ROS Crash-Course, Part II

ROS Design Patterns, C++ APIs, and Best Practices

Jonathan Bohren

With some information and figures adapted from `http://www.ros.org`

LABORATORY FOR
Computational
Sensing + Robotics
THE JOHNS HOPKINS UNIVERSITY

Outline

1. ROS Package & Stack Design

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2. Integrating ROS With Other Systems

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Splitting code into more packages

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- Wrapper Packages
  ROS's package system can be used as a lightweight way of integrating third-party software that cannot be acquired through a system's package manager.

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- Application-specific Code
  If a collection of packages are *so* application-specific that they cannot be used separately.
- Rapid Development for Experimenting and Prototyping
  Sometimes experimental or "hacked"-together code shouldn't be over-engineered into a number of packages during initial development.

When to Make a Stack

Packaging code for distribution

ROS stacks are best made when there are a collection of packages that, while not necessarily depending on each-other, are useful for a common purpose, act as *companions* to some other package, or make up the components of an application.

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- `pr2_plugs` - the PR2 autonomous recharge application

Naming Conventions

ROS Style Guidelines

under_scored	CamelCase	camelCase	ALL_CAPS
stack_name	MessageType	funcName()	CONSTANT_NAME
package_name	ServiceType		
file_name	ClassName		
namespace_name			
node_name			
topic_name			
service_name			
liblibrary_name			
variable_name			

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Adding ROS Interfaces

Lightweight addition with minimal changes to a codebase

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ALOT OF CODE

"the alot" (c) hyperboleandahalf.blogspot.com

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Transparent ROS package wrapper

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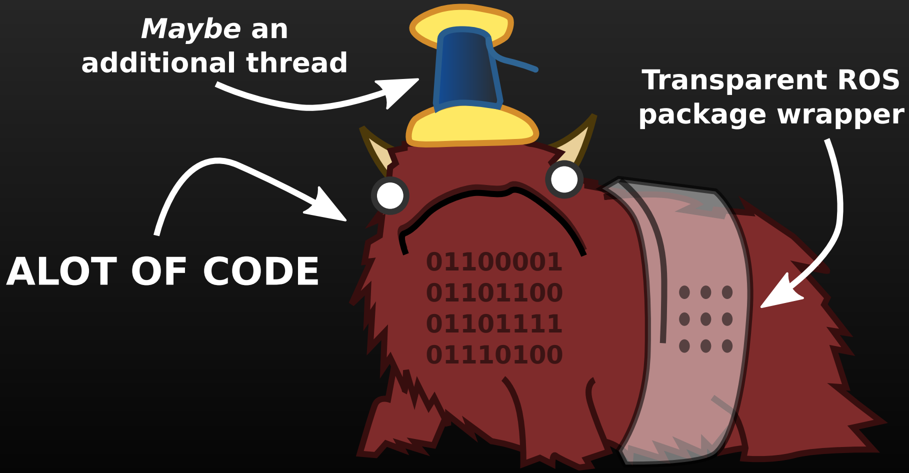

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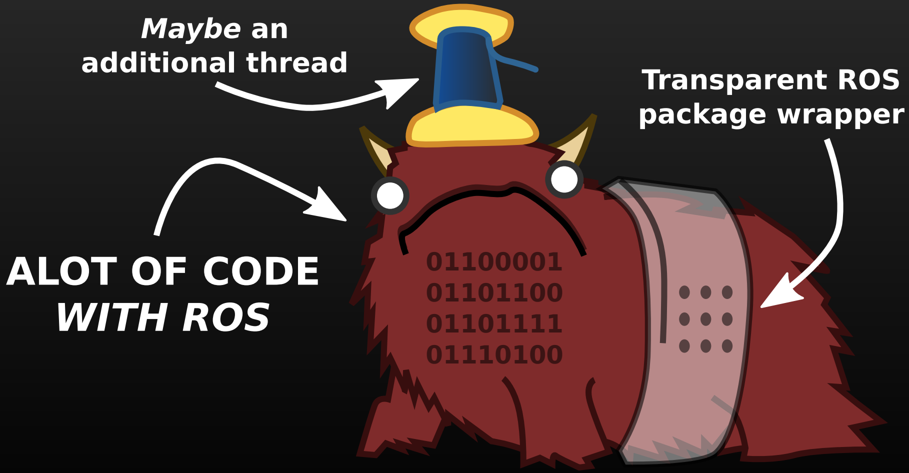

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- Message design should come *after* node design
- Try to avoid building messages that tend to not get completely filled out

Namespaces

Like Jersey barriers, but for ROS graph resources

ROS nodes, topics, services, and parameters, can all be created in namespaces, to better organize the collection of names in the ROS graph. Any ROS resoource which is named in a launchfile can be created in a given namespace, using the `<group>` tag and the `ns` attribute.

