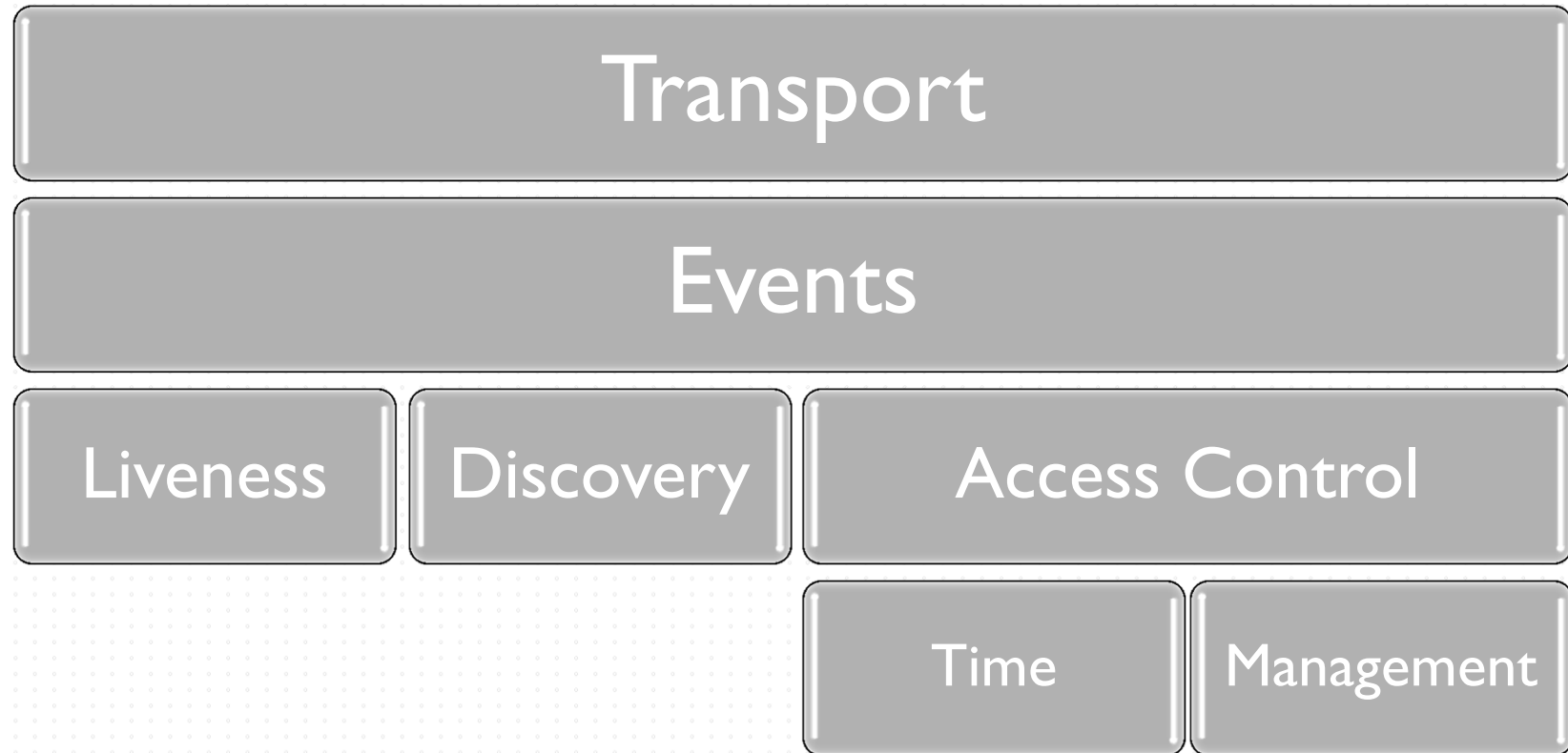
Physical Transport Layer (e.g. JUDP)



J AUS SERVICE MESSAGES

- ▶ Three types of messages to interface with a Service
 - ▶ Query
 - ▶ Report
 - ▶ Command (need control)

