ASTRO

Autonomous Satellite Test & Robotics Operations

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1. Project Overview

1.1 Motivation

The STAR laboratory at UF relies on ad hoc UDP client-server architectures to connect simulations with flight software. This limits:

- **Interoperability** — Projects cannot easily work together
- **Modularity** — Logging, calculations, and networking are bundled into monolithic executables
- **Scalability** — Simulations cannot serve multiple systems simultaneously

1.2 Goals

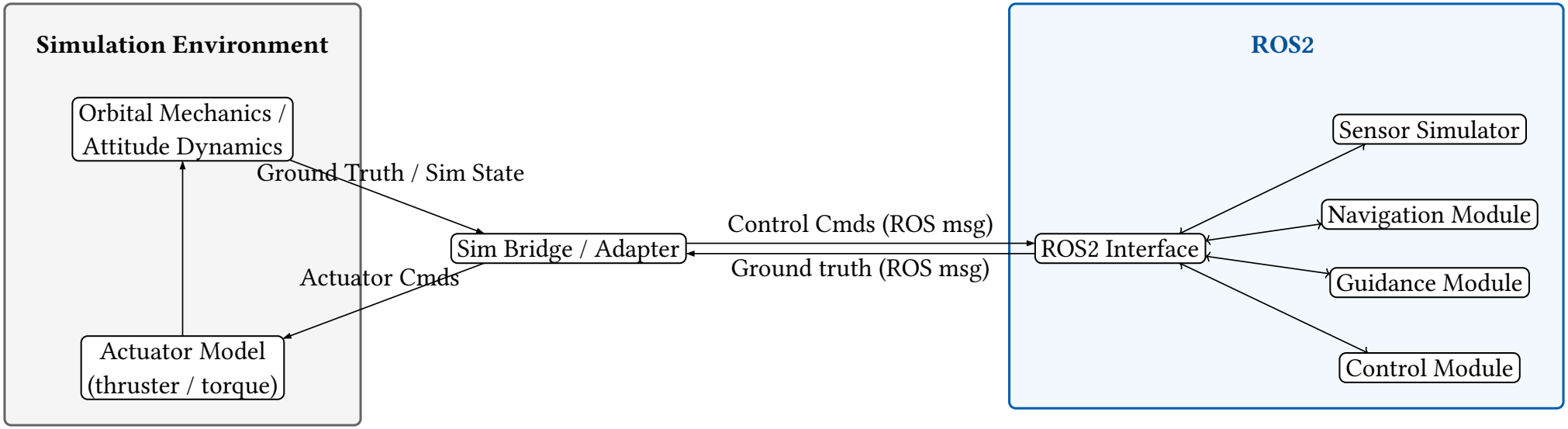
1. **Interoperate** — Enable seamless communication between simulation desktops and Jetson edge hardware through ROS 2 nodes
2. **Modularize** — Package existing lab software (orbital mechanics, GNC, logging) into discrete ROS 2 components
3. **Extend** — Build a framework that connects to *any* simulation, not just Basilisk, expanding the lab's testing and operational capabilities

2. Project Design

2.1 Software Architecture — External Sim

When the simulation environment cannot be wrapped as a ROS 2 node, a bridge adapter translates between raw simulation data and ROS messages.

2.1 Software Architecture — External Sim



2.2 Software Architecture — Internal ROS 2

When the simulation *can* be wrapped in ROS 2, all components live inside the ROS 2 graph as native nodes.

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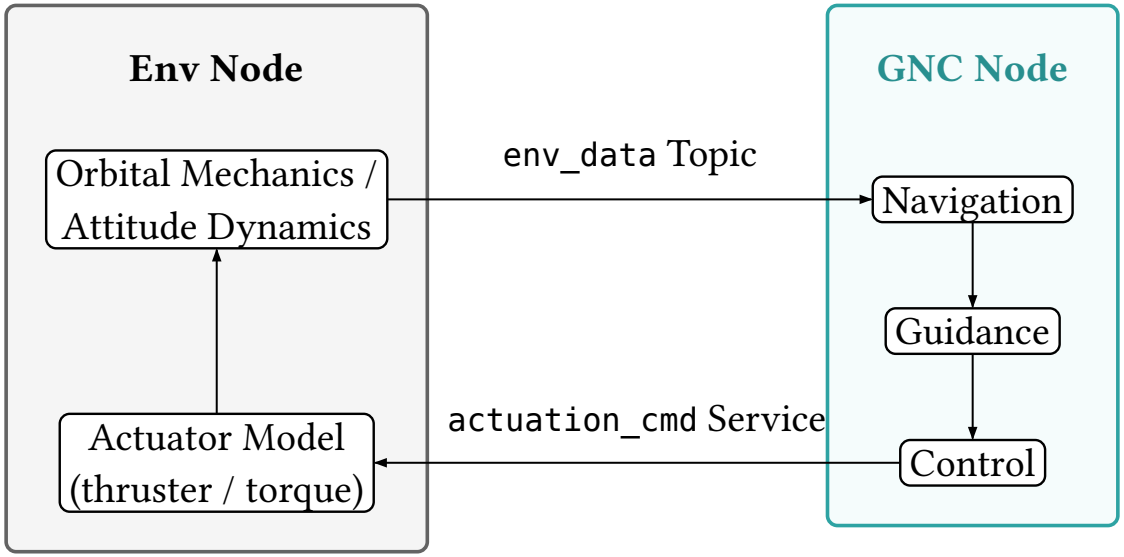

