ROS: An introduction

Brian Gerkey
Open Robotics
We create open software and hardware platforms for robotics. We use those platforms to solve important problems and we help others to do the same.
Where we are
ROS (Robot Operating System)

Open source SDK for robot applications

ROS = plumbing + tools + capabilities + ecosystem
ROS: Organizing principles

*Make it as easy to build robot software*

1. Distribution
2. Abstraction
3. Federation
4. Introspection
DISTRIBUTION

- Publish / subscribe messaging
- Discovery, transport, serialization
- Isolate components from each other
- Allow independent development
- Integrate teams of domain experts
- Support multiple languages
- Support different control structures
ABSTRACTION

- Well-defined interfaces
- Syntax & semantics
- Equivalence classes of components
- Tools target generic interfaces
- Extension via custom interfaces

```plaintext
Header header

float32 angle_min  # start angle
float32 angle_max  # end angle
float32 angle_increment  # angular increment

float32 time_increment  # time between

float32 scan_time  # time between

float32 range_min  # minimum range
float32 range_max  # maximum range

float32[] ranges  # range data
float32[] intensities  # intensity data
```
FEDERATION

- Let the code live where authors prefer
- Allow for independent releases
- Lower barrier for contributors
- Authors have control, branding, credit
- Requires tools for devs and CI
• All important data on the message bus
• Support incremental system exploration
• GUIs are always external tools
• Could build apps from CLI tools
(some of the) ROS-based products available today
Acquisitions (that we know about)

HERE, December 2015
ROS-based street mapping cars. Acquired by Audi, BMW, and Daimler for US$2.8B
**Cruise, March 2016**
ROS-based autonomous vehicles. Acquired by GM for (rumored) **US$1B**.

**Erle, October 2016**
ROS-based drones and collaborative robots. Acquired by Acutronic.

**Blue River, September 2017**
ROS-based agricultural automation. Acquired by John Deere for **US$305M**.
**AutonomouStuff, June 2018**
ROS-based autonomous vehicles. Acquired by Hexagon.

**MiR, April 2018**
ROS-based mobile industrial robots. Acquired by Teradyne for **US$272M**.

**Torc, March 2019**
ROS-based autonomy for various kinds of vehicles. Acquired by Daimler.
The next generation
ROS 2: Goals

1. Quality of design & implementation
2. System reliability
3. Real-time control & deterministic execution
4. Validation, verification, and certification
5. Flexibility in communication
6. Support for small embedded systems
ROS 2 Timeline

- **March 2014**: Work begins at Open Robotics
- **September 2014**: First ROSCon talk on ROS 2
- **August 2015**: Alpha 1: first ROS 2 release
- **July 2016**: Alpha 7: first TurtleBot 2 demo
**ROS 2 Timeline**

- **December 2016**: Ardent Apalone: first distro
- **December 2017**: Beta 1
- **July 2018**: Bouncy Bolson: first distro with external packages
- **September 2018**: TurtleBot 3 runs ROS 2
ROS 2 Timeline

**September 2018**
- Crystal Clemmys

**December 2018**
- Technical Steering Committee formed

**May 2019**
- Dashing Diademata
ROS 2 Dashing: First LTS release
(May 31 2019)

Actions: Python support & command line tool

Testing: QA, performance, security

IDL support

Diagnostics

Movelt 2 Alpha

armhf support at Tier 2
ROS 2 Technical Steering Committee (TSC)

- Manage roadmap
- Contribute development effort
- Set developer policies
Upcoming ROS-related events

**ROSCon Fr 2019**

- 03/06/2019 - Mise à jour du programme
- 17/04/2019 - Première version du programme
- 19/03/2019
  - Fixe les dates pour les inscriptions
  - Ouvre les inscriptions
  - Lien avec Autoware@2019
- 25/01/2019 - Ajout des invités

**Paris, Jun 11-12**
*(2 days from now)*

**Tokyo**
*September 24-25*

**Macau**
*October 31 - November 1*
Investment generally results in acquiring an asset, also called an investment. If the asset is available at a price worth investing, it is normally expected either to generate income, or to appreciate in value, so that it can be sold at a higher price.