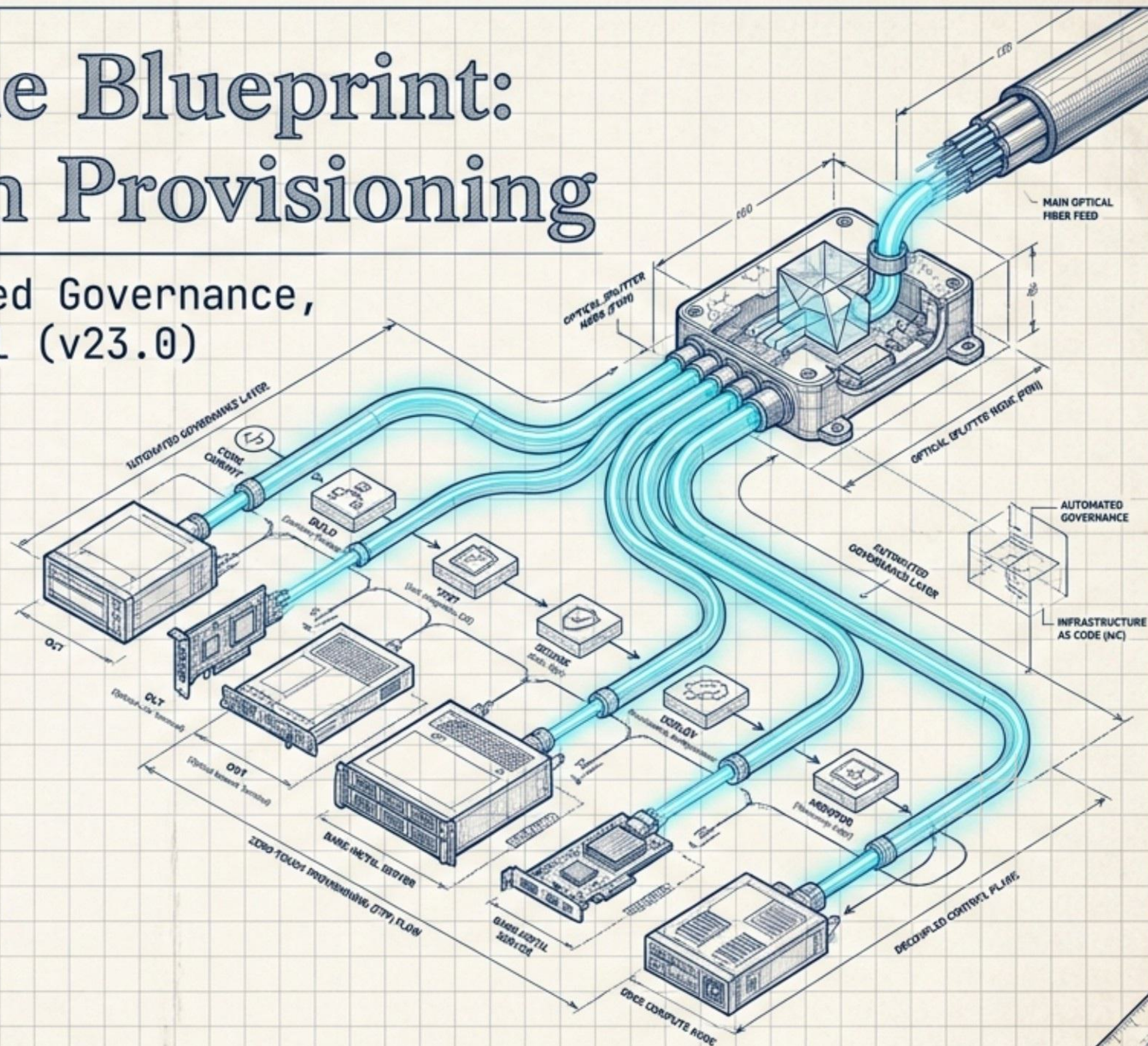


The Carrier-Grade Blueprint: FTTH Zero-Touch Provisioning

Decoupled Architecture, Automated Governance,
and the Transition to Bare-Metal (v23.0)



Engineering for a Rp 1.5 Trillion Scale



Scalability

Built to efficiently manage massive FTTH migrations through a unified, automated governance model.



