Local AI-Powered Network Assistant

Architectural Implementation using Ollama, Python, and Juniper Junos MCP

NEURAL NETWORK
(OLLAMA)

NETWORK ROUTER
(JUNIPER JUNOS)

MCP BRIDGE
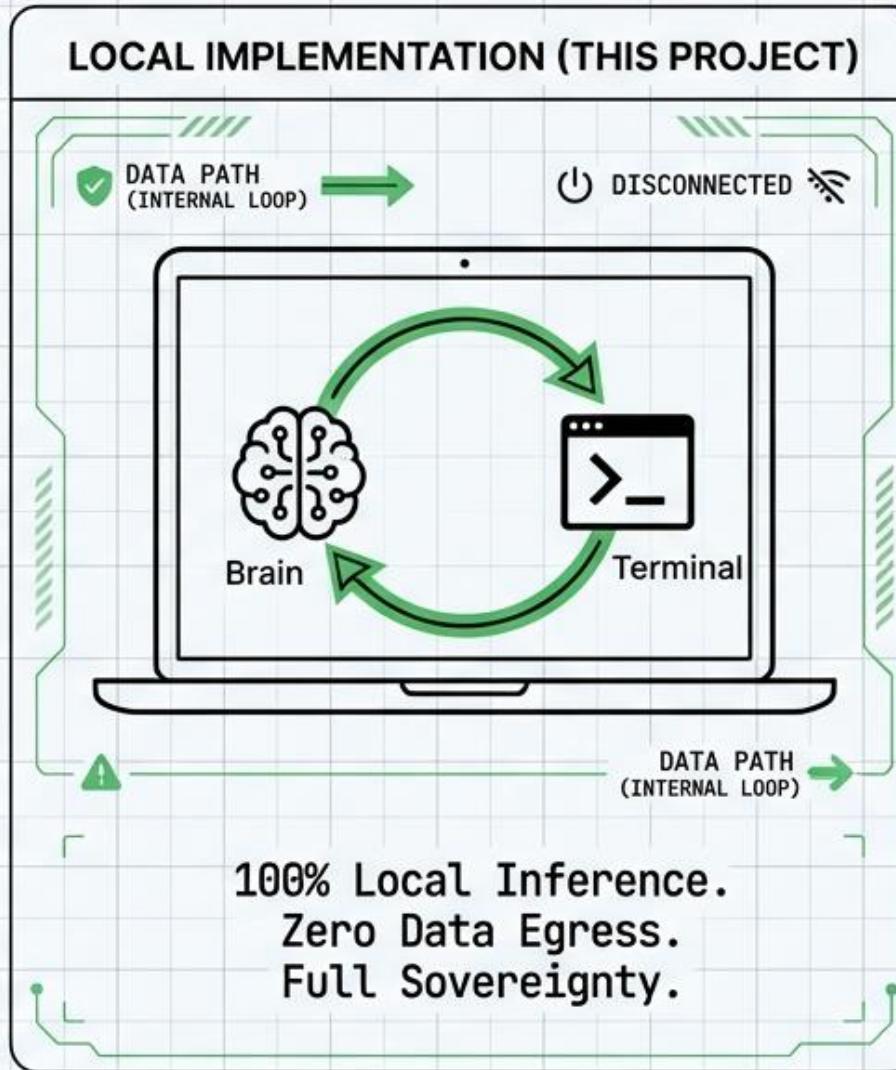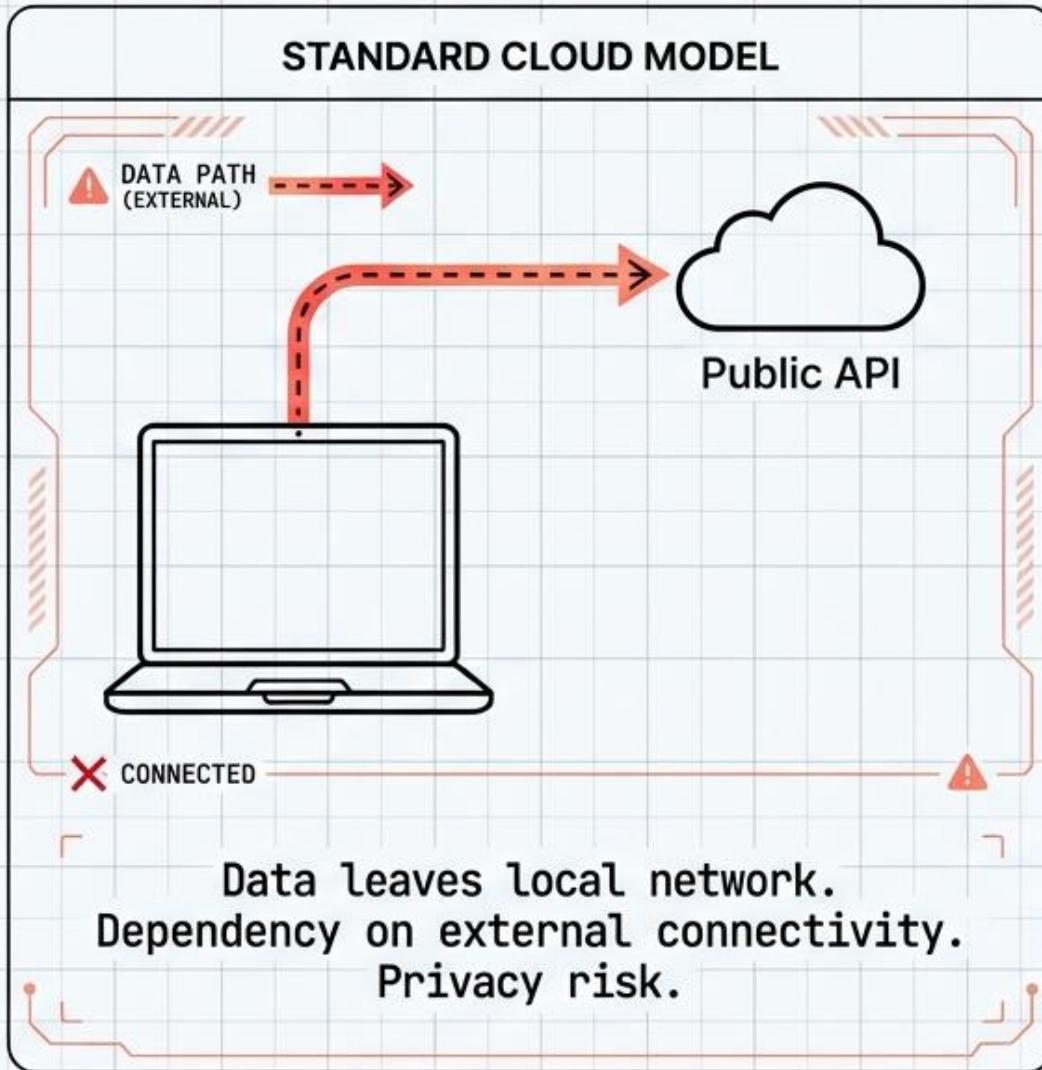
LLM CORE

