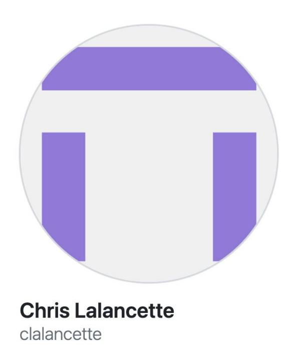
The State of ROS: From the Iron Age to the Jazzy Age

Chris Lalancette - ROS 2 Technical Lead
Yadunund Vijay - Iron ROS Boss

October 18, 2023

Who are we?



Chris Lalancette
clalancette

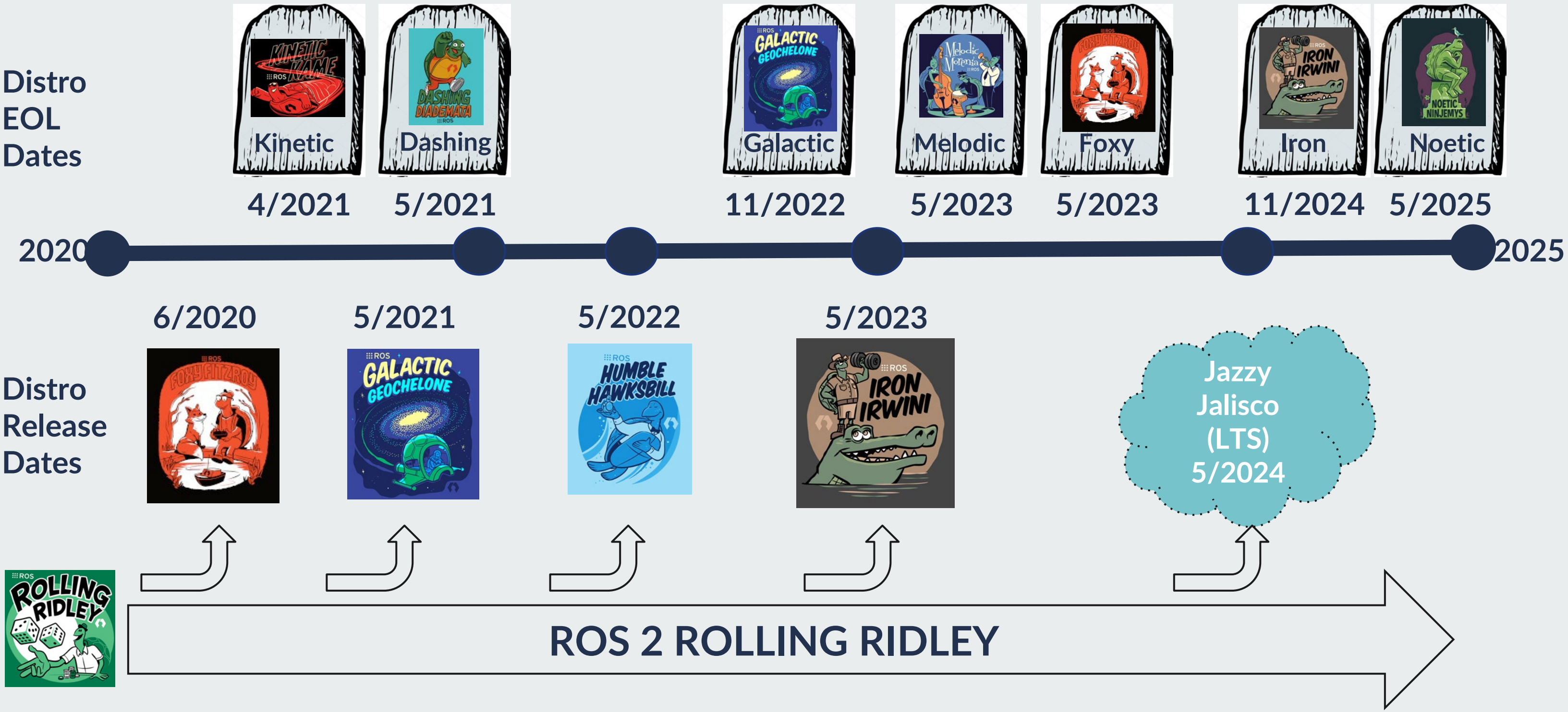
Yadu
Yadunund

Outline

- ROS distribution update
- The community
- New core features in Iron Irwini (May 2023)
- Features in development for Jazzy Jalisco (May 2024)
- Long-term outlook for core features

ROS Distribution update

ROS Distros (REP-2000)



