



# RS JPO INTEROPERABILITY PROFILES

Mark Mazzara, RS JPO Interoperability Lead



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# Agenda

- Background / Overview
  - Objectives
  - Government / Industry WIPT
  - IOPs
- Recent Activities / Path to V0 Publish
- IOP V1 and Beyond



# Interoperability Defined



The ability of software or hardware systems or components to operate together successfully with minimal effort by end user. Further attributed with functional, behavioral, lifecycle, and architectural scopes, and, therefore, can be delineated in terms of control and can be categorized into levels, types, or degrees in application programs. Facilitated by common or standard interfaces.



# Interoperability – The Problem

- Current systems generally not interoperable with each other
- Current systems not optimized to share information into other domains
- Payloads, sensors, software & computing devices anticipated to evolve much faster than base platforms
- User requirements calling for interoperable family of UGV platforms

“Interoperability is the countermeasure to obsolescence”  
– LTC Hatfield, ARCIC



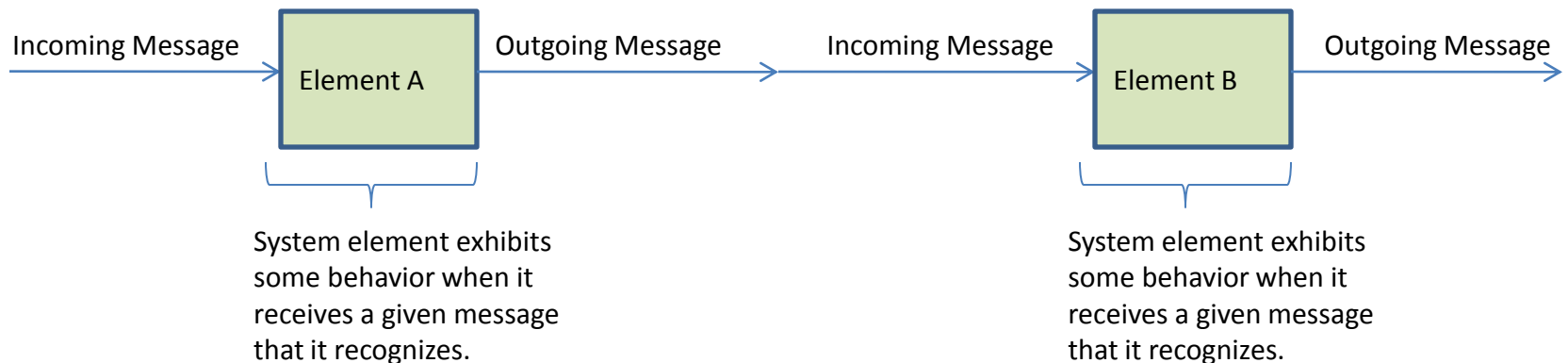
# RS JPO Interoperability Effort – Scope & Objectives

- Define interoperability standards for integration across UGVs leveraging other standards work to the greatest extent possible
  - Open Architecture & Interfaces
  - Common Control Standards
  - Communications Data Links
  - Modular Payload Interfaces
  - Conformance & Validation Criteria
- Interoperability Profile Version 0 (IOP V0) will define baseline capabilities
  - Fundamental system capabilities and functionality of fielded systems
  - Standard message sets & requirements for interoperability across platforms
- Successive IOPs (V1, V2, etc.) expand capabilities based on Combat Developer guidance



# Interoperability Capabilities Implementation Thought Process

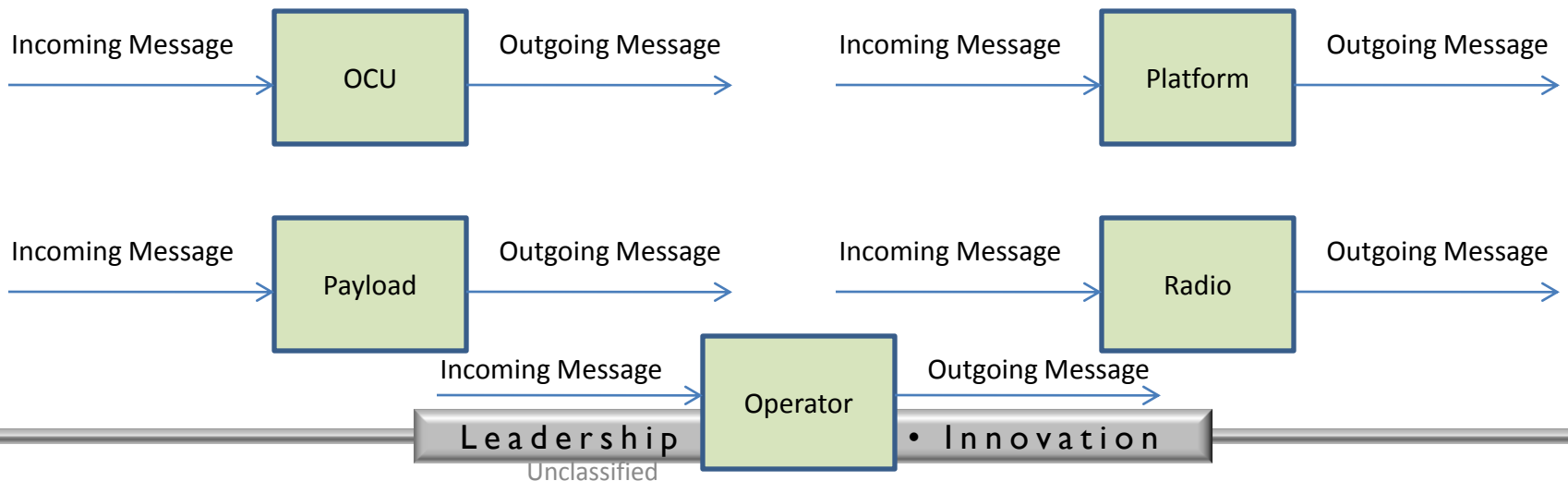
- If common messages are used by both the sender and receiver of information, then interoperability can be achieved.
- Each element of a system knows what messages to expect.
- Each element of a system knows what messages to send.





