Elfege Arthur Leylavergne

Solution Architect | Senior Software Engineer | Ph.D. Logic & Epistemology

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PROFILE

I architect systems that anticipate and resolve complexity. With 15 years studying logic and epistemology, I approach distributed systems as evolving structures with internal tensions — not static designs. Combined with hands-on engineering since 2000, I design solutions that anticipate failure modes before they occur, reduce complex problems to their essential structure, and integrate contradictory data sources into unified outputs. My work centers on translating ambiguous requirements into scalable, production-grade architectures — bridging the gap between stakeholder intent and technical execution.

CORE COMPETENCIES

Solution Architecture:	System design, requirements analysis, cross-team technical leadership, stakeholder communication, distributed system design, integration architecture, defense-in-depth design
Languages:	Python, JavaScript/ES6, TypeScript, C++, Groovy, Bash, SQL
Data & Streaming:	Apache Flink, Apache Kafka, PyFlink, AVRO serialization, XML parsing, real-time stream processing
Front-End:	React 19, Next.js 15, TypeScript, MUI, Tailwind CSS, Kendo UI, Leaflet/GeoServer, ECharts, TanStack React Query, Socket.io, jQuery, Jinja2, HTML5, CSS3
Back-End:	Flask, FastAPI, Gunicorn, Node.js/Express, PostgreSQL, PostgREST, Flyway, RESTful API design, database schema design, stored procedures, trigger functions
DevOps & Cloud:	Docker (Compose, Swarm), CI/CD, GitHub Actions, AWS (ECR, EC2, S3, Secrets Manager, SSO), Linux administration, systemd, log rotation
Async & Concurrency:	Python asyncio, aiohttp, APScheduler, multiprocessing, multithreading, event-driven architecture
Security:	NIST (SP 800-160/800-37/800-47), AES-256-CBC/PBKDF2, Fernet/OpenSSL, Bcrypt, JWT/CSRF, SSH, TLS 1.2, VPN, Docker network isolation
Networking:	TCP/IP, ICMP, SMTP, SNMP, NTCIP, RTSP, RTMP, SRT, SRTP, SFTP, MQTT, WebRTC, WHEP/WHIP, HLS, STUN/TURN, ONVIF, CORS, firewall configuration
Hardware Integration:	LiDAR/TEMS sensors, Bosch RCP+, ONVIF, SNMP relay controllers, FFmpeg
Spoken Languages:	English (native), French (native), Spanish (intermediate), Portuguese (intermediate), Academic Ancient Greek, Latin

EXPERIENCE

Senior Software Engineer — Mindhop Inc., White Plains, NY | 2023 – Present

Over Height Vehicle Detection — Real-Time Safety System for NYSDOT
Single-handedly architected and delivered production-grade edge-computing safety system — real-time over-height vehicle detection via integrated LiDAR, VCA cameras, and automated traffic control. Owned full stack from application architecture to field hardware configuration.

- Architected fault-isolated multi-process system (5 data processors + Flask app) in single Docker container with 7-layer watchdog architecture; achieved 120+ days continuous uptime.
- Implemented VCA streaming optimization: 18 duplicate detections to 1 optimal output via confidence plateau detection, maintaining ~100MB memory footprint.
- Designed dual-sensor correlation: LiDAR (TCP, millimeter-accurate) + VCA (RTSP classification) with 5-second deduplication and UUID-based video matching.
- Built MQTT/WebSocket distribution for TMC dashboards; AVRO pipeline integration with Apache NiFi.
- Created Express.js admin server in isolated container with SSH proxy for secure TMC remote management.
- Developed automated field installer handling encryption, hardware integration (LiDAR, PTZ, SNMP relays), and system service configuration.
- Engineered PostgreSQL batch operations (100/batch) with 6-day automated retention under 24/7 write loads.

DMS Control API — Highway Dynamic Message Sign Command & Control
Sole architect and developer of a production command & control API for Dynamic Message Signs across multiple state DOT deployments. Reverse-engineered NTCIP 1203 protocol from MIB specifications and IRIS open-source reference to build a vendor-agnostic driver framework — no SDK access provided.

- Designed driver-based architecture with factory/registry pattern: manufacturer-specific SNMP drivers (Daktronics VFC-3000, generic NTCIP), 4-gate request router, 3-tier quirk resolution (device override > model template > defaults).
- Implemented full NTCIP 1203 message lifecycle: MULTI markup validation, CRC computation, message activation sequences, readback verification, and scheduled message management via APScheduler.
- Built interactive API dashboard with live endpoint testing, Mermaid-based architecture diagrams, and field-level contextual help across 15+ endpoints.
- Delivered 31 end-to-end tests, Kafka event streaming integration, and MIB-driven capabilities discovery — all from protocol specs with zero vendor support.

Device Status Monitoring System — Network Infrastructure Monitoring for UDOT
Architected production-grade network monitoring system for Utah DOT, tracking 2,400 devices across 750+ subnets on state fiber infrastructure.