Distro EOL Dates

Kinetic 4/2021

Dashing 5/2021

Galactic 11/2022

Melodic 5/2023

Foxy 5/2023

Iron 11/2024

Noetic 5/2025

2020

2025

Distro Release Dates

6/2020

5/2021

5/2022

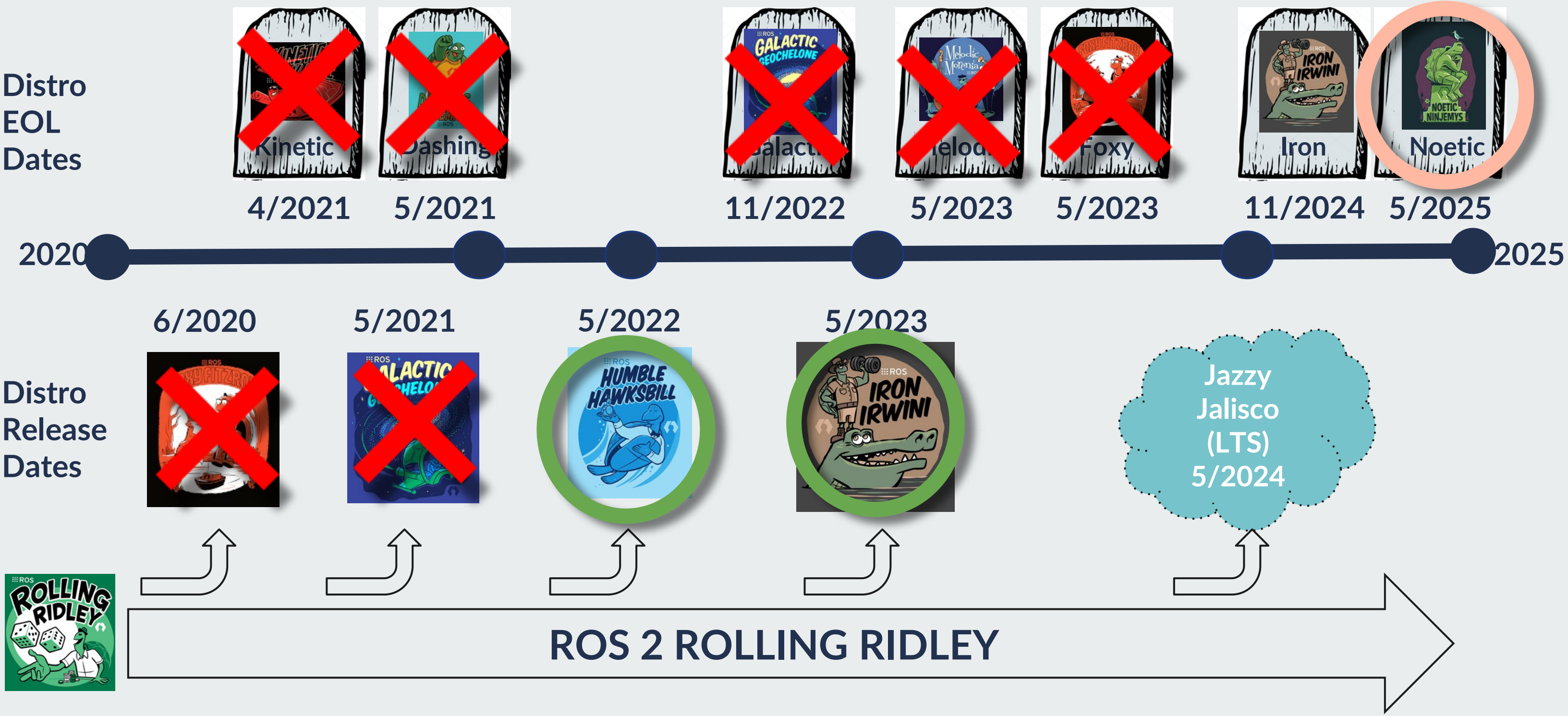
5/2023

Jazzy