CORE SERVICE SET AND TOPOLOGY

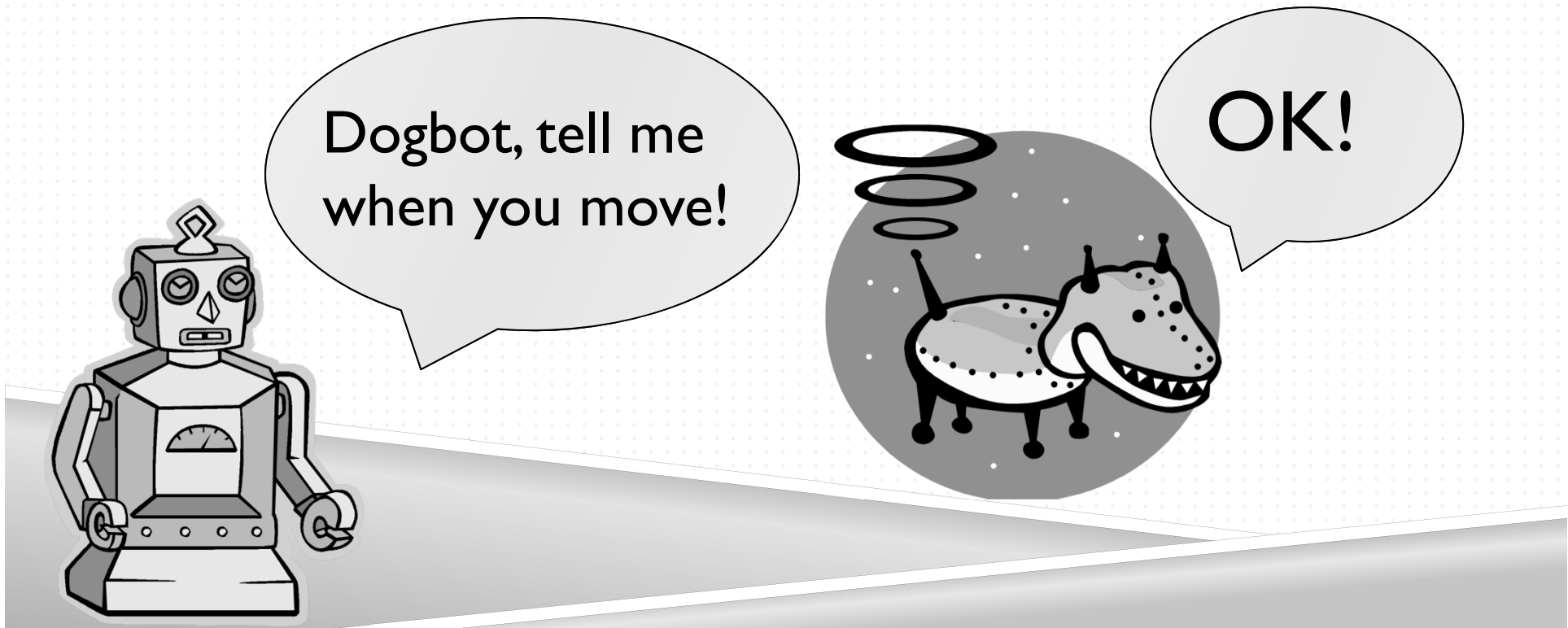


TRANSPORT SERVICE

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

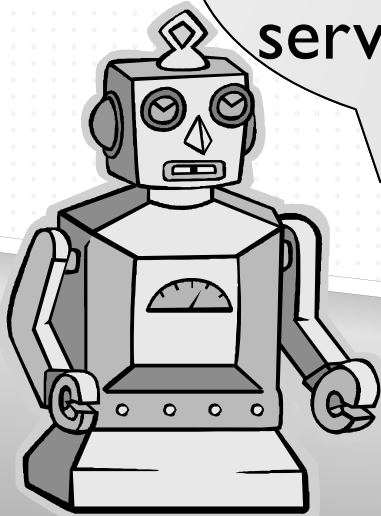
EVENTS SERVICE

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



ACCESS CONTROL SERVICE

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



