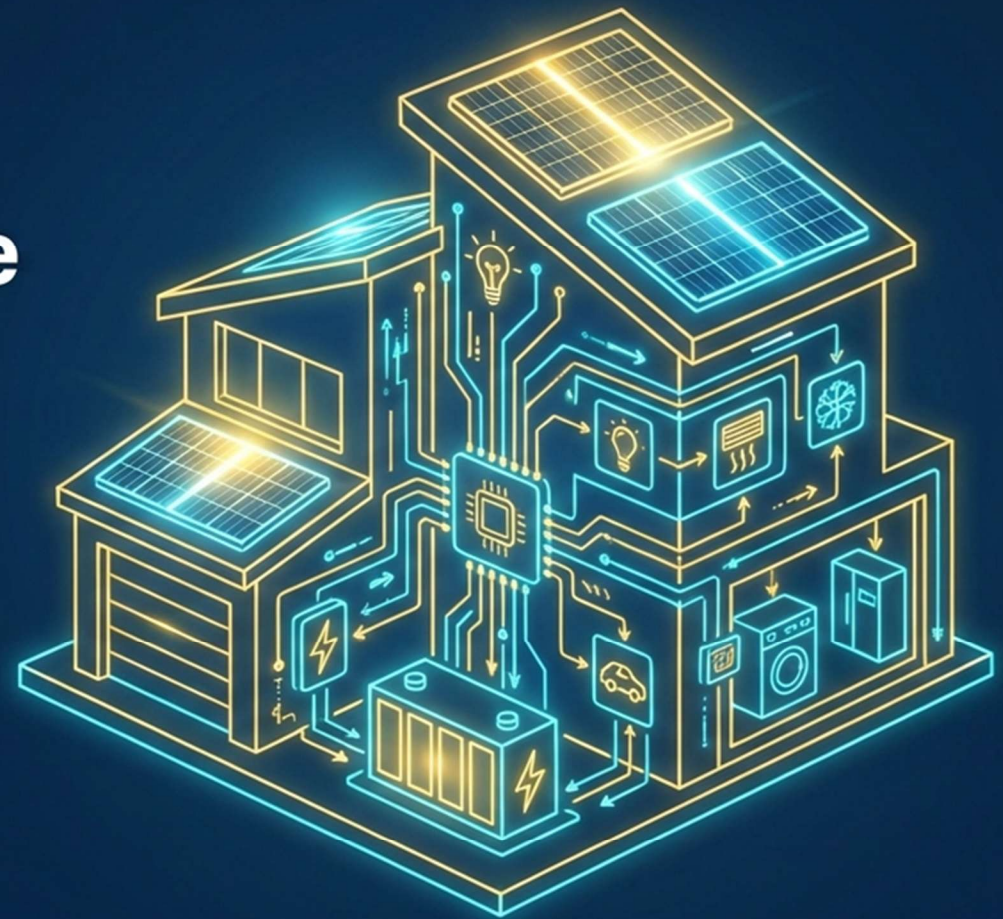


Design and Implementation of a BDI-Style Smart Home Energy Manager

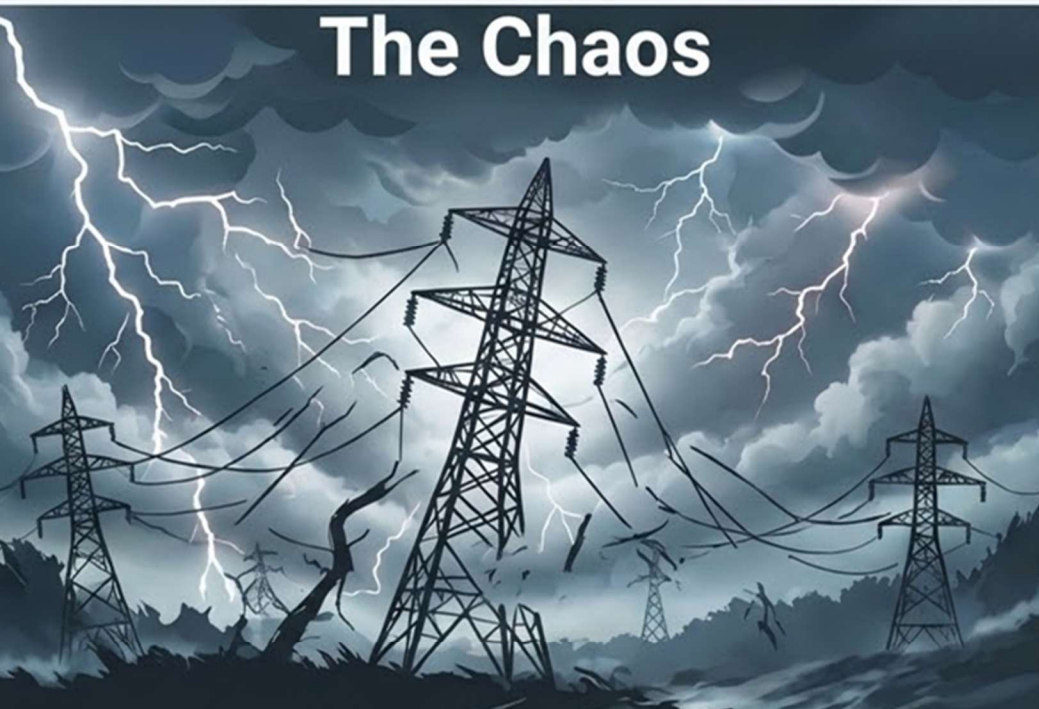
System:	SHEM (Smart Home Energy Manager)
Student:	Ryan Nii Akwei Brown (1357610)
Course:	Designing Intelligent Agents (DCIT 403)



SHEM with Ryan

Centralized Systems **Fail** in Dynamic Environments

The Chaos



The Problem: Static scripts cannot adapt to stochastic weather or random grid blackouts.