# Interoperability Capabilities Implementation Thought Process (cont.)

- We need to specify what the messages are.
- Messages themselves become the interfaces.
- System / subsystem developers know which messages to expect coming in.
- System / subsystem developers know which messages need to be sent by their elements.
- Processes & algorithms within the “black boxes” use the messages & remain proprietary and invisible to others





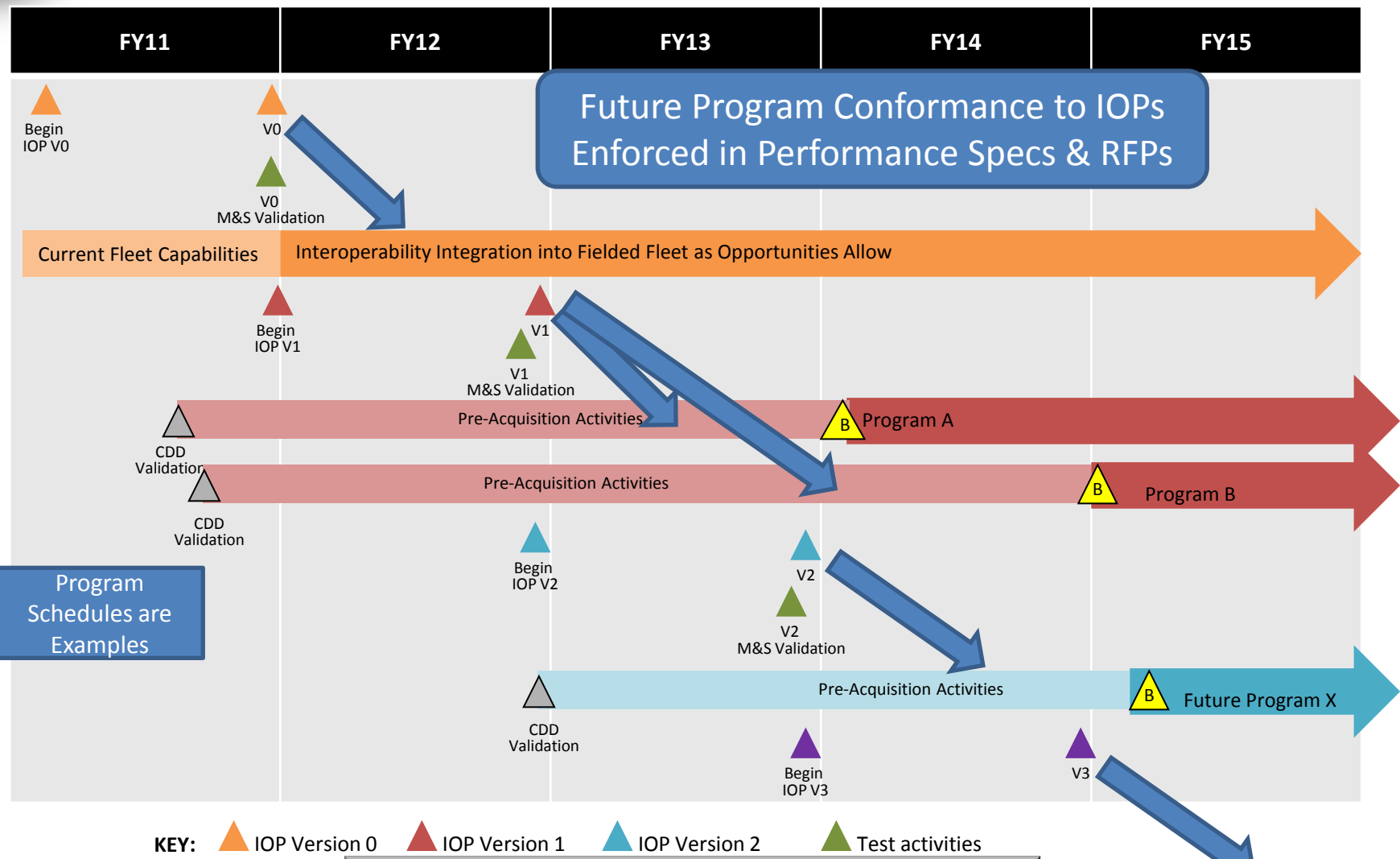
# Interoperability Capabilities Implementation Thought Process (cont.)