Jalisco
(LTS)
5/2024

ROS 2 ROLLING RIDLEY

ROS

ROS Distros (REP-2000)



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ROS 2 ROLLING RIDLEY

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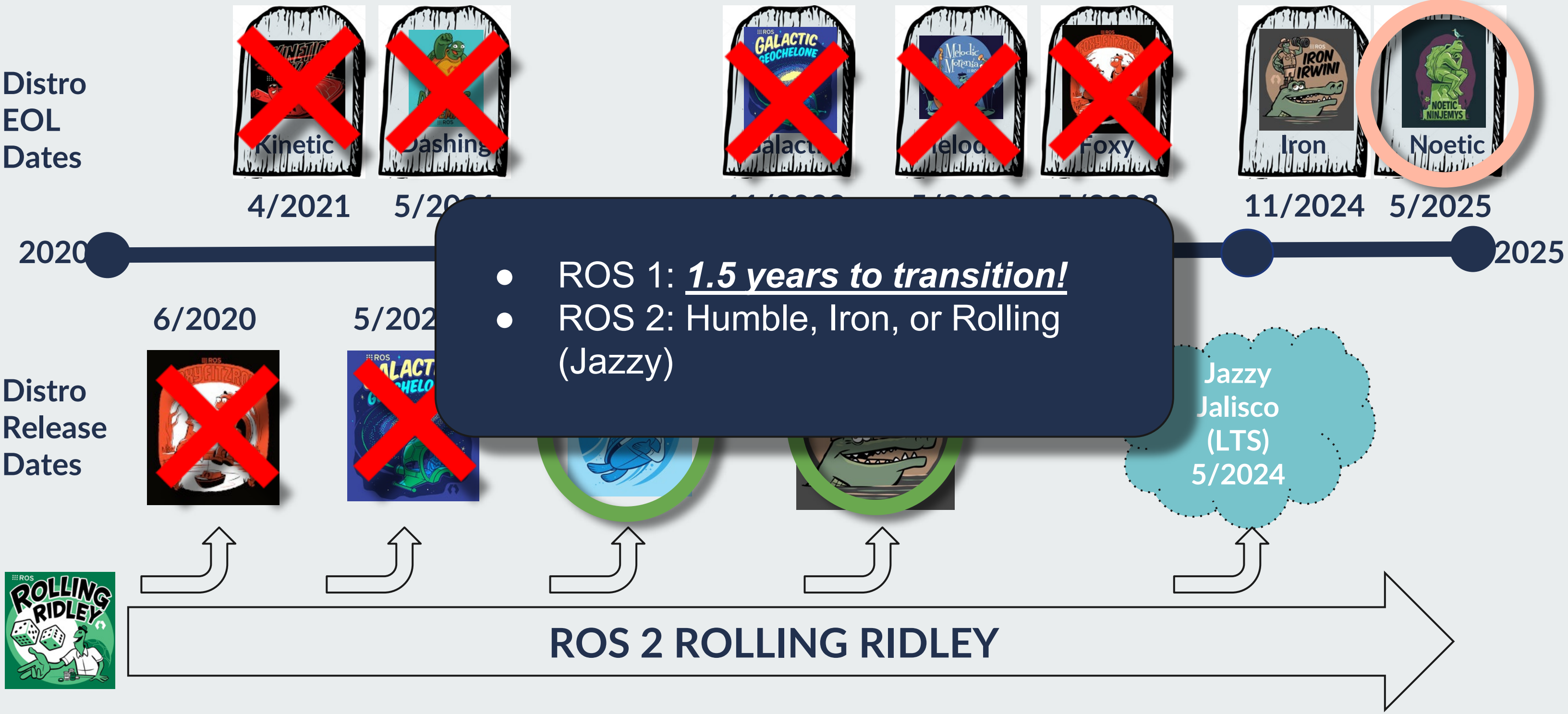