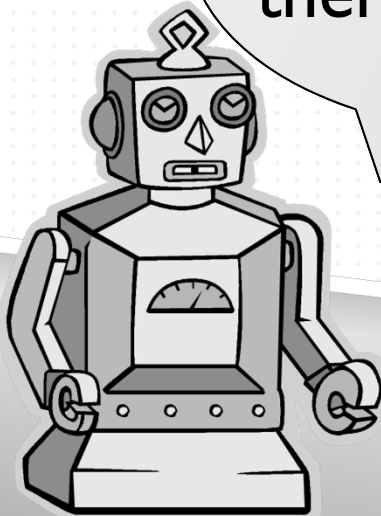
Dogbot, grant me control of your services!



OK!

LIVELINESS SERVICE

- ▶ Query Heartbeat Pulse
- ▶ Report Heartbeat Pulse



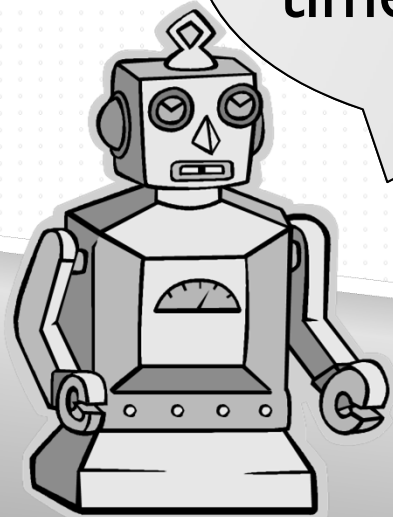
Dogbot, are you there?



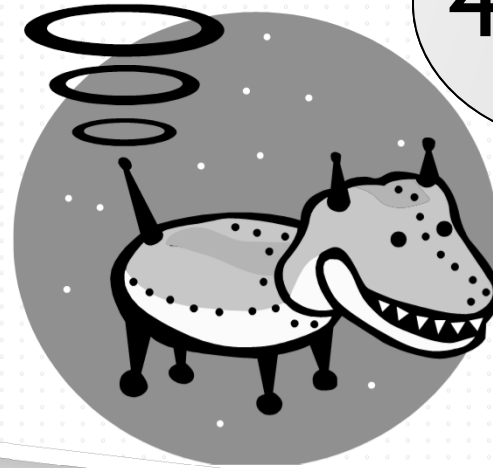
Still kicking!

