RAS-G IOP Update:
NDIA Robotics Division
December 2016

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Robotics Interoperability Lead
Agenda

- RAS-G IOP Update
- ROS-M Update
- NAMC/VRA Standard Cycle Projects
• 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)
Current WGs

- Test & Compliance
- Payloads & Platforms – looking at some new connector options
- XML
- Autonomy & Behaviors
- Comms
- Controls
- Applique
- Weapons

J1939

- Starting a J1939 Profiling Rules document
- Leveraging message sets being generated in TARDEC Autonomous Ground Resupply (AGR) project

New JAUS Messages

- Dead Man Switch
- Loading Specifications (i.e. CG for trailer, etc.)
- Driver Assist / Driver Warning
- Convoy Specification
• 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
IOP/JAUS Library & IOP to X Bridge

Register, update, etc.

Get, notify, etc.

IOP/JAUS Library

Library API

Intermediary Listener API

Intermediary Listener

Add cohesiveness to IOP development environment

ANVEL

ROS-1

ROS-2
Agenda

• RAS-G IOP Update
• **ROS-M Update**
• NAMC/VRA Standard Cycle Projects
• ROS-M development being led by TARDEC
  – Goals include software re-use, increased & improved competition, higher development efficiency, common development environment & new capabilities
• TARDEC working closely w/ industry partners in ROS-M WGs for Business Process, Cybersecurity, Software Process & Software Stack
• IOP/ROS-M Activities
  – IOP to ROS-M Bridging
  – Determining how to profile current IOP to ROS-M
  – Evaluating long term utility to migrating toward Data Distribution Service (DDS) architecture ala ROS-M
• PM FP working w/ TARDEC on long term plan for ROS-M & software repositories
TARDEC ROS-M Development Phases

Phase I: Concept Exploration
- Complete

Phase II: Concept Definition
- Complete
- Concept Definition Report
  - Determine scope of project
  - Identify potential programmatic and technical issues
  - Identify potential business models

Phase III: Detailed Implementation Planning and Execution
- Funded
- Working Group Reports
  - Refined Concept Definition Report
  - Community of Interest for ROS-M Development
  - Technical Implementation Suggestions
  - ROS-M Business considerations

Future Development: Further Refinement and Development
- Alpha ROS-M Security Features
- Alpha ROS-M Repo & Registry
- Initial ROS-M Components
- Prototype Demonstration
ROS-M Conceptual Model

**ROS-M Configuration**
- Dynamic URDF
- Poses
- IOP settings

**ROS-M Application Layer**

**ROS-M GUI**
- rqt tools
- rviz

**ROS-M GUI**
- IOP introspection
- Other tools...

**ROS-M Sensor Layer**
- Dynamic detection
- GPS
- LIDAR
- IMU
- Others...

**ROS-M Interface Layer**
- Joint Velocity Action
- Drive Velocity Action

**ROS 2 GUI**
- Anything in the ecosystem

**Move Base Layer**
- Navigation
- OD/OA

**MoveL Layer**
- Planning
- Kinematics
- Pick & Place

**ROS-M Controller Layer**
- Resource arbitration
- Vendor/Hardware specific

**ROS-M Video Streaming**
- RTSP
- H264/MJPEG

**ROS-M IOP**
- IOP to ROS bridge
# ROS-M Development Environment

## Candidate Solutions

<table>
<thead>
<tr>
<th>ROS-M Hub Service</th>
<th>Candidate Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Software Repository</strong></td>
<td><strong>Git</strong> (<a href="https://git-scm.com/">https://git-scm.com/</a>)</td>
</tr>
<tr>
<td></td>
<td>GitLab Community Edition (<a href="https://about.gitlab.com/">https://about.gitlab.com/</a>)</td>
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<tr>
<td></td>
<td>Bitbucket (self-hosted) (<a href="https://bitbucket.org/">https://bitbucket.org/</a>)</td>
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<tr>
<td></td>
<td>GitHub Enterprise (self-hosted) (<a href="https://enterprise.github.com/">https://enterprise.github.com/</a>)</td>
</tr>
<tr>
<td><strong>Registry</strong></td>
<td>Custom solution based on extending rosindex (<a href="http://rosindex.github.io/">http://rosindex.github.io/</a>)</td>
</tr>
<tr>
<td><strong>Validation</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Continuous Integration</strong></td>
<td>Jenkins (<a href="https://jenkins.io/">https://jenkins.io/</a>)</td>
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<td>BuildBot (<a href="http://buildbot.net/">http://buildbot.net/</a>)</td>
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<td></td>
<td>GitLab CI (<a href="https://about.gitlab.com/gitlab-ci/">https://about.gitlab.com/gitlab-ci/</a>)</td>
</tr>
<tr>
<td></td>
<td>Travis CI (<a href="https://travis-ci.org/">https://travis-ci.org/</a>)</td>
</tr>
<tr>
<td><strong>Documentation</strong></td>
<td>Confluence (self-hosted) (<a href="https://www.atlassian.com/software/confluence">https://www.atlassian.com/software/confluence</a>)</td>
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<td>MediaWiki (<a href="https://www.mediawiki.org/wiki/MediaWiki">https://www.mediawiki.org/wiki/MediaWiki</a>)</td>
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<td></td>
<td>Trac (<a href="https://trac.edgewall.org/">https://trac.edgewall.org/</a>)</td>
</tr>
<tr>
<td><strong>Community</strong></td>
<td>ROS Answers (<a href="http://answers.ros.org/questions/">http://answers.ros.org/questions/</a>)</td>
</tr>
</tbody>
</table>
ROS-M Candidate Metadata Contents

