FLUXEON DESIGN DOCUMENT

Digital Energy Grid Hackathon – Problem Statement 1

1. **Team Information**
   a. **Team name:** ARMEX
   b. **Institution / Organization:** Independent
   c. **Team members:**

Name	Role	Discord	Email
Azul	SWE Engineer	azul_27328	marquezlautaro16@gmail.com
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2. **Problem Focus**

   Selected: Problem 1 Utility Interface with Agentic Orchestration for Grid-Scale Demand Flexibility. FLUXEON directly targets real-time feeder-level congestion, leveraging prediction and agentic orchestration to discover DER flexibility, dispatch actions under strict SLAs, and maintain full OBP ID traceability for P444 settlement, exactly aligned with the challenge requirements.

3. **Solution Overview**

   FLUXEON is a real-time agentic system that detects feeder overload risks, predicts short-term demand trajectories, and activates DER flexibility within a strict sub–5 second detection-to-dispatch SLA. A multi-phase pipeline drives the system: curve simulation (Phase 0), TS feature extraction (Phase 1), classifier-based risk scoring 0/1/2 (Phase 2), and centralized agent reasoning (Phase 3). When a spike is classified as level 1–2, the Agent Core queries flexibility providers via Beckn ON_SEARCH, ranks DERs by capacity and response constraints, and issues INIT → CONFIRM → STATUS → COMPLETE orders (Phase 4). All operations—including operator overrides—are surfaced in a Streamlit Command Centre dashboard (Phase 5). Every decision, model output, and DER response is logged with OBP IDs for P444-compliant auditability, enabling utilities to execute transparent, automated flexibility in alignment with modern grid governance.

4. **Technical Architecture**

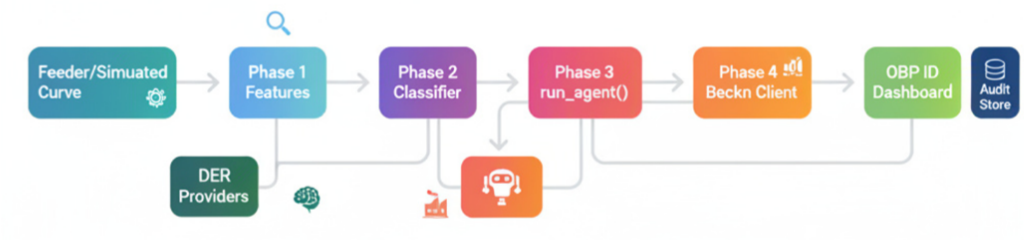
   The architecture consists of six sequential phases integrated into an agent-driven orchestration loop:

   a. Phase 0 — Curve Simulator: Generates synthetic feeder curves, randomized peak windows, and scenario variations to stress-test the classifier.
   b. Phase 1 — Fast Feature Extraction: Computes rolling means, deltas, volatility, gradient signatures, and threshold proximity for sub-100ms preprocessing.
   c. Phase 2 — Classifier (0/1/2): A lightweight tree-based or shallow neural model providing risk categories:

      i. 0: Normal, 1: Warning, 2: Critical (immediate flexibility action)

   d. Phase 3 — Agent Core (run_agent()): Interprets classifier output, checks DER requirements, and triggers Beckn workflows while guaranteeing sub-5s SLA.
   e. Phase 4 — Beckn Client:
      i. search_flexibility(): Executes Beckn ON_SEARCH and filters DERs by capacity, ramp time, and geolocation.
      ii. send_order(): Implements INIT → CONFIRM → STATUS → COMPLETE, tracking OBP IDs for settlement.

iii. Phase 5 — Streamlit Dashboard: Real-time visualization of feeder curves, classifier state, DER candidates, active orders, and audit logs.



Assumptions: Low-latency data access, Beckn sandbox DER catalog, and real-time rule-based flexibility constraints.

5. Agent Workflow:

1. Feeder data (real or simulated) enters the ML pipeline and is transformed by Phase 1 feature extraction.
2. The classifier outputs risk level 0/1/2.
3. If ≥1, run_agent() evaluates urgency and queries DERs via Beckn ON_SEARCH.
4. The agent ranks DERs using capacity, ramp time, location, and availability from the catalog.
5. Activation is initiated with INIT, confirmed with CONFIRM, monitored through STATUS / ON_STATUS, and finalized via COMPLETE.
6. All steps append OBP IDs to the audit log for P444 compliance.
7. The Streamlit dashboard displays event states, DER actions, timelines, and operator override controls.
8. End-to-end loop remains within the sub-5s SLA, fulfilling minimum capability requirements.

6. Business Model & Impact

FLUXEON operates as a B2B/B2G service focused on utilities and large-scale flexibility actors. The business model combines an annual SaaS fee per managed flexibility zone with a transactional fee per settled kWh, plus a one-off deployment charge. This structure captures value from both continuous system availability and the growth in flexibility markets. Primary beneficiaries include distribution system operators—who avoid costly grid reinforcement—along with aggregators, fleet operators, and data centers that rely on transparent and traceable flexibility orchestration. Consumers benefit indirectly through more reliable networks and the monetization of distributed assets. The model is highly scalable: each additional feeder generates recurring revenue without significantly increasing operational costs, maintaining software-level margins above 80%. From a sustainability perspective, it reduces physical grid upgrades and enables more efficient use of distributed resources, supporting electrification and the broader energy transition.

7. References / Inspiration

a. Beckn Protocol Specifications
b. P415 Virtual Lead Party Framework
c. P444 Flexibility Settlement Guidelines
d. National Grid ESO flexibility market documentation
e. Time-series classification literature
f. Problem Statement 1: Utility Interface with Agentic Orchestration for Grid-Scale Flexibility
g. Declarations

8. Declarations

- IP & Licensing: Submitted under MIT Commons License
- Submission Format: 1–2 page PDF uploaded via DoraHacks
- Deadline: 23/11/25 — 17:00 GMT