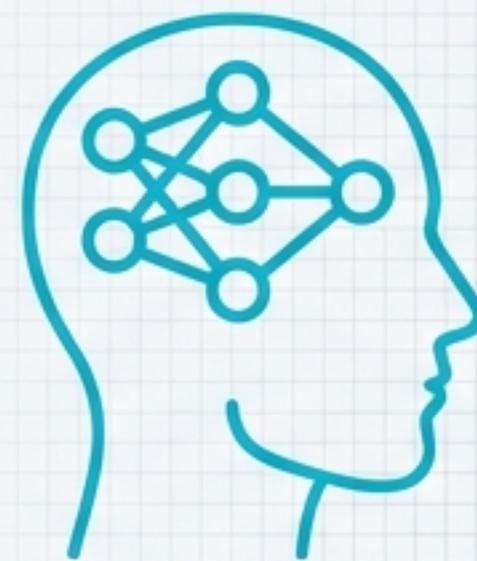
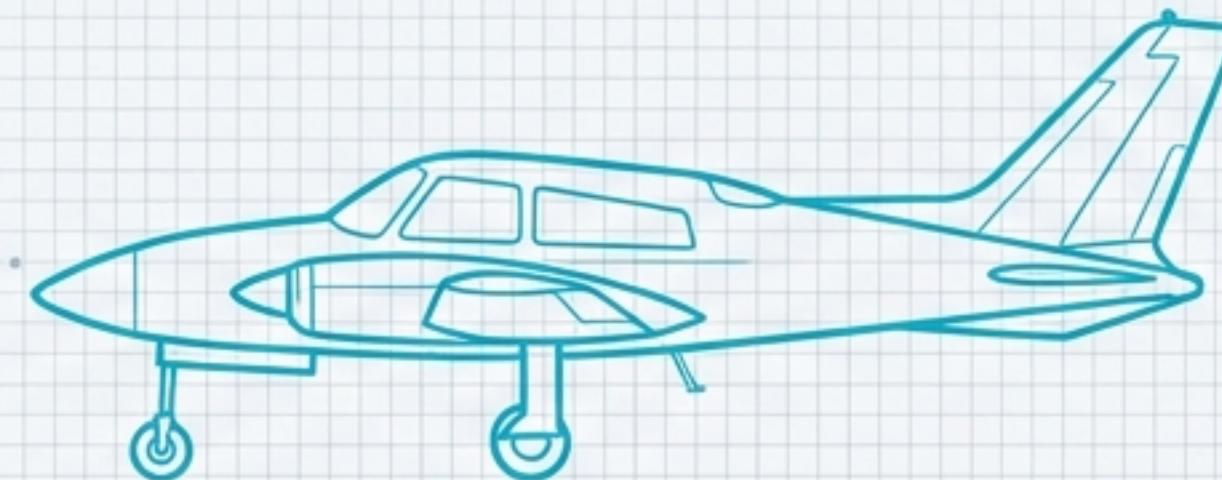


Sprint 2: The AI-SIM-C2 Integration Blueprint



AI-RL



JSBSim



C2 Front-end

Building our first fully operational training and operations pipeline.

