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JAUS Architecture

System Design with JAUS

Overview

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- Designing a JAUS system
- System Design Example:
  - OPC Experiment 3.0
- Subsystem Design Example:
  - The NaviGator
- CIMAR JAUS Libraries Introduction
- Homework review and handout

JAUS System Design

- Systems are intended to accomplish one or more missions
- A mission must be clearly defined
- Systems must have at least one Subsystem
- Top-down Design
  - Define all subsystems
    - Function, Identification, Id, and Nodes
  - Define all nodes
    - Function, Identification, Id, and Components
  - Define all Components
    - Function, Services, Inputs and Outputs

System Design Example

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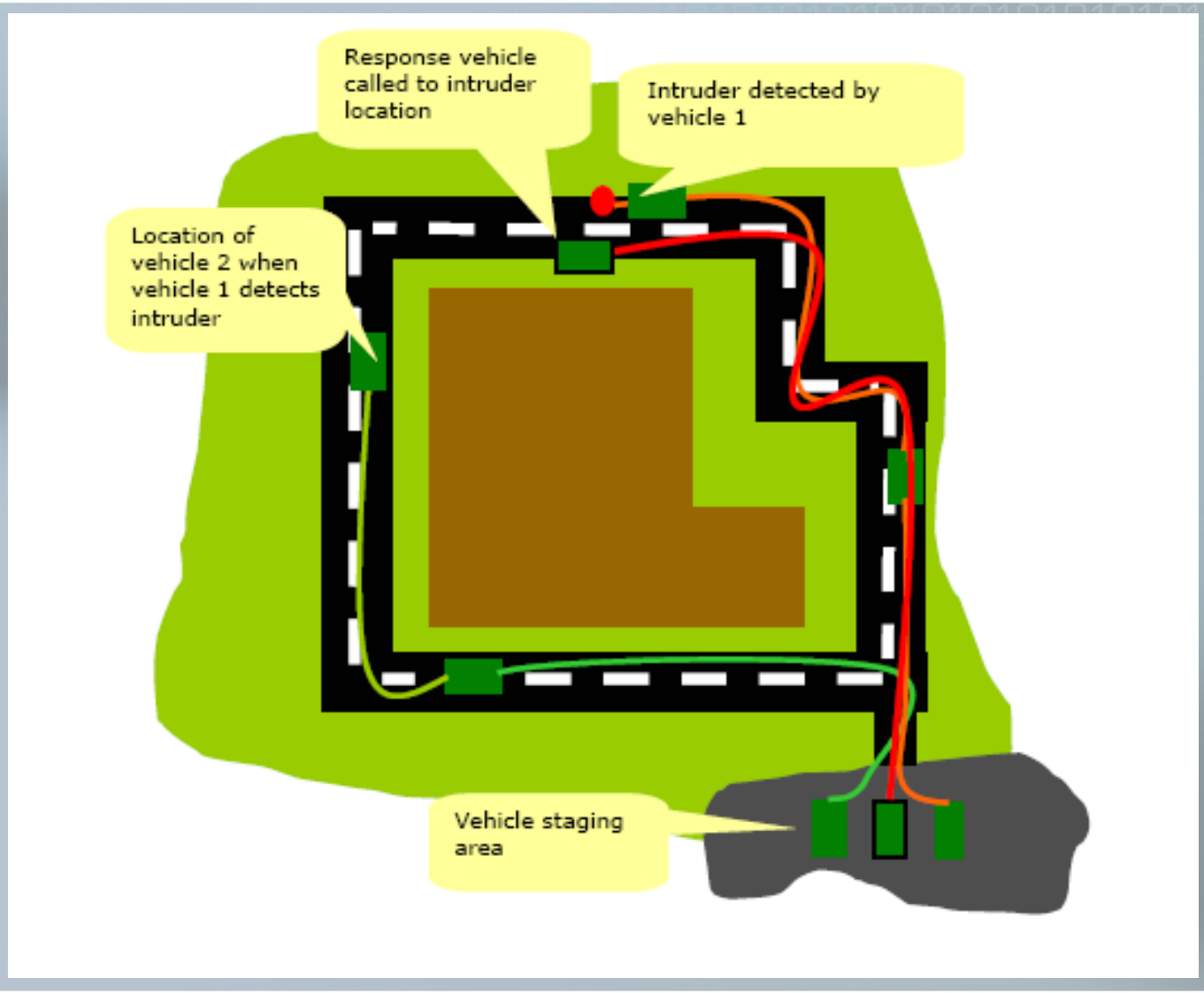
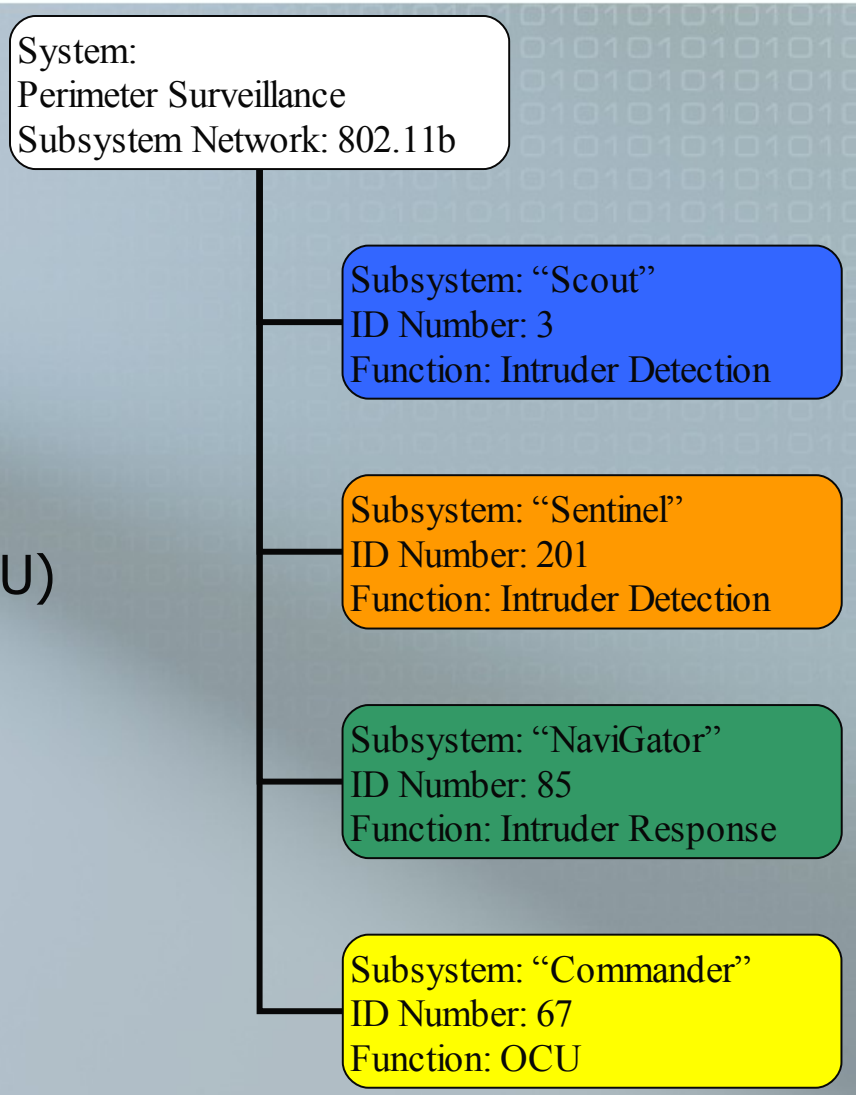
- OCU and Payloads Committee
  - Experiment 3.0
- Mission: Perimeter Surveillance and Response
  - A known and well defined perimeter is patrolled by unmanned vehicles with intruder detection capabilities
  - Upon intruder detection, an unmanned response vehicle will be sent to the intruder to take some kind of action