The Calm

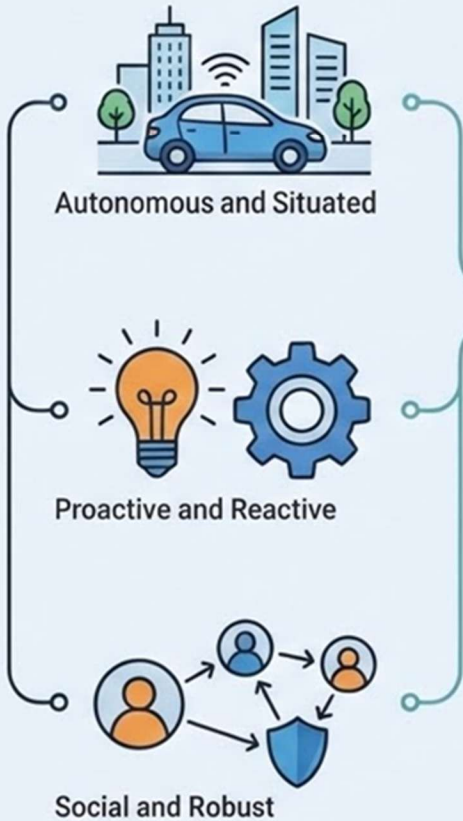


The Solution: A Multi-Agent System (MAS) autonomously balances free solar energy against battery preservation.

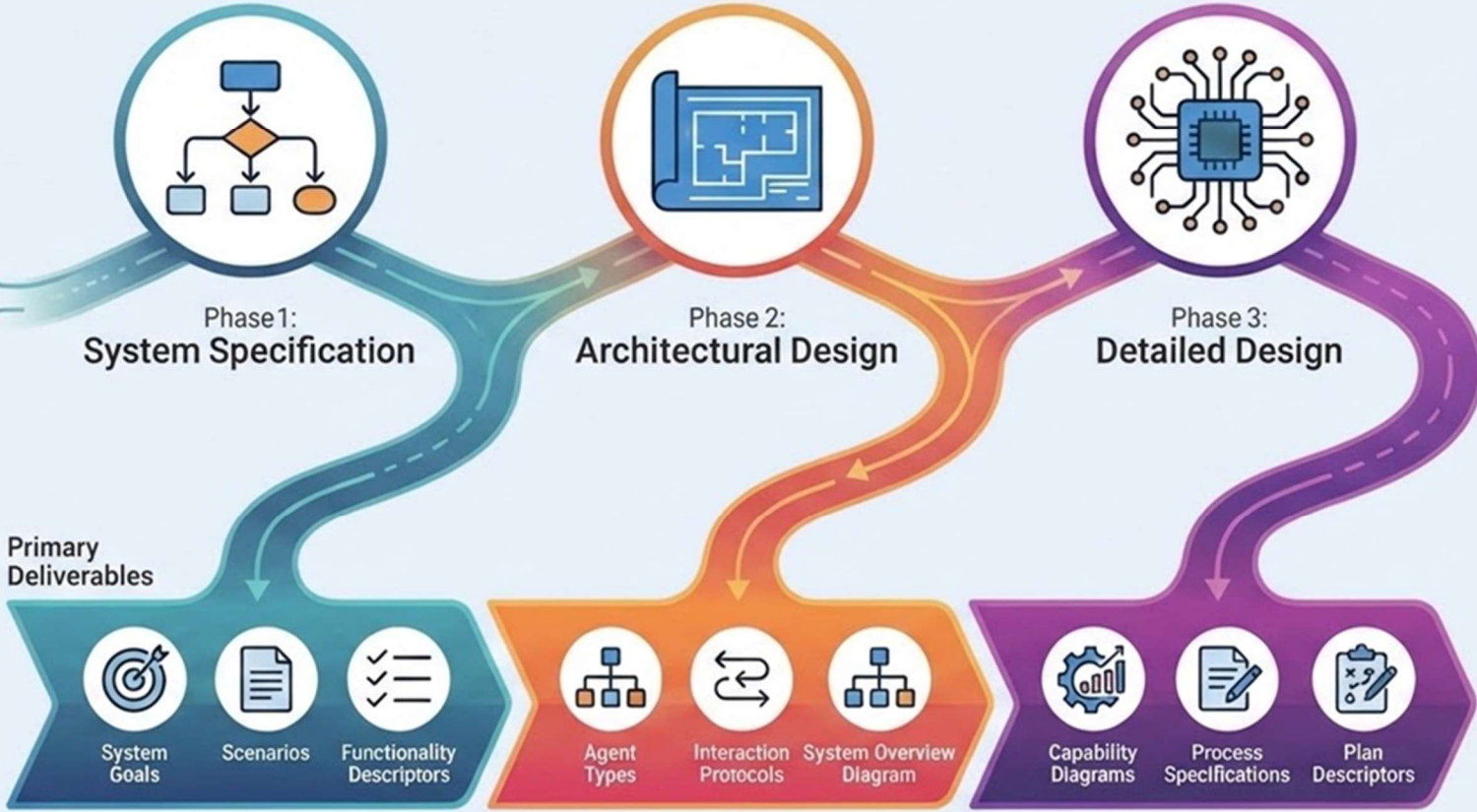
The Benefit: 100% uptime for critical appliances and maximum energy cost savings.