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2025

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6/2020

5/202

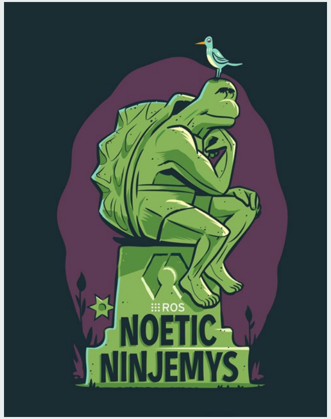
Jazzy Jalisco (LTS) 5/2024

ROS 2 ROLLING RIDLEY

- ROS 1: ***1.5 years to transition!***
- ROS 2: Humble, Iron, or Rolling (Jazzy)

How are releases produced?

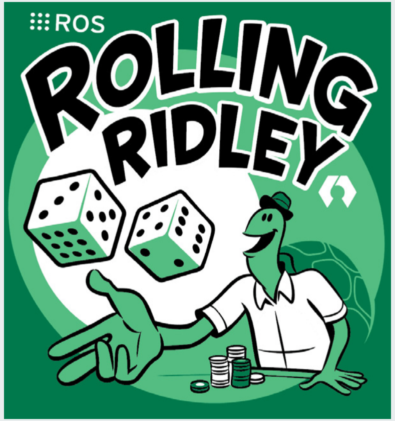
# Packages available (September 2023)



1987

1323

1156



1073

45.1%

Percentage ROS downloads that were ROS 2 in April 2023!