TIME SERVICE

- ▶ Query Time
- ▶ Report Time
- ▶ Set Time



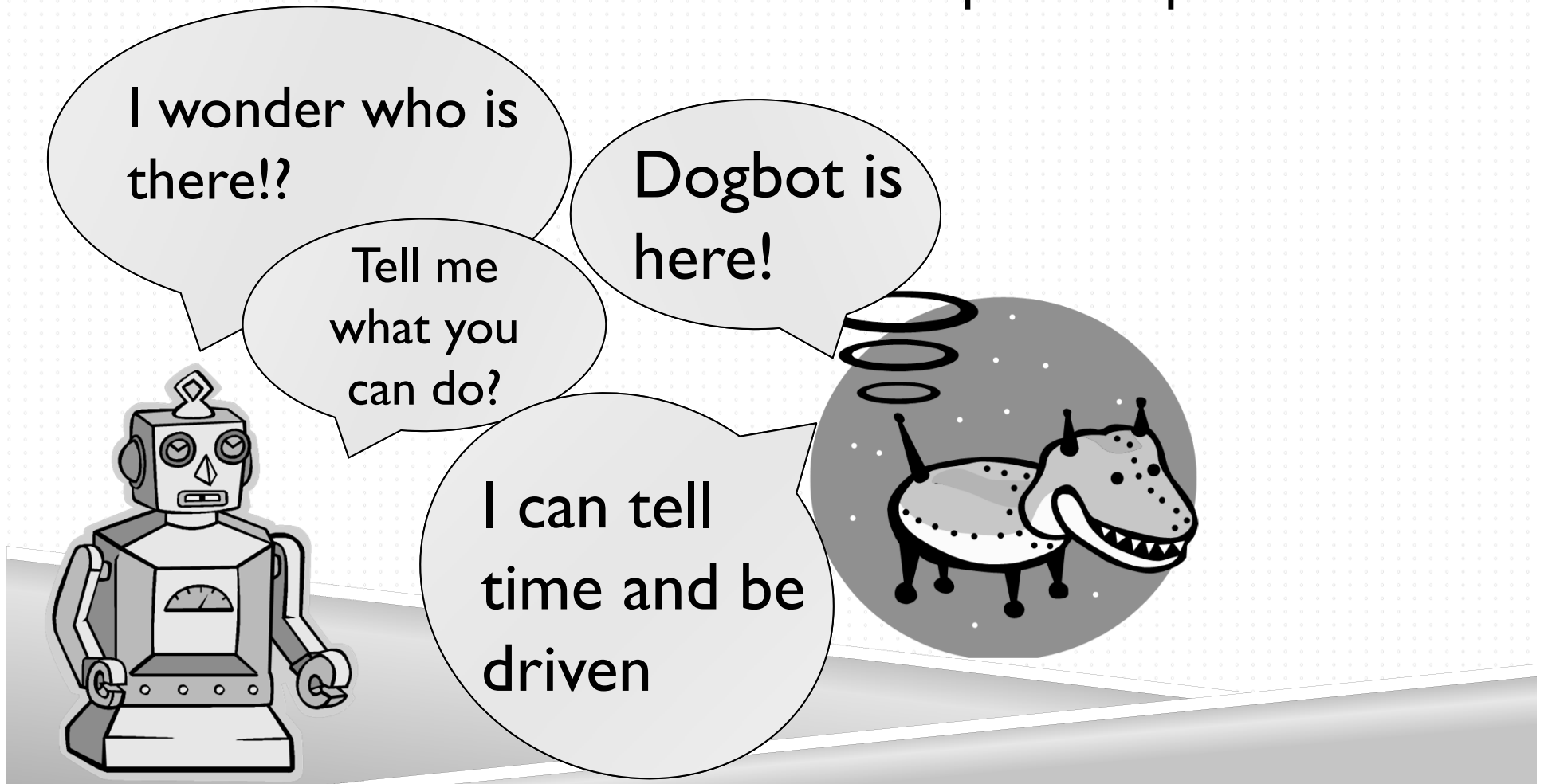
Dogbot, What time is it?