The Prometheus Methodology

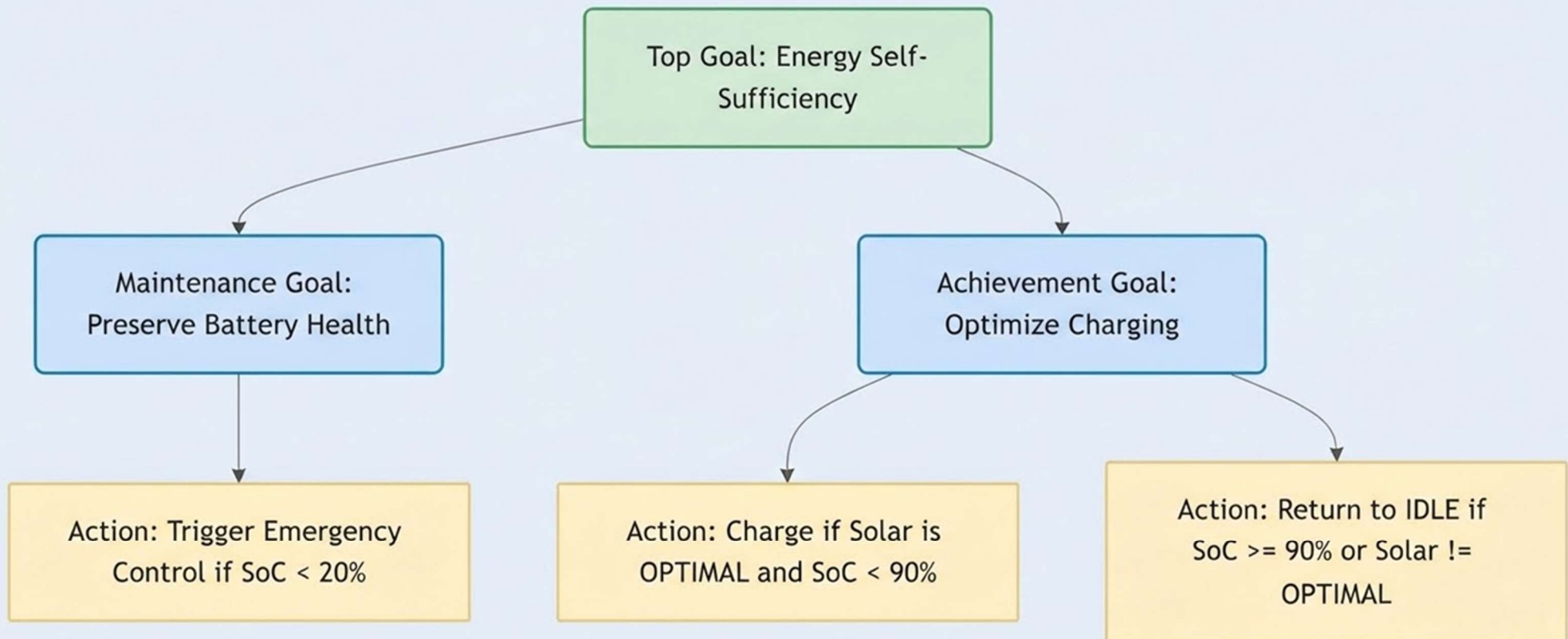
What is an Intelligent Agent?



The Three Phases of Prometheus



Engineering Rationality Through Competing Goals



Autonomous Responses to Stochastic Edge Cases



Optimal Charging

Trigger: Sun shining, Battery < 100%.
Response: Route maximum power to battery.



Stochastic Clouds

Trigger: Sudden drop in solar wattage.
Response: Dynamically transition to IDLE; maintain standard loads.



Critical Depletion

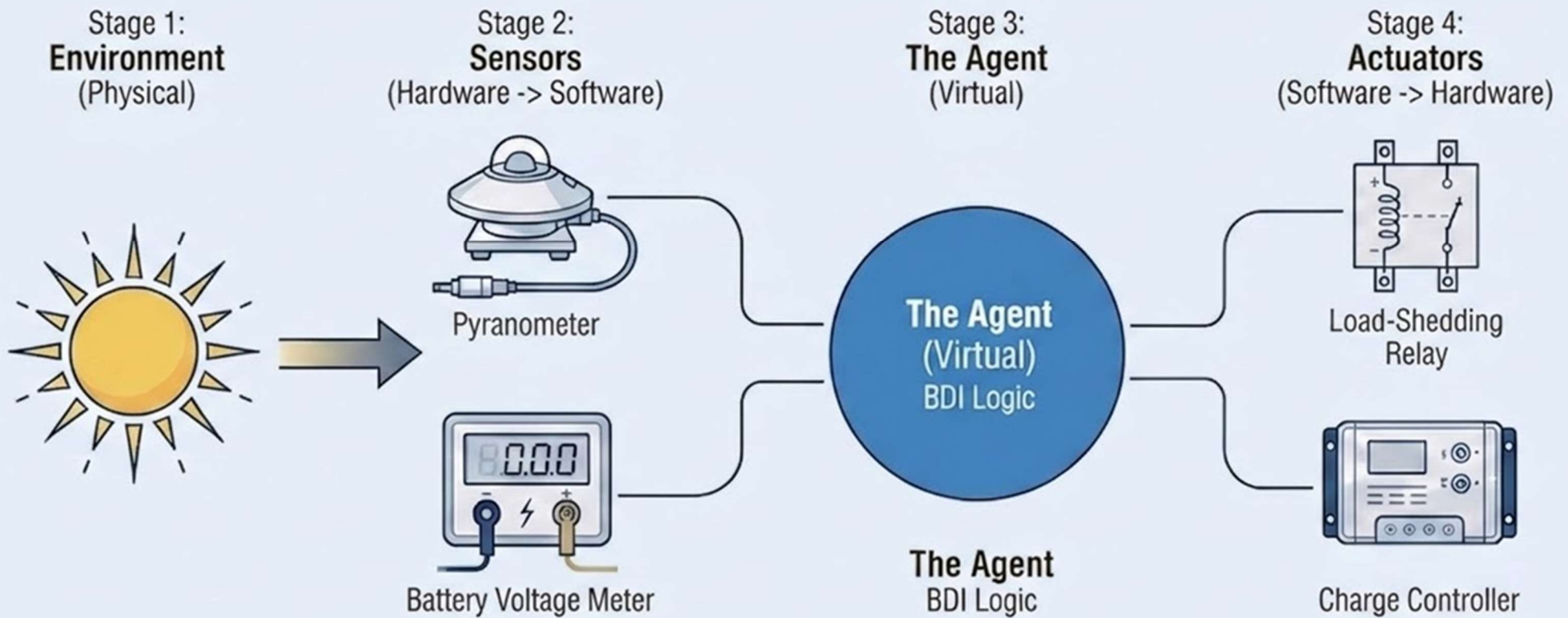
Trigger: Power drops to 19%.
Response: Trigger EMERGENCY state; shed non-essential loads.