43,447,402

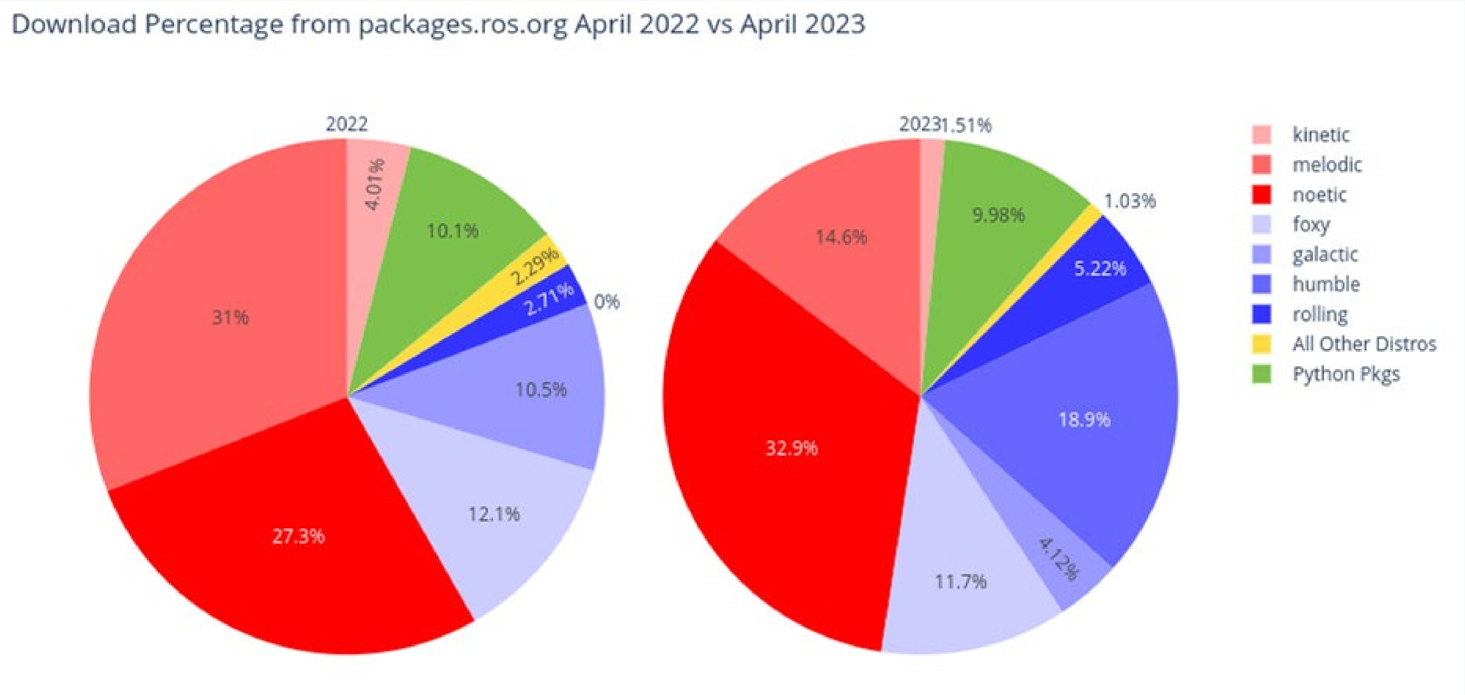
ROS package downloads in April 2023 alone!

17.14%

Growth in ROS downloads between 4/2022 and 4/2023

ROS

Package downloads



The Community

ROS Bosses

- What is a ROS Boss?
- Who are the ROS Bosses?
  - ROS 2
    - Rolling: Steven! Ragnarök
    - Jazzy: Marco A. Gutiérrez
    - Iron: Yadunund Vijay
    - Humble: Audrow Nash
    - Galactic: Scott K Logan
    - Foxy: Jacob Perron / Dharini Dutia
    - Eloquent: Michael Carroll
    - Dashing: Steven! Ragnarök
    - Crystal: Steven! Ragnarök
    - Bouncy: Mikael Arguedas / Steven! Ragnarök
    - Ardent: Steven! Ragnarök
  - ROS 1
    - Noetic: Shane Loretz
    - Melodic: Chris Lalancette
    - Lunar: Mikael Arguedas / Chris Lalancette
    - Kinetic: Tully Foote
    - Jade: Tully Foote / William Woodall
    - Indigo: Tully Foote
    - Hydro: Tully Foote
    - Groovy: Tully Foote
    - Fuerte: Ken Conley
    - Electric: Ken Conley
    - Diamondback: Ken Conley
    - C Turtle: Ken Conley
    - Box Turtle: Ken Conley

TSC (Technical Steering Committee)

ubuntu®

amazon

intel®

ROS® industrial

open robotics

SONY

iRobot®

zetta scale

Microsoft

WNDRVR

EPROSIMA
The Middleware Experts

foxglove

PICKNIK

Apex.AI

ROBOTIS

DEVCOM
GROUND VEHICLE
SYSTEMS CENTER

BOSCH
Invented for life

ROS

Resources

- Core documentation: https://docs.ros.org
- Package index: https://index.ros.org
- Discourse for discussion, announcements, or release: https://discourse.ros.org
- Discord server for real-time conversation: https://www.ros.org/blog/discord/
- ROS Robotics stack exchange: https://robotics.stackexchange.com/questions/tagged/ros
- Working groups: https://docs.ros.org/en/rolling/The-ROS2-Project/Governance/Working-Groups.html
- GitHub:
  - https://github.com/ros2
  - https://github.com/ament
  - https://github.com/ros

