Blog Post 1: The PANTHEON Blueprint – Architecting Disaster Resilience

The PANTHEON project aims to booster community disaster resilience through a sophisticated Smart City Digital Twin (SCDT) platform. To achieve this, a robust, scalable technical architecture is required to handle vast amounts of data and complex simulations in real-time. This post outlines the high-level structure that powers PANTHEON.

The Layered Approach

To ensure manageability and decoupling of complex components, PANTHEON utilizes a five-layer architecture:

1. **L1 - Data and Persistence Layer:** The foundation responsible for storage. It handles time-series data from IoT devices (registered at second intervals), unstructured big data, and simulated data using technologies like InfluxDB, PostgreSQL, and MongoDB.
2. **L2 - Models Layer:** Manages the lifecycle of Machine Learning (ML) and simulation models, including their creation, parameter adjustment, and retrieval for specific tasks.
3. **L3 - Backend Services Layer:** The engine room hosting functional modules, synchronous (REST APIs) and asynchronous (message exchange) communication mechanisms, and the core simulation procedures.
4. **L4 - Analysis and Optimizations:** Situated on top of the backend, this layer specializes in advanced processing, such as What-If analysis to measure how data uncertainties impact performance indicators during a disaster scenario.
5. **L5 - Frontend:** The presentation layer providing user interfaces (UI) for visual data analysis, system monitoring, and administration, primarily built using Angular or JSF frameworks.

Key Design Principles

The platform is designed with specific non-functional requirements to ensure reliability during crises:

- **Scalability:** The system supports horizontal scalability by deploying in distributed containerized environments (Docker).
- **Availability:** Critical components, such as the SCDT APIs, target an uptime of **99.9%**.
- **Performance:** The User Interface aims to display pages in less than **2 seconds**, and the SCDT is designed to process requests and deliver simulation results within **240 seconds** for 95% of transactions.