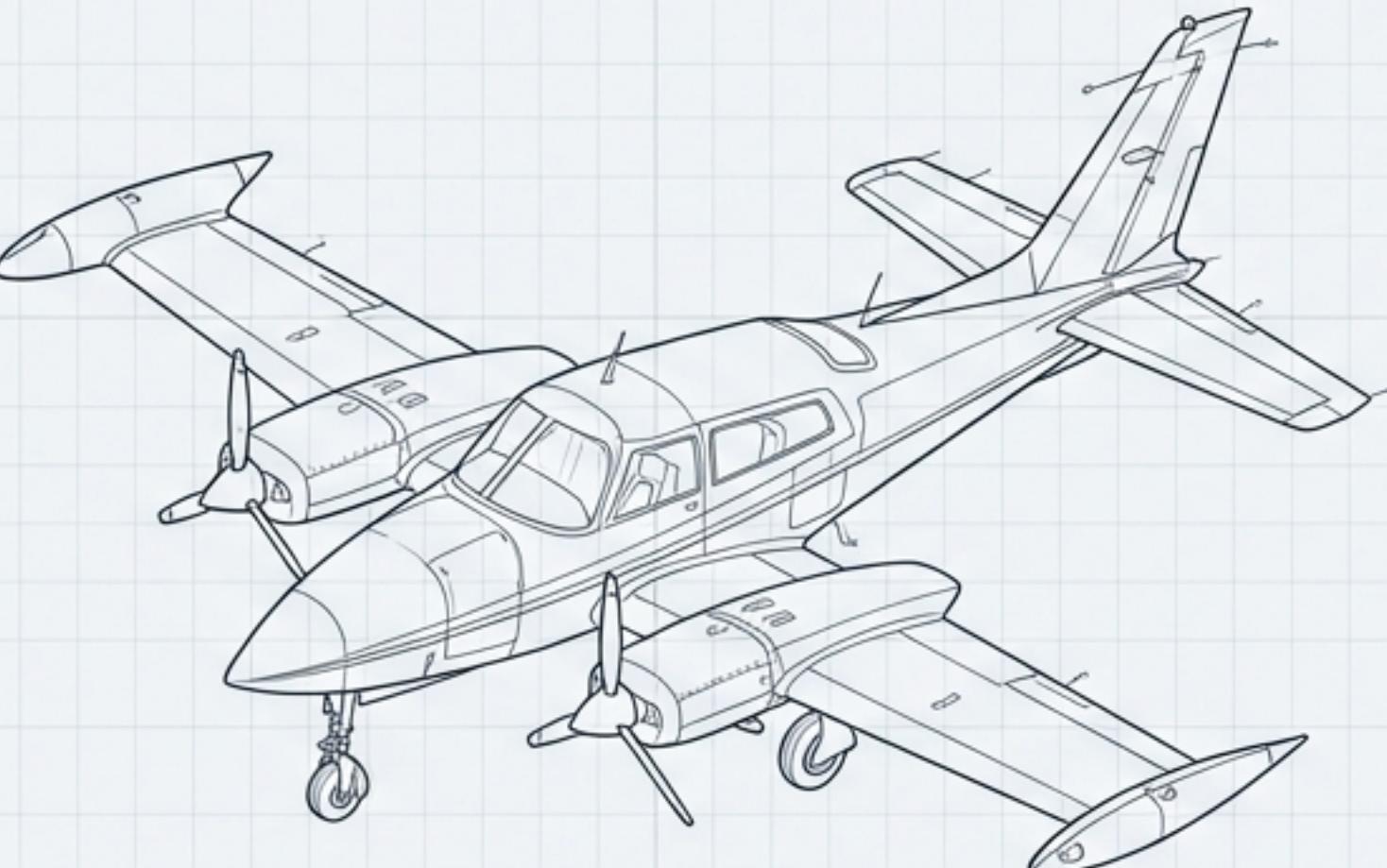
Duration: 3 Weeks | Sprint Type: Research + Systems Integration

Sprint 2 Mission Briefing

Sprint Objective

To deliver the first fully operational AI-Simulation-C2 pipeline: a reinforcement learning agent that successfully flies a **Cessna 310** from point A to point B under competing No-Fly Zone (NFZ) constraints.

Primary Aircraft Model



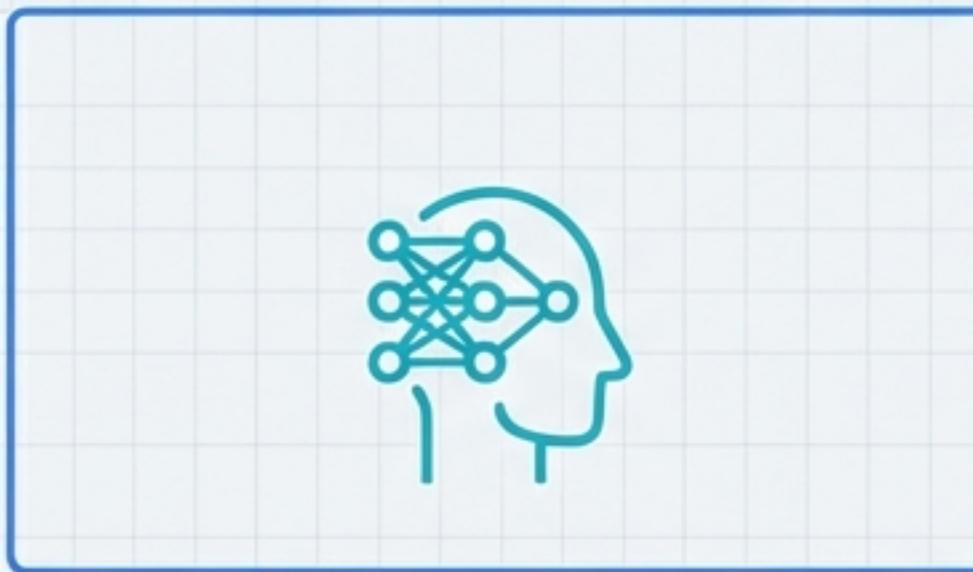
Desired Outcome

A fully integrated system with scenario control and complete mission replayability, providing a stable foundation for multi-agent research.

