RosLibRust

Easy way to talk to any ROS system from Rust

Built by: [https://github.com/Carter12s](https://github.com/Carter12s) & [https://github.com/ssnover](https://github.com/ssnover)
Rust in a Nutshell

“Fast, Reliable, Productive – Pick Three!”

“Fearless Concurrency”

“Batteries Included”
Considering Rust

by John Gjengset
AMP Robotics

- 200+ Systems operating around the world
- Started building our own sorting facilities around this tech
The Problem: Connecting to Dozens of Systems
The ROS + Rust Ecosystem is messy...

- ROS1:
  - rosrust ~639
Problems we faced:

1. All the crates have incompatible APIs

2. Some crates require a ROS installation, some are standalone

3. All crates have “strict message parsing”

4. We really like async! No async ROS1 crate exists yet…
HOW STANDARDS PROLIFERATE:
(SEE: A/C CHARGERS, CHARACTER ENCODINGS, INSTANT MESSAGING, ETC)

SITUATION:
THERE ARE 14 COMPETING STANDARDS.

14?! RIDICULOUS!
WE NEED TO DEVELOP ONE UNIVERSAL STANDARD THAT COVERS EVERYONE’S USE CASES. YEAH!

SOON:

SITUATION:
THERE ARE 15 COMPETING STANDARDS.
Not actually that bad...

Designed to run on ROS system:
- rospy
- roscpp
- rosrust

Designed to talk to ROS from non-ROS system:
- roslibpy
- roslibjs
- roslibrust

NEW
ROS Bridge!

ROS1 Listener

ROS1 Talker

TCPROS

ROS1 rosbright

ROS2 rosbright

ROS2 Listener

ROS2 Talker

"rosbridge_protocol"

JSON data over Websocket

Soon to be Zenoh

DDS
Stop talking and show us the code...
use roslibrust::ClientHandle;
use roslibrust_codegen_macro::find_and_generate_ros_messages;

find_and_generate_ros_messages!("assets/ros1_common_interfaces/std_msgs");

#[tokio::main(flavor = "multi_thread")]
async fn main() -> Result<(), Box<dyn std::error::Error + Send + Sync>> {
    let client = ClientHandle::new("ws://localhost:9090").await?
    let publisher = client.advertise::<std_msgs::Header>("talker").await?

    loop {
        let msg = std_msgs::Header::default();
        publisher.publish(msg).await.unwrap();
        tokio::time::sleep(tokio::time::Duration::from_secs(1)).await;
    }
}
Procedural macro – Rust code that generates Rust code

```rust
find_and_generate_ros_messages!("assets/rosl_common_interfaces/std_msgs");
```

- Allows library authors to write “compiler plugins”
- Invoked by compiler during compilation
- Works directly with compiler’s internal source code AST

```rust
#[proc_macro]
pub fn find_and_generate_ros_messages(input_stream: TokenStream) -> TokenStream {
```

- Recursively searches ROS_PACKAGE_PATH + input
- Find all packages (ROS1 + ROS2)
- Parse all found message, service, action files
- Resolve dependencies
- Generate Rust types
Codegen in action

What the message file looks like:

```plaintext
# This message holds the status of an individual component of the robot.
#

# Possible levels of operations
byte OK=0
byte WARN=1
byte ERROR=2
byte STALE=3

byte level # level of operation enumerated above
string name # a description of the test/component reporting
string message # a description of the status
string hardware_id # a hardware unique string
KeyValue[] values # an array of values associated with the status
```
Codegen in action

What gets generated:

Serialization hooks

Data definition

Constants
serde-rs/serde

Serialization framework for Rust

#derive(serde::Serialize, serde::Deserialize)
struct MyStruct {}
Kicking off our main function with Async!

```rust
#[tokio::main(flavor = "multi_thread")]
async fn main() -> Result<(), Box<dyn std::error::Error + Send + Sync> {
```

- Entire application is async
- Runs on a thread pool
- Allows extremely efficient parallelism and concurrency
- Rust compiler prevents all memory safety issues

(tokio-rs/tokio)

A runtime for writing reliable asynchronous applications with Rust. Provides I/O, networking, scheduling, timers, ...
let client = ClientHandle::new("ws://localhost:9090").await?
let publisher = client.advertise::<std_msgs::Header>("talker").await?

loop {
    let msg = std_msgs::Header::default();
publisher.publish(msg).await.unwrap();
tokio::time::sleep(tokio::time::Duration::from_secs(1)).await;
}
None of that is new?
Why should we care?

A more interesting example!
mod ros1 {
    crate::find_and_generate_ros_messages!("assets/ros1_common_interfaces/std_msgs");
}

mod ros2 {
    crate::find_and_generate_ros_messages!("assets/ros2_common_interfaces/std_msgs");
}

#[tokio::main(flavor = "multi_thread")]
async fn main() -> Result<(), Box<dyn std::error::Error + Send + Sync>> {
    let ros1_client = ClientHandle::new("ws://localhost:9090").await?
    let ros2_client = ClientHandle::new("ws://localhost:9091").await?
    let subscriber = ros1_client
        .subscribe::<ros1::std_msgs::Header>("/bridge_header")
        .await?
    let publisher = ros2_client.advertise("/bridge_header").await?

    loop {
        let msg = subscriber.next().await;
        let converted_msg = ros2::std_msgs::Header {
            stamp: msg.stamp,
            frame_id: msg.frame_id,
        };
        publisher.publish(converted_msg).await?;
    }
}
A really cool example!
enum GenericHeader {
    V1(ros1::std_msgs::Header),
    V2(ros2::std_msgs::Header),
}

impl RosMessageType for GenericHeader {
    const ROS_TYPE_NAME: &'static str = "std_msgs/Header";
}

async fn main() -> Result<(), Box<dyn std::error::Error + Send + Sync>> {
    let client = ClientHandle::new("ws://localhost:9090").await?
        .subscribe::<GenericHeader>("talker").await?
    loop {
        let msg = rx.next().await;
        match msg {
            GenericHeader::V1(ros1_header) => {
                info!("Got ros1: {ros1_header:?}"");
            }
            GenericHeader::V2(ros2_header) => {
                info!("Got ros2: {ros2_header:?}"");
            }
        }
    }
}
When to use roslibrust?

- You want to connect to many diverse ROS systems
- You only need low bandwidth data exchange
  - Converting back and forth to JSON ain’t the fastest thing in the world
- You want to leverage Rust’s ecosystem:
  - web servers, databases, security, high performance, badass type system
- Ideal for: fleet monitoring, metrics collection, central facility control, and various cloud tools
Roadmap

- Want to be a part of unifying the Rust experience for ROS! (sorry…)

- Crate is still in beta with an evolving API, but has seen some serious use at AMP and is proven reliable

- Have preliminary support for ROS1 native communication (TCPROS)
  - Will be first ROS1 client to provide an async API

- Sticking with “Rust Idiomatic” for now
  - No dependency on ROS1 / ROS2 installation or on catkin, ament, etc.
Thank you!