Hybrid Leadership

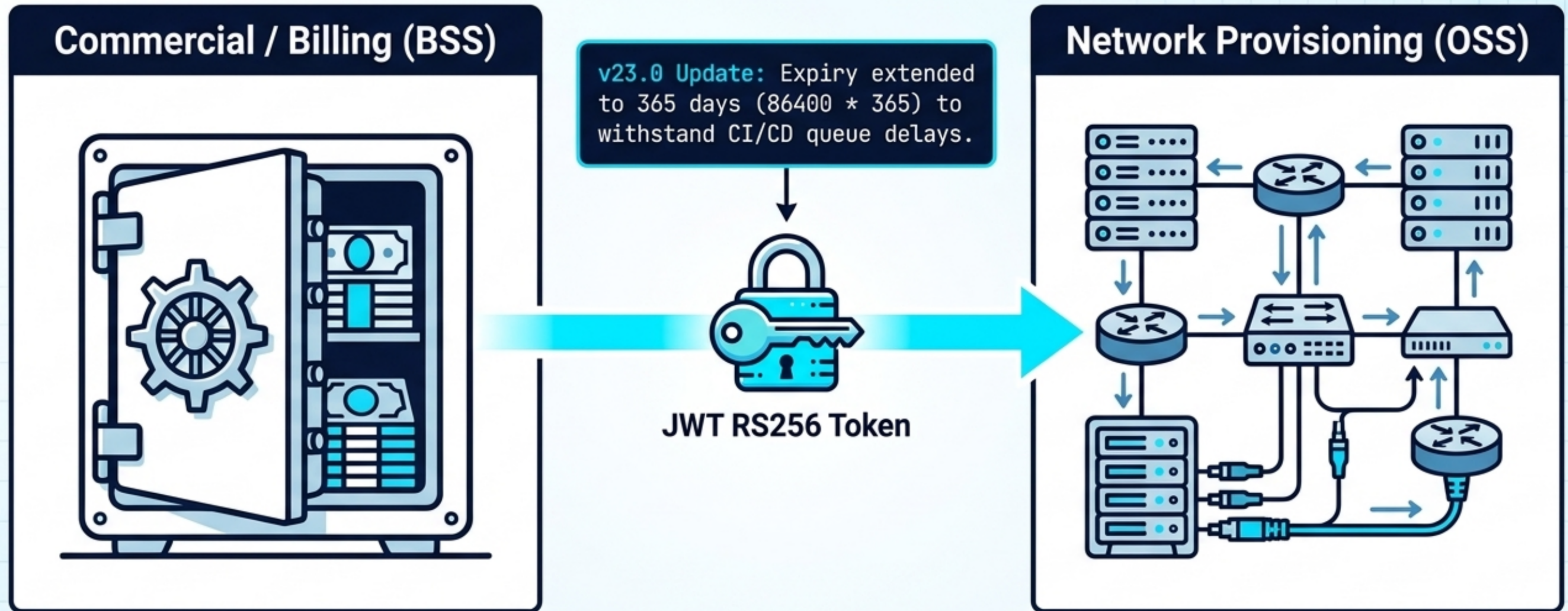
Blending DBA, SysAdmin, and Network Programming disciplines into a single operational profile.



The Kaizen Philosophy

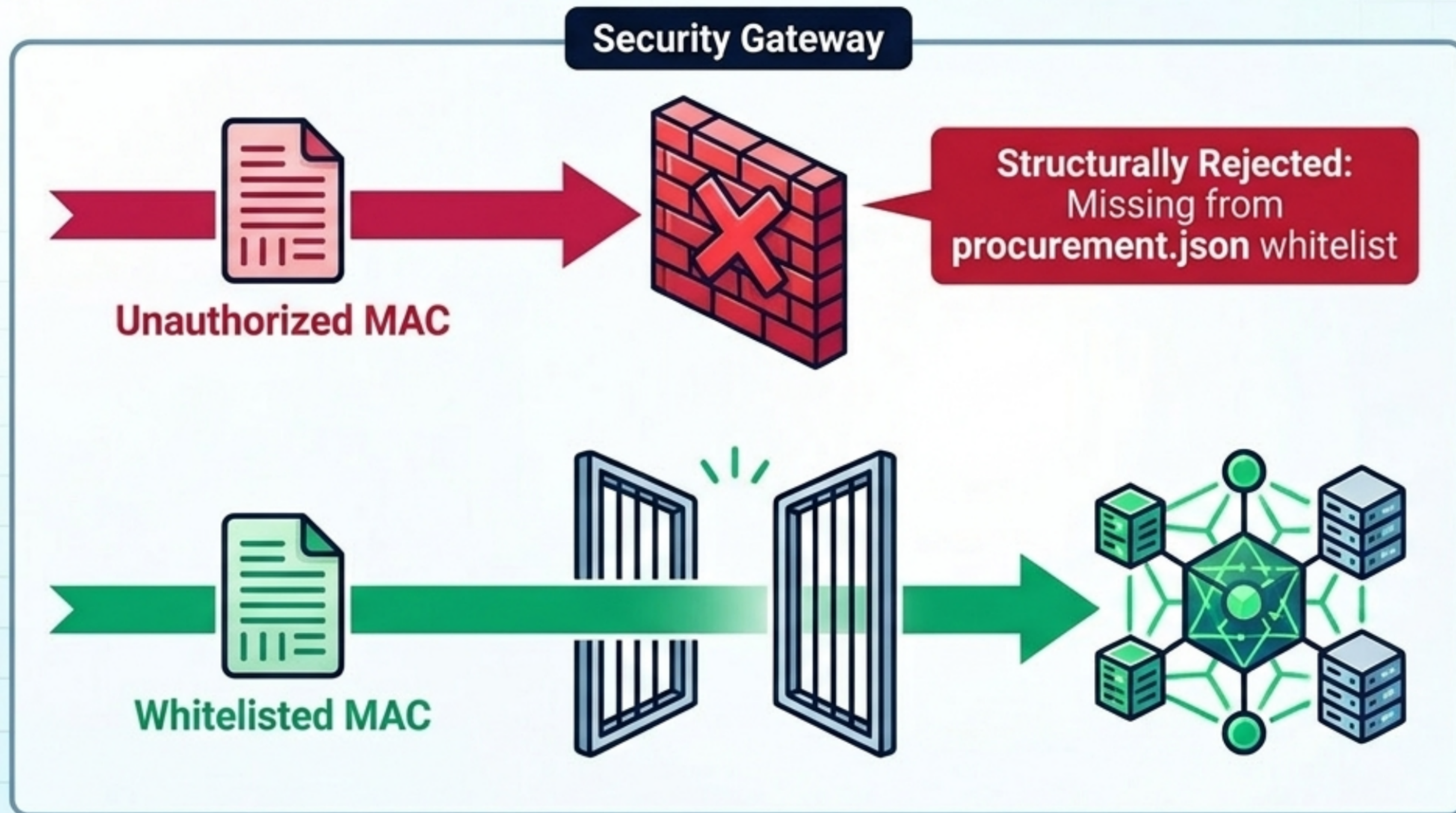
Tracing the continuous evolution from v18.0 Day-2 readiness to the peer-reviewed stability of v23.0.