vMX INFRASTRUCTURE

PLATFORM: macOS (Apple Silicon)
PROTOCOL: Model Context Protocol (MCP)
TARGET: Juniper vMX Infrastructure
AUTHOR: Senior Network Architect

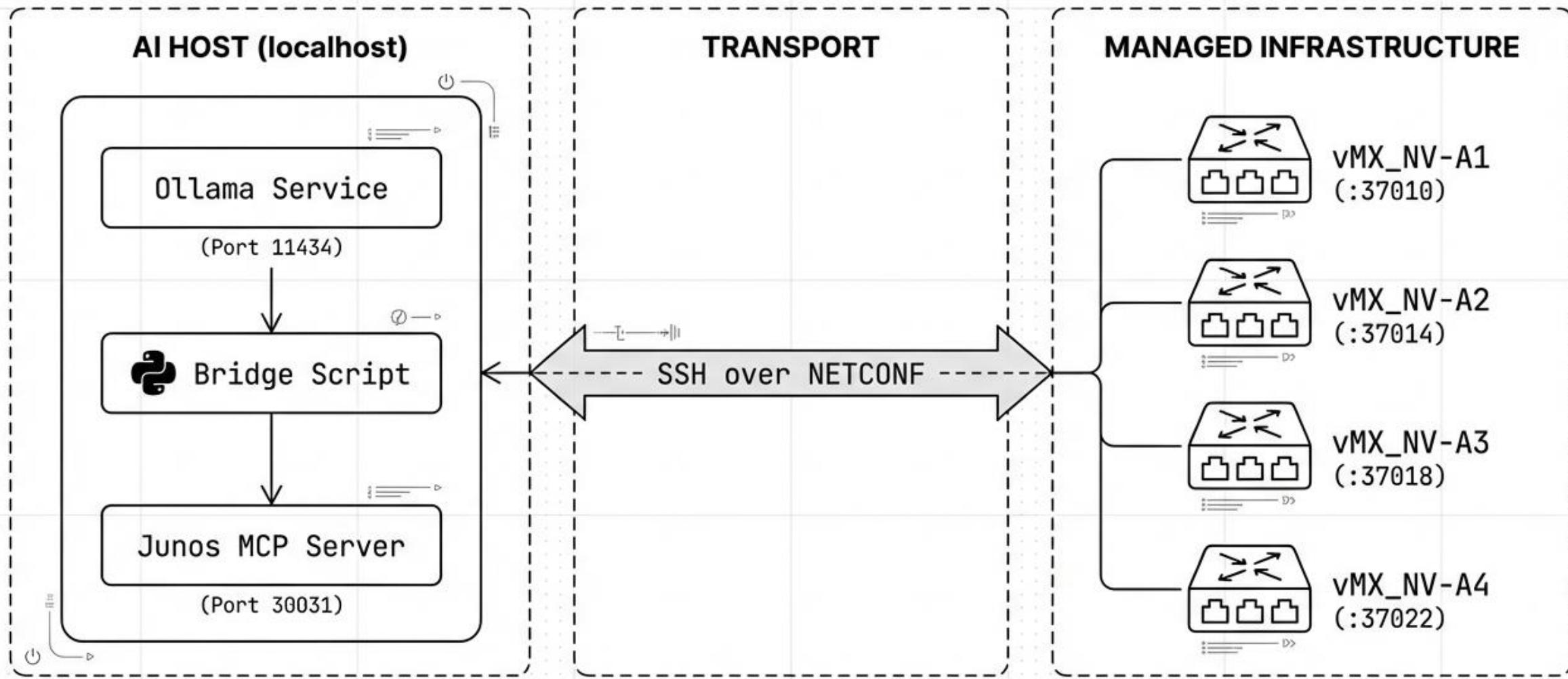# System Objective: Zero-Egress Network Operations

STANDARD CLOUD MODEL

⚠ DATA PATH (EXTERNAL)

Public API

✕ CONNECTED ⚠

Data leaves local network.
Dependency on external connectivity.
Privacy risk.

LOCAL IMPLEMENTATION (THIS PROJECT)

✓ DATA PATH (INTERNAL LOOP)   ⏻ DISCONNECTED 📶

Brain   Terminal

⚠   DATA PATH (INTERNAL LOOP) →

100% Local Inference.
Zero Data Egress.
Full Sovereignty.

