Robot Operating System - Introduction
Foundation Course - ss18

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MAS ws17/18

What is ROS?

- A “meta” operating system that enables researchers and engineers to rapidly develop new robotic systems without having to “reinvent the wheel” through use of standard tools and interfaces.

What is ROS?

- A software framework
- A collection of packaging, software building tools
- An architecture for distributed* inter-process/inter-machine communication and configuration Development tools for system runtime and data analysis
- Open-source under permissive BSD licenses
- A language-independent architecture (c++, python, lisp, java, and more)
- A scalable platform (ARM CPUS to Xeon Clusters)

Why ROS?

- Robots are complex machines with complicated software
- Need for better software segregation and modularity
- Speed up the development of robotic systems
- Need for hardware abstraction in robotics
- Need for distributed computing

What ROS is not :

- An actual operating system
- A programming language
- A programming environment / IDE
- A hard real-time architecture

ROS Basic Concepts:

- Nodes
- Topics
- Messages

ROS Concepts:

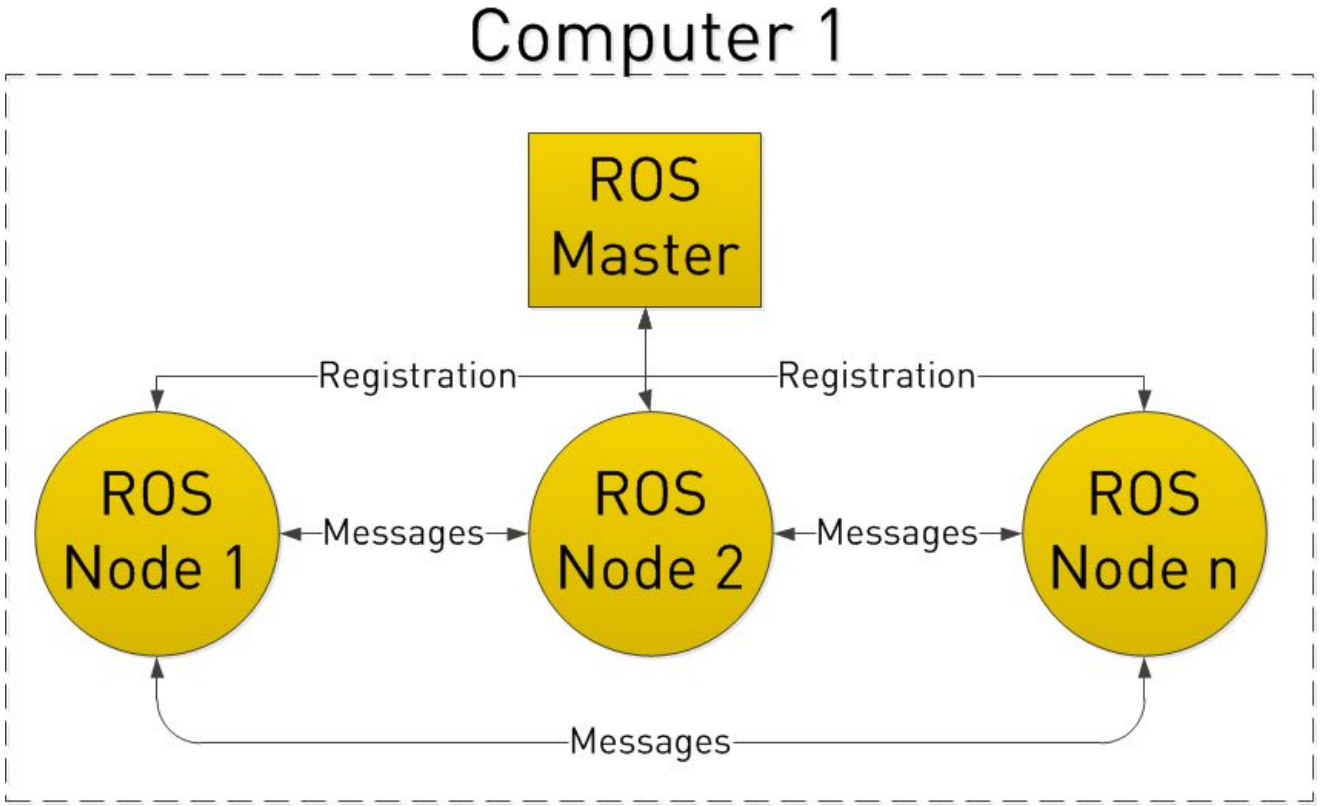


Fig 1. ROS nodes on a single computer [3]