- Additional things need to be defined to 1) facilitate proper delivery of messages and 2) enable modularity:
  - Physical interfaces (enabling modularity, as well as adequate throughput of messages & power for messages to flow)
  - Information handling techniques & protocols (enabling reliability of message delivery, flow control, message routing, etc.)
  - Human understandable messages for interaction between the operator and the OCU



# IOP Relationship to UGV Programs

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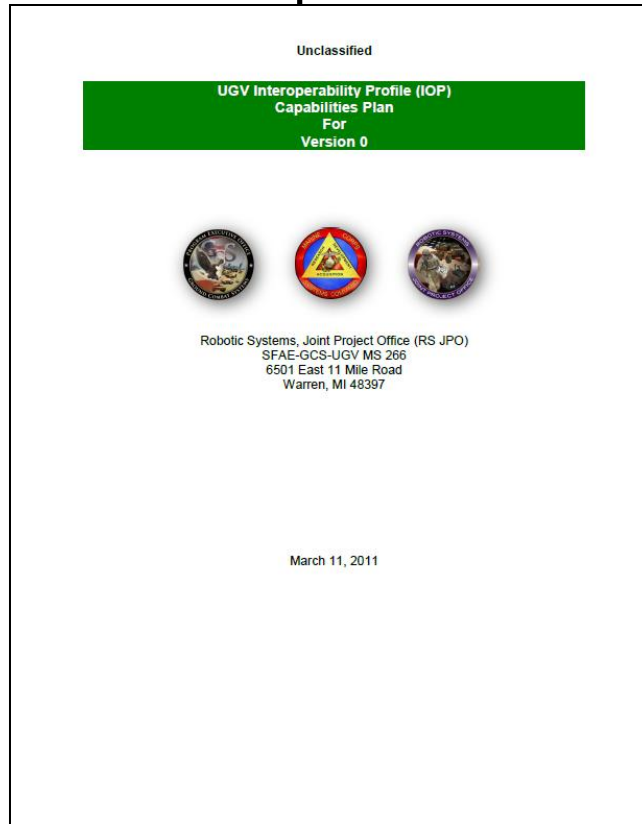


**KEY:** ▲ IOP Version 0    ▲ IOP Version 1    ▲ IOP Version 2    ▲ Test activities



# IOP V0 Capabilities Plan

- V0 Capabilities Plan was developed (March 2011)
- Scopes & bounds what IOP V0 will define
- Focused on foundational capabilities inherent in currently fielded systems

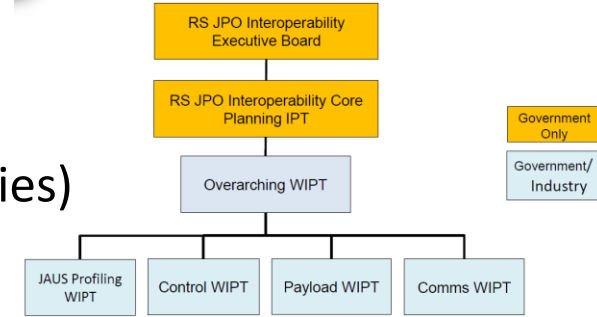




# UGV Interoperability WIPT Structure

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- Government / Industry WIPT Structure kicked-off Nov, 2010
- Industry involvement is voluntary
- As of August 2011:
  - 149 industry participants (across ~50 companies)
  - 68 government participants



217 individuals on roster as of Aug 2011

|                       | Overarching              | JAUS Profiling           | Payload                        | Comms                     | Control                      |
|-----------------------|--------------------------|--------------------------|--------------------------------|---------------------------|------------------------------|
| Industry + Government | 134                      | 37                       | 40                             | 54                        | 43                           |
| Co-Leads              | Mark Mazzara (RS JPO)    | Bashir Mekari (RS JPO)   | Brian Graham (RS JPO)          | Tom Bugg (RS JPO)         | Chris Scott (RS JPO)         |
|                       | Paul Bunker (TARDEC GVR) | Matt Skalny (TARDEC GVR) | Jacqueline Walter (TARDEC GVR) | Leif Magowan (TARDEC GVR) | Marcus Randolph (TARDEC GVR) |



# Organizations Involved in WIPT

## Government Organizations

| <u>Highly Involved</u>   | <u>Participating in WIPTs</u>  | <u>Informed</u>  |
|--|--|--|
| <ul style="list-style-type: none"> <li>• RS JPO</li> <li>• TARDEC</li> </ul> | <ul style="list-style-type: none"> <li>• Army Spectrum Management Office (ASMO)</li> </ul> | <ul style="list-style-type: none"> <li>• TRADOC Architectures Integration Cell</li> <li>• PM SUAS</li> <li>• ARDEC</li> <li>• SPAWAR</li> <li>• NASA</li> <li>• CERDEC</li> <li>• NAVEODTECHDIV</li> <li>• PEO GCS APEO SE</li> <li>• TRADOC ARCIC</li> <li>• MSCOE</li> <li>• PEO U&amp;W (Navy)</li> <li>• TCM UAS</li> <li>• USASOC</li> <li>• AMRDEC</li> <li>• AFRL</li> <li>• JIEDDO</li> <li>• Sandia National Labs</li> <li>• OSD</li> </ul> |



