

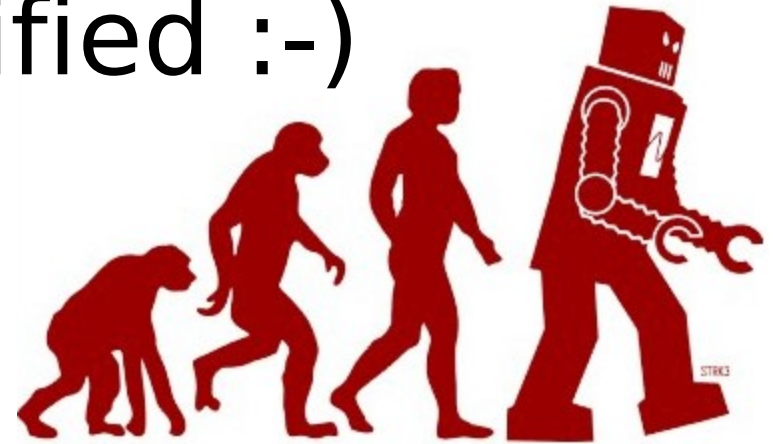
ROS (Robot Operating System)

An Introduction

Dr. Rainer Hessmer, February 2011

Hobby Robotics Evolution

- very simplified :-)



from <http://www-unix.oit.umass.edu/~blaylock/LegoRobotics/>

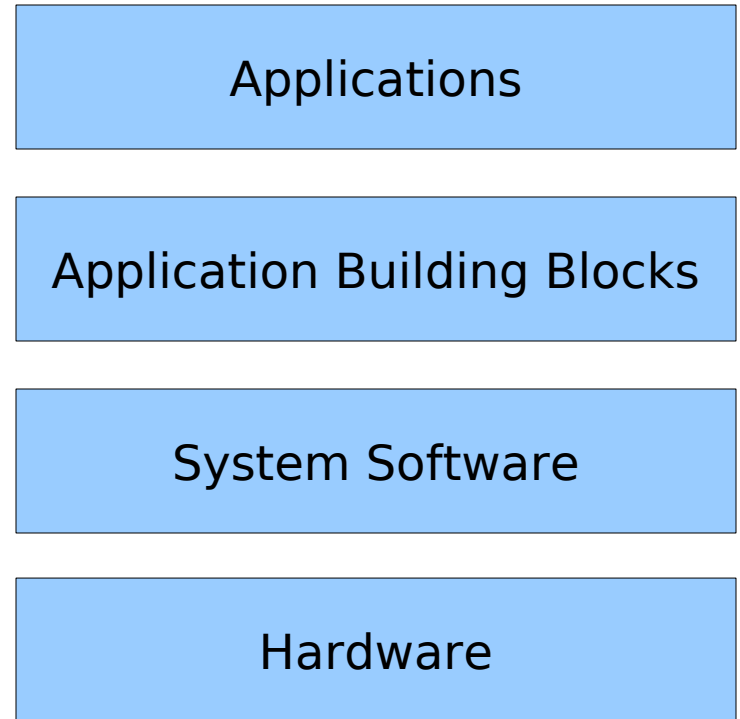
- Micro Controller Brain
 - Sumo
 - Line follower
 - Maze solver
 - Firefighting
 - ...
- Higher level logic benefits from PC
 - Magellan
 - Robot arm
 - ...
- Higher level logic requires PC
 - LEAF
 - SLAM
 - ...

But soon you hit a ceiling since ...