ROS Concepts :

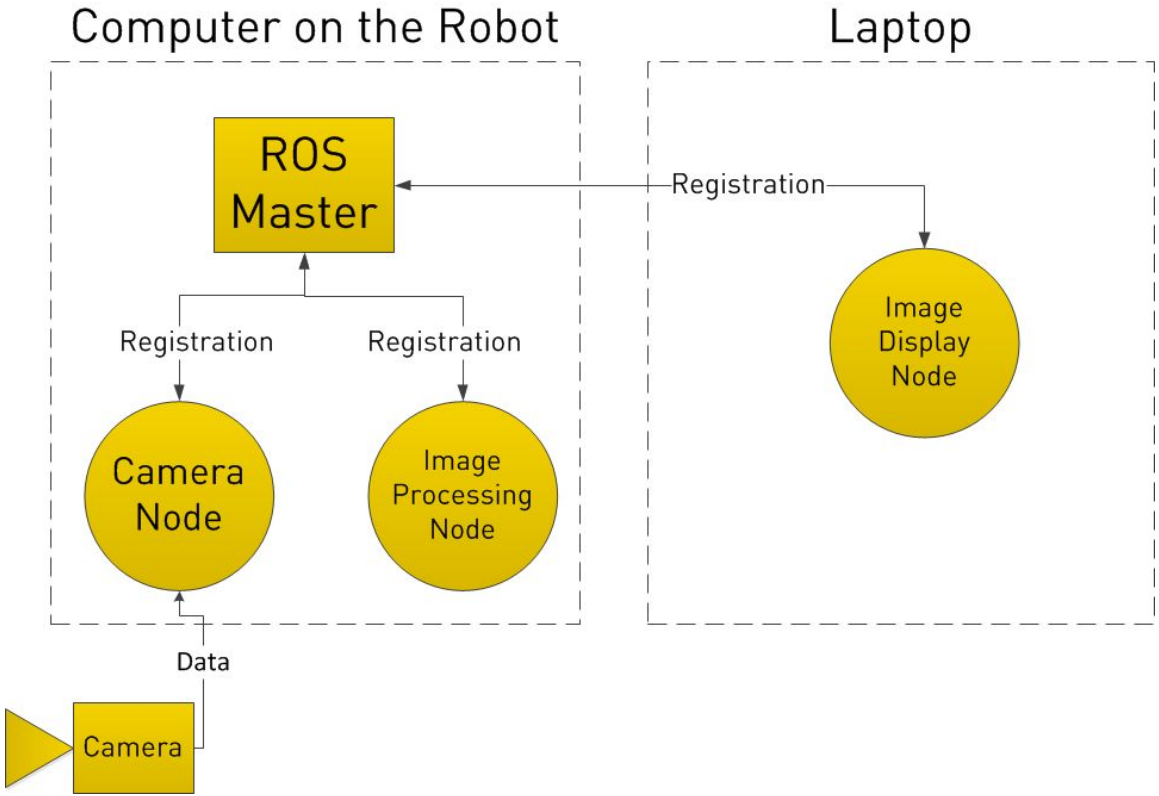


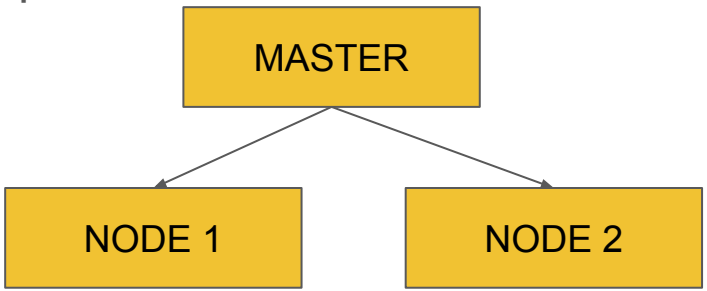
Fig 2. ROS nodes on a distributed system [3]

ROS Master:

- Manages the communication between nodes
- Every node registers at startup with the master
- Technically a centralized XML-RPC(Remote Procedure Call) server
- Usually addressed as ‘roscore’

ROS Nodes:

- Single-purpose, executable program
- Individually compiled, executed, and managed
- Organized in packages
- Nodes publish and subscribe to the desired ‘messages’ from the corresponding ‘topics’.