Mission Scenario Drawing



System Table: Experiment 3.0

- Two Intruder Detection Vehicles
  - "Scout"
  - "Sentinel"
- One Intruder Response Vehicle
  - "NaviGator"
- Operator Control Unit (OCU)
  - "Commander"



JAUS Subsystem Design

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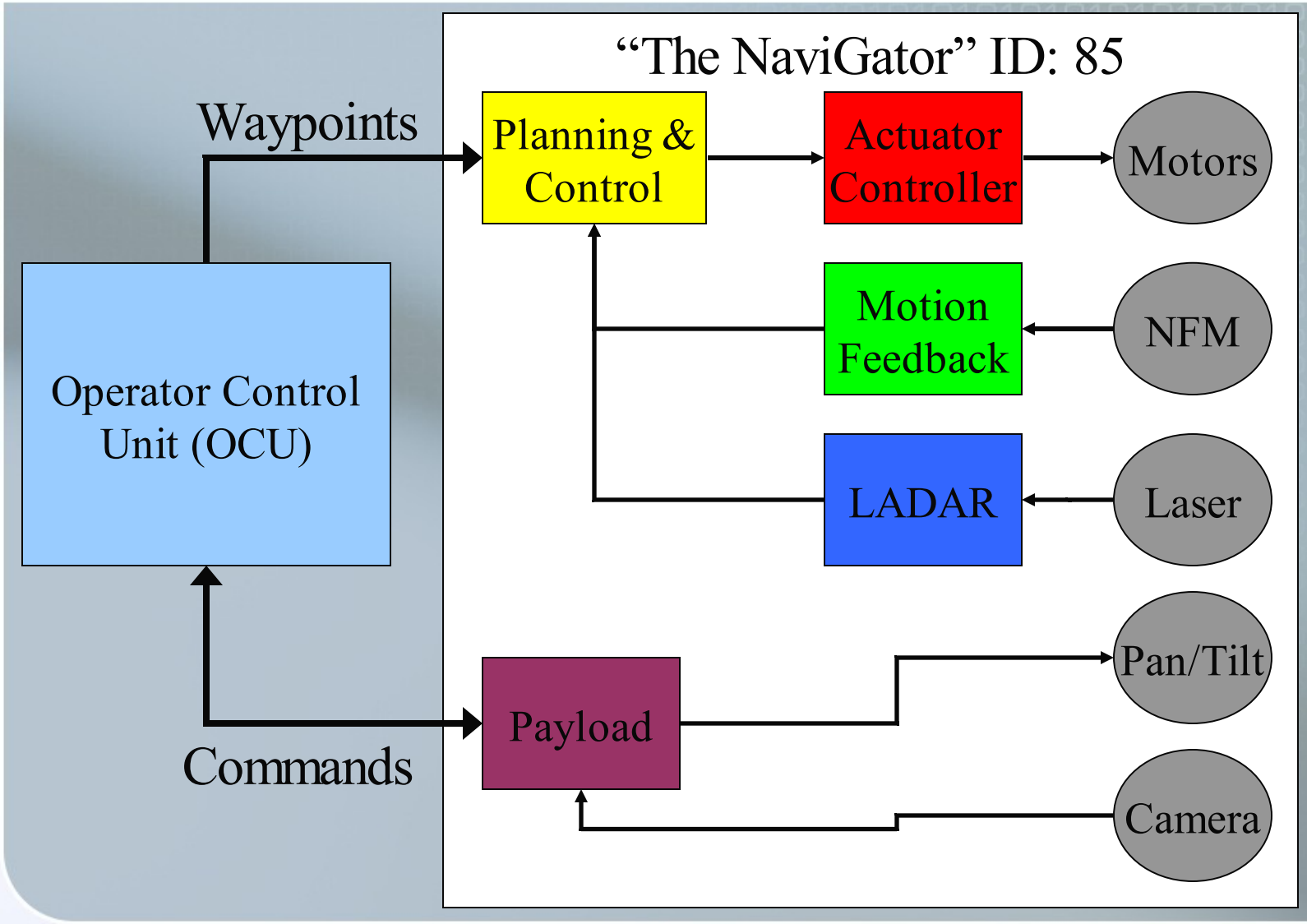
- A Subsystem is a group of "rigidly" interconnected Nodes
- Has an identification (a name)
- Has a unique ID number
- Has one or more computing nodes
- A Subsystem's function is defined by its role in the overall mission

