PROJECT MANAGER FORCE PROJECTION

Army Ground Robotics Interoperability Update

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Agenda

- IOP Update
- IOP, VICTORY & ROS-M

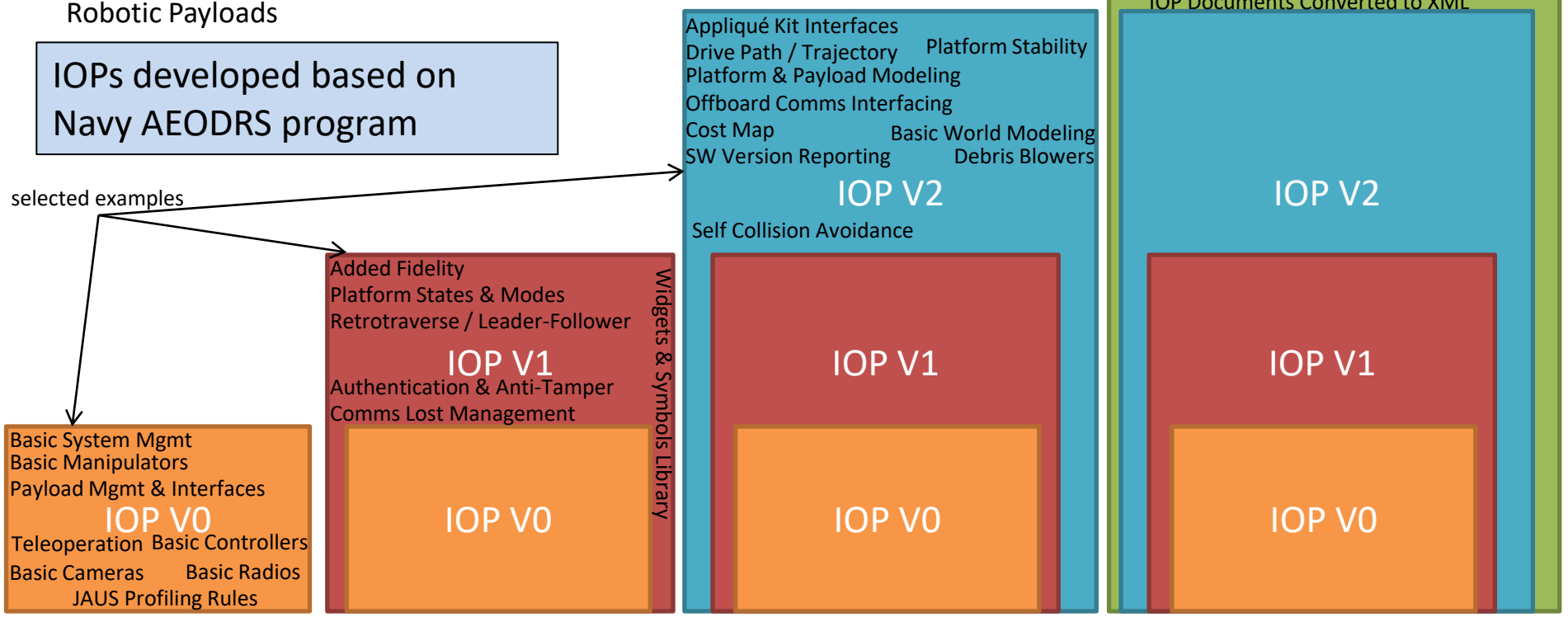
Interoperability Profiles (IOPs) Status

RAS-G IOPs enable modular open software & hardware interfaces

- IOP V0 provided interfaces for capabilities already fielded
- IOP V1 provides interfaces for MTRS Inc II, CRS-I
- IOP V2 provides interfaces for RCIS & HMDS
- **IOP V3 priority – Tactical Wheeled Vehicle Applique Kits,** SMET & other emerging requirements
- IOP V4 priority – Additional TWV autonomy, Robotic Wingman w/ VICTORY, EOD Robotic Payloads