4:19pm

DISCOVERY SERVICE

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

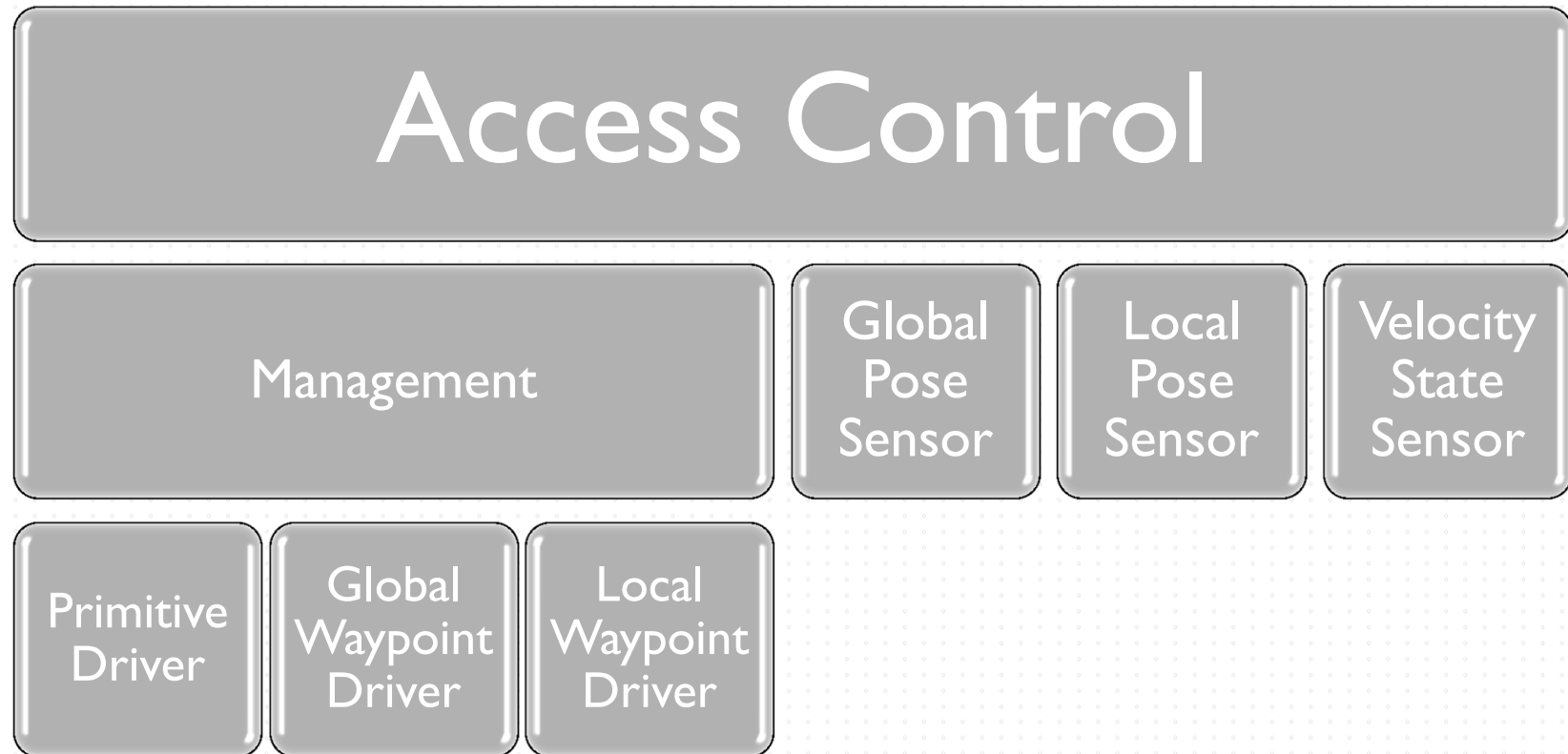


MANAGEMENT SERVICE

- ▶ Provides component States: Ready, Standby, Emergency
- ▶ Shutdown, Reset controlled components



MOBILITY SERVICE SET AND TOPOLOGY



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



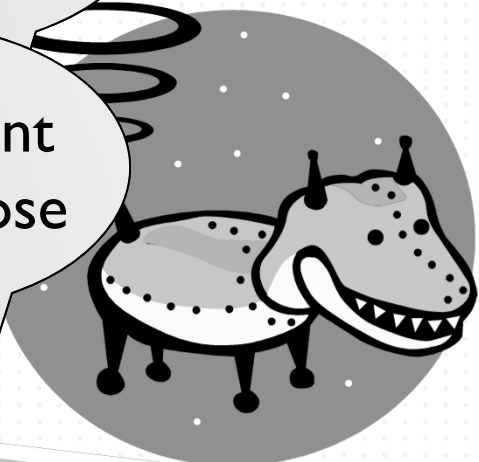
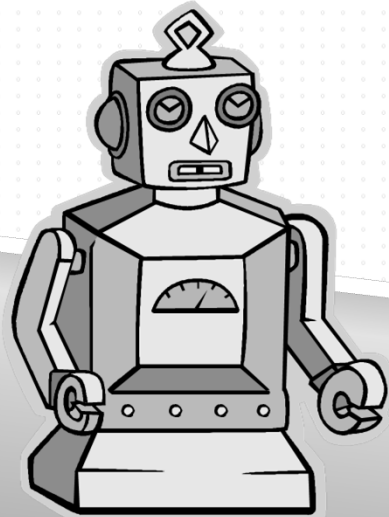
GLOBAL POSE SERVICE

- ▶ 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?