ROS Topics:

- Nodes communicate over topics
  - Nodes can publish or subscribe to a topic
  - Typically, 1 publisher and n subscribers.
- Basically a stream for ‘messages’.

ROS Topics :

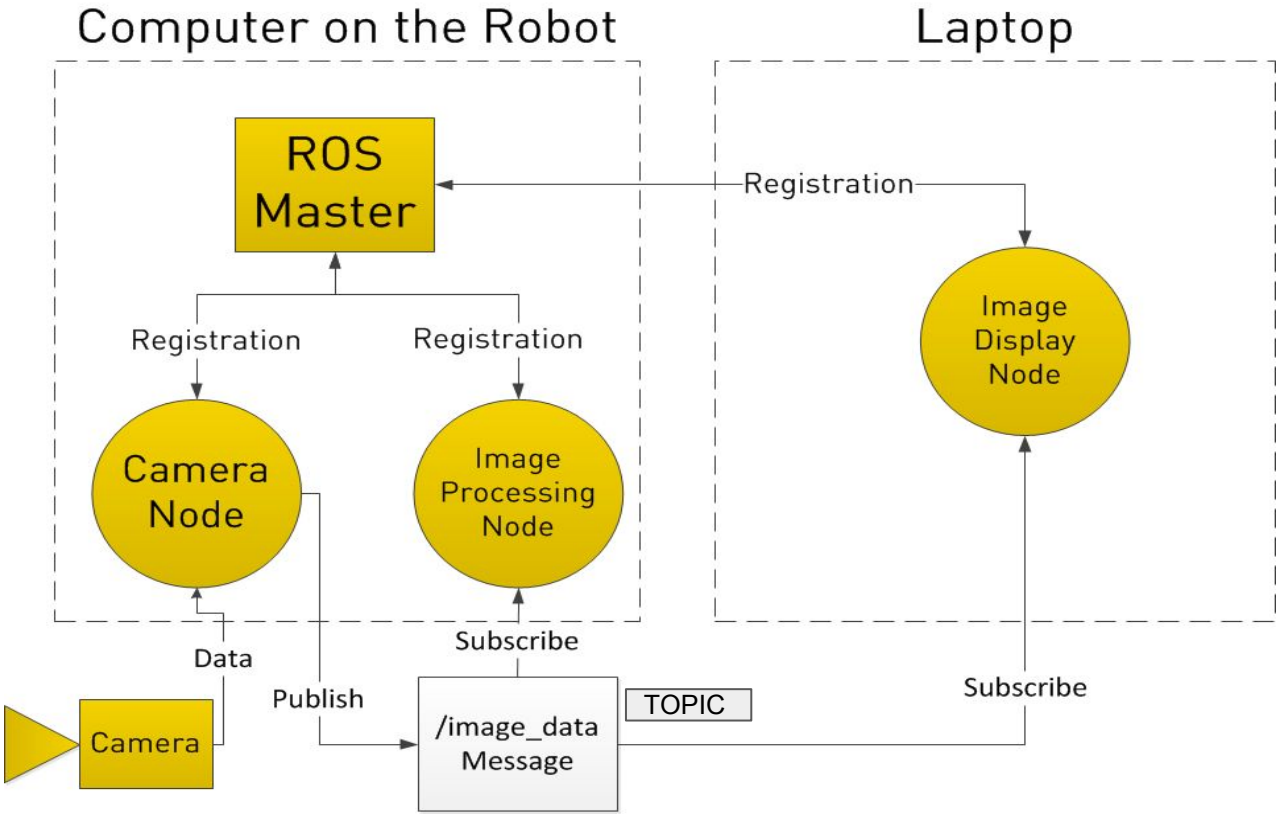


Fig 3. ROS nodes on a distributed system [3]

ROS Messages:

- Data structure defining the type of a topic
- Compromised of a nested structure of integers, floats, booleans, strings etc. and arrays of objects
- Defined in *.msg files

ROS Visualization tool: rqt graph

- GUI plugin for visualizing the ROS computation graph.