2.3 ROS 2 Component Mapping

Component	Role
Env Node	Executes simulation software (orbital mechanics, actuator models)
GNC Node	Navigation, Guidance, and Control — ported from DLQR on NJON
`env_data` Topic	High-frequency telemetry / state from Env to GNC
`actuation_cmd` Service	Control signals sent from GNC to the environment

2.4 User Interface Design

ROS 2 exposes system data through topics, services, and logging — accessible via CLI, dashboards, and plotting tools.

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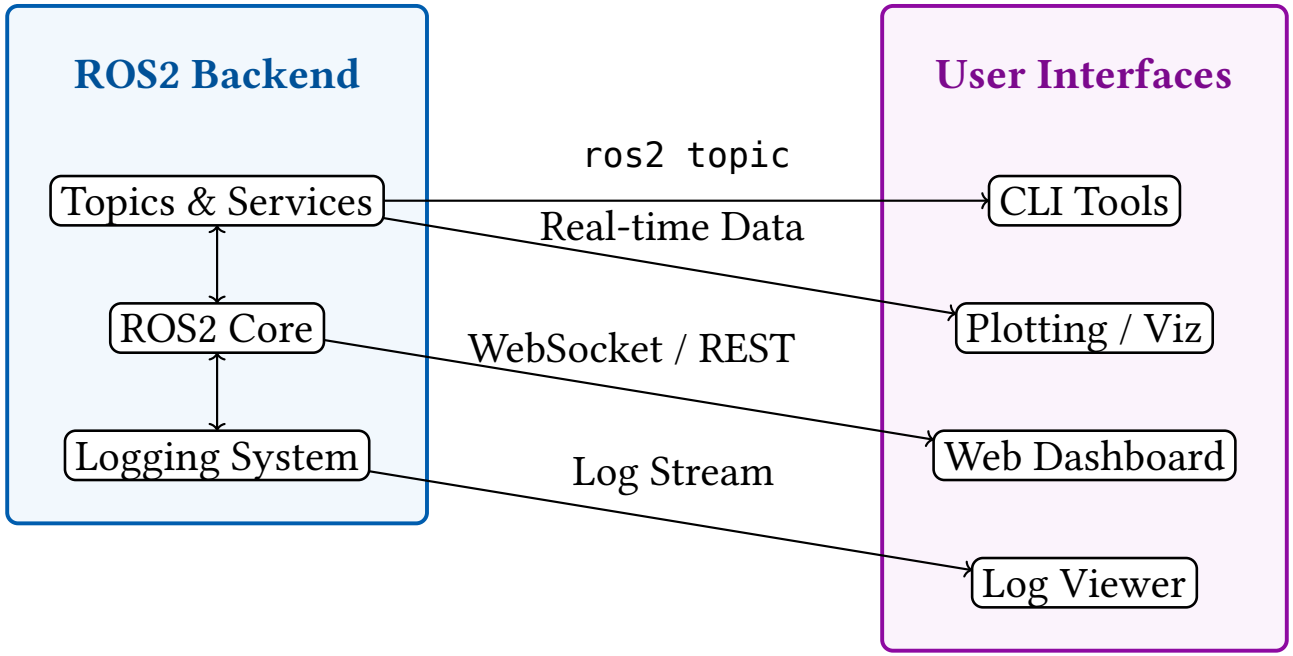

3. Project Progress

3.1 Milestones

#	Milestone	Status
1	Complete integration with DLQR	In Progress
2	Complete integration with QP_MPC	Planned
3	Add tasking layer	Planned
4	Integrate UI	Planned

3.2 Current Sprint

- Laying out the ROS 2 package structure
- Mapping existing hardware topology (Desktop + NJON) to ROS 2 nodes
- Wrapping DLQR functionality into Env and GNC nodes
- Removing ad hoc networking; replacing with ROS 2 topics and services

4. Individual Responsibilities

4.1 Cannon — Project Manager

- Extract final set of C++ header files for shared types
- Coordinate architecture decisions and team schedule
- Oversee integration testing between nodes

4.2 Dylan — SCRUM Master

- Build the ROS 2 component skeleton (package layout, launch files)
- Populate Env Node from `udp_hcw_discrete_txrx` reference code
  - Remove networking layer
  - Replace logging with ROS 2 logging

4.3 Caleb — Backend Developer

- Populate Control Node from `udp_roundtrip_discrete` reference code
  - Remove networking layer
  - Replace logging with ROS 2 logging
- Verify outputs against the original standalone executable