The Core Axiom: Absolute BSS/OSS Decoupling



Rule: Zero network provisioning occurs without explicit commercial authorization.

Automated Governance and NDA Compliance



The Day-1 Provisioning DAG: Request and Installation

Phase 1: Validation (Software Logic)



GIS Feasibility Check:

Target coordinates verified via Haversine formula strictly within 500m radius of ODP.

$$\Delta\sigma = 2\arcsin\left(\sqrt{\sin^2\frac{\Delta\phi}{2} + \cos\phi_1\cos\phi_2\sin^2\frac{\Delta\lambda}{2}}\right)$$



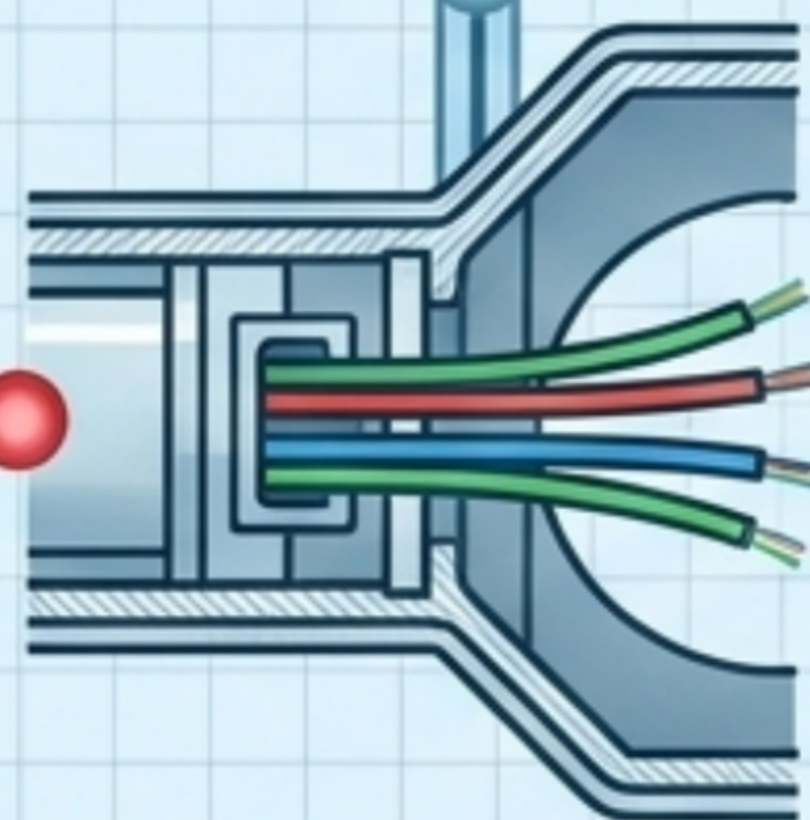
CRM Pre-Validation:

Credit Cleared /
Not Blacklisted

Phase 2: Physical Installation (Field Operations)



FMEA Focus Area



Port Full / Damaged



Operational Failure Risk
(Input for FMEA)