ROS

New Core Features in Iron Irwini

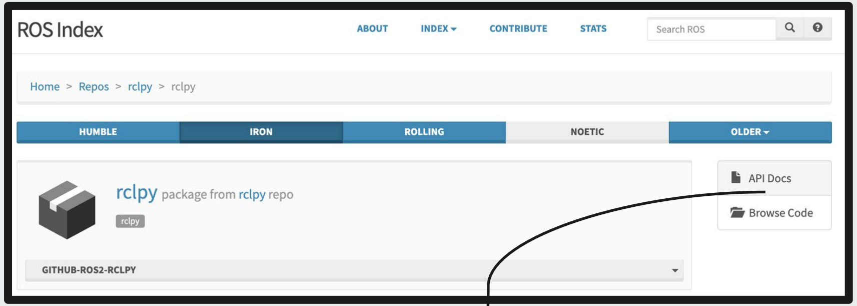
Released May 23rd 2023

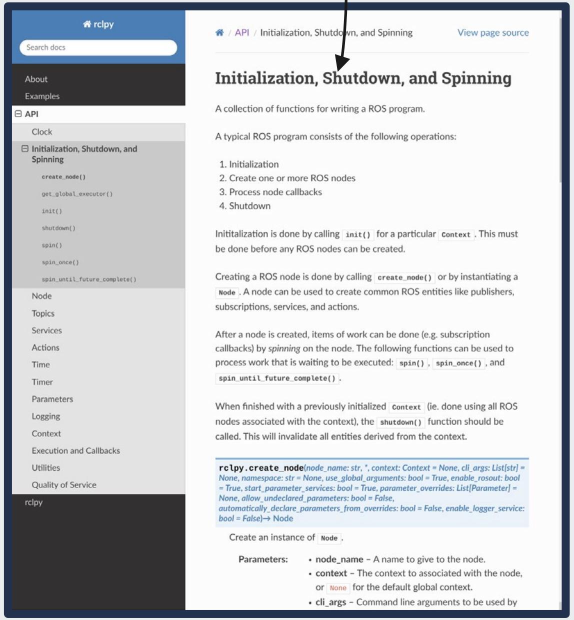
Changelog

Python API Documentation

Primary Contributors: Abrar Rahman Protyasha & Yadunund Vijay

- https://docs.ros.org contains API level documentation for all released packages
- C++ has existed for awhile
- Python API docs are new
- rclpy: https://docs.ros.org/en/rolling/p/rclpy





Initialization, Shutdown, and Spinning

A collection of functions for writing a ROS program.

A typical ROS program consists of the following operations:

1. Initialization
2. Create one or more ROS nodes
3. Process node callbacks
4. Shutdown

Inititalization is done by calling `init()` for a particular `Context`. This must be done before any ROS nodes can be created.

Creating a ROS node is done by calling `create_node()` or by instantiating a `Node`. A node can be used to create common ROS entities like publishers, subscriptions, services, and actions.

After a node is created, items of work can be done (e.g. subscription callbacks) by *spinning* on the node. The following functions can be used to process work that is waiting to be executed: `spin()`, `spin_once()`, and `spin_until_future_complete()`.

When finished with a previously initialized `Context` (ie. done using all ROS nodes associated with the context), the `shutdown()` function should be called. This will invalidate all entities derived from the context.