Cessna 310 (with Cessna 172 as a fallback).

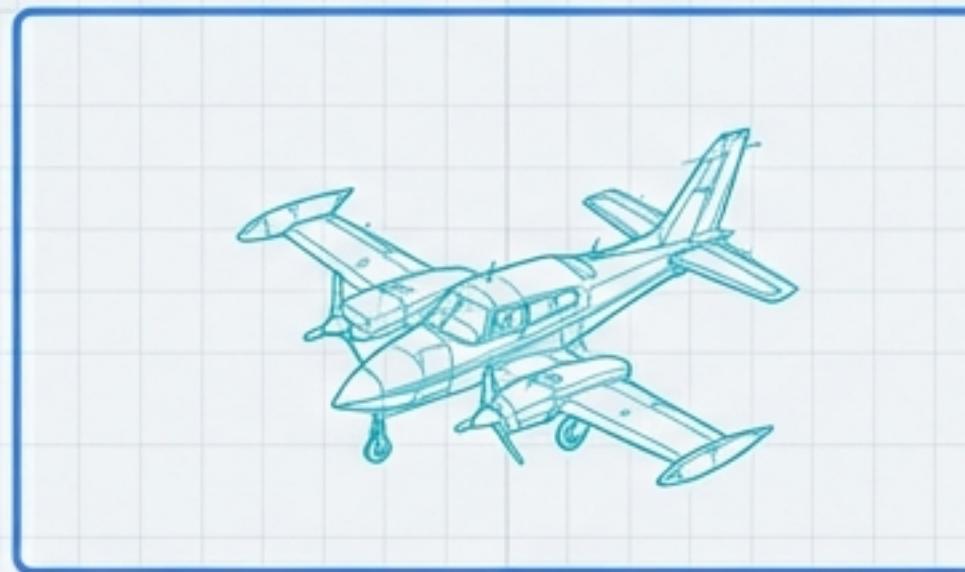
The Blueprint: From Isolated Components to an Integrated System

Following Sprint 1, we have proven capabilities in three key domains. The objective of Sprint 2 is to architect the connections between them, transforming them from separate parts into a single, deterministic pipeline for research and operations.



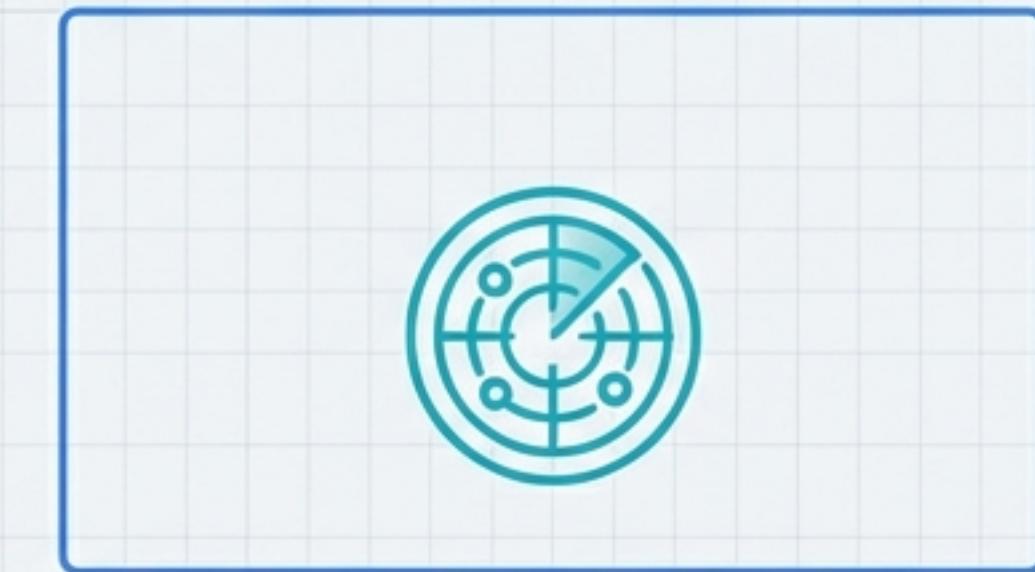
AI-RL Core

Contains the learning agent.