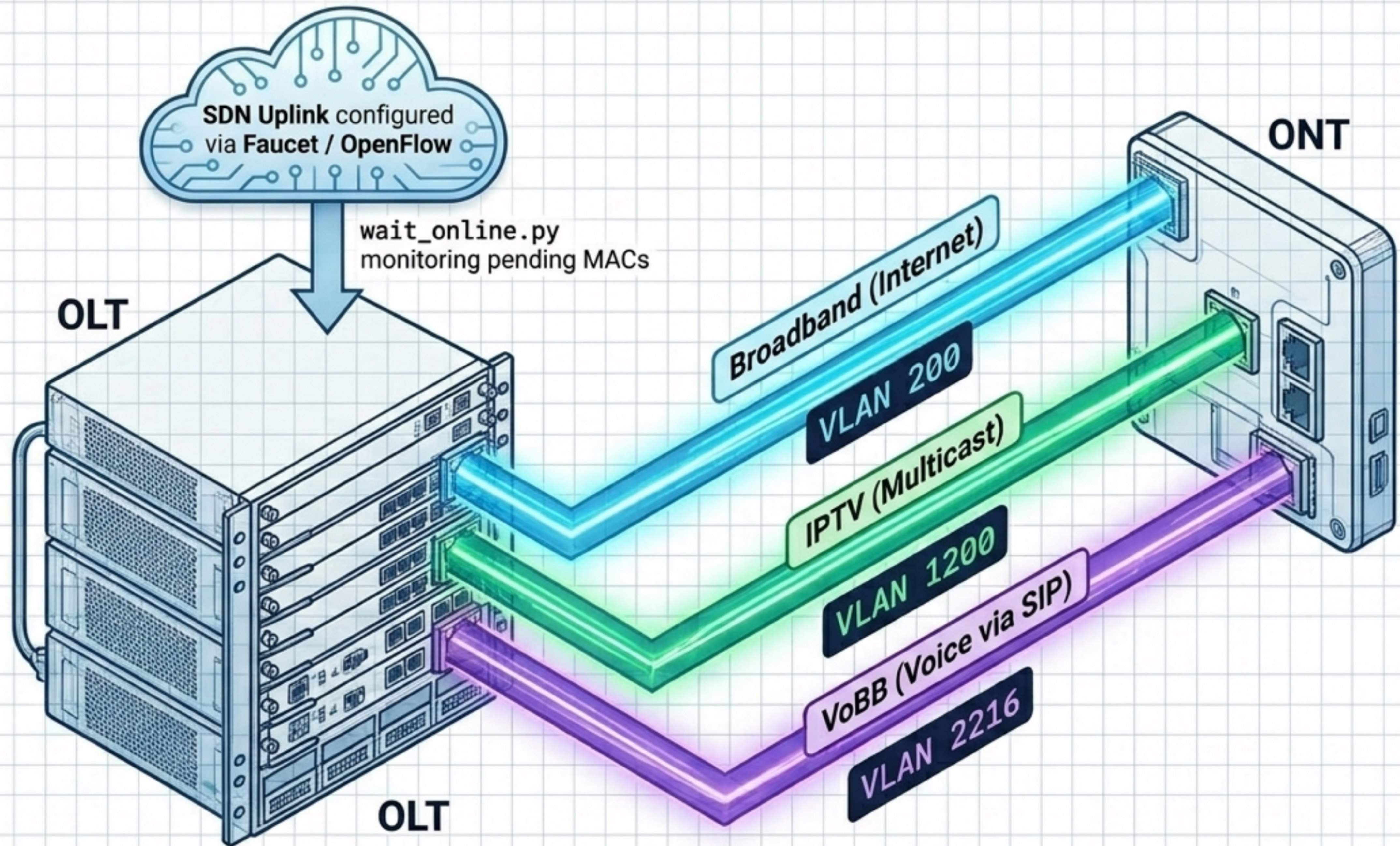


Available



Tech -> Sys: Request
Service Activation (SN)

Phase 3: Logical Activation and Triple Play Injection



Phase 4: Closing the Loop with Commercial Verification

Berita Acara Serah Terima (BAST)

End-to-End Audit Status:

ONLINE / ACTIVE

Service Handover:

Commercially Authorized

SHA-256 :

e3b0c44298fc1c149afbf4c8996fb9242
7ae41e4649b934ca495991b7852b855



E2E_VERIFIED_PASSED

1 Fulfillment SLA:
< 15 minutes

2 Activation SLG:
< 72 hours

Day-2 Operations within the NOC Control Plane



Suspend / Resume

Dropping and restoring Faucet SDN flows combined with OMCI shutdown instructions.

```
pon-onu-mng interface shutdown
```



RMA Swap

Seamlessly binding a new MAC address while retaining the subscriber's commercial state in the OSS DB.

```
sn-bind sn {NEW_MAC}
```

Berita Acara Serah Terima (BAST)

End-to-End Audit Status:	ONLINE / ACTIVE
Service Handover:	Commercially Authorized