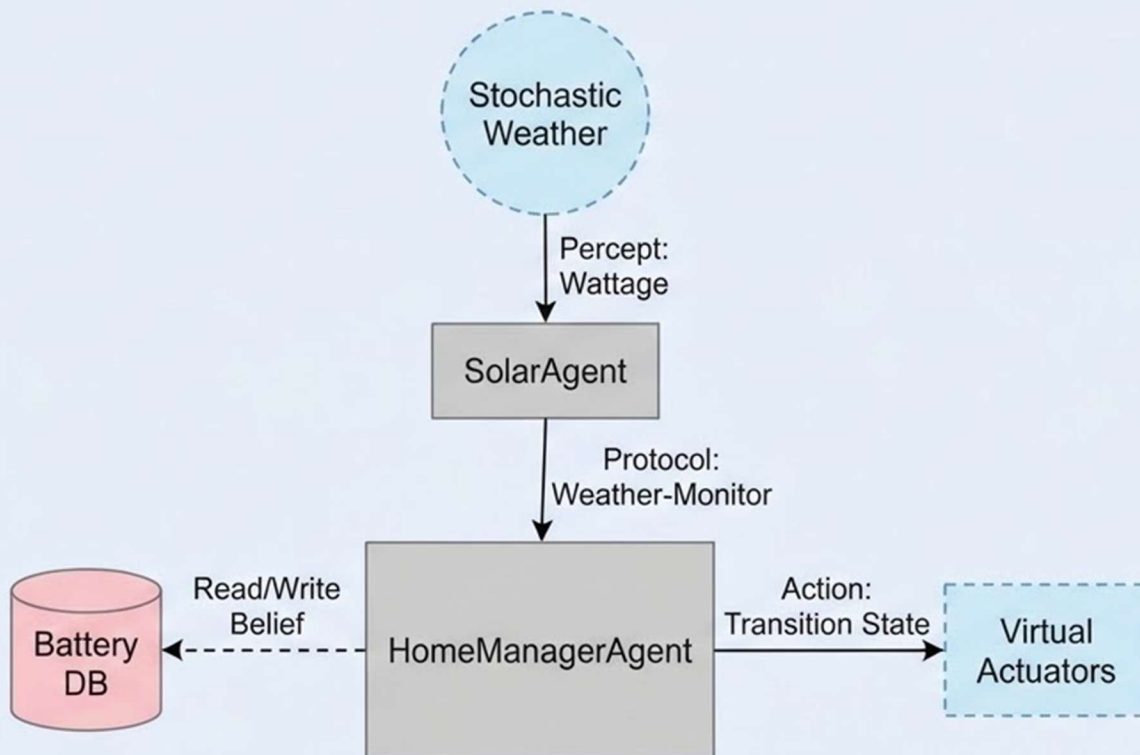
Sensor Failure

Trigger: Solar sensor disconnects (>10s).
Response: Fall back to internal decay model (SYSTEM_CHECK).

Bridging IoT Hardware and Virtual Agents



System Boundaries and Agent Classification



SolarAgent (Reflex)

