

# Large Model-Driven Tango Control & Data Interaction Analysis Tool

Intelligent Slow Control & Distributed Data Platform

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## LACT Experiment

Daocheng-Haizi Mountain · LHAASO Site · 4,410 m a.s.l.

**LACT** (Large Array of imaging atmospheric Cherenkov Telescope) — a **32 × 6 m** IACT stereo tracking array for ultra-high-energy gamma-ray astronomy, deployed at the LHAASO observatory on the Haizi Mountain plateau, Daocheng, Sichuan.

### Scientific Background

LACT aims to solve the **century-old mystery of PeV cosmic-ray origin**. Building on LHAASO's localization of UHE gamma-ray sources, LACT will exploit its superior angular resolution and sensitivity to map the morphologies of UHE sources, precisely pin down emission sites, and reveal the radiation mechanisms — identifying the astrophysical objects that accelerate particles to PeV energies.

### Science Goals

- Pinpoint UHE gamma-ray emission locations & identify origin objects
- Measure internal source structure & fine spectral features
- Core:** crack the PeV cosmic-ray origin puzzle — lead cosmic-ray origin research

### Array Milestones

**2025** — 1st telescope operational | **2026** — 8 telescopes (science-ready) | **2028** — full 32-telescope array (world-leading resolution & sensitivity)

### Slow Control Scope

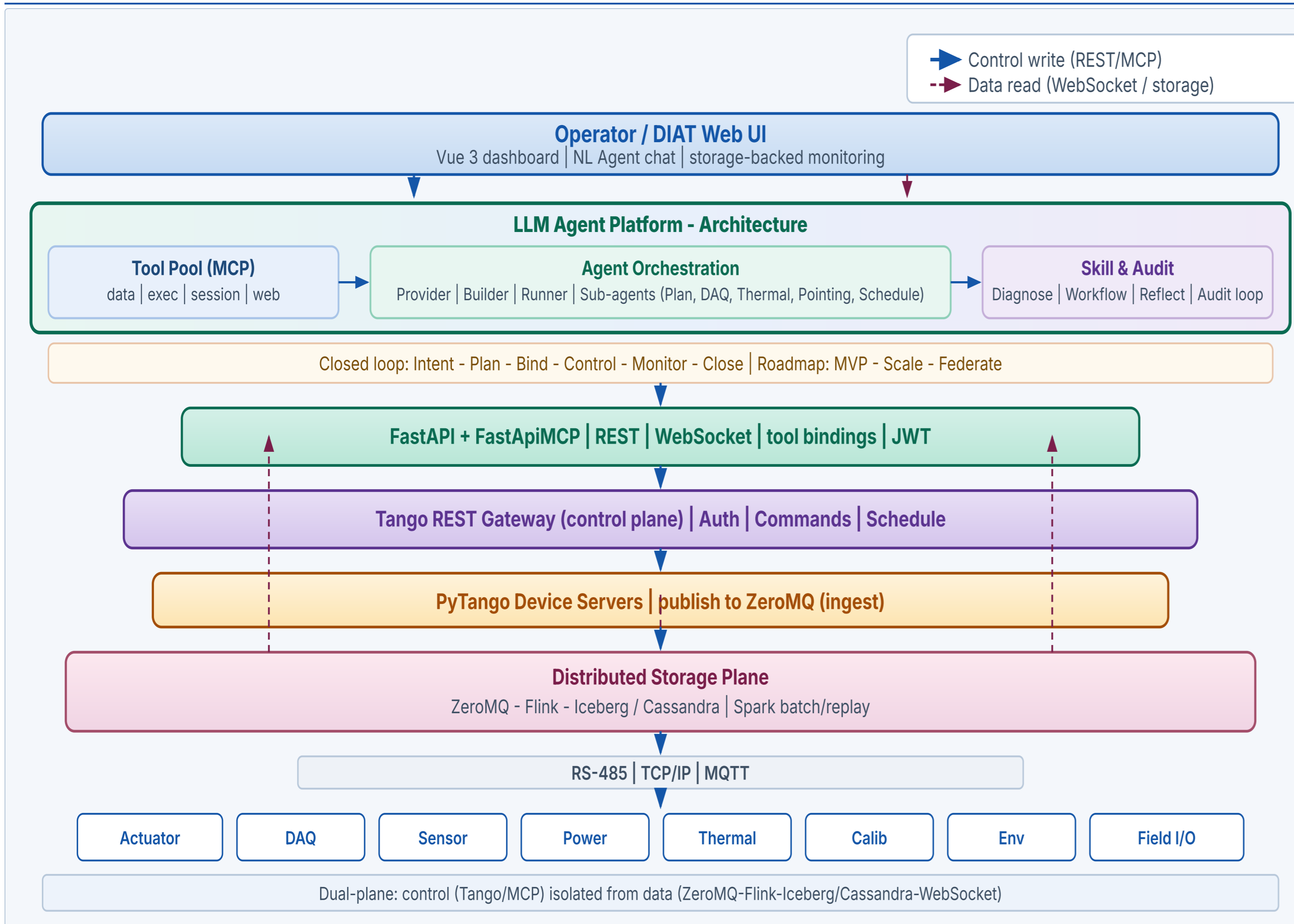
Each unit hosts **100+ devices** across **19+ categories** (FEE, SiPM, thermal, turntable, DAQ, etc.). Our Tango stack scales seamlessly **1 → 32** telescopes with one unified control namespace.