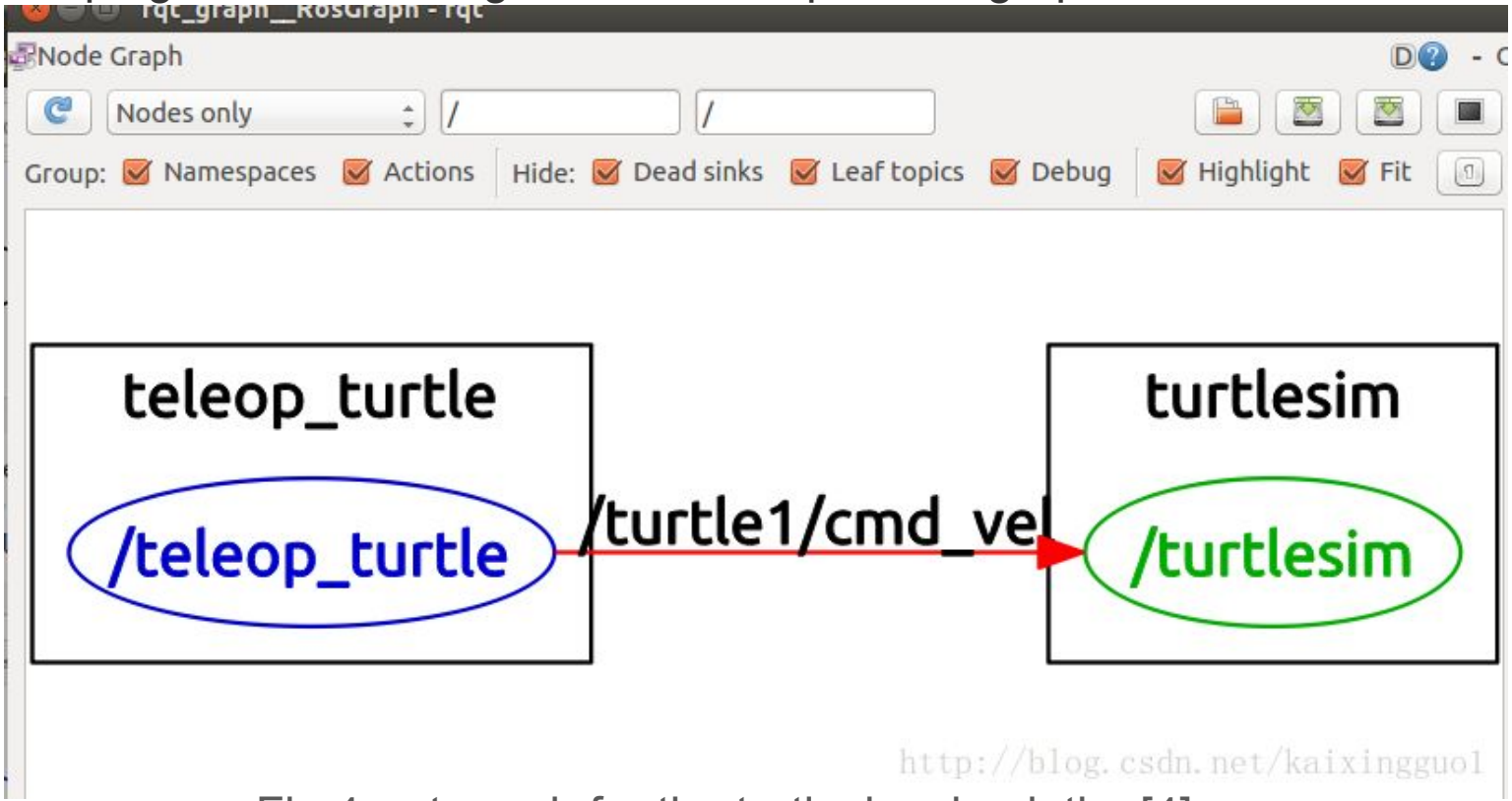


Fig 4. rqt graph for the turtlesim simulation[4]

Turtlesim Demonstration

References:

[1]ROS wiki(http://wiki.ros.org/)

[2]ETH-Zurich(https://www.ethz.ch/content/dam/ethz/special-interest/mavt/robotics-n-intelligent-systems/rsl-dam/ROS2017/lecture1.pdf)

[3]Clearpath Robotics(http://www.clearpathrobotics.com/assets/guides/ros/Intro%20to%20the%20Robot%20Operating%20System.html)

[4]University of Washington(https://courses.cs.washington.edu/courses/cse466/11au/calendar/ros_cc_1_intro-jrsedit.pdf)