IOPs developed based on Navy AEODRS program

selected examples



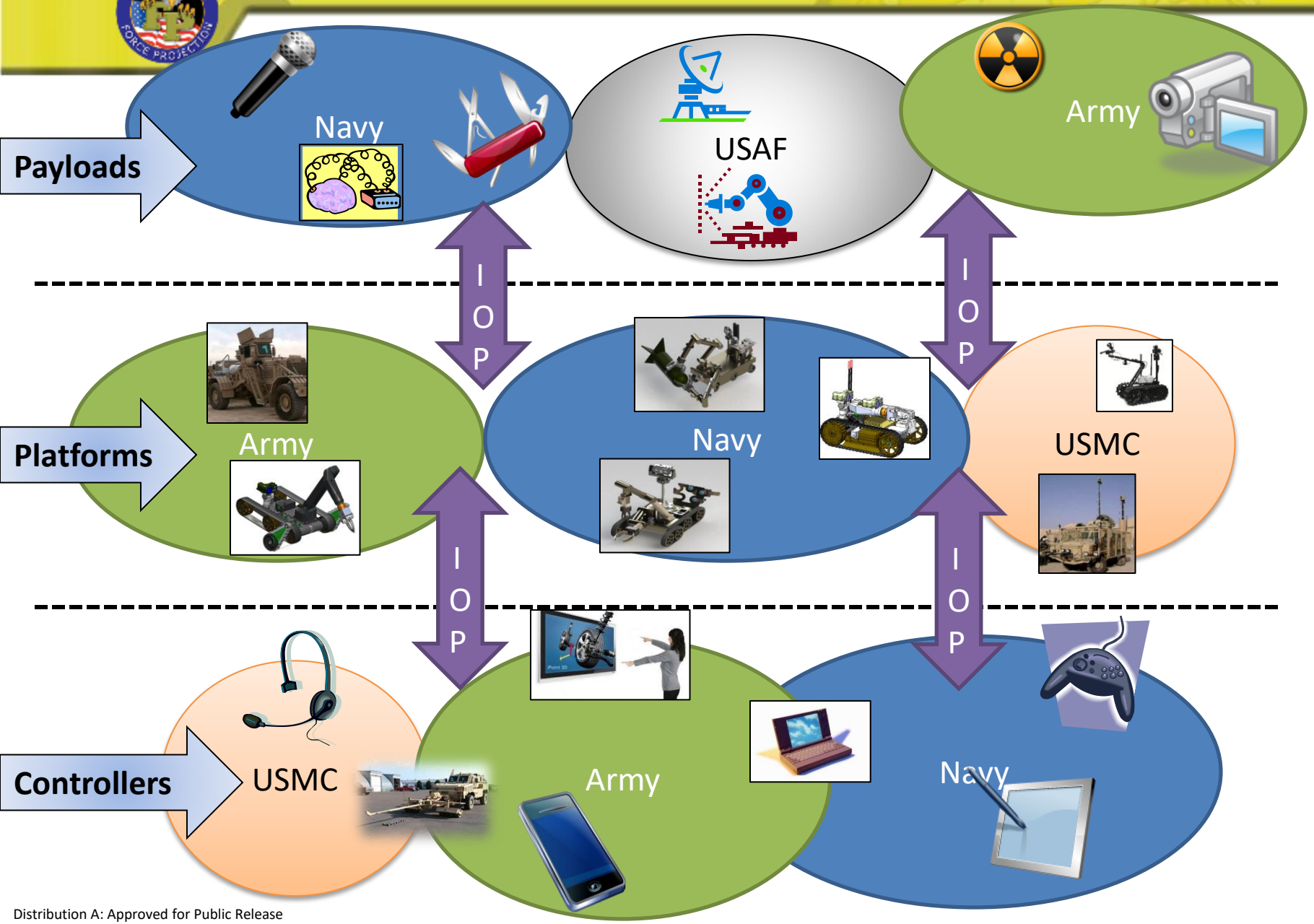
Interoperability Profiles (IOPs) Status

- RAS-Ground IOP Standard
  - IOP V2 published February 2016
  - IOP V3 under development – target publish date December 2017
- IOP Instantiations
  - Instantiations included in upcoming RFPs:
    - MTRS Inc II
    - CRS(I)
    - RCIS
  - Upcoming IOP Instantiation developments:
    - SMET
    - Leader Follower
    - CRS(H)
    - EOD Robotic Payload