- **Package name** – The name used within the development environment for the ROS-M package. Example: “cv_bridge”

- **Level of Maturity** – The state of the package (experimental, development, stable, deprecated)

- **Last Updated Date** - The date when this package was last modified.

- **Maintainer(s)** – The names and contact info for the current maintainers of this package. This can be a company name or individuals.

- **Author(s)** – The names of the original authors of this package. This can be a company name or individuals.

- **License** – The license associated with this package. Example: “BSD”

- **Link to source and/or binaries** – Links pointing to where a developer can find the source code, binaries, or an associated store/site where they can be purchased

- **Package description** – A short description of what the package offers in terms of functionality.

- **Package compatibility** - What versions of ROS-M does this package work with?

- **Metatags** – Metatags associated with this package.

- **Link to tutorial(s)** – Tutorials may take up several pages and should be separate from the main package page

- **Link to bug/feature tracker** – A link to where bugs and features are tracked for this particular package. This may be an external link.

- **Overview section** – A more in-depth explanation of the package (as compared to the “package description” section). This may include discussion of various algorithms or approaches.

- **Example usage section** – A short, basic example use of the package.

- **Link to the code API** – link to the API documentation, such as a Doxygen page. This might be an external link.

- **Link to a FAQ/QA** – Link to the QA site with tags relevant to this package (if possible)

- **Changelog** – This lists any changes that are made for each revision for this package

- **Change list** – This lists any changes that are made in each stack release for this package

- **Reviews** – API or code review meeting notes as well as the ability to request a new review of this package

- **Dependencies** – A list of packages that this package depends upon

- **Used by** – A list of packages that are known to use this package

- **Projects and Programs** - a list of military projects and programs that are known to have used this package.

- **Version** - specify which version of package is being used
TARDEC ROS-M Phase III Goals

Work to be completed by November 2017

Repository/Registry and Software Build Infrastructure Development

• Establish the registry/repository infrastructure to store and distribute ROS-M–based software components and tools

ROS Core Testing

• Perform and test the application of the Defense Information Systems Agency security guides and SE Linux with ROS

Autonomy Component Development and Maturation

• Update and/or create the software packages necessary for a typical military autonomy vehicle

Prototype System Development and Integration

• Application of the autonomy components on a physical asset (GVRBot & Representative Industry Bot)

Demonstration of System Functions

• Create a demo to present to the PM and other interested parties that highlights the benefits ROS-M brings/will bring to future military development
Agenda

• RAS-G IOP Update
• ROS-M Update
• **NAMC/VRA Standard Cycle Projects**
• VRA Annual Cycle Projects
  – These projects are solicited once per year and include the following year’s projects of interest to the Government. Project requests can be planned funded or unfunded efforts. Unfunded efforts that receive a #1 or #2 rating on their submitted proposal will go into the basket for a period of 36 months and may be funded if money becomes available and the proposal is selected from the basket by the Government.

• PM FP generated topics are summarized on the following slides
PM FP Generated VRA FY18 Topics

- **Architecture**
  - ASM-18-01: Robotics Cybersecurity Prototype Solutions
  - ASM-18-02: Nett Warrior Control of Robotic Systems
  - ASM-18-03: Net Enabled Robotic Prototype Solutions

- **Autonomy**
  - Autonomy-18-11: Robotic Enhancement Program

- **Collaboration**
  - Collaboration-18-02: Extended Range Communications

- **T&E**
  - T&E-18-01: Common Robotic Test Standards
• External
  – External-18-01: Additive Manufacturing of Robotic Parts
  – External-18-02: EOD Robotic Payload (ERP) Risk Reduction Prototype Solutions

• M&S
  – M&S-18-01: Video Technical Manuals Prototype Solutions

• Platforms
  – Platforms-18-02: SMET Risk Reduction Prototype Solutions
  – Platforms-18-03: CRS(H) Risk Reduction Prototype Solutions
  – Platforms-18-05: D7R-II (Dozer) Sifter Attachment

• Powertrain
Summary

• IOP V2 instantiation documents in current RFPs
• IOP V3 development ongoing for publish December 2017
• ROS-M development continues – Phase III results expected November 2017
• PM FP FY18 VRA topics currently out for industry review – topics give gov’t the ability to fund approved projects at any time during FY18-FY20 if funding becomes available