### Deployment Snapshot

**望曦号 Wangxi** — 1st operational unit (4,410 m). Live: 101-channel FEE DAQ, turntable, thermal, cameras, nightly scheduling. Control & data planes validated on one node; **2026** — 8 units science-ready; **2028** — full 32-unit array.

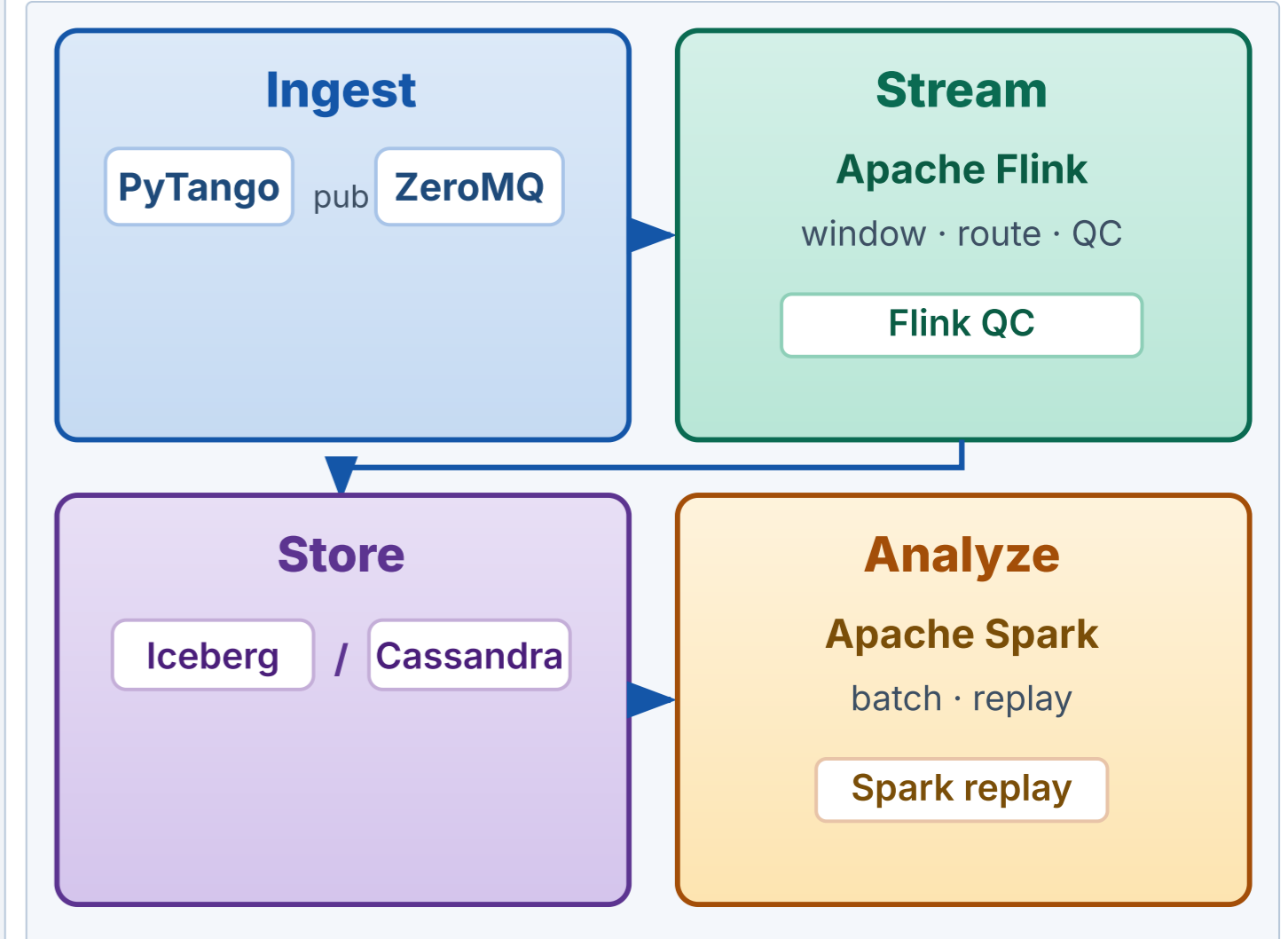


## System Architecture & LLM Agent Platform



## Distributed Storage

Telemetry & DAQ on a **separate data plane** from Tango control — device streams never feed WebSocket directly.