IOP V3 Priorities

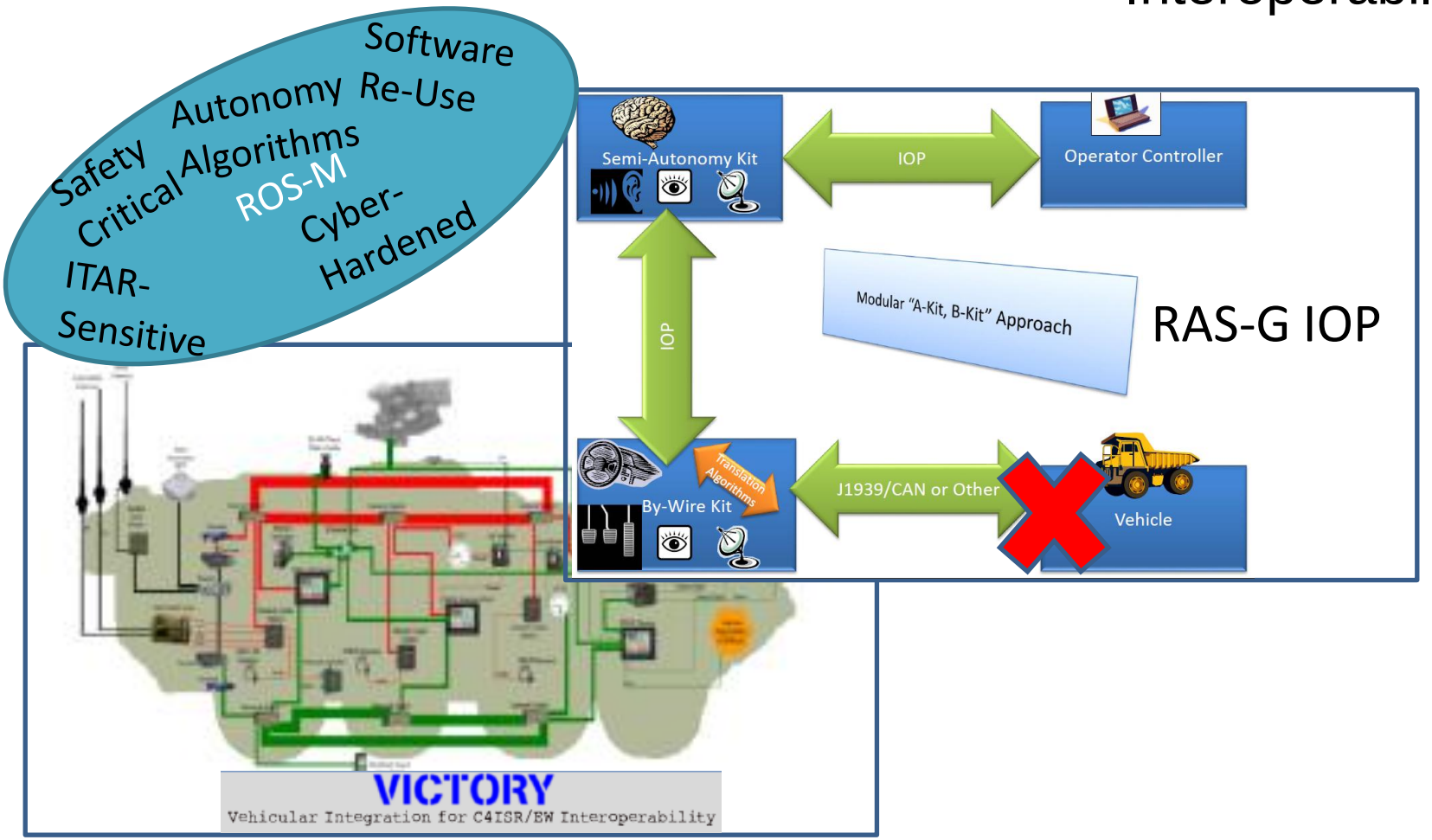
- Define optimal level of interoperability & modularity for SMET & ground vehicle applique autonomy strategy
  - Enable evolutionary upgrade of autonomy kit to support continued advancement
  - Do not compromise industry's ability to innovate
  - Focus on SMET & Heavy Tactical Vehicles
  - Resolve concerns over safety criticality (JAUS/Ethernet vs. J1939/CAN vs. others)

