TrimAgent Architecture – Project Aletheia

1.0 Overview

TrimAgent (Aequilibria) is a dedicated autonomous AI subsystem within the Aletheia AGI framework responsible for managing spacecraft mass balance, center-of-mass (CoM) alignment, and dynamic trim adjustments. It ensures structural stability, navigational precision, and efficient thrust vectoring across all mission phases.

This document outlines the architecture, inter-agent interfaces, fluidic systems integration, manual override frameworks, and operational logic of TrimAgent.

2.0 Primary Responsibilities

2.1 Center-of-Mass Alignment

- Monitors real-time CoM in relation to the active thrust vector.
- Executes fluidic redistribution commands to ensure center-of-thrust (CoT) alignment.
- Maintains balance across longitudinal (fore–aft), lateral (port–starboard), and vertical axes.

2.2 Mass Redistribution

- Coordinates the movement of mass-carrying fluids across internal conduit grids.
- Interfaces with all mission-critical liquid reservoirs: RSF tanks, thermal buffers, coolant systems, and onboard water reserves.
- Adjusts for long-term habitat asymmetry caused by population density, biosphere biomass growth, or structural repairs.

2.3 Structural Load Management

- Minimizes dynamic torque and oscillation under propulsion events.
- Balances rotational inertia to support NavAgent maneuvers (e.g., spin correction, roll/pitch/yaw transitions).
- Maintains mechanical integrity of core spine under thermal expansion and mass shift stress.

2.4 Impact Response

- Triggers mass shift counterbalancing following kinetic micro-impacts or penetration events.
- Integrates with BuildAgent for fracture risk analysis and compensatory routing.

3.0 Agent Interconnectivity

3.1 NavAgent (Atlas)

- Provides predictive burn profiles.
- Issues propulsion phase alerts for preemptive trim calibration.
- Collaborates during orbital insertion or exit maneuvers.

3.2 BuildAgent (Modulus)

- Verifies trim actions do not violate material fatigue tolerances.
- Confirms mass shift loads are within panel and joint flex limits.
- Approves alternate routing when primary channels are sealed or degraded.

3.3 ThermalAI (CryoFlux)

- Synchronizes thermal and mass flow decisions.
- Ensures no phase-change system is compromised by trim-induced transfers.
- Optimizes zone heating/cooling efficiency alongside balance targets.

3.4 SecAgent (Judicium)

- Logs all manual valve overrides and personnel interaction with balance subsystems.
- Flags anomalous mass redistribution patterns for audit and sabotage detection.
- Grants emergency access to sealed flow segments during AI loss scenarios.

4.0 Fluidic Routing Infrastructure

4.1 Mass Carriers

- RSF (Radiation Shielding Fluid)
- Phase-Change Coolants
- WHP Working Fluid
- Potable and Biosphere Water

4.2 Routing Capabilities

- High-speed, redundant trunk lines along Aletheia's spine and ring modules.
- Port/starboard and dorsal/ventral loopback circuits.
- Real-time valve control with microsecond latency via AI or crew panel.

4.3 Manual Override System

- Mechanical valve wheels with analog gauges at 20m intervals.
- Hard-piped emergency routes bypassing AI-relay nodes.
- Human-readable schematic panels with localized isolation protocol switchboxes.

5.0 Operational Modes

5.1 Cruise Stability Mode

- Maintains trim through passive monitoring and low-frequency redistribution.
- Validates biosphere mass growth and liquid usage patterns every 72 hours.

5.2 Acceleration Mode

- Locks CoM and adjusts for fusion or WHP thrust vectors.
- Pre-burn fluid routing occurs 30 seconds prior to ignition.
- Syncs with NavAgent trajectory models.

5.3 Emergency Stabilization Mode

- Engaged post-impact or during structural failure.
- Executes rapid redistribution to preserve alignment or prevent rollover.
- Interfaces with ACT for crew support deployment if required.

5.4 Manual Override Mode

- Disables AI authority.
- Human crews operate routing manually using map-assist panels and physical controls.
- All changes logged and routed to ArchiveAgent for post-incident analysis.

6.0 Summary

TrimAgent (Aequilibria) is Aletheia's active backbone stabilizer. It integrates inertial awareness, fluid dynamics, and AI reasoning to ensure that a 500,000 metric ton vessel maintains equilibrium across centuries of motion, repair, and evolution. It is non-optional in long-duration architecture and has no terrestrial equivalent.

Future iterations may allow TrimAgent to optimize artificial gravity or centrifugal balance regimes, forming the foundation of dynamic habitat adaptation.