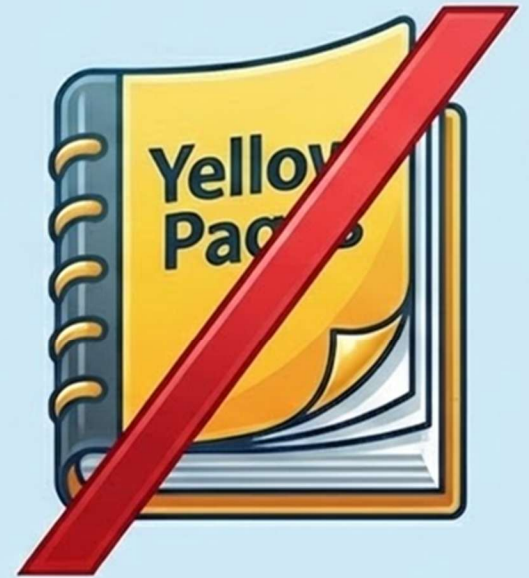
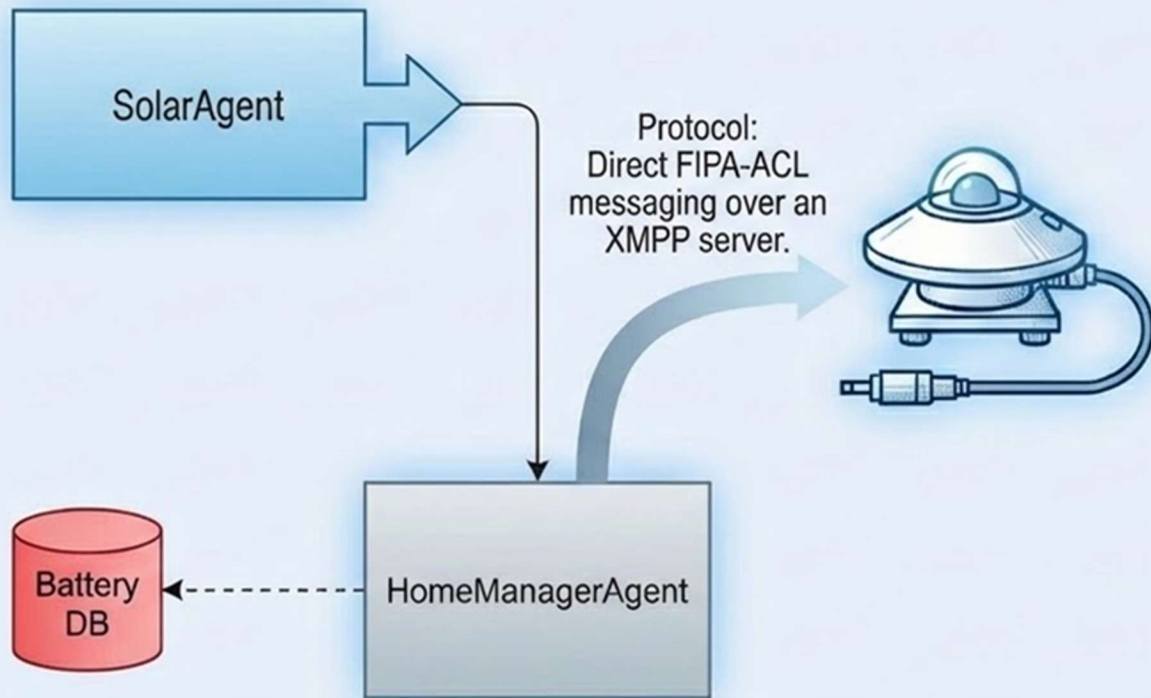
Sense-act cycle. Categorizes weather (OPTIMAL/LOW) with zero historical memory.

HomeManagerAgent (BDI Brain)

Model-based. Maintains internal Beliefs (State of Charge) and executes long-term Plans based on incoming percepts.

Asynchronous Communication and Service Discovery

Agent Acquaintance Diagram

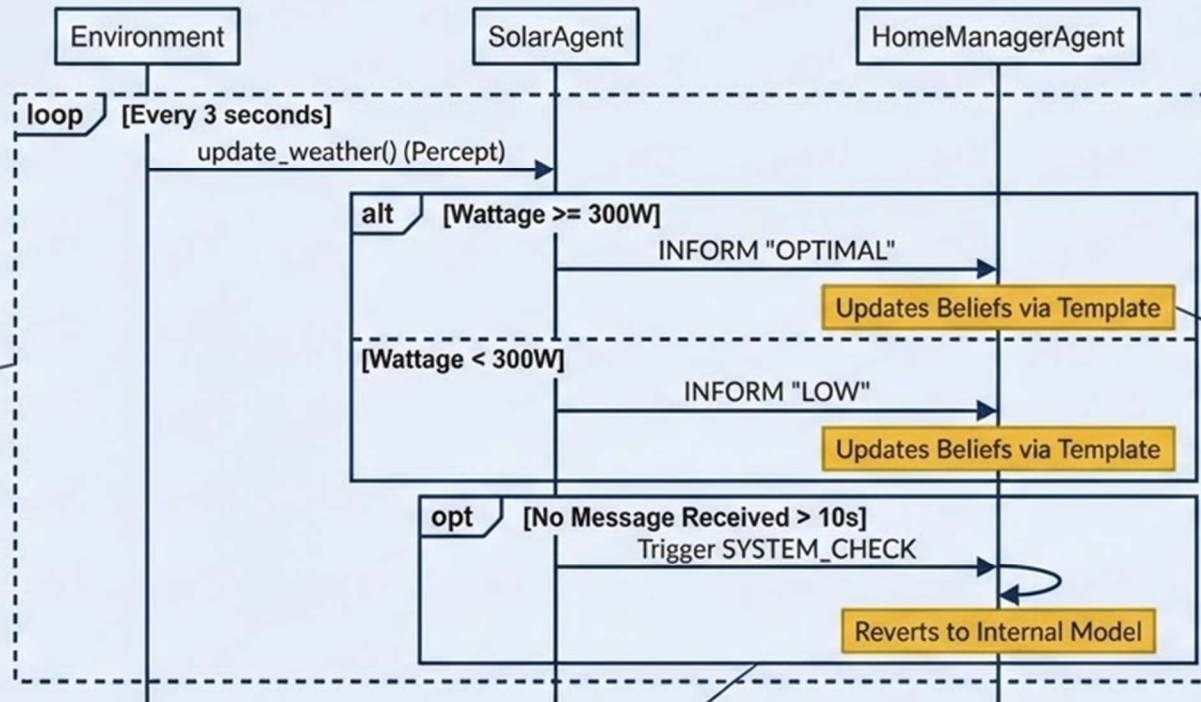


The Constraint: SPADE 4.0.3 deprecates the Directory Facilitator (spade.df).