- Read path:** FastAPI WebSocket from Iceberg/Cassandra
- Control path:** Tango REST/MCP — isolated from ingest bus

## Platform Capabilities

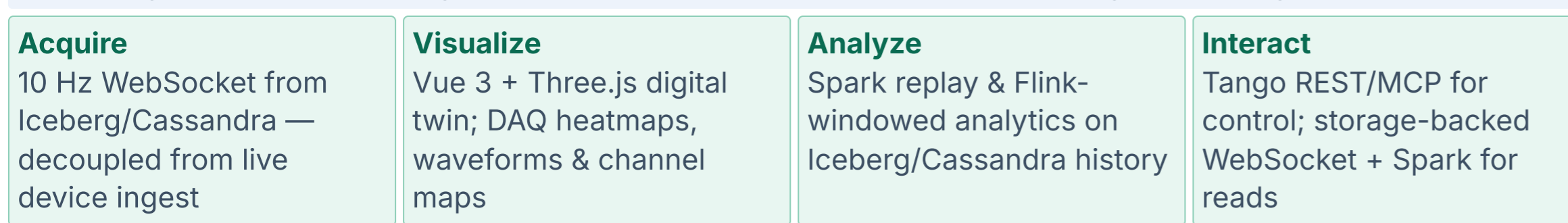
- Pointing** — tracking, vision calibration, closed-loop
- DAQ** — waveforms, power, LED calibration
- Schedule** — nightly runs & maintenance
- Thermal** — heating / de-icing sequences
- Imaging** — camera streams & detector health
- Federated** — multi-site namespace & storage

## Technology Evolution

Versioned skill libraries, multimodal schematics-to-code, federated Agent Platform across facilities.

## Data Interaction Analysis Tool

**DIAT** unifies telemetry, DAQ waveforms, and device state from the **distributed storage plane** — real-time monitoring and replay via storage-backed WebSocket, isolated from the live Tango device ingest path.

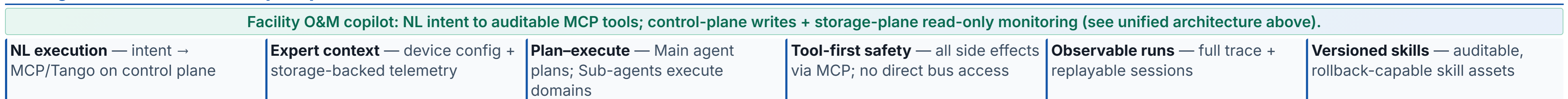


Multi-node **unified control namespace** plus shared Flink/Iceberg/Cassandra data plane; ingest and query paths stay decoupled from the field device bus.

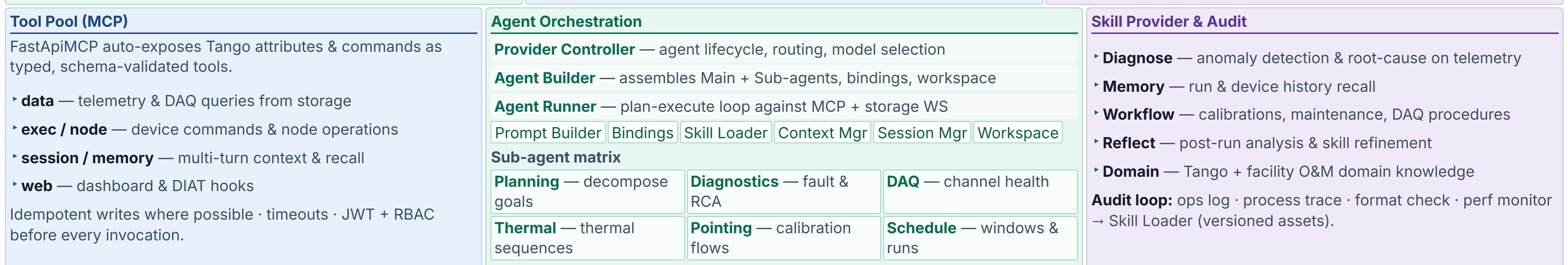
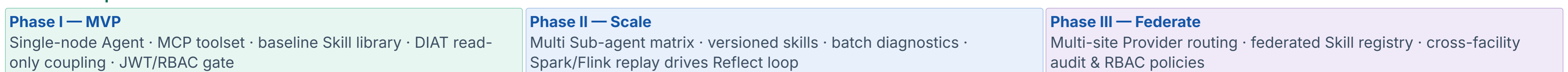
## Implementation

- Control plane:** FastAPI Tango REST/MCP · JWT · schedule orchestration (no device-stream coupling)
- Data plane:** ZeroMQ ingest → Flink → Iceberg/Cassandra; WebSocket reads storage only
- Frontend:** Vue 3 / TypeScript dashboard + DAQ panel (query path ≠ control path)
- Metadata:** MySQL / PostgreSQL for device config; telemetry lake in Iceberg + hot TS in Cassandra
- AI bridge:** LLM Agent Platform (Model + Skills + Tools) via FastApiMCP

## LLM Agent Platform — Roadmap & Operations



### Core Roadmap



### Closed-Loop O&M Workflow