JSBSim Environment

The physics-based flight simulator.



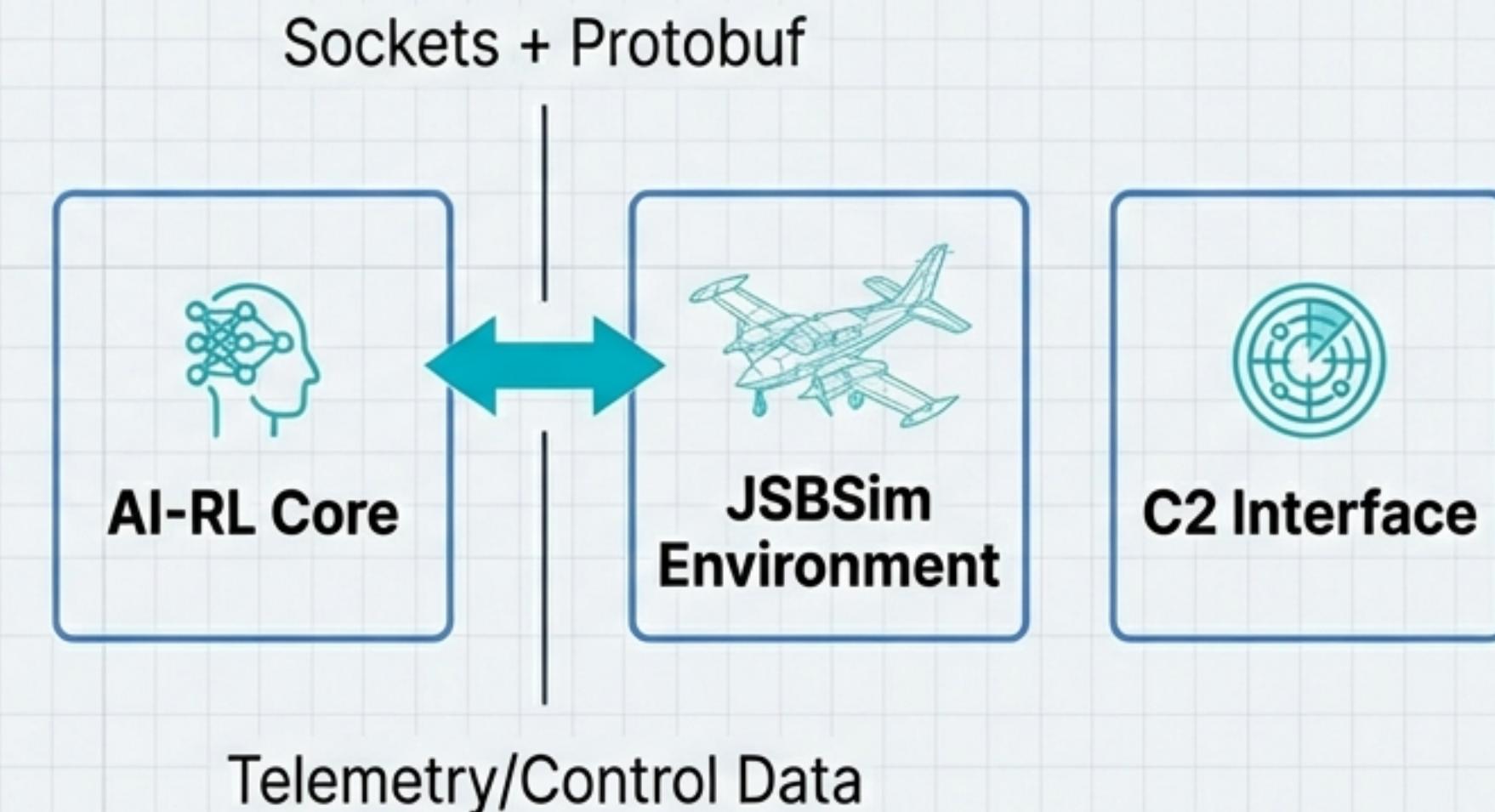
C2 Interface

For scenario control and visualisation.