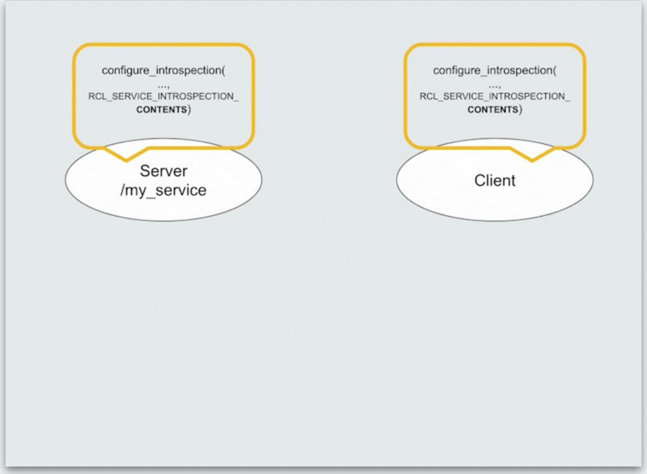
rclpy.create_node(*node_name: str, *, context: Context = None, cli_args: List[str] = None, namespace: str = None, use_global_arguments: bool = True, enable_rosout: bool = True, start_parameter_services: bool = True, parameter_overrides: List[Parameter] = None, allow_undeclared_parameters: bool = False, automatically_declare_parameters_from_overrides: bool = False, enable_logger_service: bool = False*)→ Node

Create an instance of `Node`.

Parameters:
- **node_name** – A name to give to the node.
- **context** – The context to associated with the node, or `None` for the default global context.
- **cli_args** – Command line arguments to be used by

REP-2012 Service Introspection

Primary Contributors: Brian Chen & Jacob Perron & Chris Lalancette


configure_introspection(..., RCL_SERVICE_INTROSPECTION_CONTENTS)
Server /my_service
configure_introspection(..., RCL_SERVICE_INTROSPECTION_CONTENTS)
Client

What?

Ever want to dig into a ROS service and see who called it, the request, and the results?

Now you can!

Why?

Debugging services is hard. We wanted a simple way to watch a service in a running ROS system. You can now see service events in a separate topic e.g.

`/myservice/_service_event`

How?

Service introspection is not enabled by default. It must be enabled for the Client and Server respectively.

It is a ROS service debug mode!

Pre & Post Parameter Callbacks

Primary Contributors: Deepanshu Bansal & Jacob Perron

What?

Node parameter callbacks used to be “all or nothing,” Every param had to be correct to take effect. Now you can modify parameter lists on the fly! The post parameter is where you want to change state.

Why?

We wanted to give users more flexibility without breaking API. This approach allows users to add validation and sanitization to complex parameter lists.

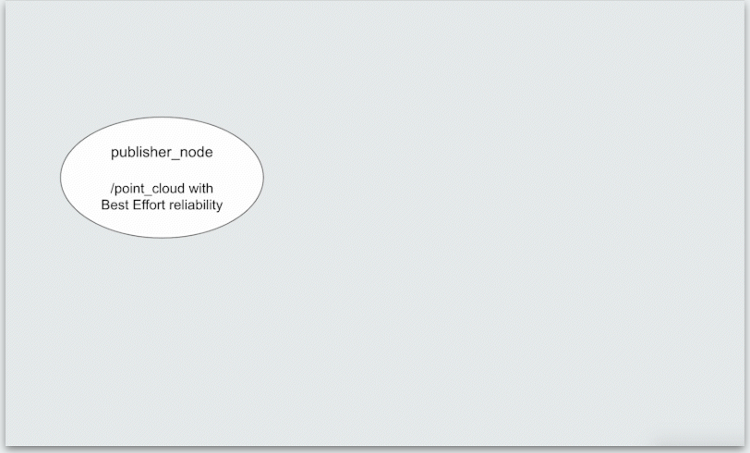
How?

Check out the

`add_pre_set_parameters_callback`

`add_post_set_parameters_callback`

methods in your ROS node.



Matched Events

Primary Contributors: Barry Xu & Tomoya Fujita

What?

Want to know when a publisher/subscriber pair establish or drop a connection? Matched event callbacks let you do just this! This can also be triggered based on compatible QoS.

Why?