# Organizations Involved in WIPT

## Industry Organizations

- |  |   |  |
|--|---|--|
| <ul style="list-style-type: none"> <li>• DCS</li> <li>• DeVivo</li> <li>• iRobot</li> <li>• Freewave</li> <li>• Esterline Control Systems</li> <li>• Real-Time Innovations</li> <li>• SwRI</li> <li>• Global ET</li> <li>• AeroVironment</li> <li>• Neya Systems</li> <li>• Cybernet</li> <li>• Technical Products, Inc.</li> <li>• QinetiQ</li> <li>• Mission Solutions Engineering</li> <li>• Trideum</li> <li>• Pratt &amp; Miller</li> </ul> | <ul style="list-style-type: none"> <li>• Ibis Tek</li> <li>• NIITEK</li> <li>• 5D Robotics</li> <li>• Northrup Grumman – Remotec</li> <li>• L3 Communications</li> <li>• American Reliance</li> <li>• Cobham Surveillance</li> <li>• Silvus Technologies</li> <li>• DRS – SSI</li> <li>• Ultra Electronics Measurement Systems</li> <li>• CyPhy Works</li> <li>• Applied Research Associates</li> <li>• American Android</li> <li>• Schafer</li> <li>• MITRE</li> <li>• Think-A-Move</li> </ul> | <ul style="list-style-type: none"> <li>• General Dynamics Robotics Systems</li> <li>• Recon Robotics</li> <li>• UNEQ Consulting</li> <li>• Harris</li> <li>• Raytheon</li> <li>• SAIC</li> <li>• Elbit Systems of America</li> <li>• Mobile Intelligence Corp</li> <li>• Rajant Corporation</li> <li>• Lockheed Martin</li> <li>• National Instruments Corporation</li> <li>• Global Technology Connection</li> <li>• Applied Systems Intelligence</li> <li>• University of Michigan</li> <li>• HDT Engineering Services</li> <li>• Johns Hopkins Applied Physics Lab</li> </ul> |
|--|---|--|



# Interoperability Government/Industry Working Groups (WGs) Established for V0

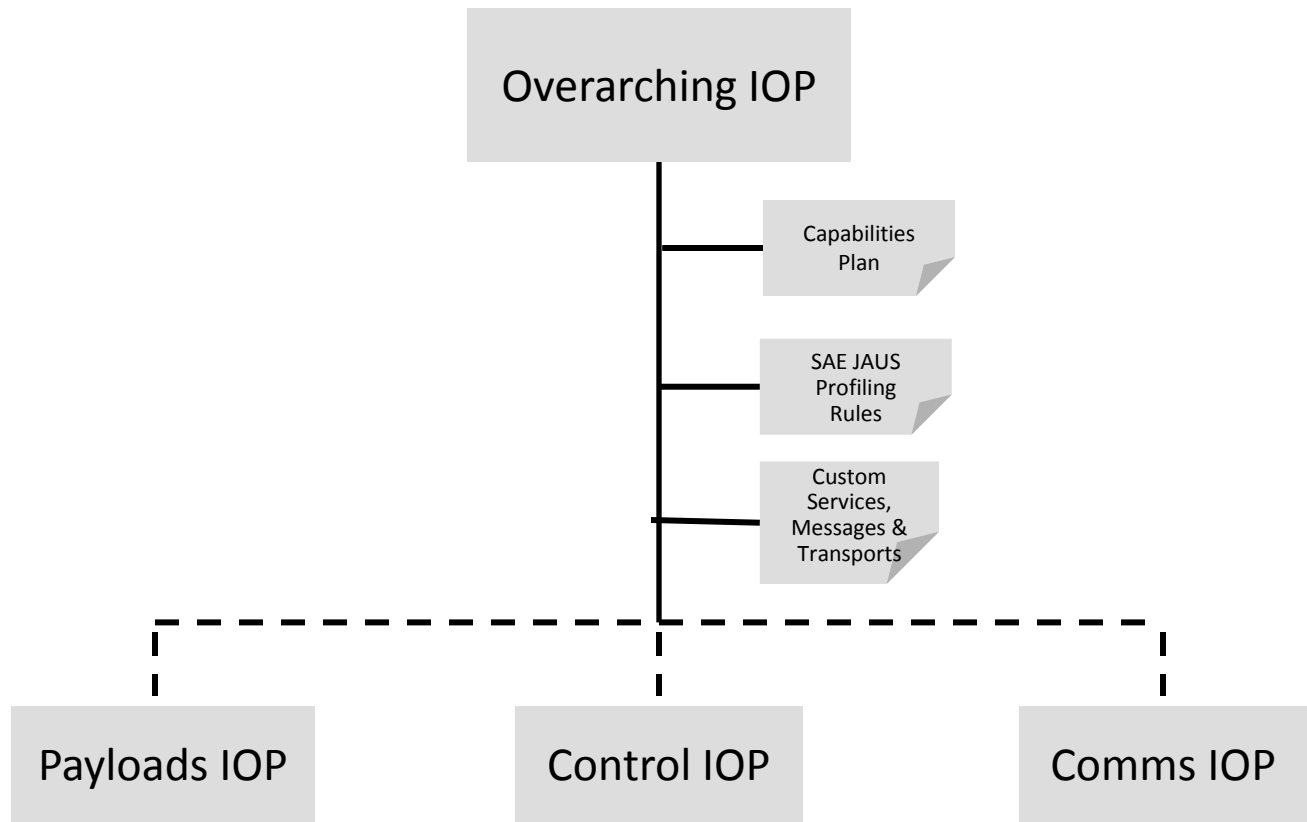
| Working IPT (WIPT) | Working Groups  |  |   |
|--------------------|---|--|---|
| Overarching        | <ul style="list-style-type: none"> <li>• Sys Eng &amp; Architecture</li> <li>• Test &amp; Validation</li> </ul>   |  |   |
| Communications     | <ul style="list-style-type: none"> <li>• Radio Link</li> <li>• Physical/Power Interface</li> <li>• Logical Interface</li> </ul>   | <ul style="list-style-type: none"> <li>• RFI Mitigation</li> <li>• Security</li> </ul> | <ul style="list-style-type: none"> <li>• Radio Status Messages (Communications Services)</li> </ul> |
| J AUS Profiling    | <ul style="list-style-type: none"> <li>• Platform Manager</li> <li>• Capability Plan Compliance</li> <li>• ID Assignment &amp; Discovery</li> <li>• Autonomy/Behaviors</li> <li>• Access Control</li> </ul> | <ul style="list-style-type: none"> <li>• Digital Video Stream</li> </ul>               |   |
| Payloads           | <ul style="list-style-type: none"> <li>• Existing Standards</li> <li>• Logical Interface / Metadata</li> <li>• Physical Interface</li> <li>• Configuration / Taxonomy</li> </ul>                            | <ul style="list-style-type: none"> <li>• Sensors Message Implementation</li> </ul>     |   |
| Control            | <ul style="list-style-type: none"> <li>• OCU</li> <li>• Human / Machine Interface</li> </ul>  | <ul style="list-style-type: none"> <li>• Existing Standards</li> </ul>                 |   |