SHA-256:
a3b0c442881v1v1VBMSIAa0P9St6R24Z
7ee4Y64B40S34ee455DV10Y8320855



EZE_VERIFIED_PASSED

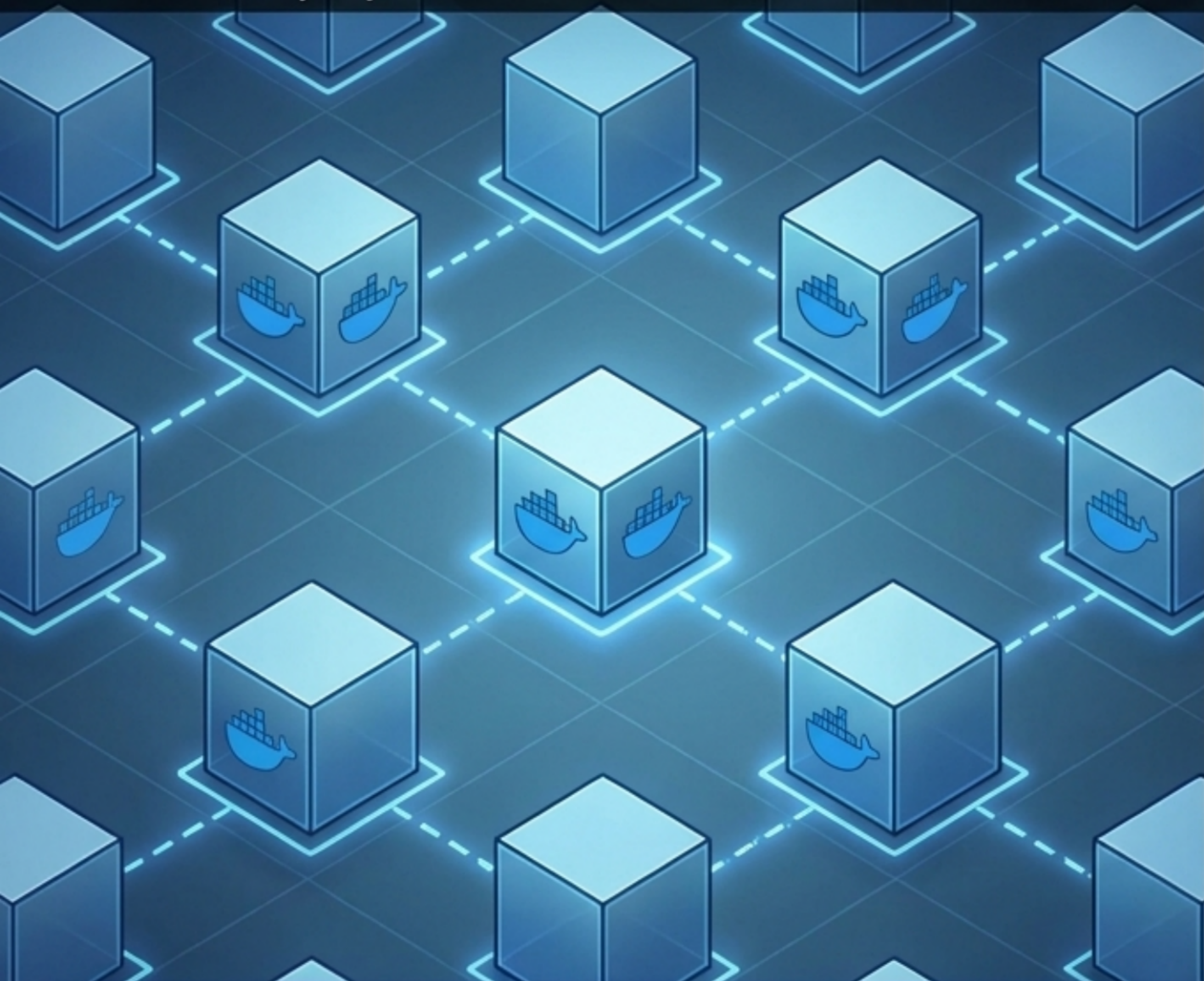
Audit Output

Automated cryptographic generation of the BAM (Berita Acara Maintenance) document.

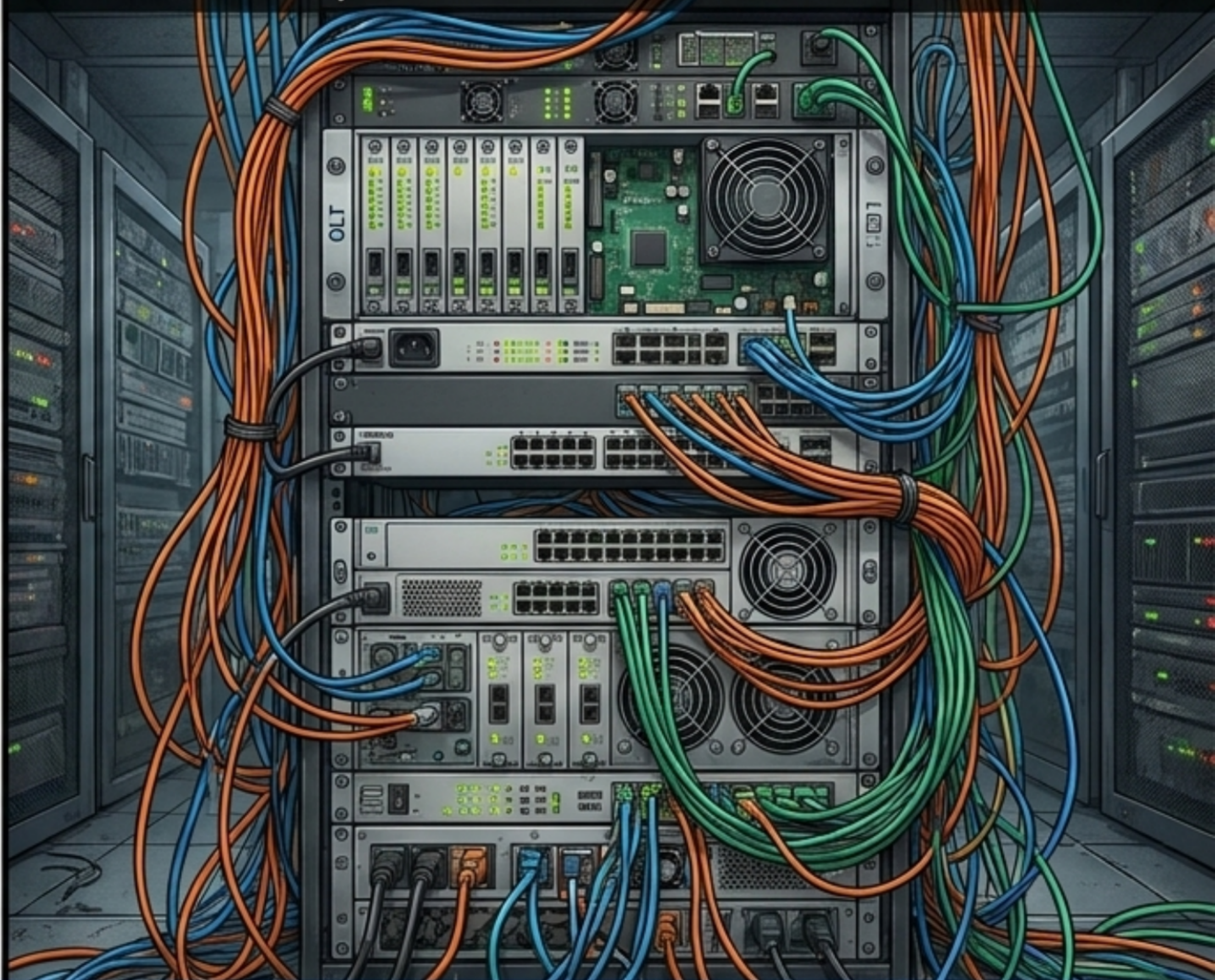
```
VERDICT: MAINTENANCE_EXECUTED
```

The Crucible: Leaving the Docker Sandbox

Lab Reality: Python Microservices & SQLite Local API



Bare-Metal Reality: Carrier-Grade Telecommunications Hardware



Transitioning from pure theory to the telecommunications battlefield.

