What's next for ROS?

ROSCon JP
Tokyo, Japan
September, 2018
The Organization

Open Robotics

We support the development, distribution, and adoption of open software and hardware for use in robotics research, education, and product development.
The Team
History: From lab to product
Robot for Research and Innovation

PR2 is a robotics research and development platform that lets you innovate right out of the box. No more building hardware and software from scratch.
20 December 2008

Navigation

Milestone 1 Reached!
Submitted by Anonymous on Sat, 12/20/2008 - 00:42

We cleanly passed our first major milestone this morning, with one of the Alpha PR2 robots (Gandalf) automate kilometers two days in a row. Gandalf had been doing a π-kilometer run each day for the past two weeks, the milestone complete until we had two consecutive clean runs. In the process, we improved the navigation to avoid low obstacles (scooters are popular here, and weren't seen by the first version of the software), to move uncharted territory when stuck, and of course by fixing a few bugs.

This milestone is very important: It demonstrates the hardware of the PR2 (except arms), from casters to sensors. It demonstrates the software on the robot from the device drivers to the executive, from the communication stack (ROS) to the application. We have a long way to go, but we're on the right track.
10 February 2009
First advertised release
7 May 2009
Second advertised release

ROS 0.5
mojito mambo
http://ros.sourceforge.net
Milestone 2 Reached!
Submitted by Anonymous on Mon, 06/01/2009 - 21:17

Today at 6pm, one of our PR2 alpha robots successfully completed Milestone 2 by performing a circuit of 10 plugin goals in just under an hour. It had previously completed the first part of the milestone, which was successful navigation around the office for 26.2 miles (a marathon). The first
22 January 2010

ROS 1.0

PR2s offered to labs

Milestone 3 Complete: PR2 Betas Ready and ROS 1.0
Submitted by admin on Fri, 01/22/2010 - 17:42

Today, we finished our third milestone! Simply put, ROS has reached 1.0 status. We also recently unveiled the PR2 Beta Program, which will distribute approximately 10 PR2 robots at no cost.

Of course, it's a lot more than that. Since work began on Milestone 3, there are now:

- 203 ROS software tutorials
- 29 ROS Stacks at 1.0 status, which contain a total of 186 ROS Packages
- 21 Completed Use Cases, requiring well over one hundred user studies
17 September 2012
First ROS-based commercial (non-research) robot

Rethink ROS
By Tully Foote on September 17, 2012 10:22 PM | No Comments | No Trackbacks

Cross Posted from the Open Source Robotics Foundation Blog

There's exciting news out of Boston today with the launch of Rethink Robotics’ new robot. Rethink Robotics is developing a family of low cost and highly intelligent robots that can perform simple tasks in a manufacturing environment, increasing the productivity of the people around them. Rethink Robotics was founded by Rodney Brooks, former Director of the MIT Computer Science & Artificial Intelligence Laboratory, and co-Founder of iRobot.

Rethink's robots can be taken out of the box, taught a task by anyone, and start working immediately without the need for systems integration. They are safe to interact with people and easy to train and retrain on the fly. They are nothing like any existing industrial robots.

While all of this is very exciting for the robotics industry, and certainly for our friends at Rethink, personally I find most exciting is the role played by ROS in today's news. Rethink, in the words of CEO Scott Eckert, "built upon ROS." We had some hint from Rethink at ROSCon 2012 that they were doing something with ROS, but we were very pleased to hear that ROS is such a central part of Baxter.
(some of the) ROS-based products available today
Gazebo: Simulate your robot(s)
## Importance of Simulation

<table>
<thead>
<tr>
<th>Design</th>
<th>Testing</th>
<th>Productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prototype configurations and sensor placement.</td>
<td>Simulation based CI</td>
<td>Reduce constraint on shared hardware</td>
</tr>
<tr>
<td>Experiment with different scenarios.</td>
<td>Scale up with cloud computing</td>
<td>Less overhead with software-only system</td>
</tr>
<tr>
<td></td>
<td>Tools to understand and debug tests</td>
<td>Simulation is very safe</td>
</tr>
</tbody>
</table>
Simulation: Robots for Disaster Response

Virtual Robotics Challenge, 2013
Simulation: Robots for Planetary Exploration

Space Robotics Challenge, 2017
Simulation: Robots for Industrial Automation

Agile Robotics for Industrial Automation Competition, 2018
Simulation: Boats for Ocean Monitoring

Virtual Maritime Robotics Challenge, 2019
Metrics: Community size & health
The ROS wiki

- 178K monthly users**
  - 35% annual increase*
- 1.49M annual users***
- 24.48M annual page views***

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* Source: Google Analytics
* July 2018 vs. July 2017
** Month ending July 31, 2018
*** Year ending July 31, 2018
## Documentation

The ROS wiki

- Global impact: USA constitutes 19% of users***
- Partial translations in 14 languages