The Solution: Hardcoded XMPP contacts used in place of dynamic 'Yellow Pages' service discovery to maintain rapid, asynchronous routing.

Formalizing the Weather-Monitoring Protocol

AUML Weather-Monitoring Protocol



3-Second Loop:
Continuous environmental perception via FIPA-ACL INFORM

Symbolic Payloads:
Translating raw wattage to actionable states

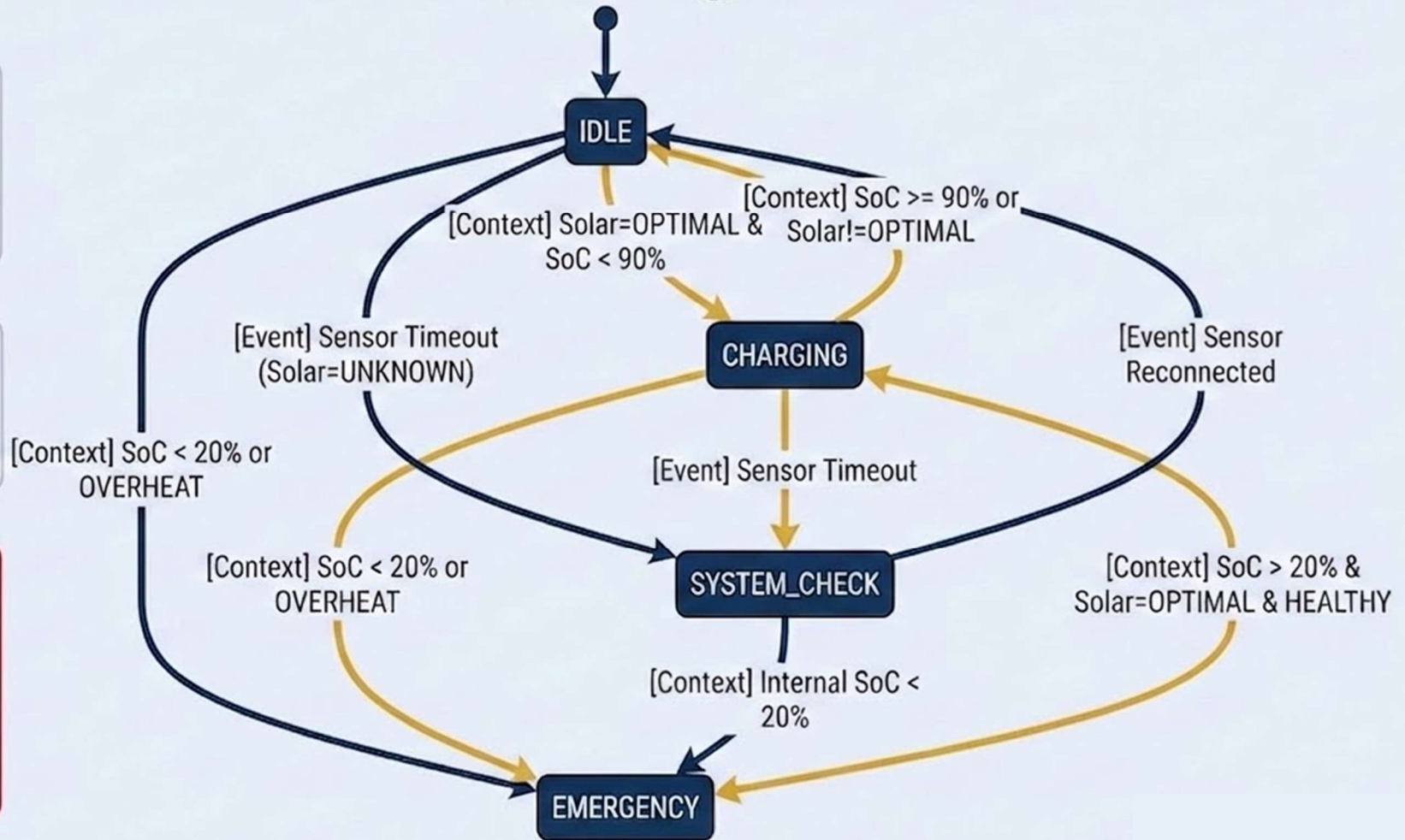
Robustness Guard: The 10-second timeout block ensuring the manager detects a dead sensor and acts autonomously.