RAS-G Modularity Vision

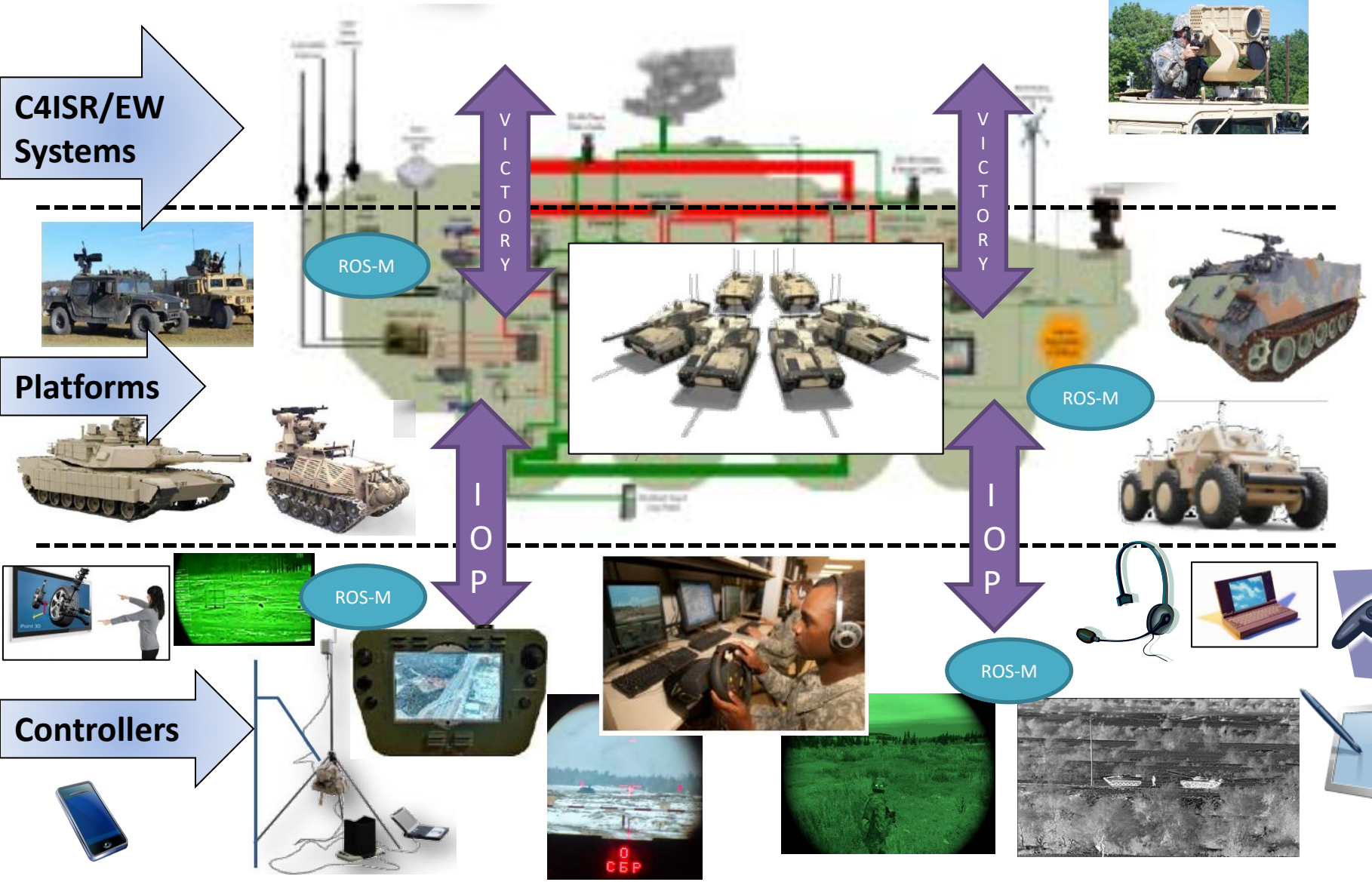


IOP, VICTORY & ROS-M

- Hypothesis: VICTORY + IOP + ROS-M = Robotic Wingman Interoperability



Robotic Wingman Interoperability



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Back Up

