

# Parameters Should Be Boring

*generate\_parameter\_library*

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# Tyler Weaver



- Racing Kart Driver
- MoveIt Maintainer
- Rust Evangelist
- Docker Skeptic



# RCLCPP

# Parameters

Part 1

# Getting Started



```
int main(int argc, char ** argv)
{
    rclcpp::init(argc, argv);

    auto node = std::make_shared<rclcpp::Node>("minimal_param_node");
    auto my_string = node->declare_parameter("my_string", "world");
    auto my_number = node->declare_parameter("my_number", 23);

    rclcpp::spin(node);
    rclcpp::shutdown();
}
```

# Parameter Struct



```
struct Params {  
    std::string my_string = "world";  
    int my_number = 23;  
};
```

# Parameter Struct



```
struct Params {
    std::string my_string = "world";
    int my_number = 23;
};

int main(int argc, char ** argv)
{
    rclcpp::init(argc, argv);
    auto node = std::make_shared<rclcpp::Node>("minimal_param_node");
    auto params = Params{};
    params.my_string = node->declare_parameter("my_string", params.my_string);
    params.my_number = node->declare_parameter("my_number", params.my_number);

    rclcpp::spin(node);
    rclcpp::shutdown();
}
```

# ParameterDescriptor



```
auto param_desc = rcl_interfaces::msg::ParameterDescriptor{};
param_desc.description = "Mine!";
param_desc.additional_constraints = "One of [world, base, home]";
params.my_string = node->declare_parameter("my_string",
    params.my_string, param_desc);
```

```
auto param_desc = rcl_interfaces::msg::ParameterDescriptor{};
param_desc.description = "Mine!";
param_desc.additional_constraints = "One of [world, base, home]";
params.my_string = node->declare_parameter("my_string",
    params.my_string, param_desc);
param_desc = rcl_interfaces::msg::ParameterDescriptor{};
param_desc.description = "Who controls the universe?";
param_desc.additional_constraints = "A multiple of 23";
params.my_number = node->declare_parameter("my_number",
    params.my_number, param_desc);
// ...
```



```
auto const _ = node->add_on_set_parameters_callback(  
    [](std::vector<rclcpp::Parameter> const& params)  
    -> rcl_interfaces::msg::SetParametersResult {
```

```
auto const _ = node->add_on_set_parameters_callback(  
    [](std::vector<rclcpp::Parameter> const& params)  
-> rcl_interfaces::msg::SetParametersResult {  
    for (auto const& param : params) {  
        if(param.get_name() == "my_string") {  
            auto const value = param.get_value<std::string>();
```

```
auto const _ = node->add_on_set_parameters_callback(
  [](std::vector<rclcpp::Parameter> const& params)
  -> rcl_interfaces::msg::SetParametersResult {
    for (auto const& param : params) {
      if(param.get_name() == "my_string") {
        auto const value = param.get_value<std::string>();
        auto const valid = std::vector<std::string>{"world", "base", "home"};
        if (std::find(valid.cbegin(), valid.cend(), value) == valid.end()) {
          auto result = rcl_interfaces::msg::SetParametersResult{};
          result.successful = false;
          result.reason = std::string("my_string: {")
            .append(value)
            .append("} not one of: [world, base, home]");
          return result;
        }
      }
    }
  }
);
```

- parameter name: 6 separate copies
- declaration: re-init description for each parameter
- validation: convert vector to map

30 lines of C++ boilerplate per parameter

30 lines of C++ boilerplate per parameter  
Before handling of dynamic parameters