Key Constraint Data Block

HOST HARDWARE:
MacBook Pro
M3 Pro
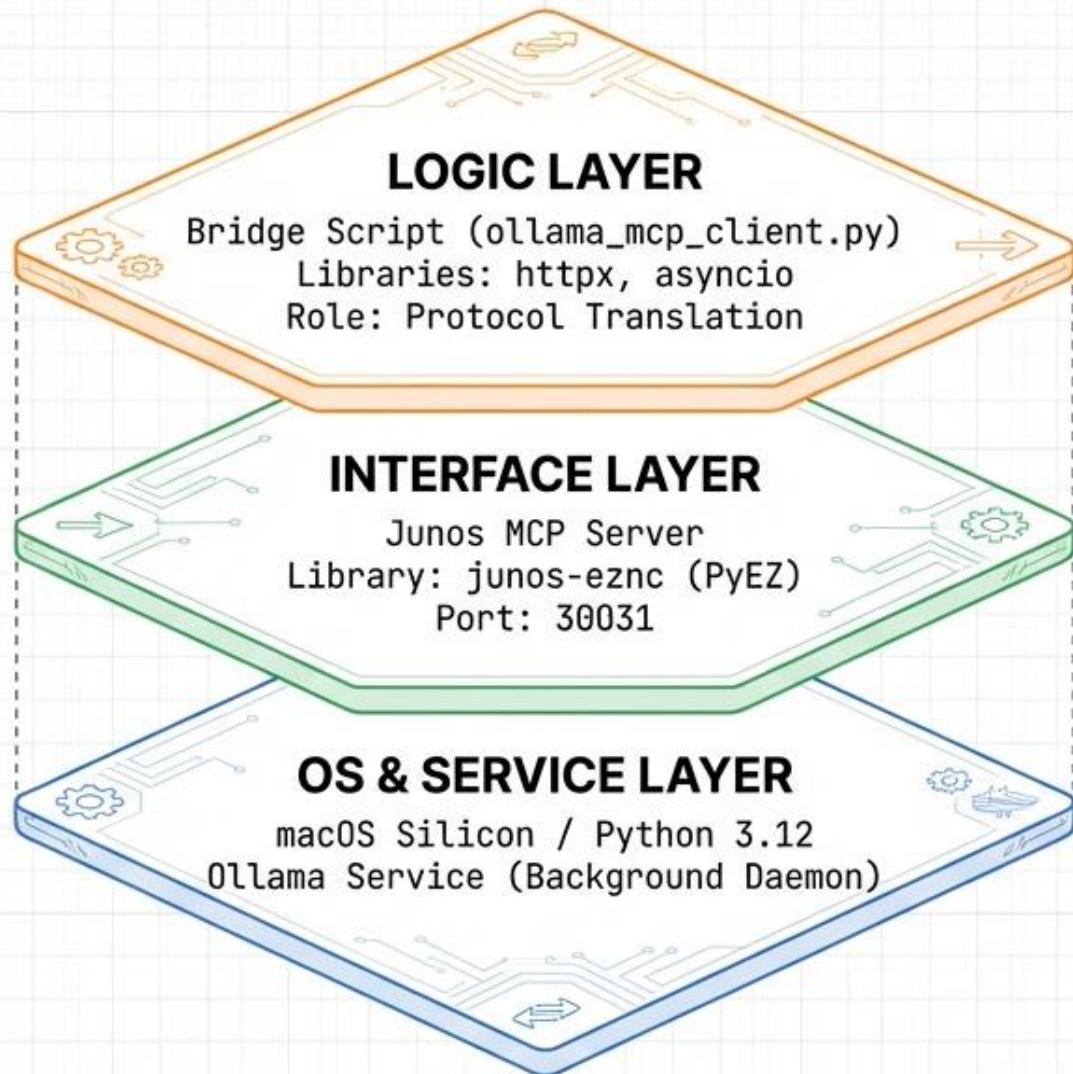
MODEL:
llama3.1:8b
(4.9GB RAM)

SCOPE:
Localhost
Loopback Only
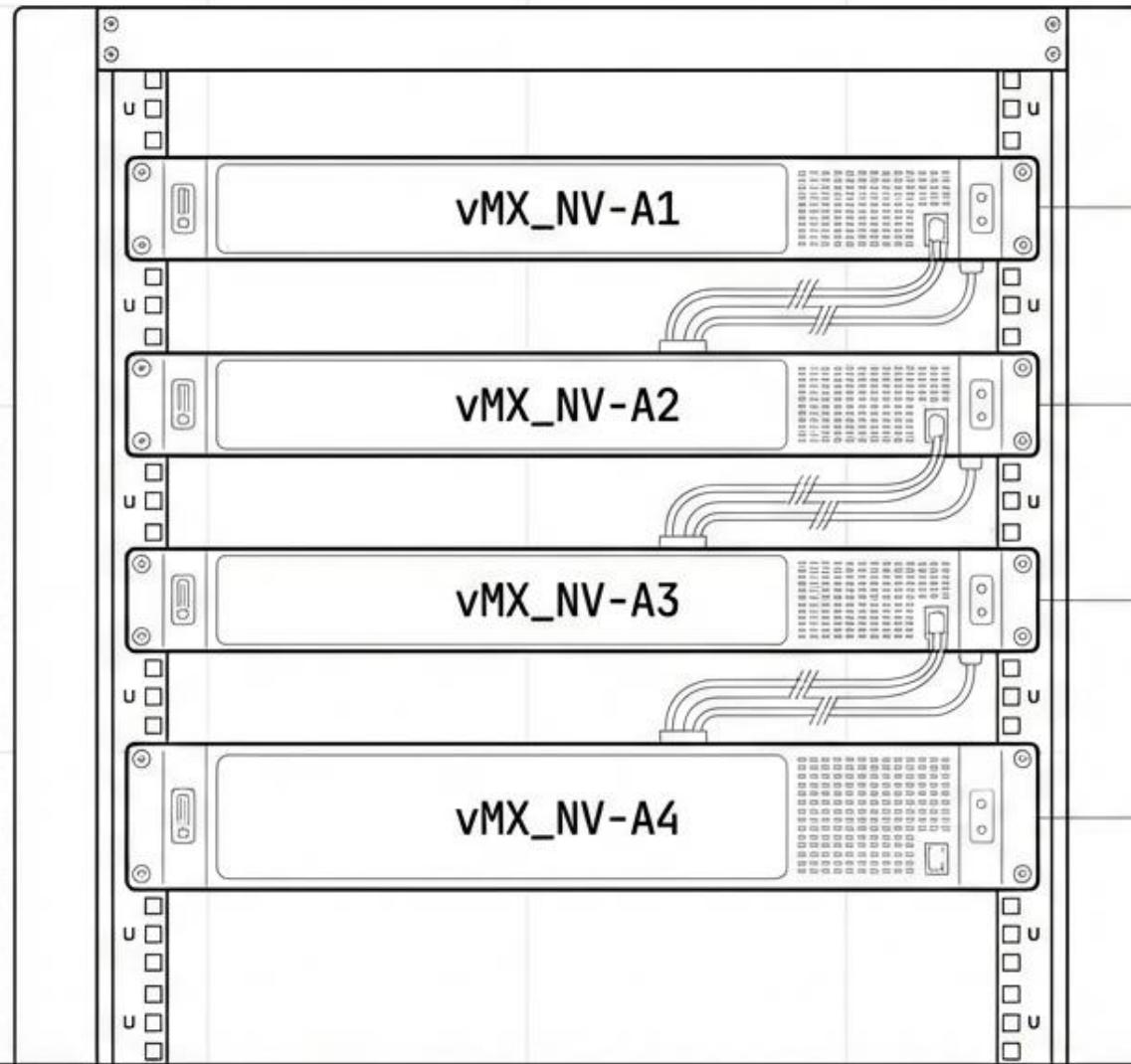
Logical Topology: The Localhost Ecosystem