Focus Area 1: Forging the Link Between Agent and Airframe

SIM \leftrightarrow RL Integration

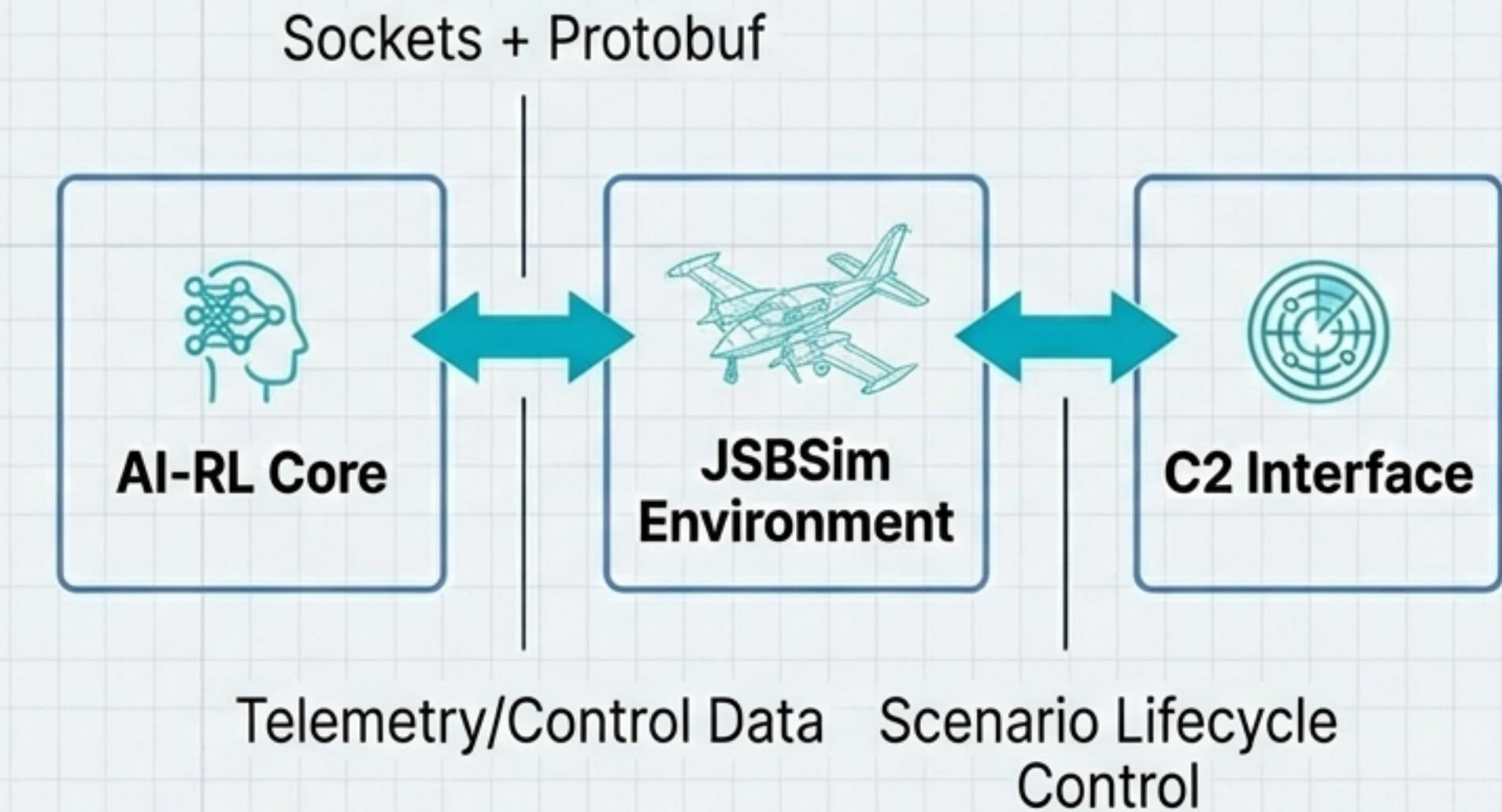
- + Establish a high-throughput, low-latency data channel using **Sockets and Protobuf**.
- + Implement a **deterministic control loop** to ensure reproducible simulation runs.
- + Enable **full telemetry logging** from the simulator to the RL core for training and analysis.