- You develop
 - Your own logging
 - You write your own messaging infrastructure (protocols)
 - Your own coordinate system transformations
 - Your own joystick driver
 - Your own basic navigation logic
 - Your own basic vision system
 - ...
- And you never catch up

Compare with PC Ecosystem

- Standardized Layers
- System software abstracts hardware
- Applications leverage other applications (e.g. database, web server) and huge sets of libraries



ROS – Open Source System Software for Robotics

Robotics Applications

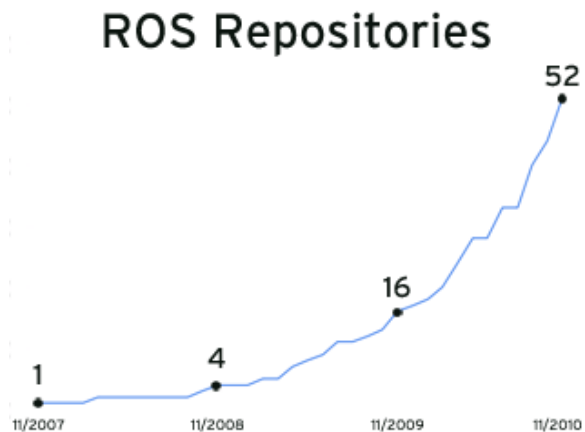
ROS

Hardware
(PR2, Texai, etc. & your own)

ROS



- Headed up by Willow Garage
(<http://www.willowgarage.com>)
- Three years old
(<http://www.willowgarage.com/blog/2010/11/08/happy-3rd-anniversary-ros>)
- The software basis of Willow Garage's PR2
- Exponential adoption



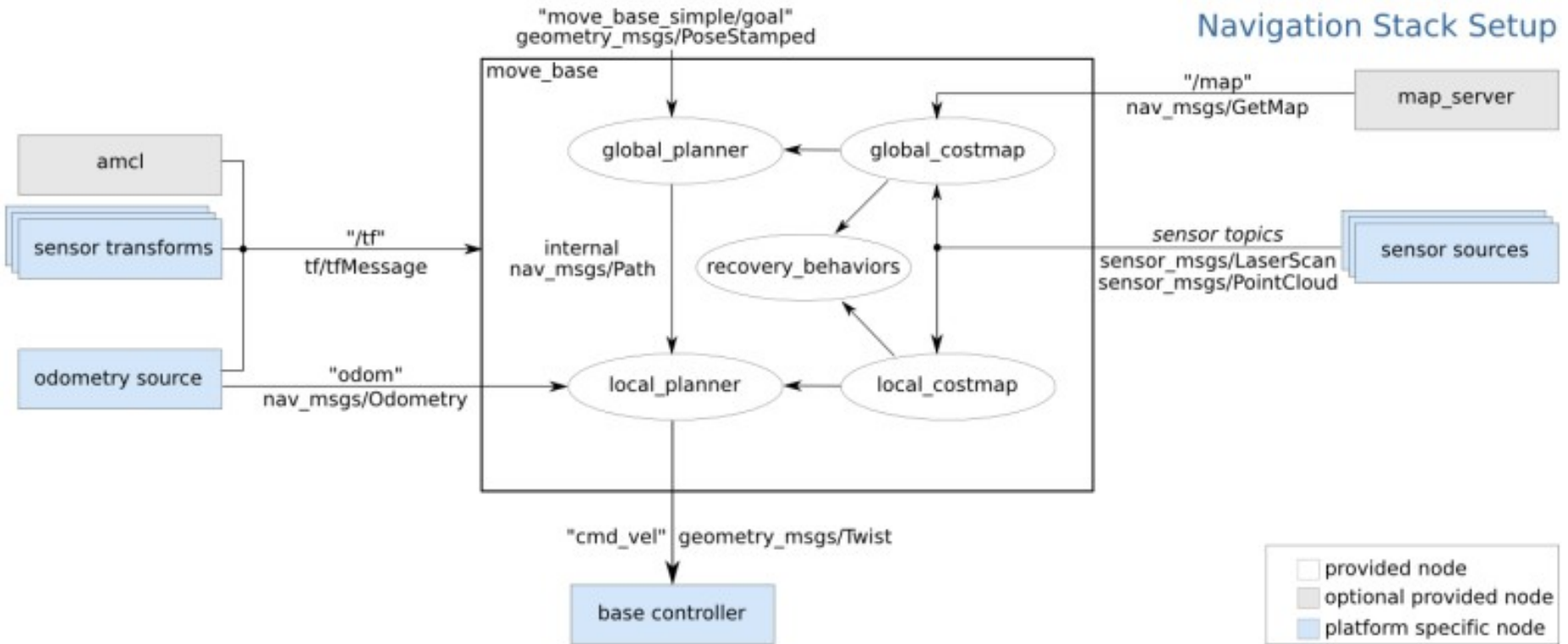
So what is it?