WGs Established March 2011 & Completed V0 Tasks July 2011



# Interoperability IOP Framework

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**Legend**

|         |                                 |
|---------|---------------------------------|
| Profile | Separately Published Attachment |
|---------|---------------------------------|

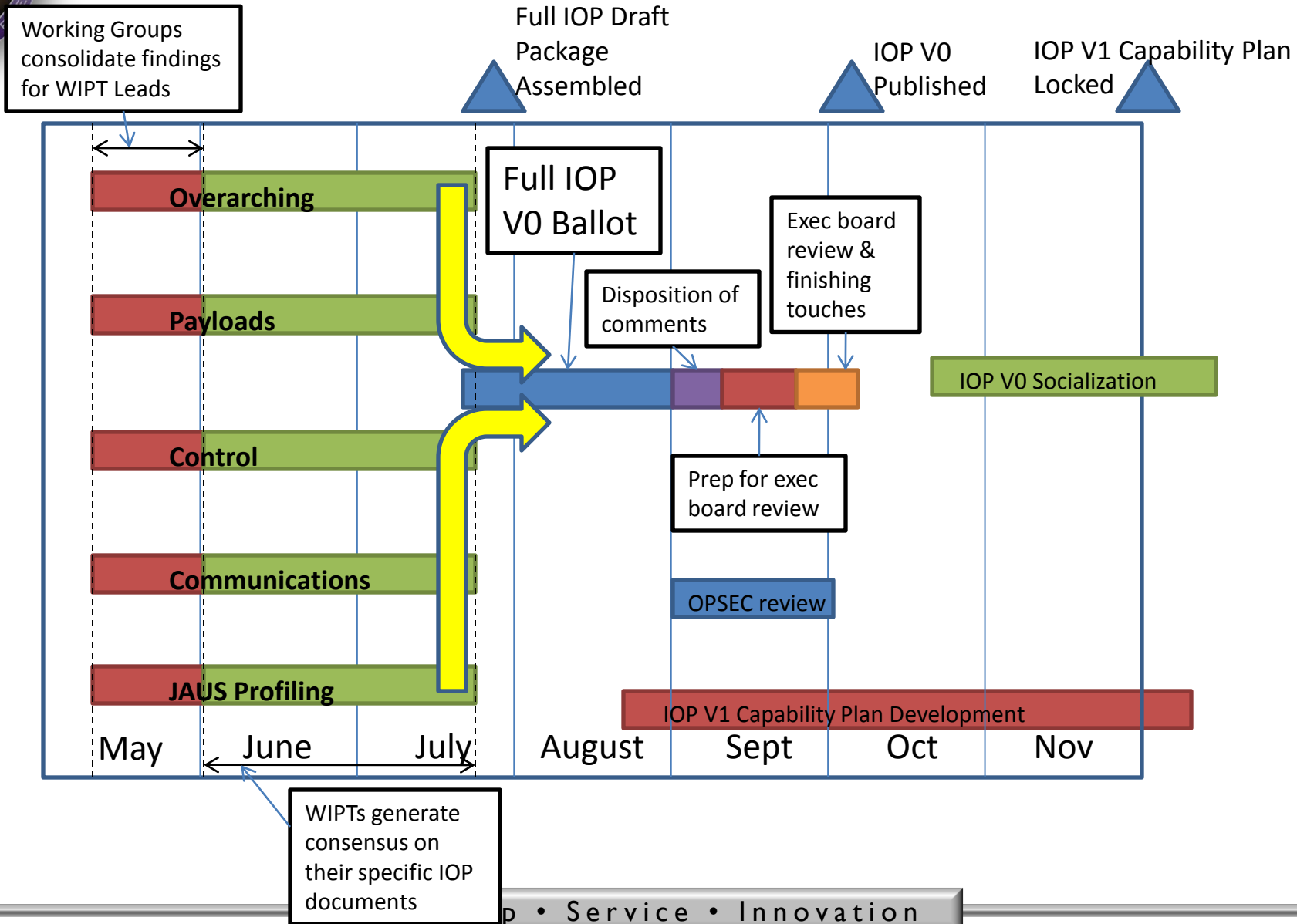


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- **Recent Activities / Path to V0 Publish**
- IOP V1 and Beyond



# Recent Activities / Upcoming Events





# Custom JAUS Services Developed for IOP V0

- Leader Management
- Leader/Follower Driver
- Communicator
- Platform Mode
- Health Monitor
- Health Reporter
- Digital Stream Discovery
- Preset Pose

Services being brought to  
SAE AS-4 (JAUS) Committee  
for official adoption



# TARDEC Interoperability Lab

- TARDEC UGV Interoperability Lab being stood up
- Interoperability Lab will be utilized to:
  - Assess IOPs' ability to enable interoperability
  - Assess commercial products' conformance to IOPs
- Test scenarios have been defined & equipment has been purchased
- Integrations/demonstrations being conducted Sept-Dec 2011



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# IOP VI

- Need to develop IOP V1 Capability Plan (1QFY12)
  - Expand the scope of capabilities beyond IOP V0
  - Keep pace w/ Combat Developer requirements
  - Keep pace w/ technology evolution
- Formal requirements crosswalk/analysis will be performed
- Initial (TBD) ideas on what needs to be included:
  - Full set of Autonomous Mobility Applique System (AMAS) related capabilities
  - Additional payload types
    - » Ground Penetrating Radars (GPRs)
    - » Multi-Point Range finders (i.e., LIDAR, etc.)
    - » Advanced Manipulators
  - Mesh Networking
  - Voice Control
  - Common Operating Picture Interface
  - Basic Unmanned Aerial Systems (UAS) Interface



# Beyond IOPVI (V2+)

- Future Versions of the UGV IOPs will provide interface guidance and requirements for the following:
  - UAS Interoperability
    - » Shared control
    - » Shared video streams
    - » One System Remote Video Terminal (OSRVT)
    - » Data Archival Repository (DAR) Access
    - » Chat/Text Messaging btwn Controllers
    - » Comms Relays
  - Interoperability w/ Manned Systems
    - » VICTORY Interfaces
  - ASA(ALT) Common Operating Environment (COE) Interfaces
    - » Mobile / Hand-Held Interfaces
    - » Connectivity to Overarching Networks
  - Joint Service / Multi-National Interoperability
  - UGV Radio Waveforms
  - And more....



# Summary

- RS JPO is committed to interoperability
- RS JPO values industry participation
- Keep your eyes peeled for IOP V0
  
- Contact: [mark.mazzara@us.army.mil](mailto:mark.mazzara@us.army.mil)