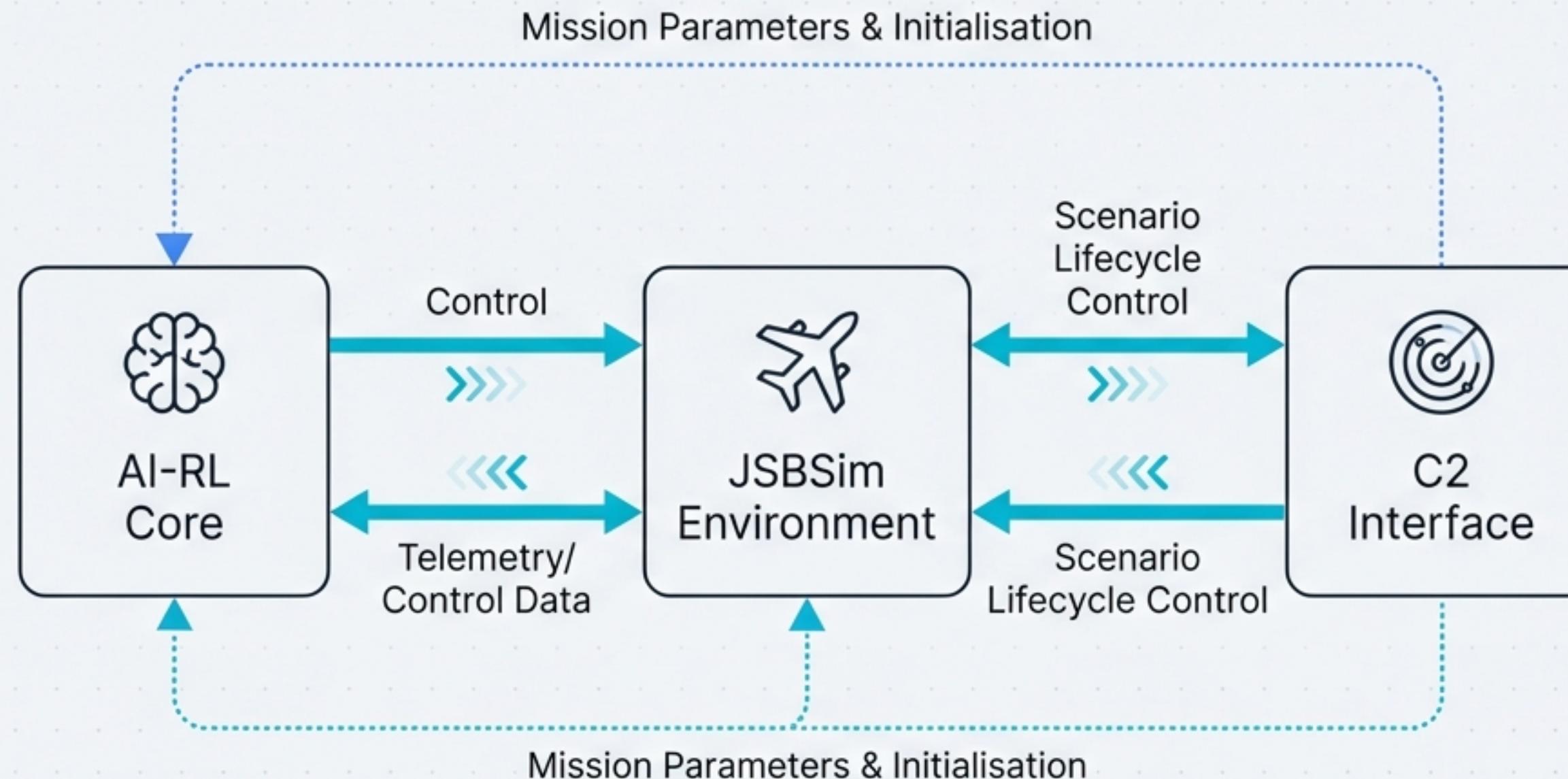
Focus Area 2: Establishing Command & Control

SIM \leftrightarrow C2 Integration

- + Implement **scenario lifecycle control** directly from the C2 front-end.
- + Provide operators with the ability to **Start, Stop, Reset, and Replay** any mission scenario on demand.



The Result: A Fully Integrated Operational Pipeline



By connecting these three components, we create a seamless flow of data and control. The agent's decisions influence the simulation, the simulation's state is fed back to the agent and visualised in the C2, and the C2 controls the entire scenario.