Subsystem Design Example

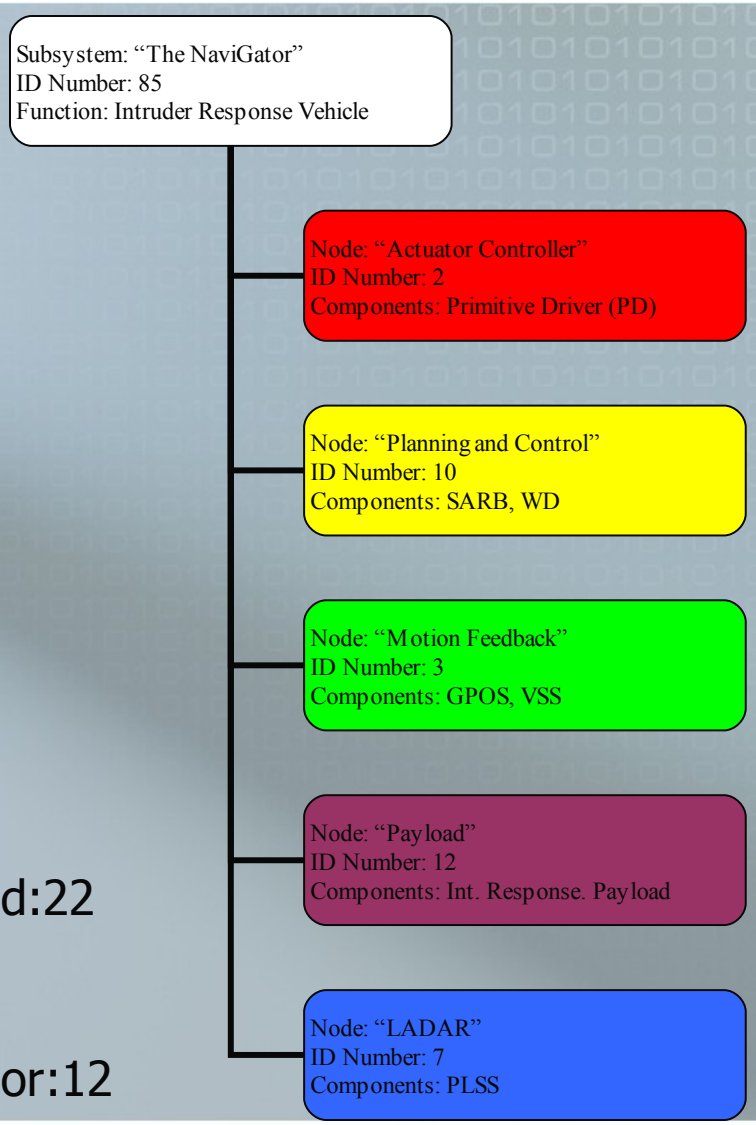
- OPC Experiment: Intruder Responder
- CIMAR: "The NaviGator"
- Function and Capabilities:
  - Follow a sequence of Waypoints
  - Obstacle avoidance
  - Real-time planning and control
  - Intruder Response Payload

NaviGator Schematic



Subsystem Table: NaviGator

- The NaviGator: 85
  - Actuator Controller: 2
    - Node Manager: 1
    - Primitive Driver: 33
  - Planning/Control: 10
    - Node Manager: 1
    - Waypoint Driver: 45
    - Smart Arbiter: 11
  - Motion Feedback: 3
    - Node Manager: 1
    - Global Pose Sensor: 38
    - Velocity State Sensor: 42
  - Payload: 12
    - Node Manager: 1
    - Intruder Response Payload:22
  - LADAR: 7
    - Node Manager: 1
    - Planer LADAR Smart Sensor:12



JAUS Node Design

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- A Node is a computing resource capable of JAUS message I/O
- Has an identification (a name)
- Has a unique ID number within its Subsystem
- Has two or more Components (always one Node-Manager)
- A Node's function is usually defined by its physical connections within the Subsystem (Sensors, Actuators, etc…)