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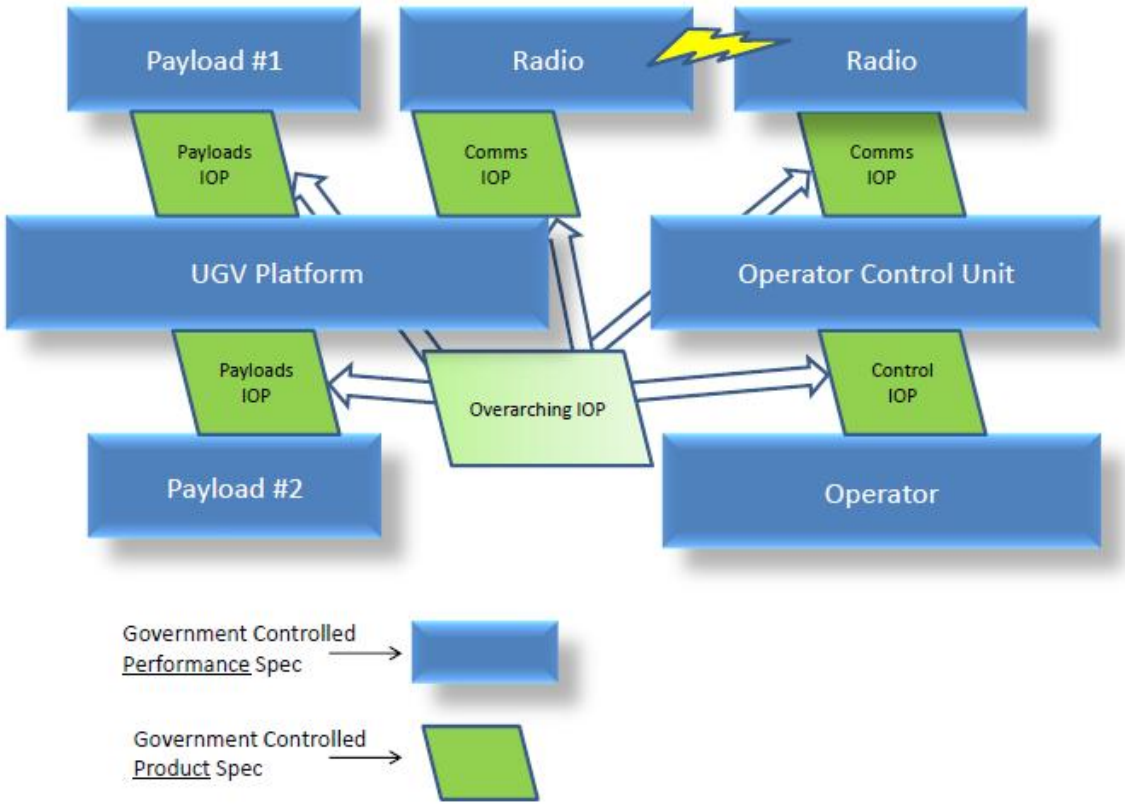
RAS-G IOPs Basic Overview

- Robotics & Autonomous Systems, Ground (RAS-G) Interoperability Profiles (IOPs)
- Defines software messaging & hardware interfaces between major subsystems of unmanned ground systems