The Core Mission: Navigating Complex Constraints

Training a Converging RL Agent in the Cessna 310

Mission Profile

Objective

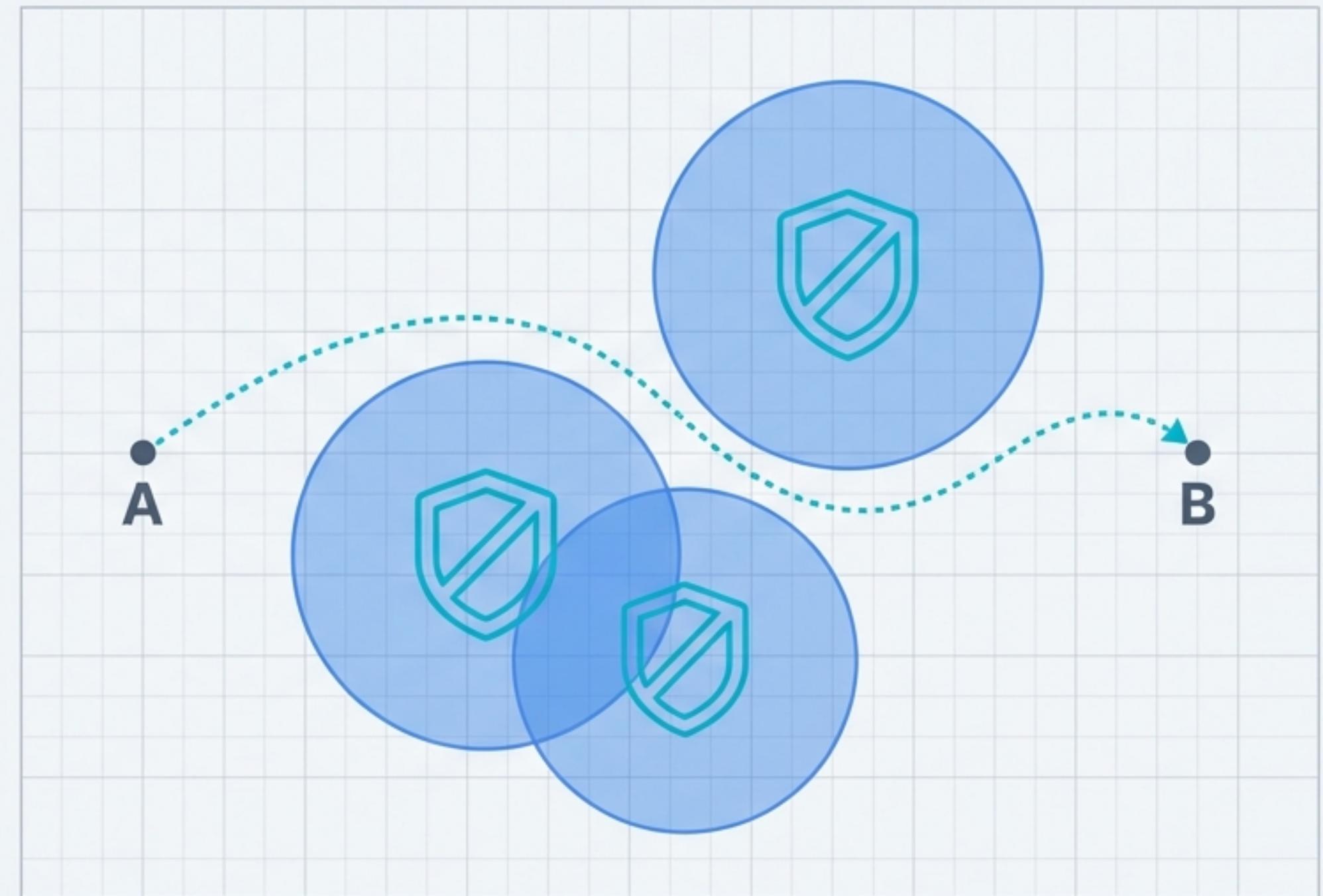
Pilot the aircraft between two distinct geospatial points (A → B).

Primary Constraint

Actively avoid multiple, competing No-Fly Zones (NFZs).