AI HOST (localhost)

Ollama Service

(Port 11434)

↓

Bridge Script

↓

Junos MCP Server

(Port 30031)

TRANSPORT

◄─── SSH over NETCONF ───►

MANAGED INFRASTRUCTURE

vMX_NV-A1
(:37010)

vMX_NV-A2
(:37014)

vMX_NV-A3
(:37018)

vMX_NV-A4
(:37022)

Software Stack: The Local Runtime

LOGIC LAYER
Bridge Script (ollama_mcp_client.py)
Libraries: httpx, asyncio
Role: Protocol Translation

INTERFACE LAYER
Junos MCP Server
Library: junos-eznc (PyEZ)
Port: 30031

OS & SERVICE LAYER
macOS Silicon / Python 3.12
Ollama Service (Background Daemon)

Target Infrastructure: Managed Device Inventory

vMX_NV-A1
IP: 66.129.234.205
Port: 37010
Status: ONLINE

vMX_NV-A2
IP: 66.129.234.205
Port: 37014
Status: ONLINE

vMX_NV-A3
IP: 66.129.234.205
Port: 37018
Status: ONLINE

vMX_NV-A4
IP: 66.129.234.205
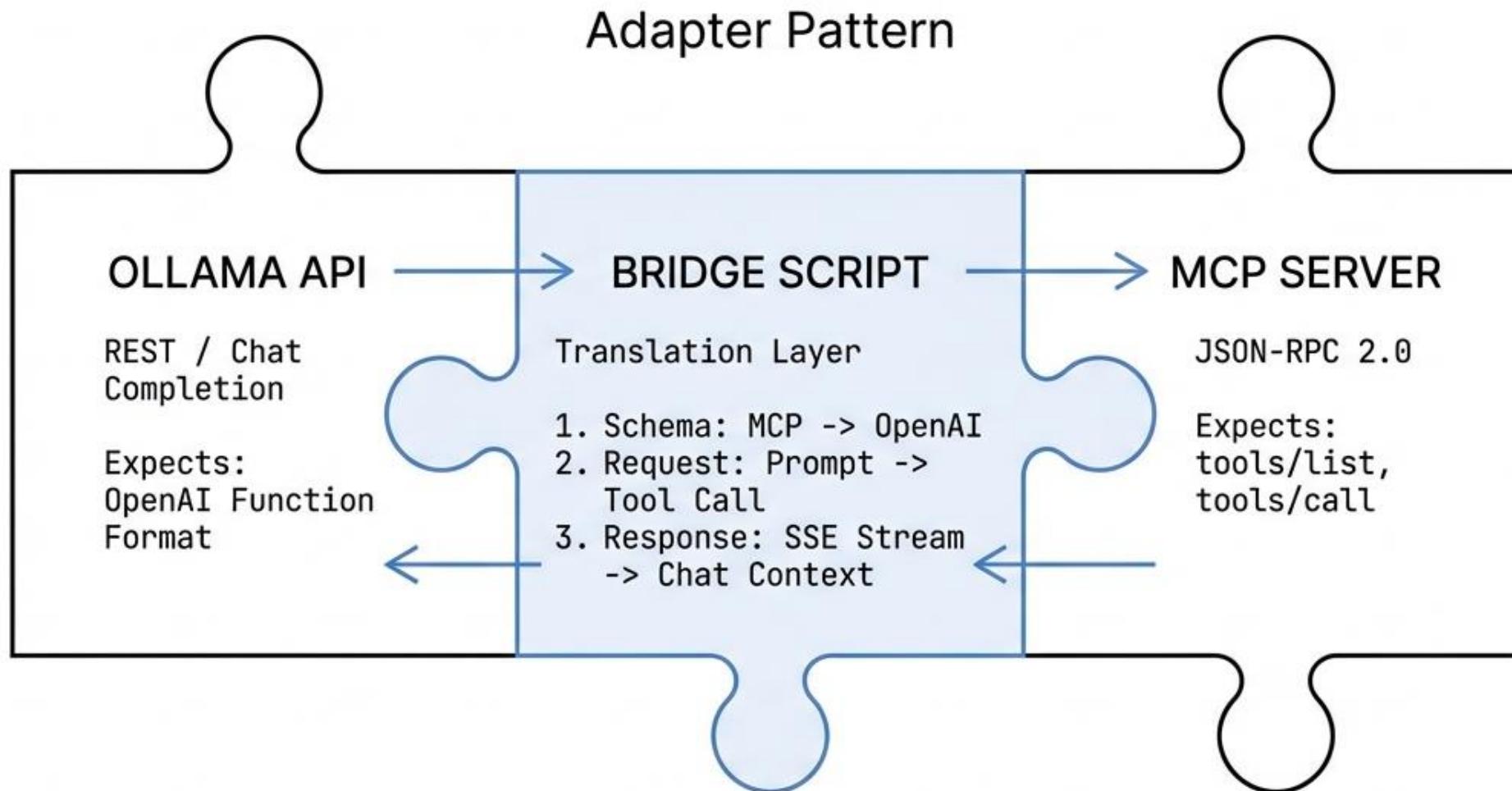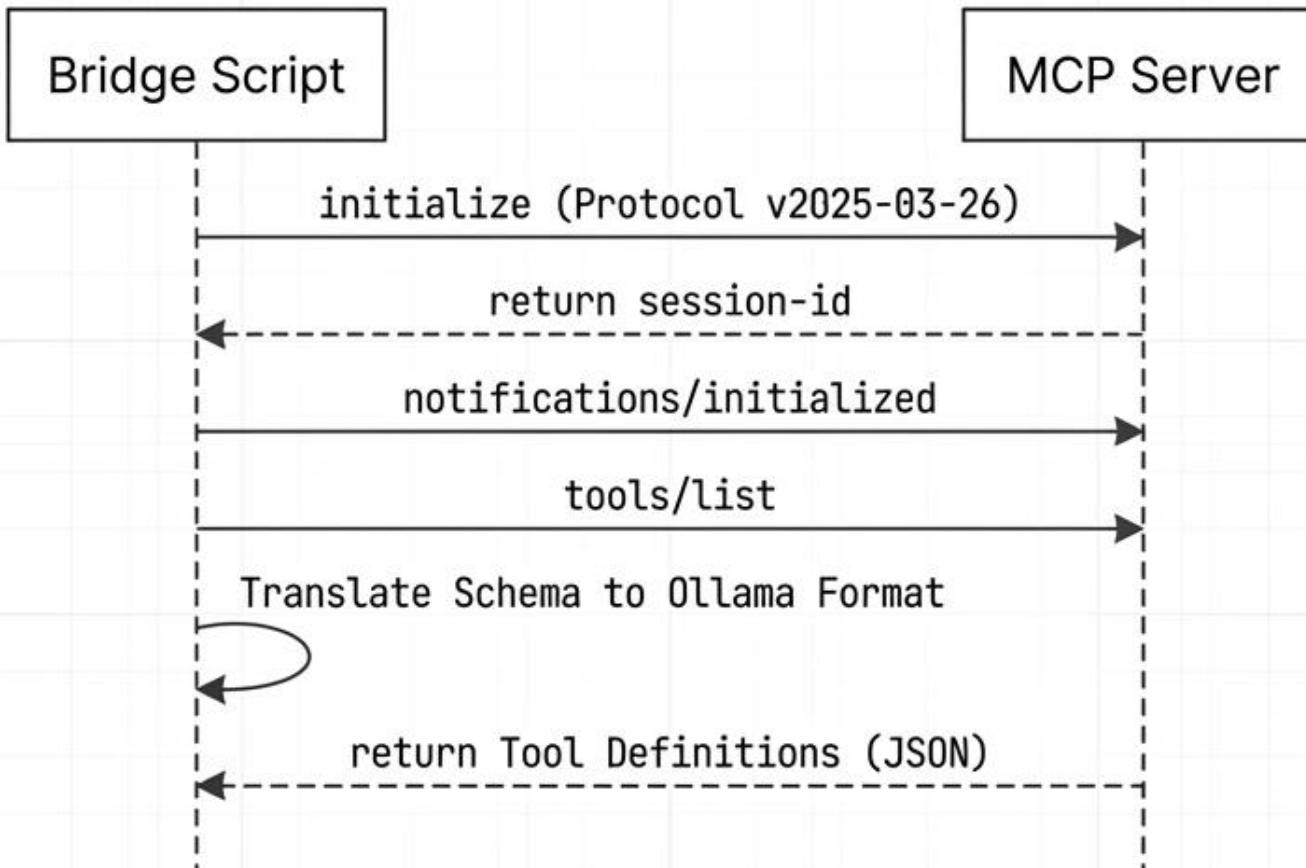Port: 37022
Status: ONLINE