Transport and Protocol Evolution Matrix

Architecture Layer	Lab / Simulation (Current)	Real Bare-Metal (Target)
CPE Discovery	HTTP POST via JSON	PLOAM & OMCI (ITU-T G.988)
Provisioning	String Parsing via Python	OMCI / TR-069 via ACS
Authentication	SQLite Local State	PPPoE & RADIUS (UDP 1812/1813)
SDN Uplink	Faucet OpenFlow 1.3	NetCONF/YANG or SNMPv3

Trade-Offs: State Concurrency and Physical Latency

State Management



Crashes under 1,000+ concurrent hardware restarts.

Solution: PostgreSQL Cluster + Redis Cache for in-memory storm handling

Asynchronous Flow

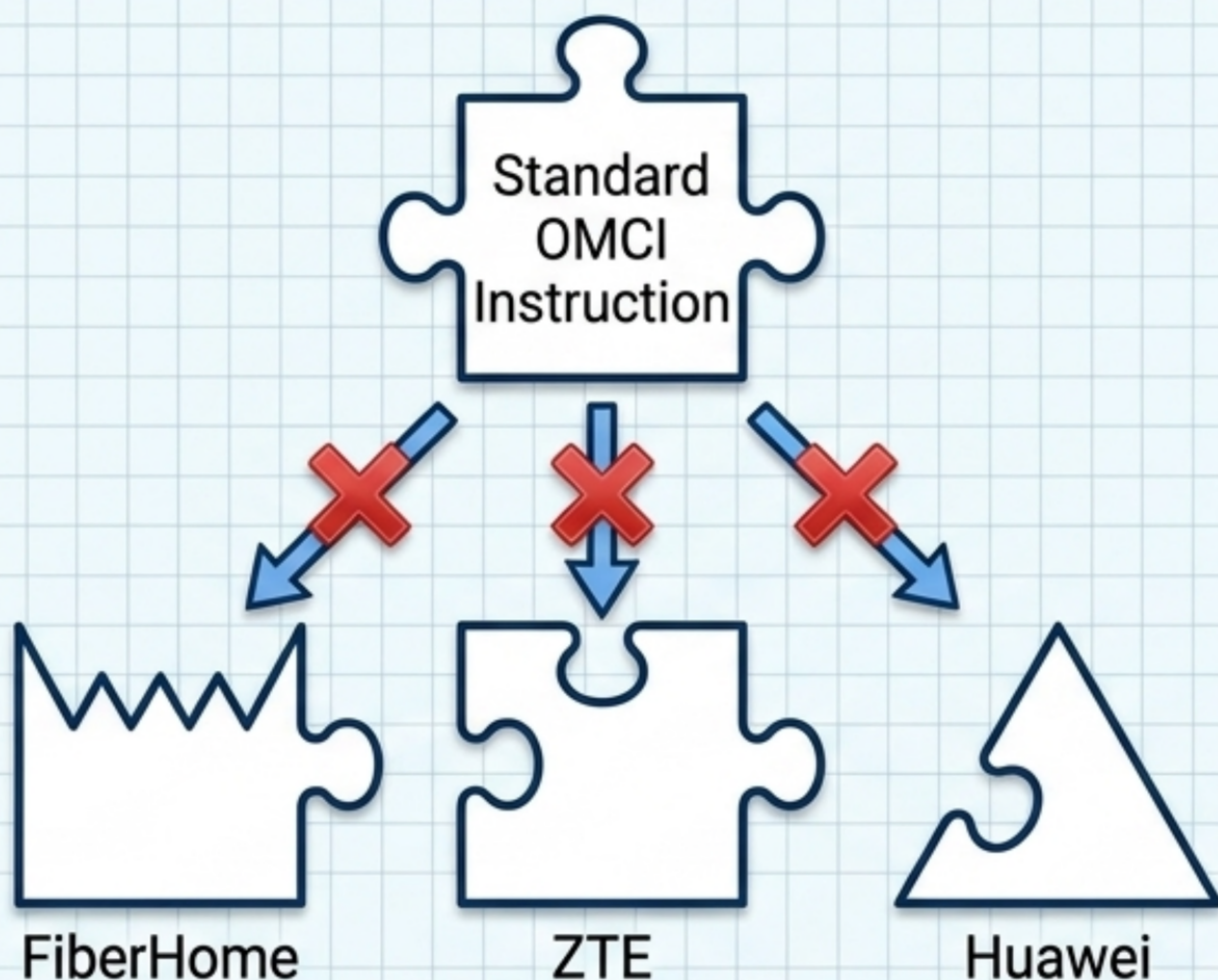


Synchronous script fails
(Timeout due to 15-60s physical laser sync)