Namespaces for Designating Topics

An illustration

sensor-##1

viewer

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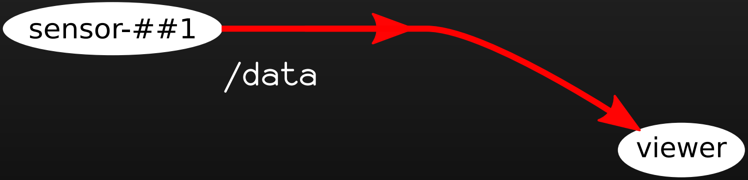
An illustration



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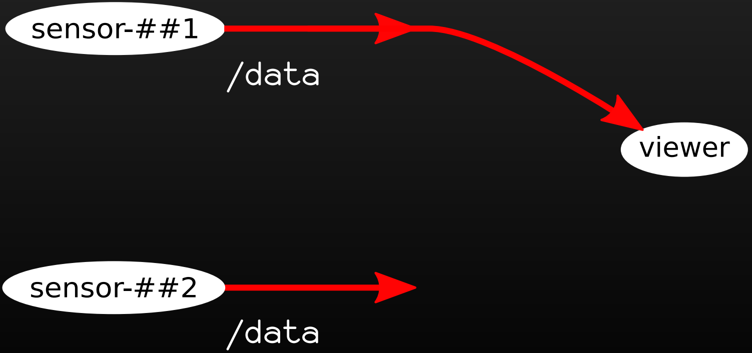

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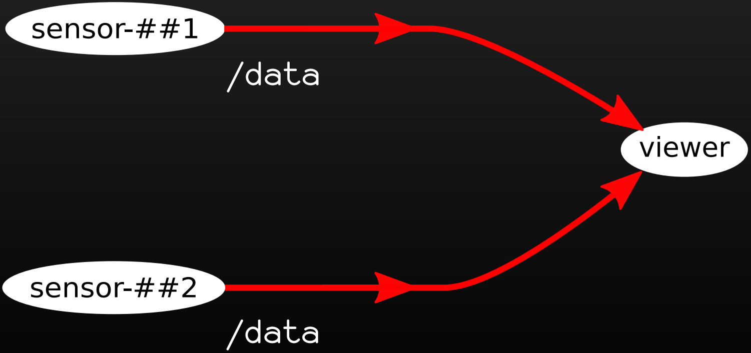

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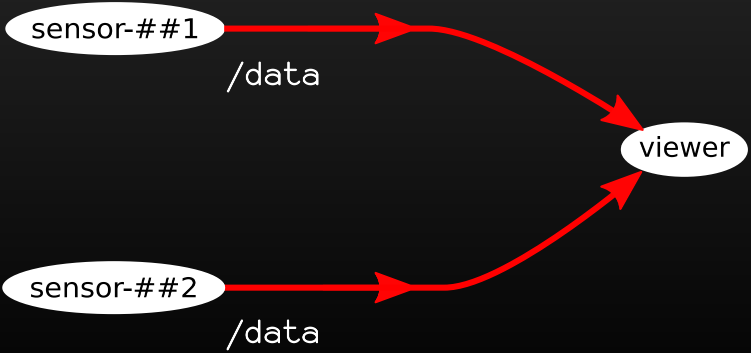

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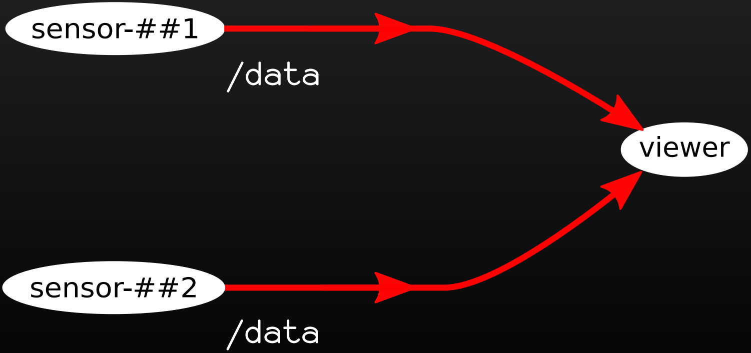

Resource Name “Remapping”

Powerful abstraction interface

One of the most-used and under-documented patterns in ROS communication is resource remapping. While remapping might first appear to simply be another way of reducing naming collisions, it is actually a powerful design tool.

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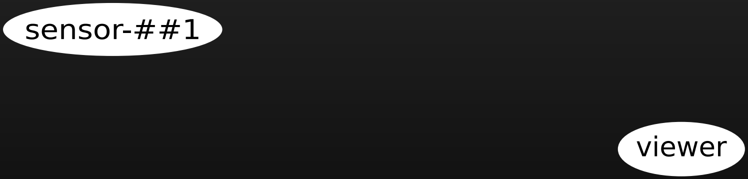
An illustration



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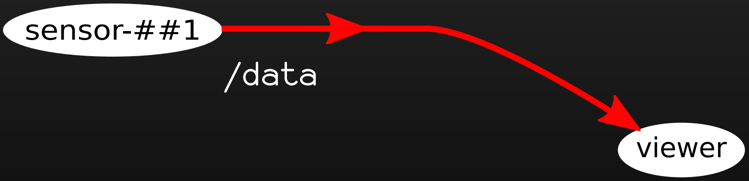