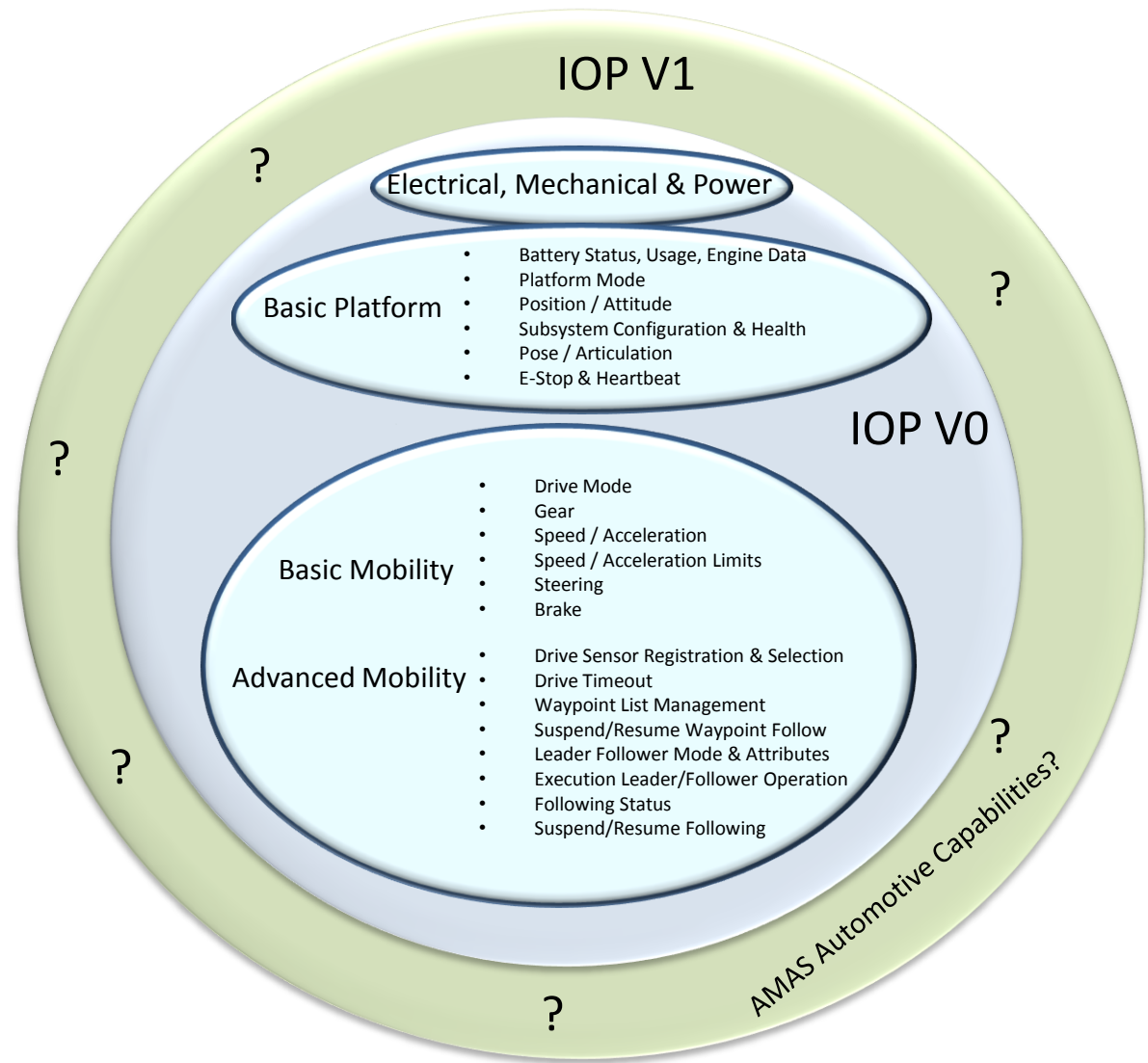


# Backup Slides



# IOP VI Brainstorming - Overarching