AUTHENTICATION

User: jcluser
Method: Password / SSH Key
OS: Juniper Junos
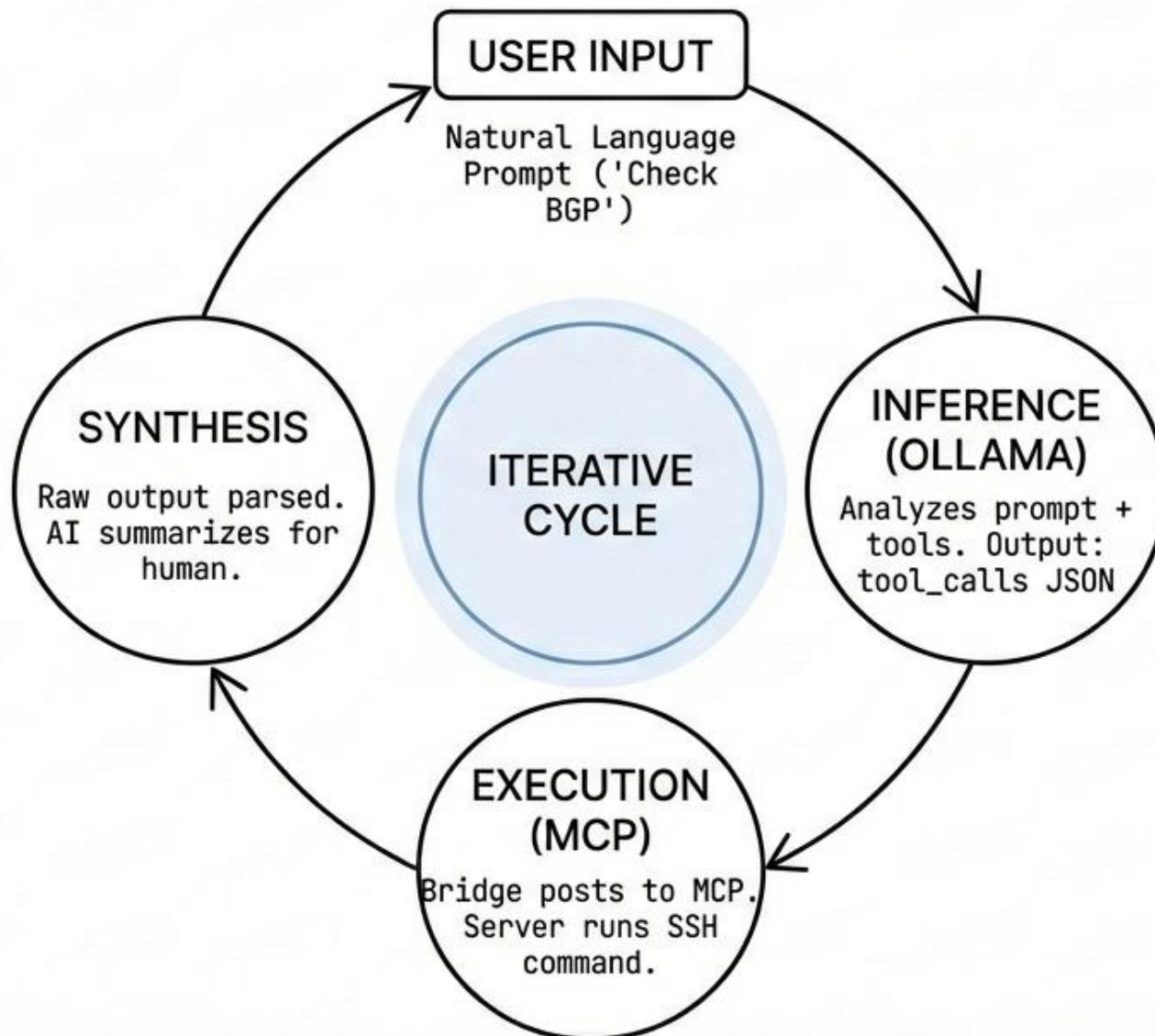
The Integration Challenge: Protocol Mismatch