TARDEC IOP Activities

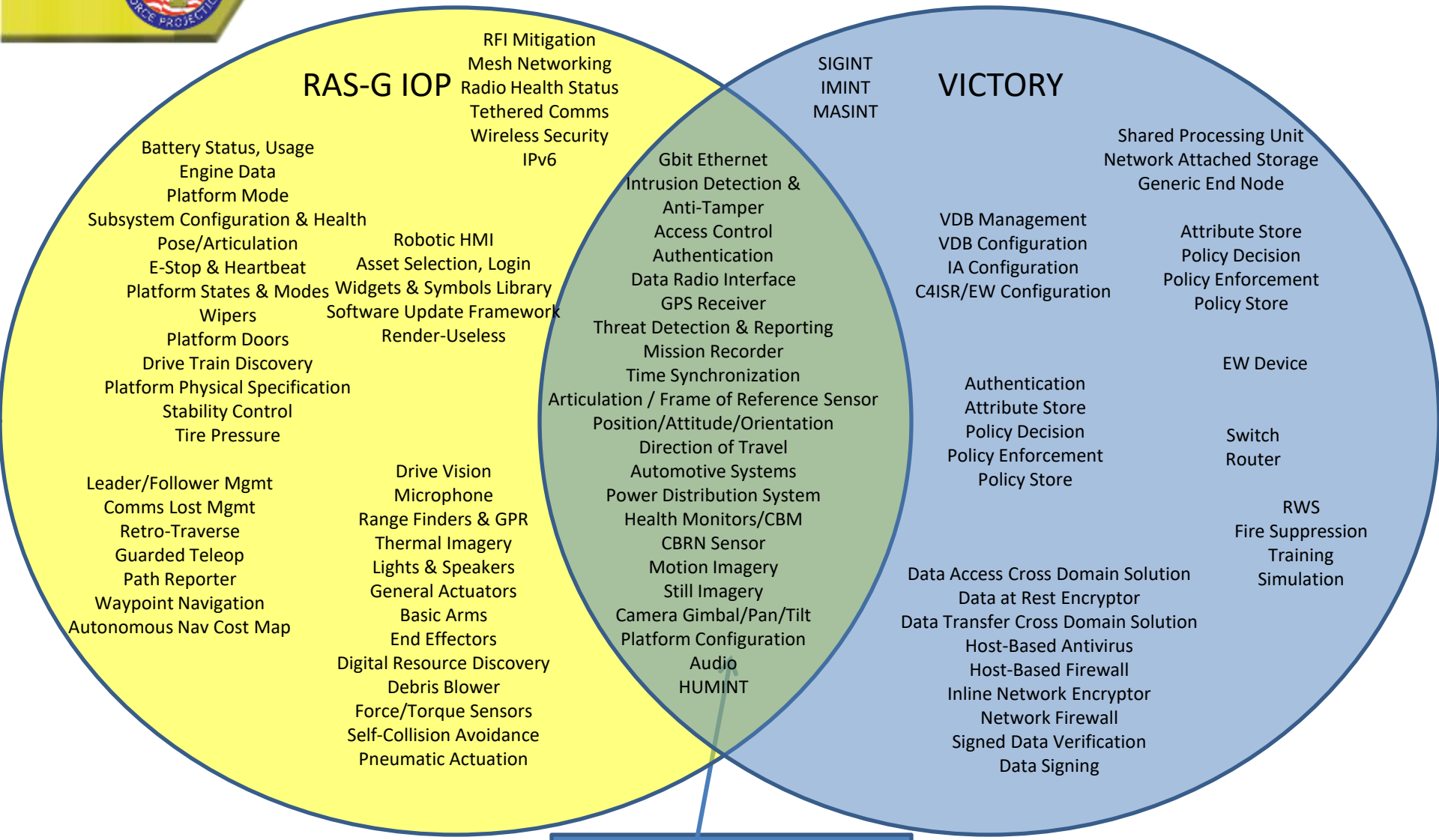
- TARDEC RAS-G IOP Lab
  - Conformance Verification Tool (CVT) v2.4.2-1.beta released Nov 2016
  - CVT March 2017 update will no longer be “beta”
- Joint Communications Architecture for Unmanned Systems (JCAUS) testing in IOP lab – January 2017
- Common CBRN Sensor Interface (CCSI)
  - Obtaining tools in house & determining how to test
- AEODRS
  - Formally assessing how well AEODRS complies w/ IOP
  - Conducting comparison between IOP tools & AEODRS tools
- IOP/JAUS Library & IOP to X Bridge

Key Requirements Drivers – RAS-G IOP versus VICTORY

Consideration	RAS-G IOP	VICTORY
Controllers/HMI	Wirelessly removed from vehicle; Shared across vehicles	Within vehicle
Safety critical mobility control	Computer (Real Time Teleop or Autonomous Mobility)	Operator (in vehicle)
Wireless	At least 1 wireless link within "single system"	No wireless link within "single system"
Interoperability, MOSA, SWaP	Facilitate interop; reduce platform SWaP; share resources; prevent "bolt-on" approach; open architecture for future upgrades	
Payloads / C4ISR/EW Devices	Shared across vehicles	