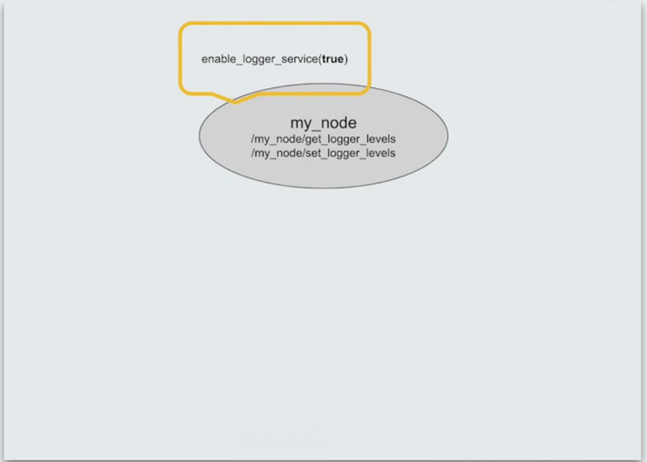
ROS node computations can be expensive, and some users don’t want to publish unless the right nodes are listening. Matched events allow this feature.

How?

Matched callbacks can be set within `PublisherEventCallbacks` and `SubscriptionEventCallbacks` which are passed as options to the publisher or subscription resp .

External Logger Configuration!

Primary Contributors: Lei Liu & Barry Xu & Tomoya Fujita


enable_logger_service(**true**)
my_node
/my_node/get_logger_levels
/my_node/set_logger_levels

What?

ROS logging is normally configured at the system level. Have you ever wanted to set just one node to verbose mode at runtime?

Now you can!

Why?

ROS systems can be huge! Users needed a granular way to set node level logging from the CLI.

How?

Enable `enable_logger_service` at node creation which will create two new services:

1. `mynode/set_logger_levels`
2. `mynode/get_logger_levels`

New Default Bag Format: MCAP

Primary Contributors: James Smith & Emerson Knapp & Michael Orlov

Standards Evolution

Influenced by ROS 1 bags, and fixing many of the issues in SQLite3, MCAP is the new default bagging format for ROS 2 that's optimized for read and write!

Baked in Message Defs

Message definitions are baked into MCAP, making the format portable! Third party tools like `PlotJuggler` and Foxglove can now render any MCAP bag file.

Enhanced Performance

Preliminary performance evaluation indicates a ~2-5x increase in message throughput over SQLite on ROS bag benchmarks (YMMV).

Experimental rclcpp executor

Primary Contributors: Mauro Passerino & Lenny Story & Alberto Soragna

What?

The executor is responsible for calling your callbacks. The default one uses a fixed priority order. The new `EventsExecutor` maintains a queue of events and executes them as they arrive.

Why?

The `EventsExecutor` can be more fair to events and can have better performance than the default executor.

How?

When writing your nodes, first explicitly create the `rclcpp::experimental::executors::EventsExecutor`. Then add your node to the executor and spin it!

Features in development for Jazzy Jalisco

rmw_zenoh

- DDS is here to stay but we think an alternative middleware protocol is beneficial to the community.

- Motivations and community discussions: https://discourse.ros.org/t/investigation-into-alternative-middleware-solutions/32642/43

- Report: https://discourse.ros.org/t/ros-2-alternative-middleware-report/33771/14

rosbag2 service/action record and play

Long term outlook for core features

Use of “conda” for Windows

Performance improvements

Ability to release Rust packages

Evolving messages over time

Automatically detect “best” data delivery

Interested in helping?

http://docs.ros.org/en/rolling/The-ROS2-Project/Contributing.html

Gazebo

Gazebo Harmonic features

- Python bindings for systems
- Automatically compute Moment of Inertia of meshes
- Exert forces and torques by dragging objects in the scene
- Simulate virtual mass of displaced volume of objects in fluids
- Generate custom Gazebo messages
- Lens Flare support

ROS is healthy and growing, thanks to you!