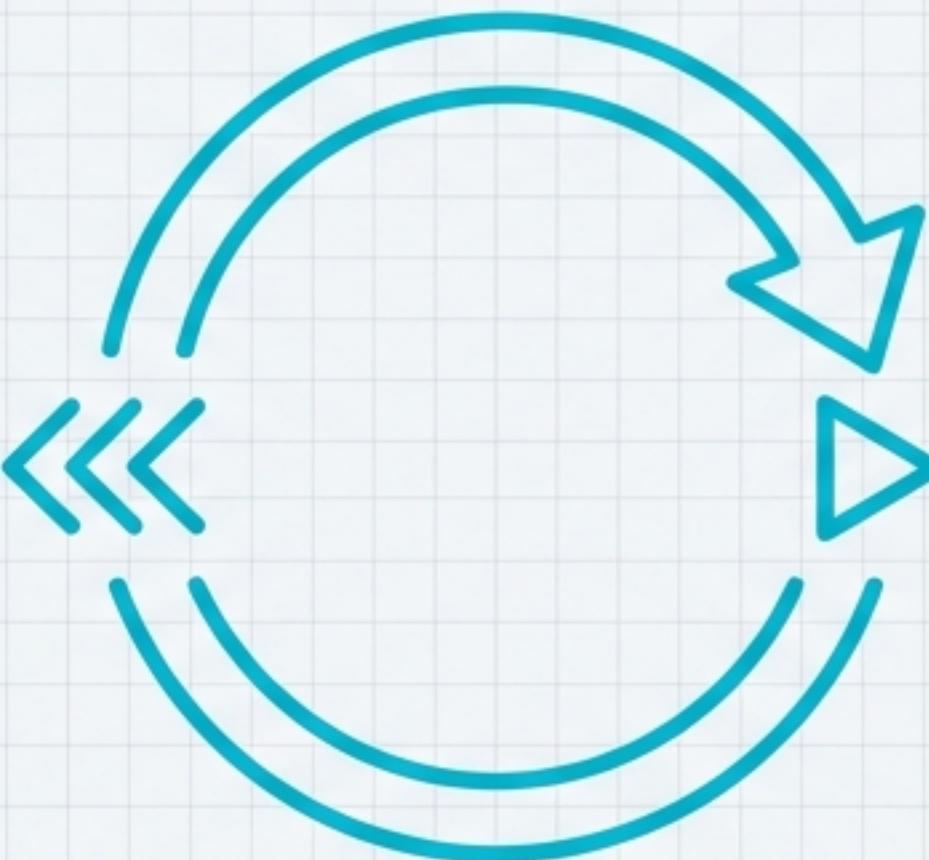
Outcome

The agent must find a convergent policy that reliably completes the mission while satisfying all constraints.



Ensuring Mission Integrity: Determinism & Full Replayability

Foundational Architectural Principles



For our research to be valid, every action and outcome must be fully reproducible. This sprint establishes a system where any mission can be logged, saved, and replayed with perfect fidelity, enabling deep analysis and validation.

 **Determinism:** Identical inputs produce identical outputs.

 **Reproducibility:** Any training run or mission can be recreated perfectly.

 **Clean Separation of Components:** Each system is modular and independent.

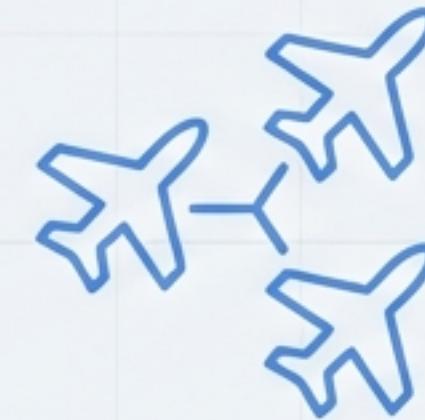
Building the Foundation for Future Capability

This integration is not just an end in itself. It provides the essential tooling and frameworks required for our next phase of research.



Training & Dataset Framework

We will formalise the entire training and validation pipeline. This creates a robust "engine" for generating, testing, and comparing agent policies.



Multi-Plane Research Kickoff

The architecture is explicitly designed for expansion. This sprint lays the groundwork for multi-aircraft learning and coordination experiments.

Sprint 2 Mission Success Checklist



RL Agent Performance: The agent consistently completes the A → B mission while avoiding all NFZs in the Cessna 310.



End-to-End Integration: The full AI ↔ SIM ↔ C2 pipeline is operational and stable.



Full Replayability: Complete scenario replay support is implemented and verified.

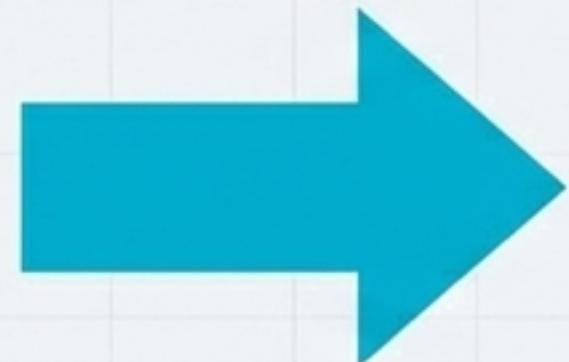


Architectural Stability: The final architecture is stable and documented, ready for multi-agent expansion.

The Impact: From a Single Agent to a System of Systems

Completing Sprint 2 delivers more than an integrated pipeline. It provides the stable, reproducible research platform that is the non-negotiable prerequisite for tackling our ultimate goal: coordinating intelligent multi-agent systems.

This Sprint



Next Horizon