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Users</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>United States</td>
<td>34,710</td>
<td>(19.08%)</td>
</tr>
<tr>
<td>2</td>
<td>China</td>
<td>31,946</td>
<td>(17.56%)</td>
</tr>
<tr>
<td>3</td>
<td>Japan</td>
<td>15,518</td>
<td>(8.53%)</td>
</tr>
<tr>
<td>4</td>
<td>Germany</td>
<td>12,711</td>
<td>(6.99%)</td>
</tr>
<tr>
<td>5</td>
<td>India</td>
<td>8,400</td>
<td>(4.62%)</td>
</tr>
<tr>
<td>6</td>
<td>Philippines</td>
<td>7,235</td>
<td>(3.98%)</td>
</tr>
<tr>
<td>7</td>
<td>South Korea</td>
<td>6,790</td>
<td>(3.73%)</td>
</tr>
<tr>
<td>8</td>
<td>United Kingdom</td>
<td>4,325</td>
<td>(2.38%)</td>
</tr>
<tr>
<td>9</td>
<td>Taiwan</td>
<td>4,233</td>
<td>(2.33%)</td>
</tr>
<tr>
<td>10</td>
<td>France</td>
<td>3,725</td>
<td>(2.05%)</td>
</tr>
</tbody>
</table>

* Source: Google Analytics
* July 2018 vs. July 2017
** Month ending July 31, 2018
*** Year ending July 31, 2018
Binary packaging

The ROS build farm

- 327K monthly downloaders**
  - 41% annual increase*
- 16.2M monthly binary packages downloaded**
  - 21% annual increase*
- 5.9TB monthly download traffic**
  - 25% annual increase*

* Source: awstats @ OSUOSL
* * July 2018 vs. July 2017
* ** Month ending July 31, 2018
ROS 2: The next generation
# Goals for ROS 2

<table>
<thead>
<tr>
<th>product-ready</th>
<th>mission-critical</th>
<th>...but also familiar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use industry-standard middleware (e.g., DDS)</td>
<td>Support real-time control</td>
<td>Keep the core concepts from ROS 1</td>
</tr>
<tr>
<td>Build in security from the beginning</td>
<td>Static analysis (e.g., MISRA)</td>
<td>Distributed systems</td>
</tr>
<tr>
<td>Support Linux, macOS, and Windows</td>
<td>Document design choices</td>
<td>Federated development</td>
</tr>
<tr>
<td></td>
<td>Support safety certification</td>
<td>Permissive open source license</td>
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Timeline for ROS 2

March 2014
Work begins at Open Robotics

August 2015
Alpha 1: first ROS 2 release

September 2014
First ROSCon talk on ROS 2

July 2016
Alpha 7: first TurtleBot 2 demo

December 2016
Beta 1

December 2017
Ardent Apalone: first distro

July 2018
Bouncy Bolson: first distro with external packages

September 2018
TurtleBot 3 runs ROS 2

December 2018
Crystal Clemmys
(some of the) Companies supporting ROS 2 development
ROS 2 & Gazebo Use Case: Automotive
Open non-competitive features
Safety and security
do not differentiate.
Shared Engineering

Example: ROS Navigation

A path planner and obstacle avoidance library.

Forked and modified by numerous companies, who contribute upstream.

Goal: Reference implementations

High quality, best in class implementation of commonly required components.

Vendors customize as needed, but also contribute upstream.

Anecdote: ABS Brakes

- Concept existed for many years
- Companies modified and applied their own features
Simulation: Automobiles

Autonomous vehicles require hundreds of millions of miles (or more) to prove reliability. [1]

Software Platforms

“...an open, reliable and secure software platform for its partners to develop their own autonomous driving systems ...” -- http://apollo.auto

“We use the latest technologies, such as ROS (Robot Operating System), and are able to see the results quickly and directly in the vehicle. It is extremely exciting to be working on such an important area for the future.” -- André Müller, BMW

https://github.com/CPFL/Autoware

https://github.com/ApolloAuto/apollo
Hardware Platforms

Autonomous Stuff
Supplies components and engineering services for automotive autonomy.
https://github.com/astuff

Dataspeed ADAS Kit
Complete solution to control throttle, brake, steering, and shifting.
https://bitbucket.org/DataspeedInc/
Successful Exit: HERE

Mar 2014
HERE mapping fleet running ROS

Dec 2015
Nokia Closes Its $2.8B Sale of HERE to the Audi, BMW, And Daimler Car Consortium
Successful Exit: Cruise Automation

Mar 2016
“GM reportedly spent over $1 billion on a tiny startup that holds a key to the future of driving” -- Business Insider

Sep 2018
“Cruise Automation’s self driving car runs on top on ROS” -- ROSCon 2018 program
Philosophy: Be active in open source
Provide Feedback
Let projects know about your problems and needs.

Private communication
ros@openrobotics.org   |   sim@openrobotics.org
Contribute
Upstream code when possible.

What?
- Bug fixes and patches
- Tools and applications that don’t affect value proposition.

Why?
- Less code for you to maintain.
- More testing.
- Build a user group.
Publicize

Share your experience.

Support publication of your usage.
We're hiring!

http://www.ros.org/
http://gazebosim.org/

https://www.openrobotics.org