- Achieved 90%+ cycle time reduction (54–60 min to 5–7 min) through device-type filtering and adaptive batching.
- Designed Python asyncio/aiohttp architecture with configurable worker pools (2,000 concurrent pings) preventing file descriptor exhaustion.
- Engineered APScheduler-based per-device-group scheduling with independent intervals (12/24/48 min cycles), 100% adherence.
- Integrated PostgREST streaming writes for real-time visibility; containerized via Docker Compose with AWS (ECR, Secrets Manager, SSO).
- Validated 120+ hours continuous operation, zero errors.

Real-Time Alert Routing System — Event Processing & Notification

Architected real-time alert processing system using Apache Flink and Kafka, dispatching personalized notifications via email, SMS, and WebSocket.

- Designed event-driven architecture processing complex trigger conditions across multiple event types.
- Integrated PostgreSQL with stored procedures for optimized operations; modular dispatch supporting SMTP and Twilio.
- Containerized with Docker Compose; implemented multiprocessing/multithreading for concurrency.

Video-Streaming Platform — Low-Latency DOT Camera Infrastructure

- Built core video-streaming platform: Flask + FFmpeg encoding/compression with WebRTC/HLS delivery.
- Implemented React monitoring interface for real-time stream health and metrics visualization.
- Automated deployment infrastructure via Bash scripting and CI/CD pipelines.

Front-End — DotStream React/Next.js Monorepo

Contributor to production Next.js 15 / React 19 / TypeScript monorepo (Turbo, pnpm workspaces) serving 15+ dashboard pages across multiple state DOT deployments.

- Integrated full OHVD real-time subsystem into the React platform: alert providers, WebSocket event streams, map panel hierarchies, and Kendo data grids.
- Contributed to migration from 5,000+ line vanilla JS monolith to modular React component architecture with Jest unit tests and Playwright E2E coverage.

Software Engineer — PowerYou AI, New York, NY | 2022

Inherited React.js and React Native codebase in critical state following abrupt departure of prior development team. Stabilized, debugged, and partially refactored both web and mobile applications.

- Implemented testing protocols and deployment workflows to establish reproducible release processes.
- Audited and restructured AWS environment: IAM policy hardening (least privilege), S3 backup procedures, EC2/Route53 configuration.
- Transitioned infrastructure from ad-hoc configuration to documented, maintainable state.

Professor, Researcher & Technology Integrator — Lycée Français of New York | 2007 – 2022

- Founded and directed Polysophia research collective (2009–2022) — coordinated projects with Columbia University, Rockefeller University, Nassau Community College, and TED-Ed (2014).
- Founded and directed Robotics program (2015–2022) — hands-on design, build, and programming curriculum.
- Technology Integrator (2012–2016): helped transform a $100M institution to a technologically advanced environment; integrated Blackbaud SIS API with enrollment solutions.

Open-Source Developer — Personal Projects & Community | 2012 – Present

Anamnesis — Vector-Based Episodic Memory for AI Instances

Designed and built a semantic memory system enabling AI instances to retain and retrieve contextual knowledge across sessions — grounded in epistemological theory of episodic memory.

- Architected FastAPI async backend with MongoDB Atlas Local native $vectorSearch (HNSW, 1024-dimensional embeddings) — zero cloud dependency.
- Built multi-model embedding pipeline (sentence-transformers) with automatic re-embedding on model change, checkpoint-based resumption, and JSONL bulk ingestion.
- Implemented cross-instance coordination: file crawler auto-ingests from handoff buffers, project histories, and CLAUDE.md files across networked machines.
- Integrated streaming chat with memory injection — semantic search before each turn, session persistence with rename history, three LLM backends (Ollama, Claude CLI, Claude API).

MOBIUS.NVR — Multi-Vendor Video Surveillance Platform

Unified NVR managing 17+ IP cameras across 4 vendors and growing (Python/Flask/Docker), with ONVIF/WebRTC/MediaMTX streaming at 200ms latency and Neolink bridging for non-ONVIF devices.

IoT & Home Automation — SmartThings, Hubitat, ESP32

- Reverse-engineered iRobot Roomba 980 WiFi protocol (HTTPS/JSON API/Node.js) — first SmartThings/Hubitat integration, subsequently forked and extended by community developers.
- Thermostat Manager (Groovy): multi-device HVAC automation with narrow-AI learning features.
- Dashboard interface (JavaScript/HTML) for real-time IoT device control.
- IoT firmware (C++): ESP32/ESP8266 smart sensors, remote controllers, window actuator controllers.

IT Administrator & Operations Manager — Teleperformance, Strasbourg, France | 1999 – 2001

- Migrated server infrastructure from Novell NetWare to Windows NT with LDAP/IIS; upgraded network from IPX/SPX to TCP/IP (500% throughput increase).
- Migrated data systems from dBASE/flat files to MySQL RDBMS with web-based reporting.
- Managed 20+ person team; achieved 20% productivity increase and 10% profit increase.

EDUCATION

Springboard Software Engineering Curriculum (800+ hours), Calif. BPPE — Certification 2023

Ph.D., Université de Nantes — Logic & Epistemology | Summa Cum Laude | Published thesis (ISBN 978-989-20-3141-5)

Master's, Université de Grenoble Alpes | ENS Lyon — Logic, Epistemology, Sciences of Languages & Philosophy | Magna Cum Laude

INTERESTS

Robotics, home automation (integrated systems with hundreds of DIY IoT devices), philosophy, martial arts (Karate, Wing Chun), swimming.