Understanding nodes

Goal: Learn about the function of nodes in ROS 2, and the tools to interact with them.

Tutorial level: Beginner

Time: 10 minutes

Contents

Background

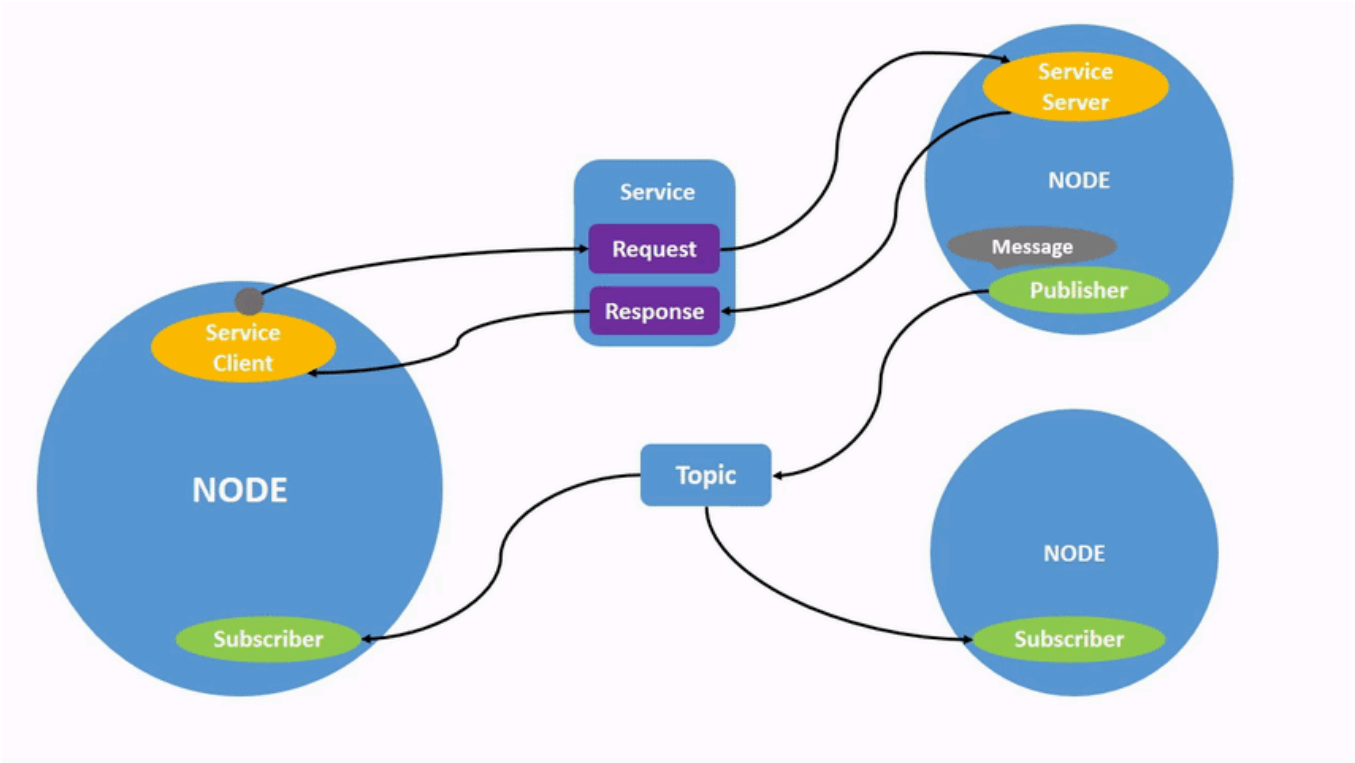
1 The ROS 2 graph

Over the next few tutorials, you will learn about a series of core ROS 2 concepts that make up what is referred to as the “ROS (2) graph”.

The ROS graph is a network of ROS 2 elements processing data together at the same time. It encompasses all executables and the connections between them if you were to map them all out and visualize them.

2 Nodes in ROS 2

Each node in ROS should be responsible for a single, modular purpose, e.g. controlling the wheel motors or publishing the sensor data from a laser range-finder. Each node can send and receive data from other nodes via topics, services, actions, or parameters.



A full robotic system is comprised of many nodes working in concert. In ROS 2, a single executable (C++ program, Python program, etc.) can contain one or more nodes.

Prerequisites

The previous tutorial shows you how to install the `turtlesim` package used here.

As always, don't forget to source ROS 2 in every new terminal you open.

