Digital Energy Grid Hackathon - Idea Submission

Team Information

Team Name: Project Reflex

Institution / Organization: Kings College London and University of Manchester

Team Members:

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Problem Focus

Problem 1: Utility Interface with Agentic Orchestration for Grid-Scale Demand Flexibility

Solution Overview

Our system uses three cooperating agents to detect feeder overloads and automatically orchestrate demand flexibility. The Forecast Agent predicts loading, the Optimisation Agent finds and selects DER actions via Beckn using a knapsack model, and the Dispatch Agent activates them through P415 while generating P444-ready audit logs. This delivers transparent, low-cost flexibility with sub-5 second response times. If flexibility is insufficient, the system escalates to fallback options such as cross-feeder rebalancing and also determines whether the situation requires incentive-based action or emergency curtailment.

Technical Architecture

The architecture is built around three cooperating agents designed for fast, transparent flexibility activation.

1. **Prediction Agent:** This agent continuously reads feeder data and uses exponential smoothing to forecast short-term loading. If it spots that demand is about to exceed the feeder's safe limit, it calculates how much flexibility (in kW) is needed and passes that requirement to the next agent.
2. **Optimisation Agent:** When flexibility is required, the agent sends a Beckn /search request to discover available DER capacity from participating aggregators. Each DER advertises its response capability, limits, and expected cost. The agent then runs a 0/1 knapsack optimisation to pick the combination of DERs that meets the required flexibility while respecting cost and user comfort preferences collected from consumer devices.
3. **Dispatch Agent:** Once the best set of DERs is chosen, this agent triggers activation using the Beckn /select → /init → /confirm sequence, following the P415 workflow. It logs every action with timestamped OBP identifiers so the full trail is ready for P444 auditing.

Together, these modules create a fast, modular orchestration loop suitable that fits into Beckn-native flexibility markets.

Agent Workflow

1. **Load Prediction:** Our Load Prediction Agent detects that a feeder is about to exceed its safe limit. It calculates the amount of flexibility required to prevent the overload.
2. **Discovery:** A Discovery Request is sent via Beckn's /search call to find all available DERs published by subscribed aggregators that can reduce load at that moment.
3. **Selection & Optimisation:** Aggregators reply with their /on_search catalogues. The Optimisation Agent evaluates every DER offer, balancing factors like cost, user comfort, and availability. It then runs a 0/1 knapsack optimisation to choose the best combination of DERs that can reliably deliver the required kW.
4. **Dispatch:** The Dispatch Agent activates the selected DERs using Beckn /select → /init → /confirm, aligned with the P415 market workflow
5. **Feedback Logging:** Aggregators return execution confirmations from participating DERs and all interactions are automatically logged with OBP IDs for P44 compliant auditing, completing the full sub-5 second detection-to-dispatch loop.

Business Model & Impact

Stakeholders: DSOs, flexibility aggregators, and consumers.

Business Model:
We offer the platform as a B2B SaaS product for DSOs, priced per feeder or zone. Aggregators get simple, lightweight integrations that let them capture customer comfort settings without adding friction to their apps.

Impact:
For DSOs: Automated, transparent activation lowers congestion costs and reduces the need for costly reinforcement.
For Consumers: Comfort and incentive preferences ensure actions stay fair and user-aligned, encouraging participation.
For Regulators: OBP-tagged logs and clear optimisation steps P415/P444 settlement, increasing trust and auditability.

Overall, this system improves reliability, reduces costs, and supports a more flexible, resilient low-carbon grid.

References / Inspiration

Digital Energy Grid (DEG) Vision Paper
Beckn Protocol Specifications
Ofgem P415 & P444 flexibility reforms
0/1 Knapsack Optimisation Framework

Declarations