Asynchronous Event-Driven Broker
(Kafka/Celery) waits for hardware callback

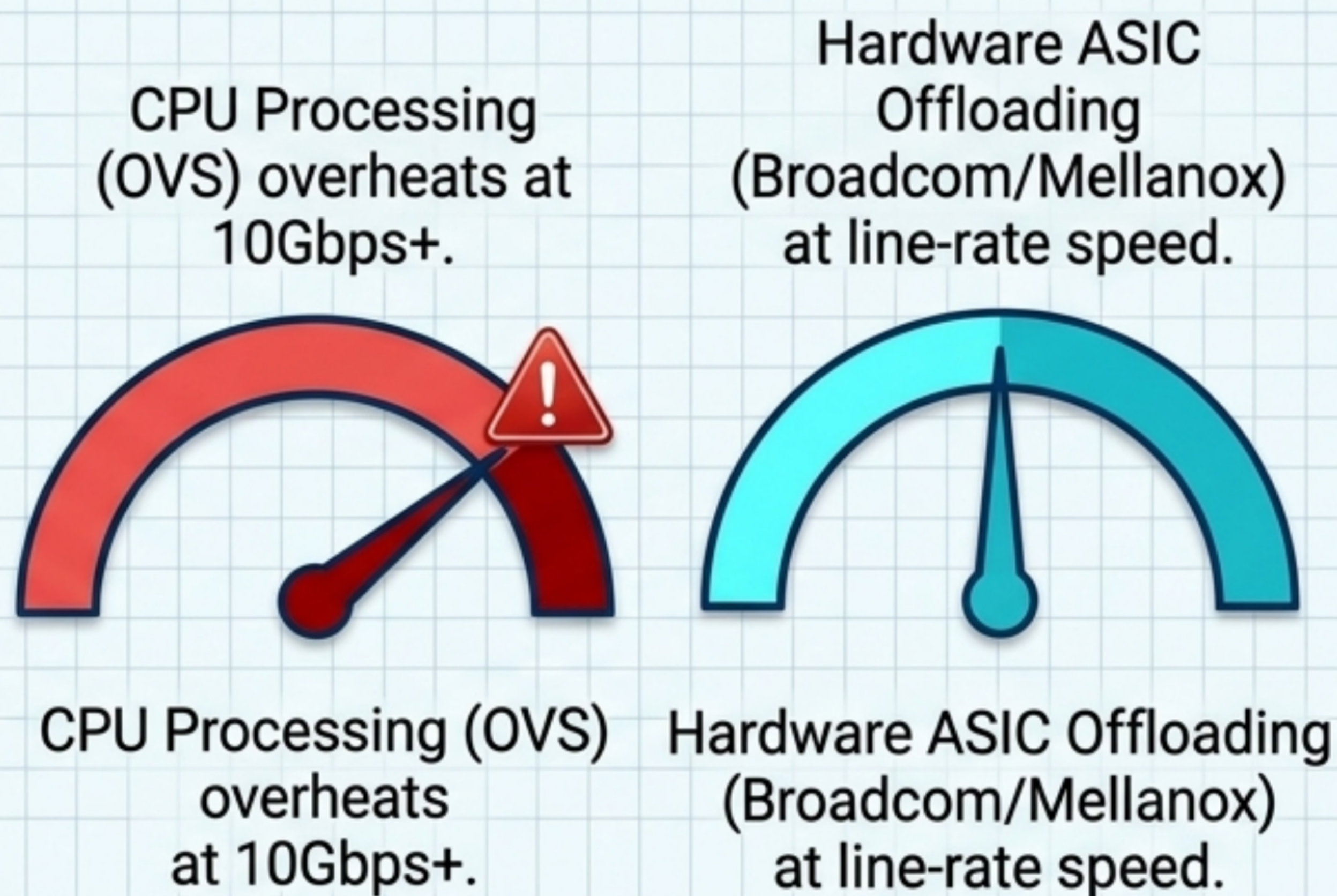
Trade-Offs: Vendor Dialects and Hardware Offloading

(Translation Layers)



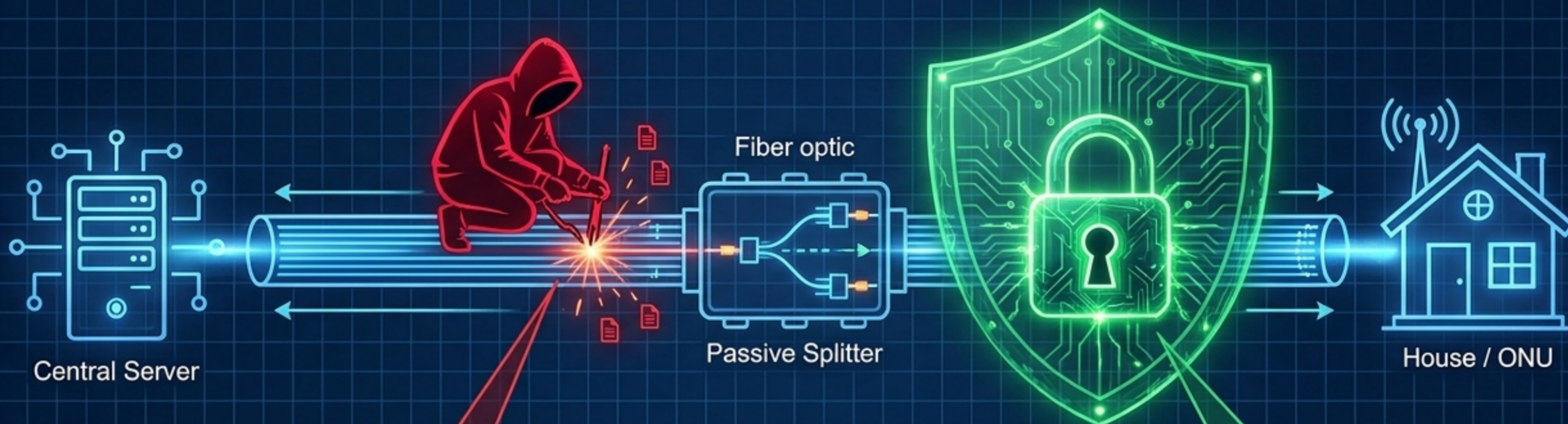
Proprietary Managed Entities (MEs) require complex Southbound Interface (SBI) Translation Layers.