Paul Gesel @pac48

# generate\_ parameter\_library

Part 2

```
minimal_param_node:  
  my_string: {  
    type: string,  
    description: "Mine!",  
    validation: {  
      one_of<>: ["world", "base", "home"]  
    }  
  }  
  my_number: {  
    type: int,  
    description: "Mine!",  
    validation: {  
      multiple_of_23: []  
    }  
  }  
}
```



```
~/ws$ ros2 run ...  
terminate called after throwing an instance of  
  'rclcpp::exceptions::InvalidParameterValueException'  
  
what(): Invalid value set during initialization for parameter 'my_string':  
Parameter 'my_string' with the value 'place' is not in the set  
  '[world, base, home]'
```

```
~/ws$ ros2 param set /node_name my_string "hello"  
Setting parameter failed: Parameter 'my_string' with the value 'hello' is  
not in the set '[world, base, home]'
```

```
find_package(generate_parameter_library REQUIRED)

generate_parameter_library(
  minimal_param_node_parameters
  src/minimal_param_node.yaml
)

add_executable(minimal_node src/minimal_param_node.cpp)
target_link_libraries(minimal_node PRIVATE
  rclcpp::rclcpp
  minimal_param_node_parameters
)
```

```
#include <rclcpp/rclcpp.hpp>
#include "minimal_param_node_parameters.hpp"

int main(int argc, char * argv[])
{
    rclcpp::init(argc, argv);
    auto node = std::make_shared<rclcpp::Node>("minimal_param_node");
    auto param_listener =
        std::make_shared<minimal_param_node::ParamListener>(node);
    auto params = param_listener->get_params();

    // ...
}
```

# Built-In Validation Functions

- bounds (inclusive)
- less than
- greater than
- less than or equal
- greater than or equal

# Built-In Validation Functions

- bounds (inclusive)
- less than
- greater than
- less than or equal
- greater than or equal
- fixed string/array length
- size of string/array length greater than
- size of string/array length less than
- array contains no duplicates
- array is a subset of another array
- bounds checking for elements of an array

```
#include <rclcpp/rclcpp.hpp>
#include <fmt/core.h>
#include <tl_expected/expected.hpp>

tl::expected<void, std::string> multiple_of_23(
    rclcpp::Parameter const& parameter) {
    int param_value = parameter.as_int();
    if (param_value % 23 != 0) {
        return tl::make_unexpected(fmt::format(
            "Invalid value '{}' for parameter {}. Must be multiple of 23.",
            param_value, parameter.get_name()));
    }
    return {};
}
```

- Dynamic parameters
- Generation of RCLPY Parameter Libraries
- Generation of Markdown Docs
- Examples and docs at [github.com/PickNikRobotics/generate\\_parameter\\_library](https://github.com/PickNikRobotics/generate_parameter_library)
- Released on Humble, Iron, and Rolling

# Contributions



- agonzat
- bijoua29
- Błażej Sowa
- Bruno-Pier
- Chance Cardona
- Charles Cross
- Chien shao-yu
- Chris Thrasher
- chriseichmann
- Christoph Fröhlich
- Denis Stogl
- Diogo Almeida
- Felix Exner (fexner)
- Florian Vahl
- g-argyropoulos
- Griswald Brooks
- Guelakais
- GuiHome
- Jan Gutsche
- light-tech
- Marq Rasmussen
- Masaya Kataoka
- Michael Carroll
- Michael Wrock
- mosfet80
- Paul Gesel
- Sai Kishor Kothakota
- Scott K Logan
- Siddharth Saha
- sprenger120
- Steven! Ragnarök
- Tony Najjar
- Tyler Weaver



- MoveIt 2
- ros2\_control
- PickNik Clients
- you?

# Boring?

Part 3

# Why so many parameters?



- Users use defaults for most parameters

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- Authors only test default values

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- Permutations of parameters grow exponentially

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- The more complex your interface the less useful your abstraction

# Why so many parameters?



- Users use defaults for most parameters
- Authors only test default values
- Permutations of parameters grow exponentially
- The more complex your interface the less useful your abstraction
- Resist the urge to expose interior details as parameters

# What is a good parameter?



- Express user intent (latency or throughput)



# What is a good parameter?



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- Details like buffer sizes scale with hardware

# What is a good parameter?



- Express user intent (latency or throughput)
- Details like buffer sizes scale with hardware
- Leave the door open to improvements in behavior for the user

# Questions?