Adapter Pattern

OLLAMA API

REST / Chat
Completion

Expects:
OpenAI Function
Format

BRIDGE SCRIPT

Translation Layer

1. Schema: MCP -> OpenAI
2. Request: Prompt ->
   Tool Call
3. Response: SSE Stream
   -> Chat Context

MCP SERVER

JSON-RPC 2.0

Expects:
tools/list,
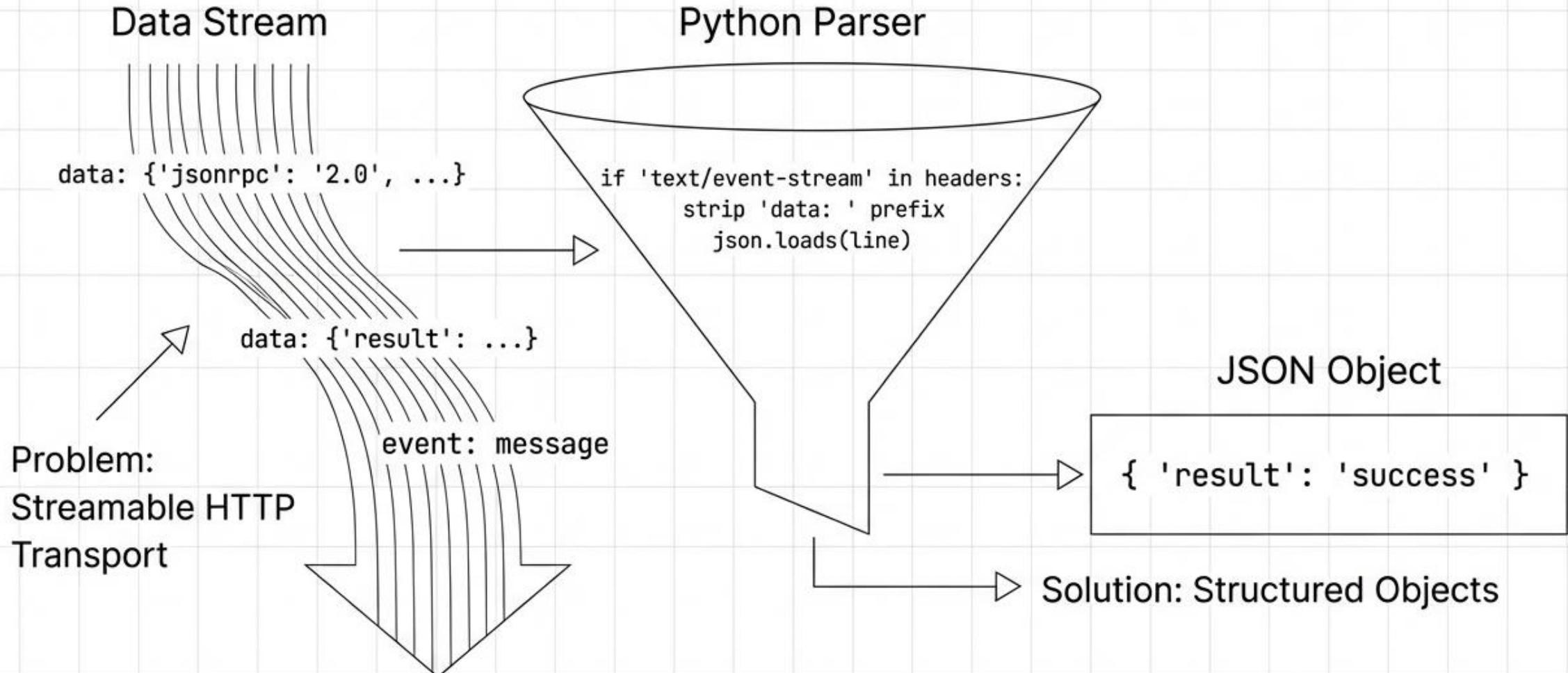tools/call

Middleware Logic: Phase 1 - Initialization & Discovery

Middleware Logic: Phase 2 - The Inference Loop

Engineering Detail: Handling Server-Sent Events (SSE)

