ROS-INDUSTRIAL ASIA PACIFIC UPDATES

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Overview
ROS and ROS-Industrial

ROS is an open-source, meta-operating system for your robot

ROS-Industrial uses ROS as the core framework to enhance industrial capabilities for manufacturing industries and applications in a consortium model.

ROS-Industrial High Level Architecture

- **ROS GUI**
  - Plug in base GUI tool kit
  - RViz, introspection, Web-browser

- **ROS Layer**
  - ROScore—Open Robotics supported content
  - ROS-I and General ROS packages
  - Access to 3rd Party Libraries

- **Motion Planning Layer**
  - Planning
  - Kinematics
  - Pick & Place
  - State

- **ROS-I Simple Message Layer**
  - Package: simple_message

- **ROS-I Controller Layer**
  - Package: vendor specific

- **ROS-I Application Layer**
  - Process Planner
  - State Machines

- **ROS-I Interface Layer**
  - Package: industrial_robot_client

- **ROS-I GUI (Future)**
  - Generic Pendant
  - Standard Industrial UI

- **ROS-I Configuration**
  - urdf parameters
  - Extras required to create a moveit package for industrial manipulator

Hardware

- I/O devices
- Sensors
- Robots

Visualization

ROS

ROS Industrial

Open Robotics

Simulation
A Global Consortium with regional presence:

- Southwest Research Institute, Texas
- Fraunhofer IPA, Germany

Asia-Pacific consortium led by:

- In partnership with
ROS Growth Trend

Unique Monthly Downloads

Unique Wiki visitors 2016 → 2017

Download data excludes all mirrors so actual growth is higher!

- 8 APAC countries in top 20
- APAC user base grew 44% YoY!
ROS Popularity is Growing in Various Sectors

ROS is rapidly becoming the de-facto standard robotics software stack!
ROS Releases and Journey to Industry

2008
- PR2 and ROS start at a research platform for universities and research institutes

Jan 2010
- ROS 1.0 is released with tutorials
- 12 releases between 2010-2018

Dec 2017
- First Beta release of ROS 2.0 for general use

Jul 2018
- Actions support
- Navigation package

Dec 2018
- MoveIT package Alpha support

May 2019
- Start using for next generation platform development

10 Year Development Cycle

Source: Open Robotics Presentation at ROSCON 2018 (Updated)
# Goals for ROS 2.0 from Open Robotics

## product-ready
- Use industry-standard middleware (e.g., DDS)
- Build in security from the beginning
- Support Linux, macOS, and Windows

## mission-critical
- Support real-time control
- Static analysis (e.g., MISRA)
- Document design choices
- Support safety certification

## ...but also familiar
- Keep the core concepts from ROS 1
- Distributed systems
- Federated development
- Permissive open source license – allows for commercial hybrid model

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Important for mass-scale adoption!

*Source: Open Robotics Presentation at ROSCON 2018 (Updated)*
Market Disruption with Open Source

Linux
- Linux was Born: 1999
- Google Android: 2008
- 34bn IBM Acquisition

ROS
- ROS was Born: 2007
- Microsoft ROS: 2019
- ROS 2.0 Industry Ready: 2019-2020

Smartphone Global Market 2020 (355bn)
- Android Linux: 75%

Robotics Global Market 2024 (99bn)
- ROS: 55%

Window of Opportunity!
54bn
Market Currents

**Today**
- Wage inflation and an aging population is backing the need for robotics upgrades.
- Automotive Industry Transition from ICE to EV.
- Declining Smartphone Growth.
- Standardization of Industrial Mobile Robot (IMR) - R15.08.
- China-U.S. Trade Tensions Could Affect the Robotics Supply Chain.

**Future**
- Increased manufacturing flexibility.
- Demographic “Time Bomb”.
- Emerging and rapidly growing market segments.
- Accelerate adoption of disruptive technology (eg: A.I., Cloud robotics).
- Business and Technological Innovation, e.g. for SME Category.
Year in Review
Highlights – ROS-Industrial Asia Pacific Workshop

• The 2018 edition of the Asia Pacific Workshop held 27-28th June hosted 66 attendees from more than 20 countries and included industry talks, demonstrations and group activities.

Showcased Scan’n’Plan, Augmented Reality concept among others!

Today we are 110 attendees from 25 countries!
Mr. Nicholas Yeo represented ROS-Industrial at ROSCON Japan which was held September 14th 2018, sharing the ROS-Industrial Consortium Asia Pacific journey, experiences and challenges faced in the robotics industry today.
Highlights – Singapore International Robotics Expo

- ROS-I exhibited at the Singapore International Robo Expo (SIRE) November 1-2\textsuperscript{nd} 2018, showcasing demos on ROS2 with our member ADLINK (also at Industrial Transformation Asia Pacific), pick and place and mobile manipulation solutions
Highlights – Student Engagement

- In March this year, ROS-I together with new member Singapore Polytechnic organized a one week ROS Turtlebot hands on learning and coding challenge with 10 participating Polytechnic students to spur further interest in ROS and robotics in our youth.