Tasks

1 ros2 run

The command `ros2 run` launches an executable from a package.

```
ros2 run <package_name> <executable_name>
```

To run turtlesim, open a new terminal, and enter the following command:

```
ros2 run turtlesim turtlesim_node
```

The turtlesim window will open, as you saw in the previous tutorial.

Here, the package name is `turtlesim` and the executable name is `turtlesim_node`.

We still don't know the node name, however. You can find node names by using `ros2 node list`

2 ros2 node list

`ros2 node list` will show you the names of all running nodes. This is especially useful when you want to interact with a node, or when you have a system running many nodes and need to keep track of them.

Open a new terminal while turtlesim is still running in the other one, and enter the following command:

```
ros2 node list
```

The terminal will return the node name:

```
/turtlesim
```

Open another new terminal and start the teleop node with the command:

```
ros2 run turtlesim turtle_teleop_key
```

Here, we are referring to the `turtlesim` package again, but this time we target the executable named `turtle_teleop_key`.

Return to the terminal where you ran `ros2 node list` and run it again. You will now see the names of two active nodes:

```
/turtlesim
/teleop_turtle
```

2.1 Remapping

Remapping allows you to reassign default node properties, like node name, topic names, service names, etc., to custom values. In the last tutorial, you used remapping on `turtle_teleop_key` to change the cmd_vel topic and target **turtle2**.

Now, let's reassign the name of our `/turtlesim` node. In a new terminal, run the following command:

```
ros2 run turtlesim turtlesim_node --ros-args --remap __node:=my_turtle
```

Since you're calling `ros2 run` on turtlesim again, another turtlesim window will open. However, now if you return to the terminal where you ran `ros2 node list`, and run it again, you will see three node names:

```
/my_turtle
/turtlesim
/teleop_turtle
```

3 ros2 node info

Now that you know the names of your nodes, you can access more information about them with:

```
ros2 node info <node_name>
```

To examine your latest node, `my_turtle`, run the following command:

```
ros2 node info /my_turtle
```

`ros2 node info` returns a list of subscribers, publishers, services, and actions. i.e. the ROS graph connections that interact with that node. The output should look like this:

```
/my_turtle
  Subscribers:
    /parameter_events: rcl_interfaces/msg/ParameterEvent
    /turtle1/cmd_vel: geometry_msgs/msg/Twist
  Publishers:
    /parameter_events: rcl_interfaces/msg/ParameterEvent
    /rosout: rcl_interfaces/msg/Log
    /turtle1/color_sensor: turtlesim/msg/Color
    /turtle1/pose: turtlesim/msg/Pose
  Service Servers:
    /clear: std_srvs/srv/Empty
    /kill: turtlesim/srv/Kill
    /my_turtle/describe_parameters: rcl_interfaces/srv/DescribeParameters
    /my_turtle/get_parameter_types: rcl_interfaces/srv/GetParameterTypes
    /my_turtle/get_parameters: rcl_interfaces/srv/GetParameters
    /my_turtle/list_parameters: rcl_interfaces/srv/ListParameters
    /my_turtle/set_parameters: rcl_interfaces/srv/SetParameters
    /my_turtle/set_parameters_atomically: rcl_interfaces/srv/SetParametersAtomically
    /reset: std_srvs/srv/Empty
    /spawn: turtlesim/srv/Spawn
    /turtle1/set_pen: turtlesim/srv/SetPen
    /turtle1/teleport_absolute: turtlesim/srv/TeleportAbsolute
    /turtle1/teleport_relative: turtlesim/srv/TeleportRelative
  Service Clients:

  Action Servers:
    /turtle1/rotate_absolute: turtlesim/action/RotateAbsolute
  Action Clients:
```

Now try running the same command on the `/teleop_turtle` node, and see how its connections differ from `my_turtle`.

You will learn more about the ROS graph connection concepts including the message types in the upcoming tutorials.

Summary

A node is a fundamental ROS 2 element that serves a single, modular purpose in a robotics system.

In this tutorial, you utilized nodes created in the `turtlesim` package by running the executables `turtlesim_node` and `turtle_teleop_key`.

You learned how to use `ros2 node list` to discover active node names and `ros2 node info` to introspect a single node. These tools are vital to understanding the flow of data in a complex, real-world robot system.

Next steps

Now that you understand nodes in ROS 2, you can move on to the topics tutorial. Topics are one of the communication types that connects nodes.

Related content

The Concepts page adds some more detail to the concept of nodes.