Data Stream

Python Parser

data: {'jsonrpc': '2.0', ...}

```
if 'text/event-stream' in headers:
    strip 'data: ' prefix
    json.loads(line)
```

data: {'result': ...}

JSON Object

Problem:
Streamable HTTP
Transport

event: message

{ 'result': 'success' }

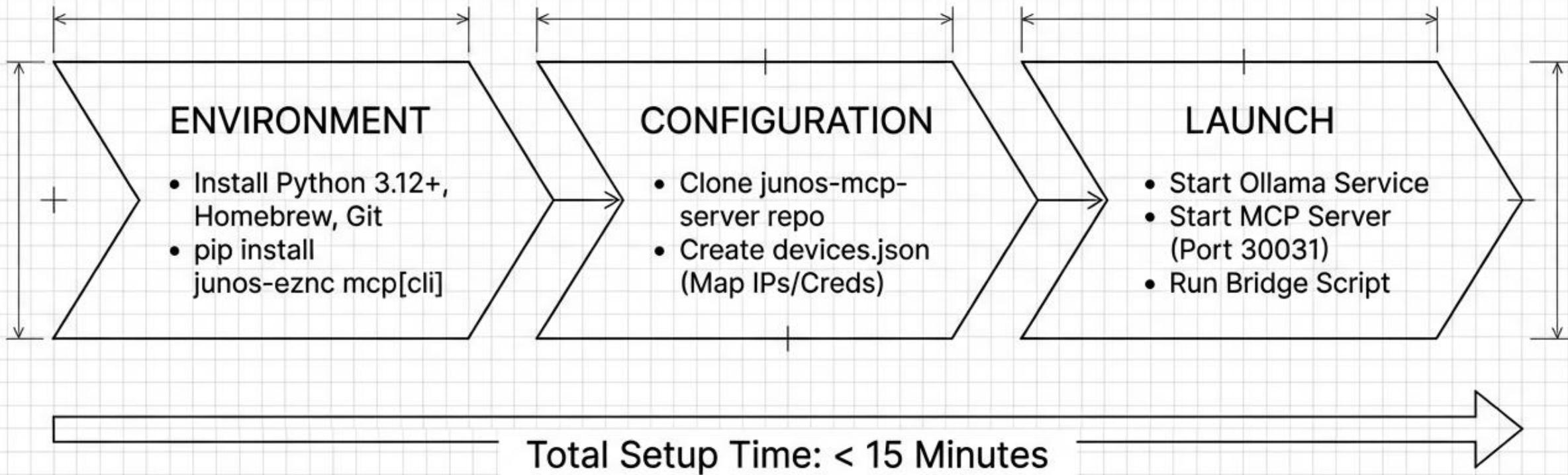Solution: Structured Objects

Capability Set: Available MCP Tools

Operational

- **execute_junos_command** ⟶
  Inter Tight: Run arbitrary CLI commands.

- **execute_junos_command_batch**
  Inter Tight: Parallel execution on multiple nodes.

- **get_junos_config**
  Inter Tight: Retrieve full device configuration.

- **get_router_list**
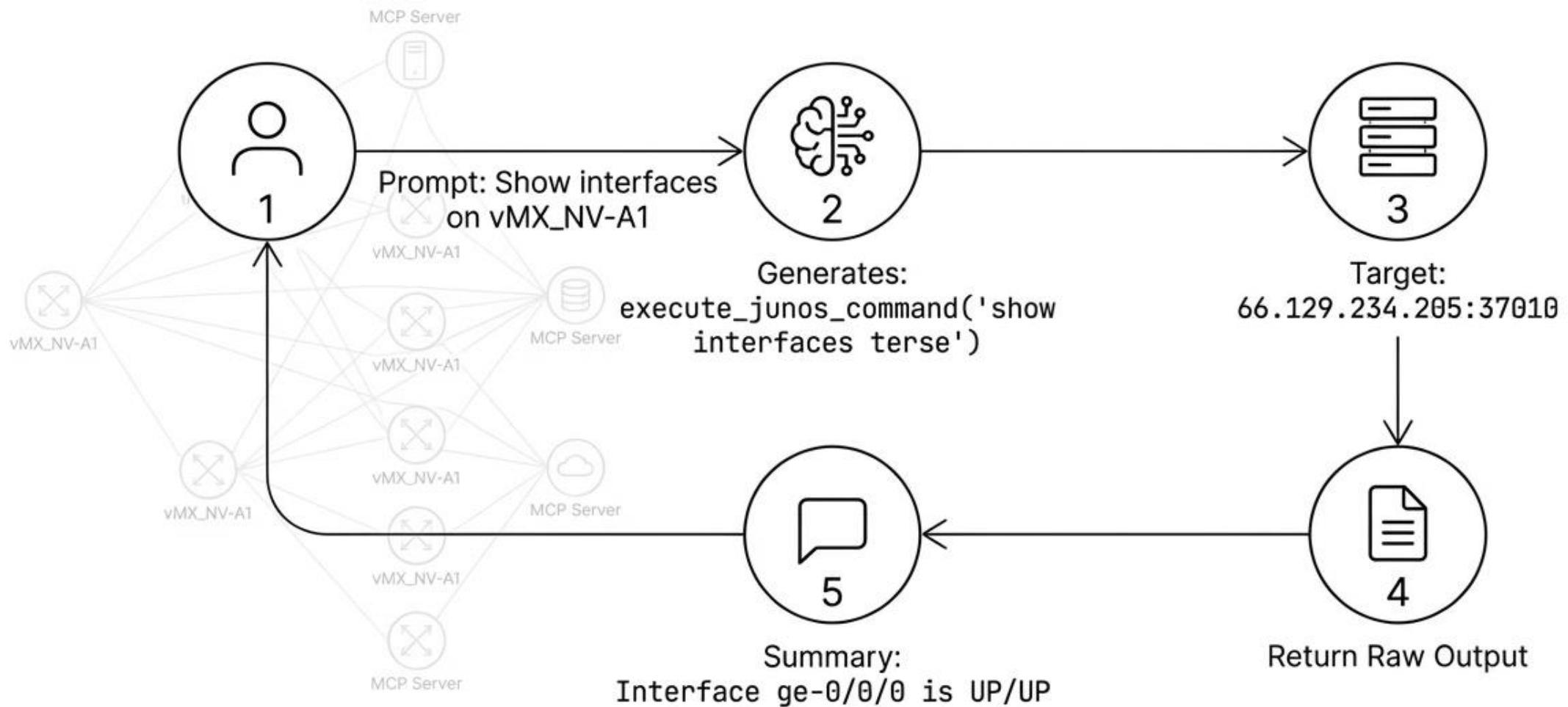 Inter Tight: Inventory of connected devices.

Configuration & Facts

- **junos_config_diff**
  Inter Tight: Compare candidate vs. rollback config.