(Data Plane Speed)



Trade-off: Restricts strict OpenFlow flexibility.

Trade-Offs: Enforcing Security at the Physical Layer

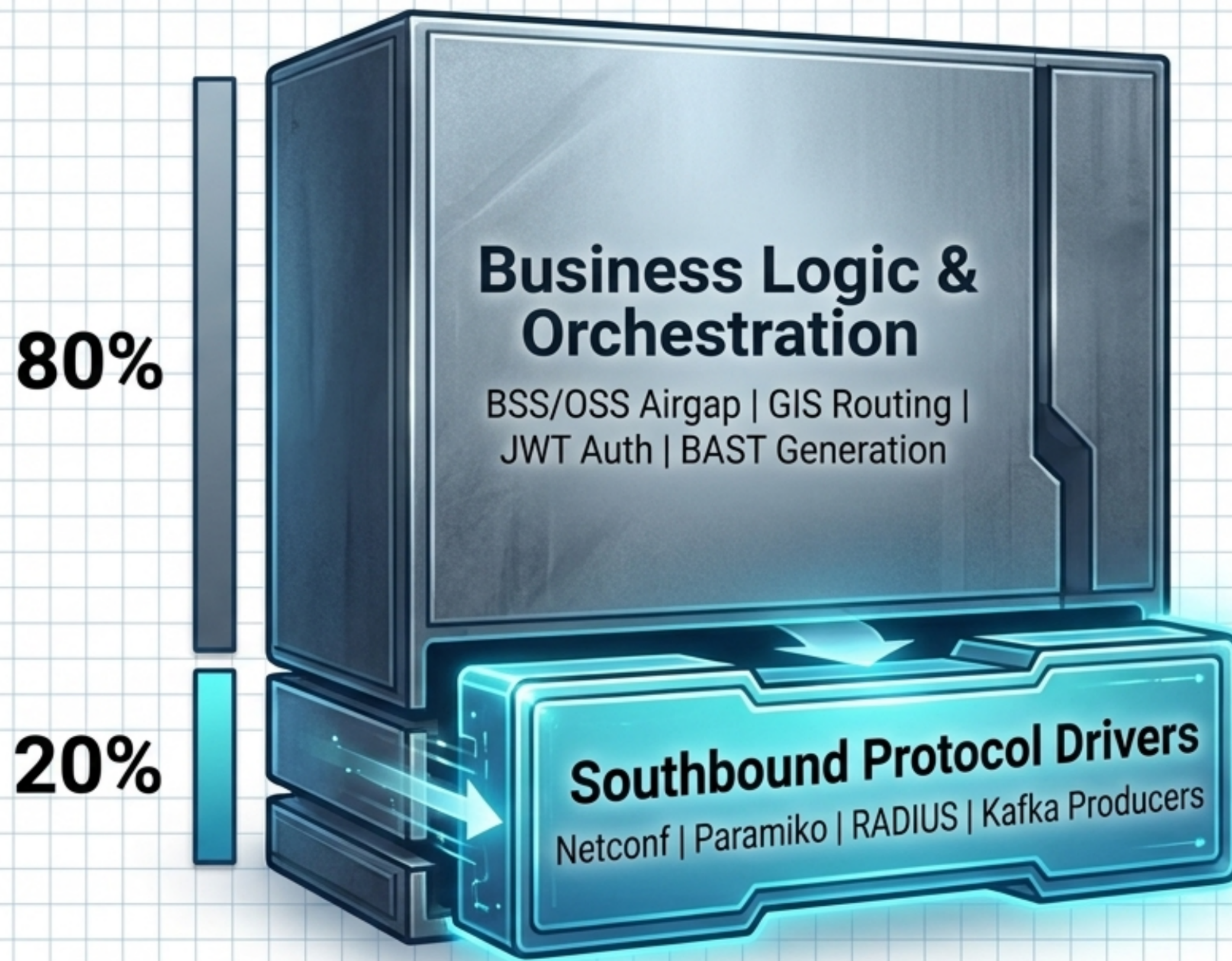


Vulnerability: MAC Spoofing bypasses logical JSON whitelists during physical wiretapping.



Bare-Metal Defense required: Implementation of Logical ONU ID (LOID) combined with AES-128 PON layer encryption to render optical signals useless to physical intruders.

The Swappable Architecture: Accelerating the Rollout



Maintain 100% of the automated business governance. Swap only the Southbound driver layer to conquer physical vendor hardware.