Future robotics engineers in the making!?!
Highlights - Training

• We continue to support the industry with ROS-based training on regular basis:
  – Aug 28-31st - Developer’s Training
  – Dec 10-14th - Developer’s Training
  – Milestone 100 - ROS-Industrial Asia Pacific, supported by Southwest Research Institute, trained more than 100 participants on ROS since its start in 2017
  – April 24-26th - Developer’s Training (ARTC internal)
  – May 21-24th - Developer’s Training – First training on Melodic

• Future plans:
  – We are reviewing and improving training content
  – Planning for ROS 2.0 based training
  – Exploring more specialized ROS topics as additional courses
Membership

• 2019 new members highlighted in green:
Technology – Object Detection and Accurate Positioning

- **Collaborators:** In-house development

- **Problem Statement:** Grasp pose determination libraries need to be combined with object detection and filtering mechanism to be more effective in cluttered environments, often need for more accurate object positioning after machine learning object detection

- **Delivered:**
  - Object detection and accurate object positioning module
  - Easy to use sort, pick and place use case demonstrator

- **Future Plans:**
  - Integrate with state-of-the-art grasp pose libraries
  - Open Source reference solution in H2 2019

We continue to focus R&D in areas of Perception and Smart Manipulation

In-house

Data Pipeline Overview

Used in Sort, Pick and Place Demo
Technology – Augmented Reality Robotics

• **Collaborators:** In-house development

• **Problem Statement:**
  – Scalability of robotics solutions are hampered by the need of skilled engineers/technicians to program robots
  – Human robot collaboration requires improved safety visualization

• **Delivered:**
  – ROS to Microsoft Hololens bridge
  – Robot demo with interactive user interface in Hololens

• **Future Plans:**
  – Use cases and application specific implementations (call for end user collaboration)
Technology – PackML Collaboration Project

- **Collaborators:** 3M, ARTC, SwRI, PlusOne Robotics

- **Problem Statement:** Software development of a PackML state machine to communicate between PLCs and ROS

- **Delivered:**
  - **Tested** with a remote PLC using a standard PackML implementation using OPC-UA to connect to the PLC
  - **Developed** an open-source C++ library, Python (SMACH) to implement the PackML state machine abstraction for use in ROS-I.
  - **Integrate RVIZ plugin for PackML**
    * PACKML State Machine
    * Provide options for mode selection
    * Show accumulative timer per state

Updated – Ported to ROS 2.0 (Crystal Clemmys)
Looking Forward
2019 Calendar

- **Jan**
  - ROS-I Summer School (Singapore) Apr 4-8

- **Feb**
  - ROS-I ARTC Internal Training (Singapore) Apr 22-24

- **Mar**
  - ROS-I Americas Annual Meeting Apr 11-12

- **Apr**
  - ROS-I Training (Singapore) May 21-24
  - ROS-I AP Workshop (Singapore) 18-19 Jun

- **May**
  - World ROS-I Day (Hackaton) 2 Jul

- **Jun**
  - World Movelt! Day (Hackathon) TBD

- **Jul**
  - ITAP 22-24 Oct

- **Aug**
  - ROS-I Training (Singapore) Aug

- **Sep**
  - ROSCON Macao 2019 Oct 31-Nov 1

- **Oct**
  - ROS-I Europe Workshop 10-12 Dec

- **Nov**
  - ROS-I Training (Singapore) Dec

- **Dec**

**Events & Workshops**

- Training
- Workshops / Events / Annual Meeting / Hackathons
- ROS Conferences / IEEE / Exhibitions
Our Journey

2017
- Inception of ROS-I AP

2018
- Jan: ROS-I Office Completed
- Oct: 1st Membership Signed
- Dec: Build Core Team

2019
- Q2: Focus on Value Creation with Industry Partners
- Q4: Gov. Promote more Open Source

2020
- Q2: Deepen Technologies
- Q4: Strengthen Ecosystem

2021...

Phases
- Start-up
- Ramp up
- Expand
- Stable
Ecosystem Engagement

- Developer’s Training in C++
- Educate Students and Upcoming Talent
- Conduct Hackathons
- Future: Application-level Training

Focus on Talent Pool Development

Collaborate and Extend ROS Hardware Support, Capabilities and Quality

- Code maintenance and updates

Institutes of Higher Learning

End Users

Invest R&D in key industry problem statements

Solution Providers

Develop Solution Providers’ ROS capability to address market needs

- Roadmapping
- Focused Technical Projects
- Contribute back to Community
- Direct Projects

Technology Providers

End Users

Develop Solution Providers’ ROS capability to address market needs

- Same as above
2019 Key Focus

• **Membership** – ROS-I Asia Pacific will continue to grow its membership base with active companies that are embracing open collaboration as well as equipment providers to grow the ROS ecosystem.

• **ROS 2.0** – core development activities started will now be based on ROS 2.0 (with qualification). Plan for ROS 2.0-based training.

• **Leapfrog** – looking at key collaboration projects enabling advanced features for the industry on top of ROS 2.0 that would help to reduce barriers for adoption. Technology areas include:
  - Advanced Perception
  - Smart Manipulation
  - Intelligent Navigation
  - Unified Communication with Robots

Call for Collaboration
We continue to work collaboratively with our partners, in our mission to grow the ROS ecosystem and allow for accelerated success in adoption of robotics.
Thank You
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