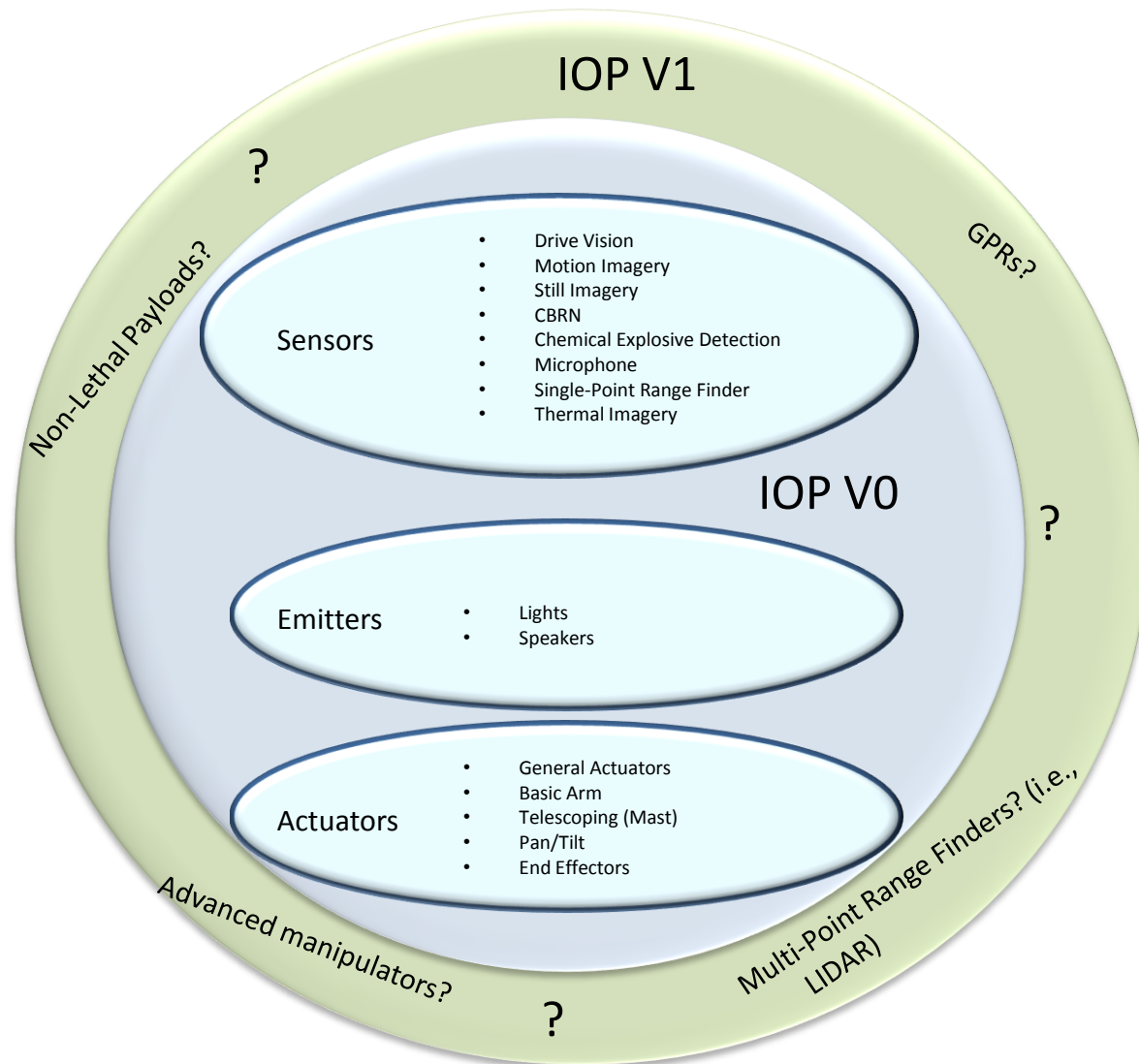
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Leadership • Service • Innovation