The State Logic

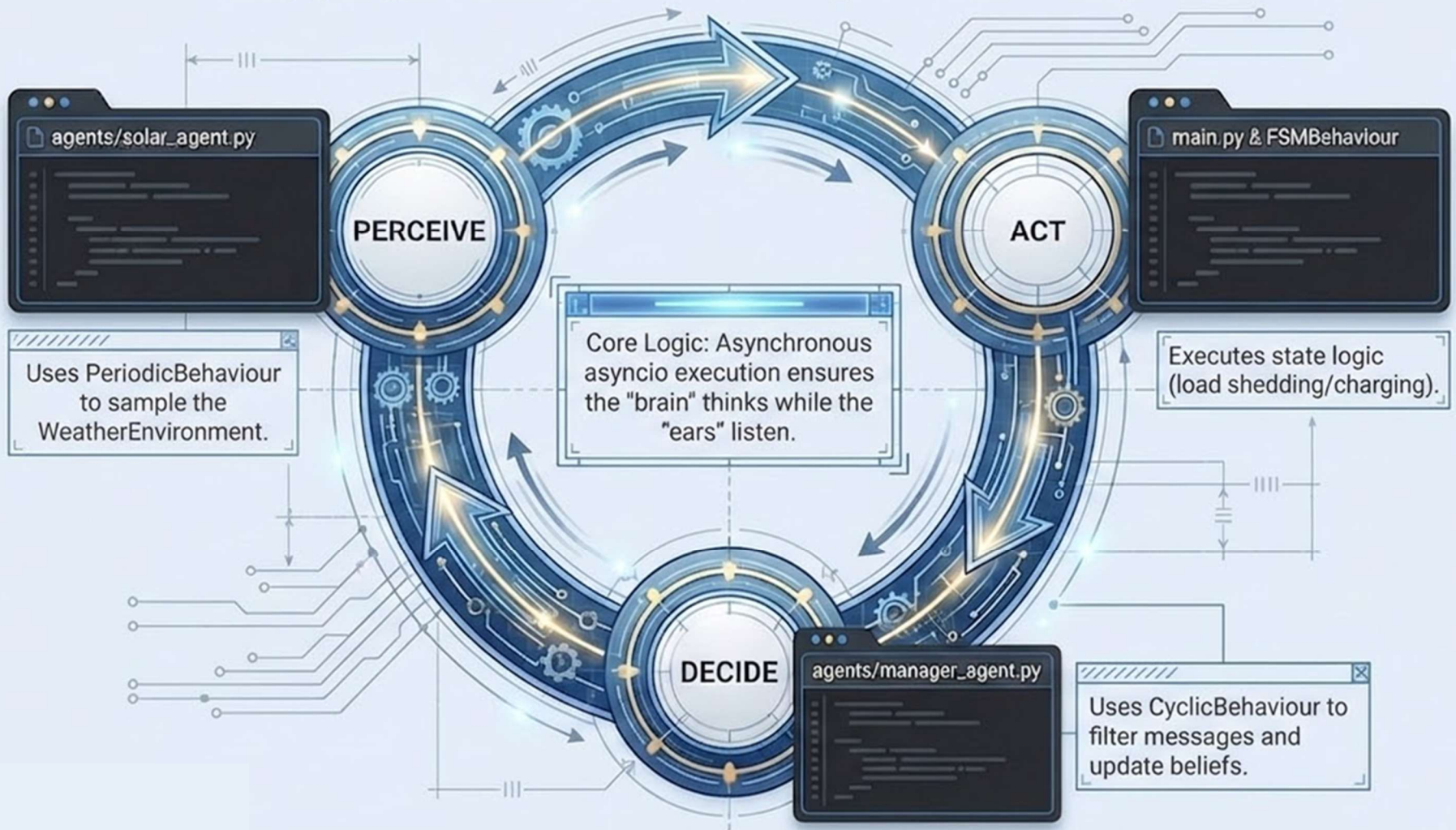
Capabilities:
EnergyMonitoring
(parses messages) +
BatteryManagement
(executes FSM).

Belief Updates:
Internal State of
Charge (SoC) model
dictates all transitions.

Rational Safeguard:
The stochastic 5%
"overheat" event
immediately forces an
EMERGENCY state,
overriding the
charging plan.