- **load_and_commit_config**
  Inter Tight: Push changes to device.

- **gather_device_facts**
  Inter Tight: Hardware/Software inventory.

- **add_device / reload_devices**
  Inter Tight: Dynamic fleet management.
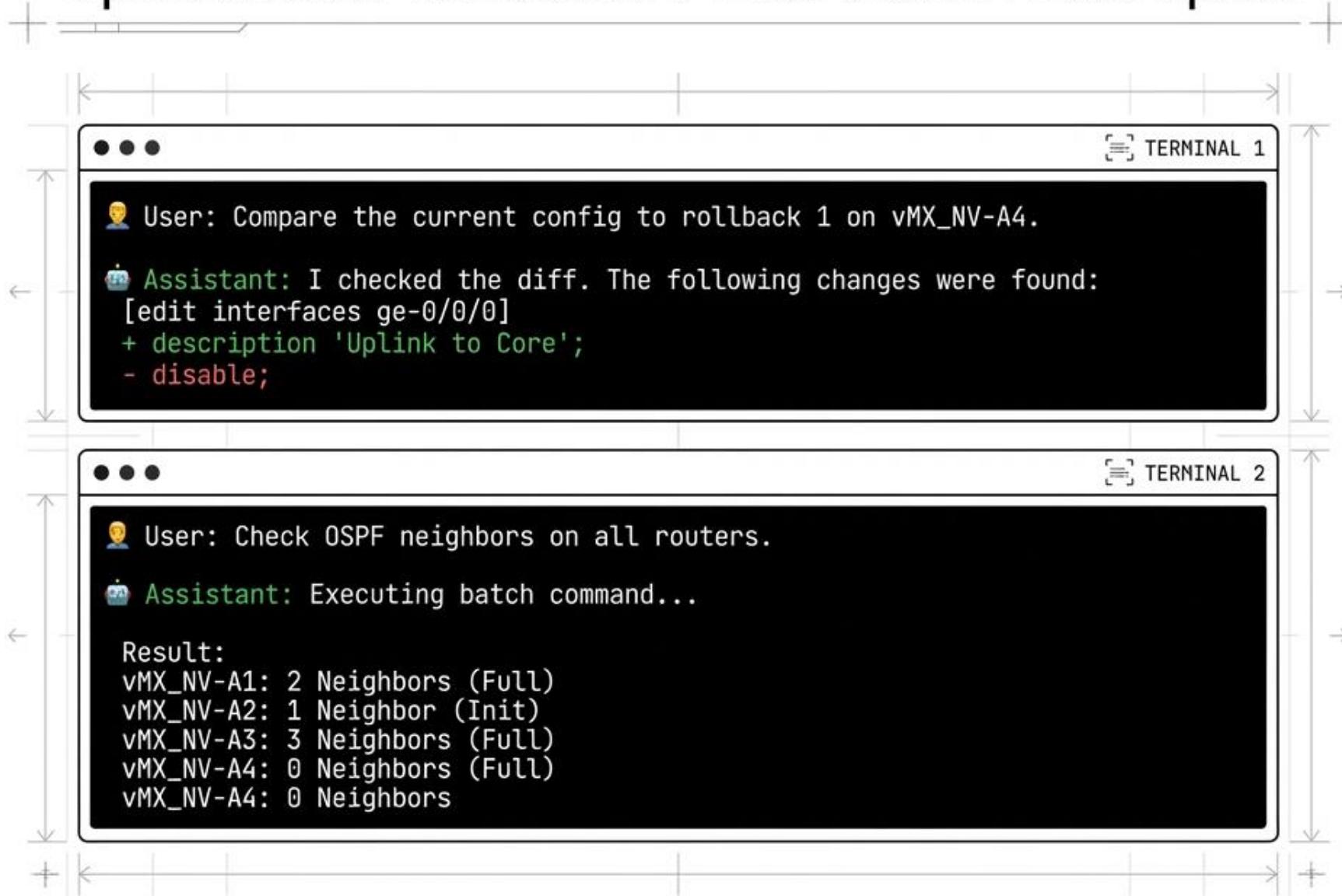
Deployment Roadmap: Build Sequence

ENVIRONMENT
- Install Python 3.12+, Homebrew, Git
- pip install junos-eznc mcp[cli]

CONFIGURATION
- Clone junos-mcp-server repo
- Create devices.json (Map IPs/Creds)

LAUNCH
- Start Ollama Service
- Start MCP Server (Port 30031)
- Run Bridge Script

Total Setup Time: < 15 Minutes

Trace Analysis: Request Lifecycle

Operational Validation: Interaction Examples

TERMINAL 1

👤 User: Compare the current config to rollback 1 on vMX_NV-A4.

🤖 Assistant: I checked the diff. The following changes were found:
[edit interfaces ge-0/0/0]
+ description 'Uplink to Core';
- disable;

TERMINAL 2

👤 User: Check OSPF neighbors on all routers.

🤖 Assistant: Executing batch command...

Result:
vMX_NV-A1: 2 Neighbors (Full)
vMX_NV-A2: 1 Neighbor (Init)
vMX_NV-A3: 3 Neighbors (Full)
vMX_NV-A4: 0 Neighbors (Full)
vMX_NV-A4: 0 Neighbors

System Maintenance: Troubleshooting Vectors

PORT CONFLICTS	LATENCY TIMEOUTS	PROTOCOL ERRORS
Issue: Port 30031 busy.	Issue: Lab routers slow to respond.	Issue: JSONDecodeError.
Fix: `lsof -i :30031` or use `--port` flag.	Fix: Increase `httpx` timeout (30s → 120s).	Fix: Ensure SSE parser is active for `text/event-stream`.

Technical Specifications & Resource Profile

PRIVACY RATING	COMPUTE COST
AIR-GAPPED LOGIC (Localhost Only)	$0.00 (Local Silicon)

LATENCY	SCALABILITY
Network RTT + Inference Time	Managed via devices.json

SYSTEM SUMMARY

A functional, privacy-first bridge for Natural Language
Network Engineering using standard open-source protocols
(MCP, SSH, NETCONF).

BUILD ✓ COMPLETE

JetBrains Mono