Key differences

RAS-G IOP / VICTORY Comparison

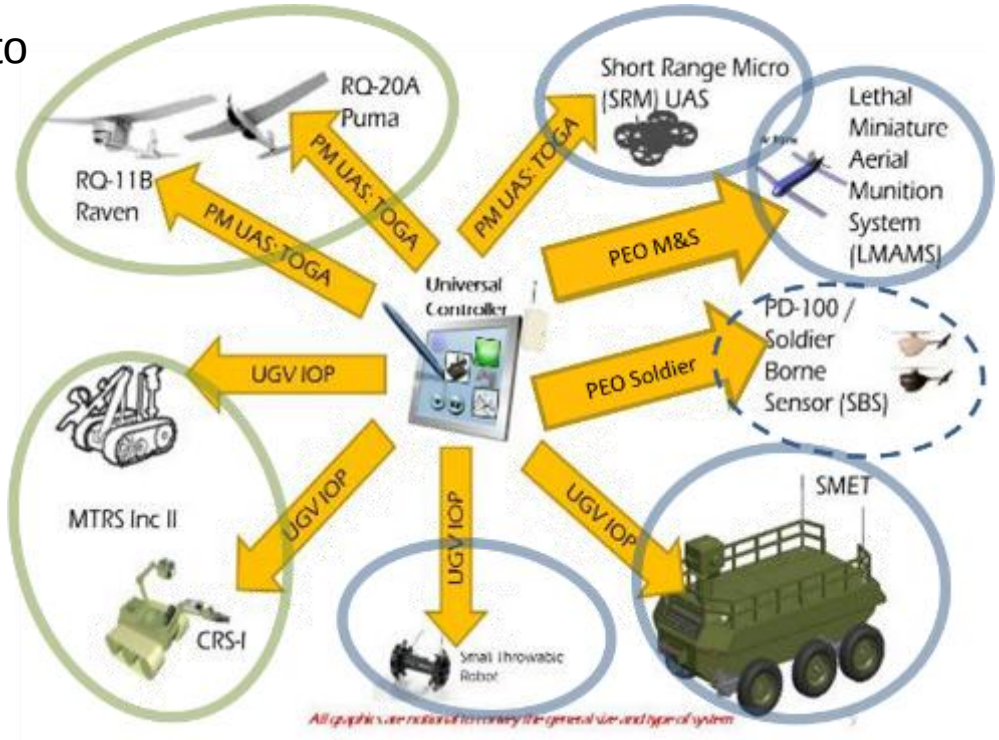


Possible areas of overlap & commonality - can utilize bridge between IOP & VICTORY services

Universal Controller Strategy

Vision: Controller(s) which meets or exceeds CRS(I) threshold while leveraging Better Buying Power emphasis areas:

- Provide draft technical requirements to industry early and involve industry in funded concept definition
- Modular Open Systems Architecture
- Interoperability
- Organic engineering capabilities
- Extensibility & Commonality
- Cybersecurity
- Commercial Technology
- Supportability & Maintainability