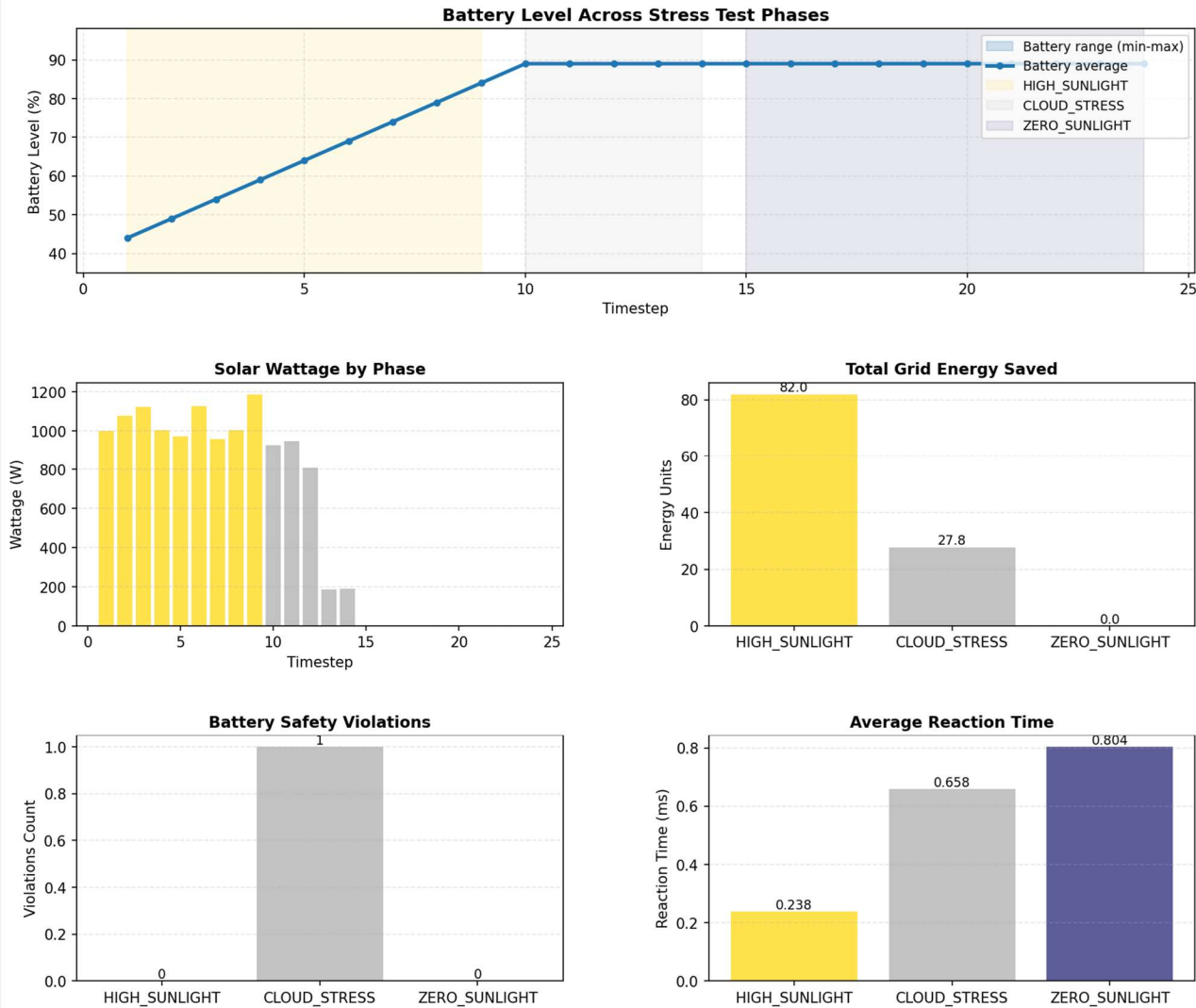


Mapping Prometheus Theory to SPADE Python

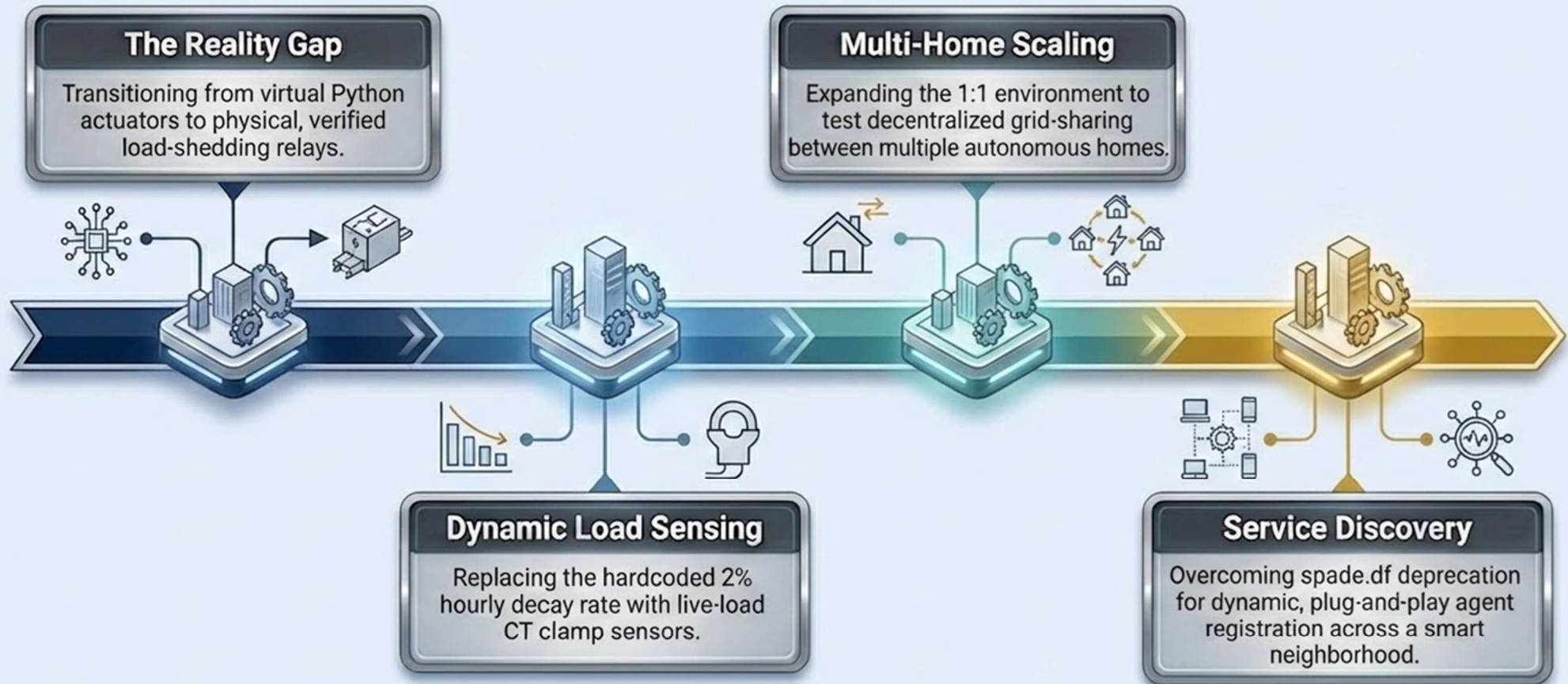


Indeed,
the agent
approach
is working

SHEM System Performance Dashboard



System Limitations and Real-World Deployment



SHEM with Ryan

Thank You!

Ryan Nii Akwei Brown