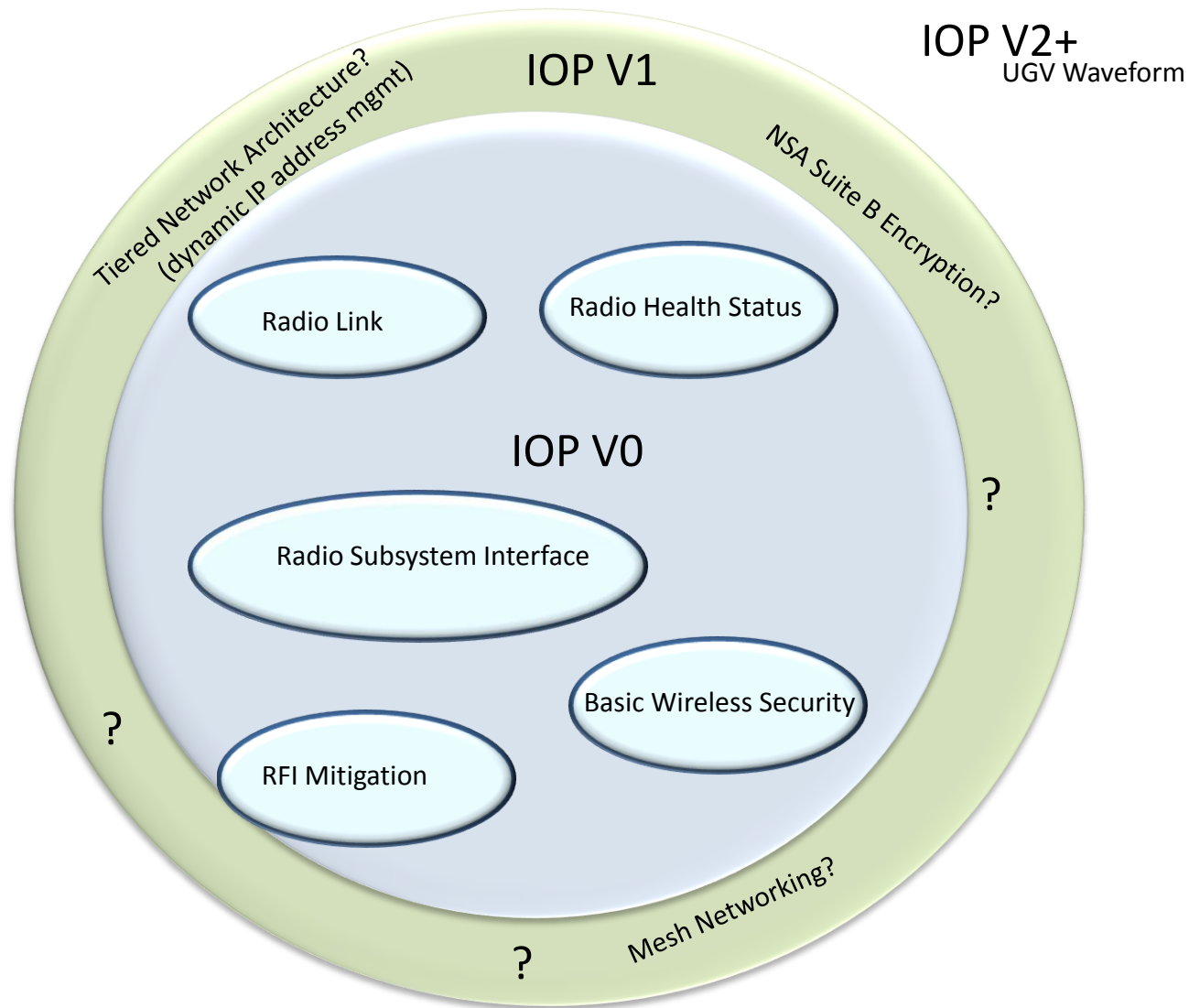


# IOP VI Brainstorming - Payloads





# IOP VI Brainstorming - Communications





# IOP VI Brainstorming - Control