Programs of Record

RAS* Identified PORS

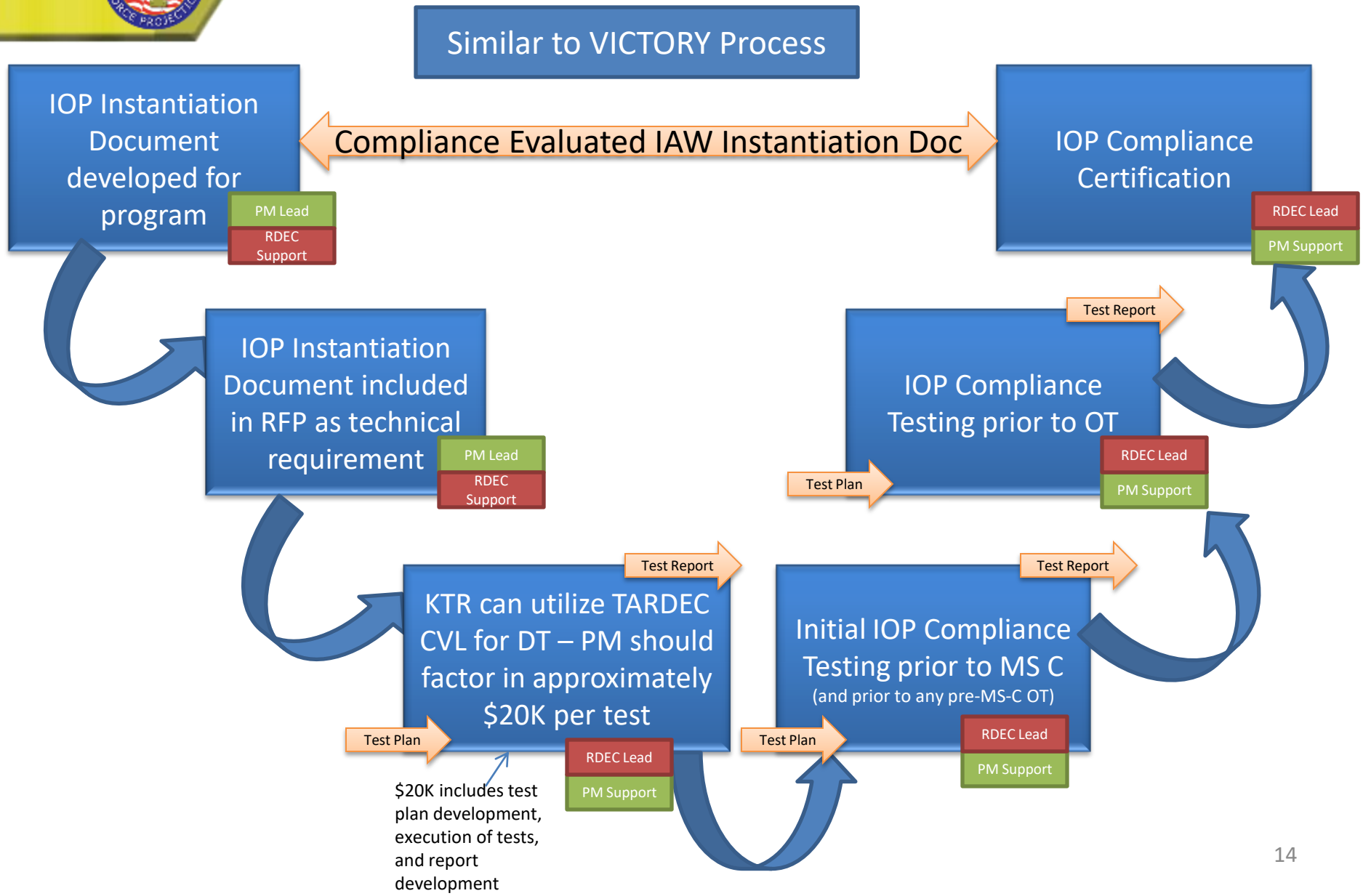
Architecture Supported

*RAS – Robotic and Autonomous Systems

Risk Mitigation:

- **Controller and Software demonstrations (Sept 16 and Jan 17) to mature MOCU4 software to handoff/operate on multiple controllers controlling multiple platforms**
- **Robotic Enhancement Program (REP) authorized purchase of Bokam, TRC-Lite controllers and UAS controller (TOGA H-GCS)**

IOP Conformance Validation Process



RAS-G Interoperability Planning

Near Term (0-5 yrs)

Standardized interfaces must be enforced between UGV platforms, payloads, controllers, and wireless communication devices. This will enable interoperability and modularity within systems and will lay the foundation for an affordable and sustainable lifecycle management model.

Mid Term (5-10 yrs)

UGVs must begin interfacing with authorized external systems and domains, such as other unmanned systems, manned ground vehicles, remote video terminals, and mobile/hand-held devices. This will enable a variety of new capabilities for Warfighters in different domains, as well as for UGVs themselves. This activity will be coordinated through the Army Common Operating Environment and other joint activities. Additionally, joint and multinational interoperability with key allies must be established through the use of shared interface requirements.

Far Term (10-20 yrs)

The ability to interface with UGVs will be widely achievable by authorized external systems. Higher level interoperable message types will facilitate increases in system autonomy and distributed computing will be enabled via interoperable offloading of computing-intensive functions to appropriate systems. UGVs will be capable of sharing a variety of collected and processed information to a variety of consumers, which will enable enhanced situational awareness and decision making capability in both manned and unmanned consumers.