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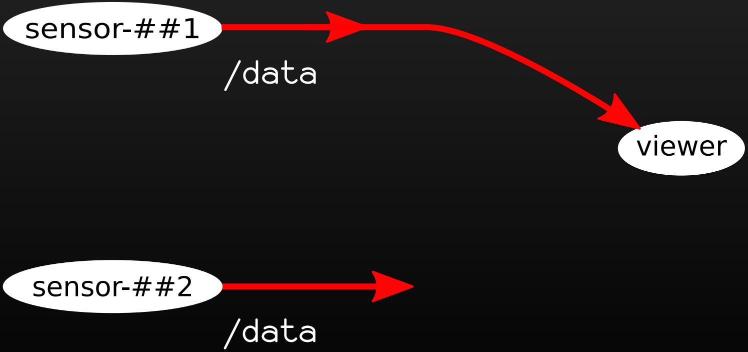

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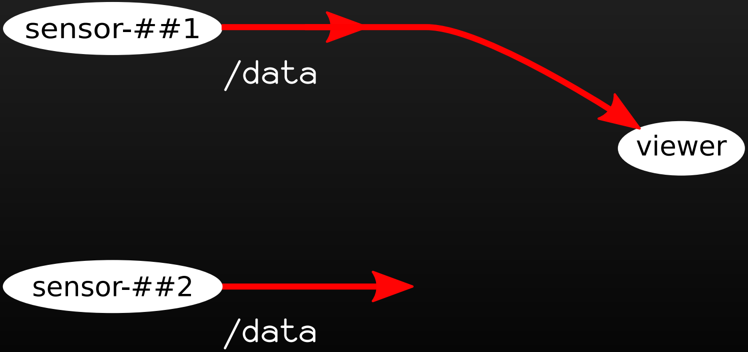

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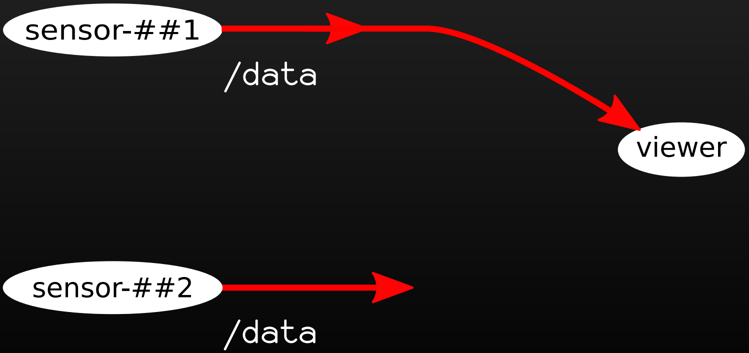

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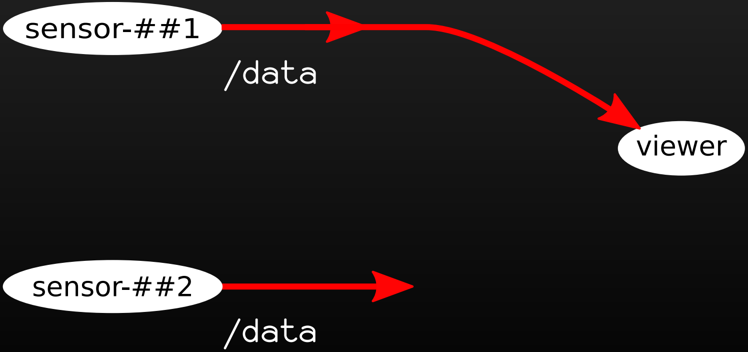

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Initialization

The first thing you will ever do with ROS

Any progam that uses the ROS APIs must *intialize* the ROS runtime. This is done with a single call to `ros::init()`. This function generally conforms to the format:

```
void ros::init(argc,argc,
               std::string node_name,
               uint32_t options);
```

- `roslaunch` passes arguments into ros via `argc, argv` so these must be passed into your `ros::init()` in order for launchfile settings to take effect.
- Note that if using `roslaunch`, the `node_name` may be over-written
- `options` is a bitfield for advanced use (see online documentation)

“Spinning”

Where all the magic happens

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    Similar to `ros::spinonce()`, but services callbacks in multiple threads

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  - `ros::AsynchSpinner`
    Non-blocking, multi-threaded service of callbacks (tends to be the most useful for multi-threaded programs)

Shutting Down

The last thing you will ever do with ROS

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- `ros::ok()`
  Returns `false` once *this node's* ROS interfaces have completely shut down
- `ros::isShuttingDown()`
  Discouraged except in advanced cases, returns `true` once `ros::shutdown()` has been called

Time & The ROS Clock

FIXME: 2038 A.D.

ROS provides a time abstraction interface to provide a mechanism to spoof the wall clock for simulation. ROS time is preferred over a system's clock routines (for non-realtime systems). The `ros::Time` API has the following features:

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- `ros::[Time/Duration]::toSec()` - (double) in seconds

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- `ros::[Time/Duration]::toSec()` - (double) in seconds
- `ros::Rate` - fixed-rate duration for sleeping