JAUS Component Design

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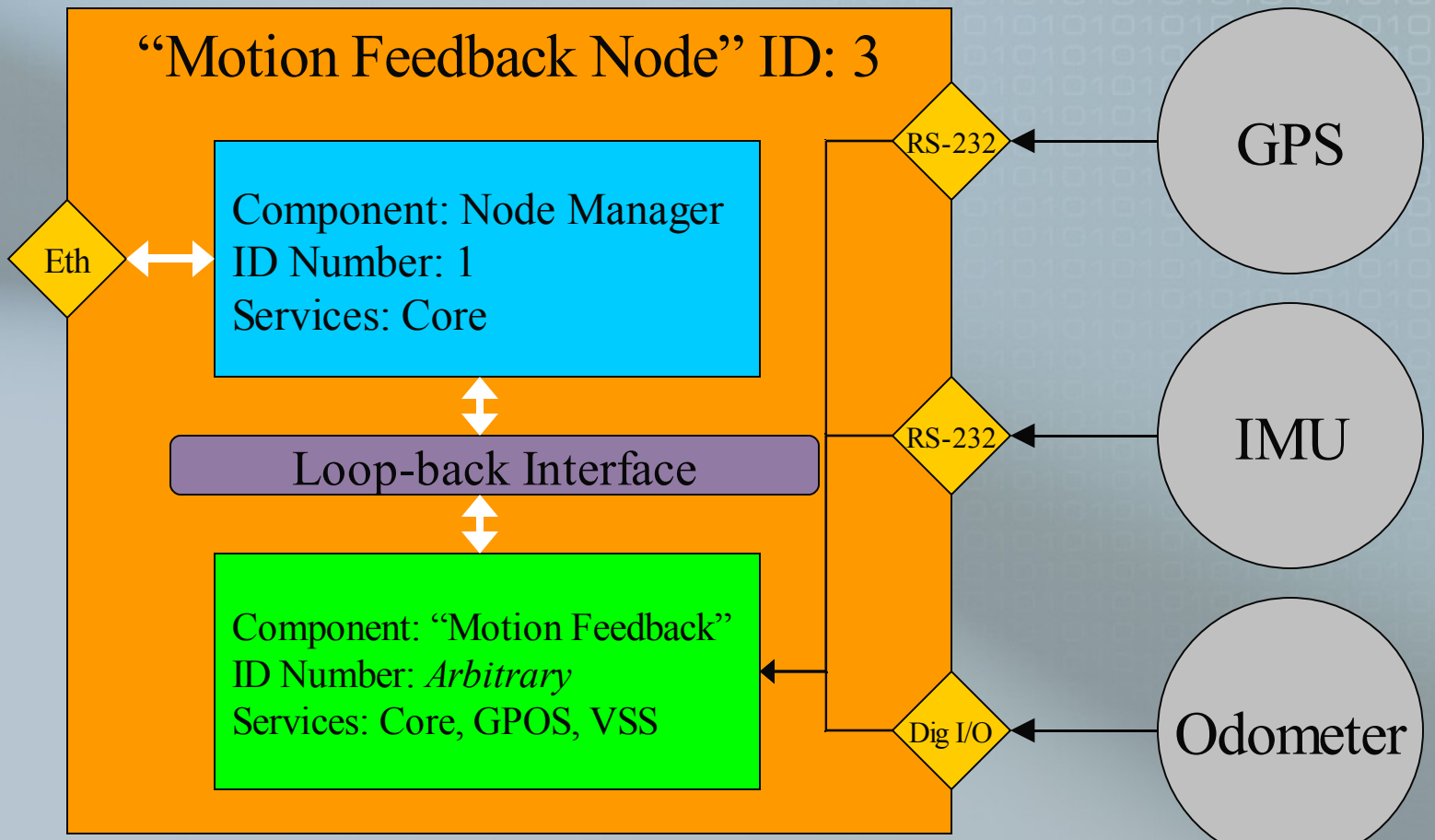
- A Component is an executable process capable of JAUS message I/O
- Has an identification (a name)
- Has a unique ID number within its Node
- Components must provide at least one Service
- Component's function is usually selected from the standard defined JAUS services, or its experimental capability

Node Design Example

- Motion Feedback Node
- Node is connected to GPS, IMU, and Odometer navigation hardware
- Need to use this Node to provide the JAUS position, orientation, and velocity state messages
- The Components on this node must provide the correct corresponding services

Motion Feedback Node Diagram



Motion Feedback Table

- Node Manager: 1
  - Core Message Support Service: 1
- Motion Feedback: 21
  - Core Message Support Service: 1
  - GPOS Service: 38
    - Input Messages:
      - Query Global Pose: 2402h
    - Output Messages:
      - Report Global Pose: 4402h

What JAUS Doesn't Say

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- Common designer misconceptions
  - Each computer on a Subsystem has to be a JAUS Node (FALSE)
  - JAUS Components only communicate with JAUS Messages (FALSE)
  - All JAUS Messages on a Node must pass through the Node Manager (FALSE)
  - JAUS Systems must use 802.11b and Ethernet networks (FALSE)

CIMAR JAUS Libraries

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- Provide API(s) for implementing JAUS
- Designed for Linux OS
- Written in C and JAVA
- Standardize Component Implementations

CIMAR JAUS Libraries

- Written in C
  - Linux Dependant, Low level interfaces (RS-232, eth, timing, etc..)
  - JAUS Message Library
  - Node Manager Interface Library
  - Component templates
- Written in JAVA
  - Node Manager
  - JAUS Message Library (Subset)

Dependency Diagram