- A 'Meta' OS. Open Source!
 - _ Sits on top of Linux (preferably Ubuntu)
 - _ Windows implementation started
(<http://www.ros.org/wiki/cturtle/Installation/Windows>)
- Agent based
- Message passing
 - _ Publish / Subscribe
 - _ Service (remote operation) invocation
- Package Management
- Name and Parameter Services
- Programming Language Support
 - _ C++
 - _ Python
 - _ Lisp?

So what is it? (cont.)

- Low level device abstraction
 - _ Joystick
 - _ GPS
 - _ Camera
 - _ Controllers
 - _ Laser scanners
 - _ ...
- Application building blocks
 - _ Coordinate system transform services
 - _ Visualization tools
 - _ Debugging tools (e.g., recording)
 - _ Robust navigation stack (SLAM with loop closure)
 - _ Arm path planning
 - _ Object recognition
 - _ ...

ROS Navigation Stack



from <http://www.ros.org/wiki/navigation/Tutorials/RobotSetup>

Where is it used?

- More than 50 robots use ROS
(<http://www.ros.org/wiki/Robots>)

Including Hobby and Low-Cost Platforms

ROS now runs on many lower-cost, hobby-friendly platforms. 2010 started off with Andrew Harris providing [ROS libraries for the Arduino](#) and was quickly followed by [I Heart Robotics's WowWee Rovio drivers](#). You can now use [Lego NXT](#) robots with ROS as well as [Taylor Veltrop's drivers](#) for [Roboard](#)-equipped humanoids. Companies have also contributed: [Vanadium Labs provided ROS drivers](#) for their [ArbotiX](#) line of robocontrollers.

The ROS iRobot Create/Roomba community has also expanded greatly this year, with many institutions and individuals now providing drivers and libraries: [Brown's RLAB](#), [CU Boulder's Correll Lab](#), [Aptima](#), [Stanford](#), [OTL](#), and [ISR - University of Coimbra](#).

From:

<http://www.willowgarage.com/blog/2010/11/08/happy-3rd-anniversary-ros>

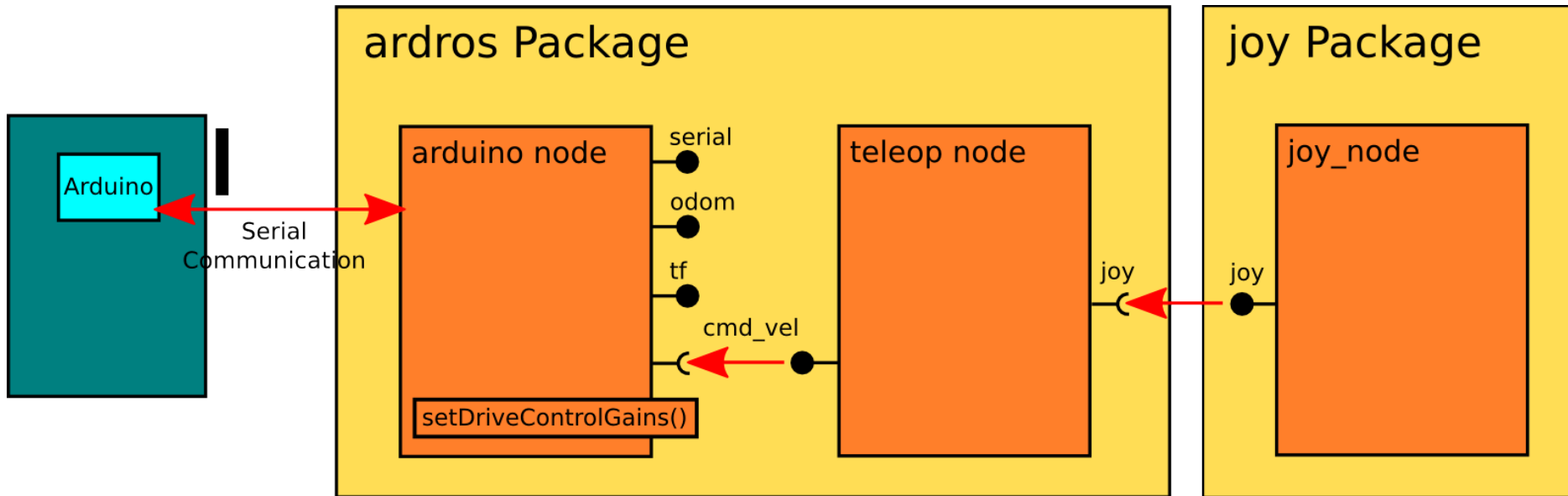
Key Concepts

- roscore: Name and Parameter server; singleton
- Package: A virtual directory holding one or more executables (nodes)
- Node: An agent communicating with ROS and other nodes via
 - Topics (publish / subscribe) using typed messages
 - Services: Request / Response paradigm (think of method or operation) via typed messages

Utilities Demo

- roscore
- roscd
- rosrun
- roslaunch
- rostopic
- rxgraph
- rosservice
- rosparam
- rosconsole / rxloggerlevel / rosout

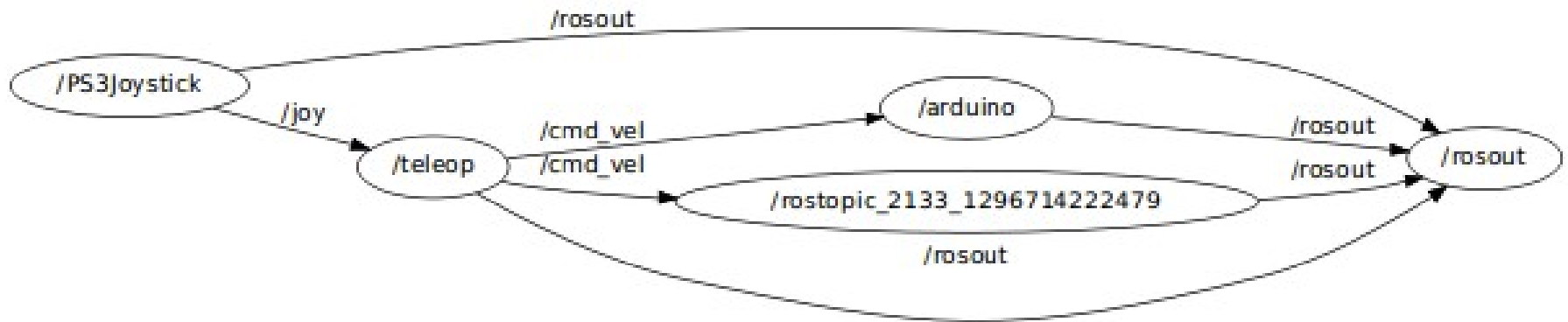
Python Implementation Demo



Source available at: <http://code.google.com/p/drh-robotics-ros/>

Communication Graph

- rxgraph



References

- ROS wiki:
<http://www.ros.org/wiki>
- Tutorials:
<http://www.ros.org/wiki/ROS/Tutorials/>
- IREX 2009 Presentation
<http://www.willowgarage.com/blog/2009/12/02/irex-2009-platform-personal-robotics?page=22>
- Willow Garage
<http://www.willowgarage.com/>
- Happy 3rd Anniversary, ROS!
<http://www.willowgarage.com/blog/2010/11/08/happy-3rd-anniversary-ros>
- ChiPy Presentation (ROS overview, emphasis on Python)
<http://www.ros.org/news/2011/01/chipy-presentation-ros-overview-and-robomagellan-demo.html>
- Windows Support
<http://www.ros.org/news/2011/01/chipy-presentation-ros-overview-and-robomagellan-demo.html>
- My own blog and web site
 - _ <http://www.hessmer.org/blog>
 - _ <http://www.hessmer.org/>

Questions?

