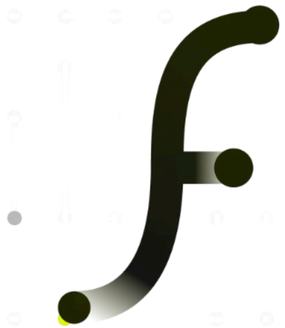


FOLIAGE

Control Plane

Digital Twin

Simulation and Cluster Management Fusion

Anton Katenev
Senior System Architect, Founder
Listware

We build and manage HPC clusters for decades

PCK

Listware

Composable compute platforms for HPC

4 systems in IO500 rating built with Foliage

814.56 TFLOPS/м³

World record in computing and energy density

But who really knows what will happen with your cluster if something went wrong?

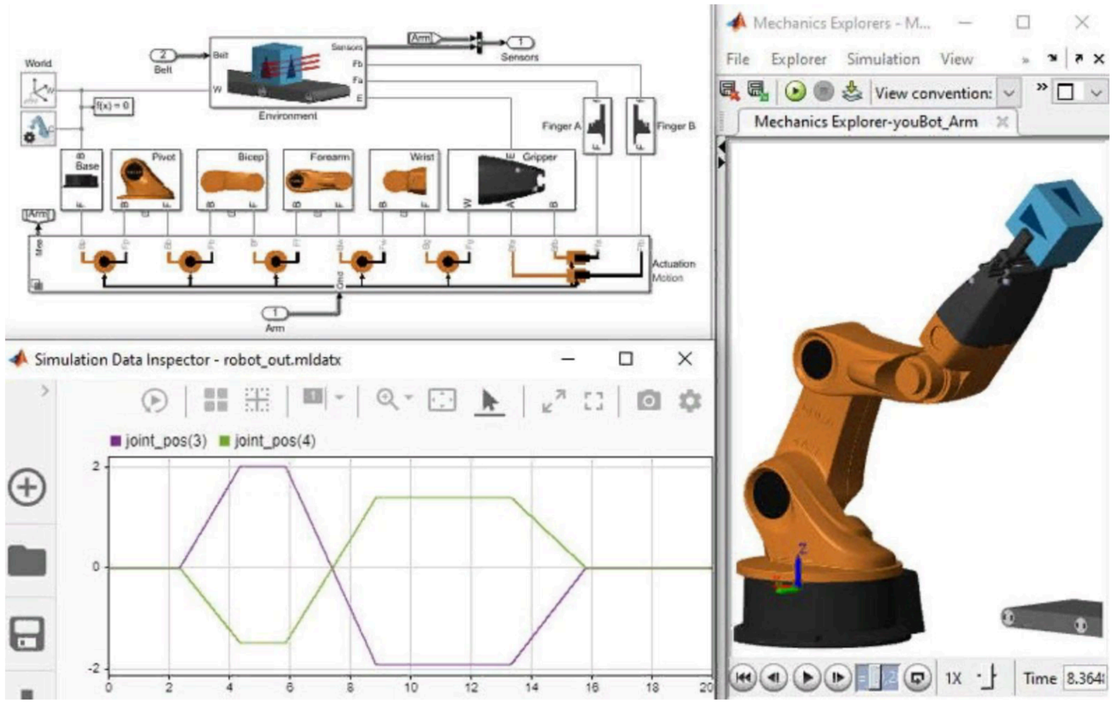
- What will happened with user data on this RAID?
- What other services and systems are depending and will be affected?
- What is the best mitigation strategy?

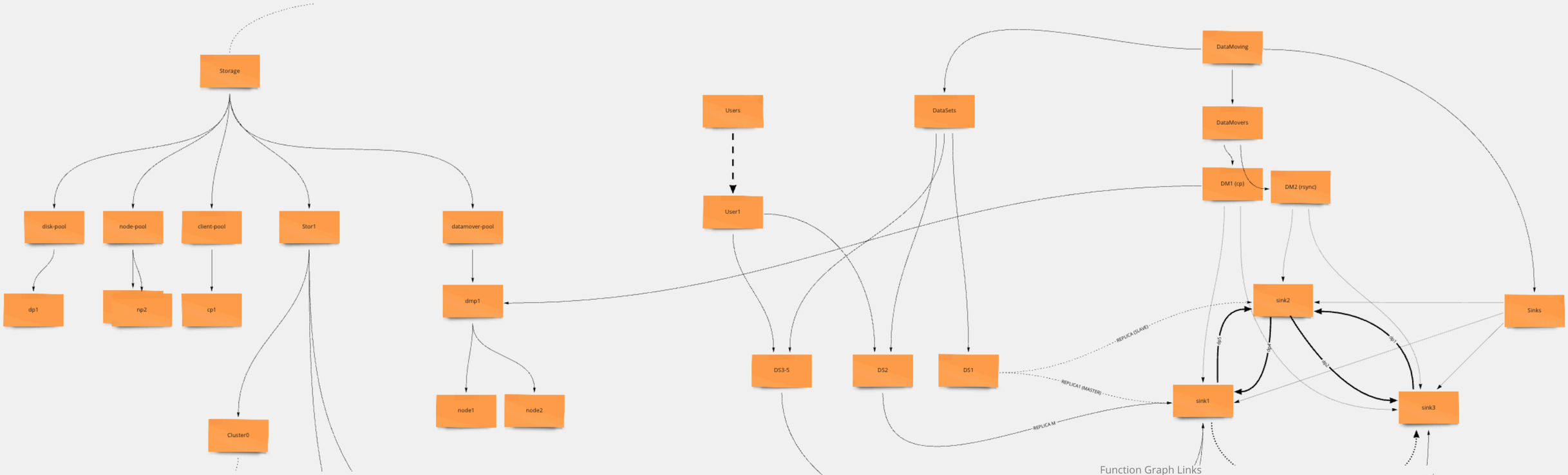
Simulation improves cluster management

- Simulation can increase the quality of cluster management
- Simulation will quantify how much the performance of the various subsystems will degrade

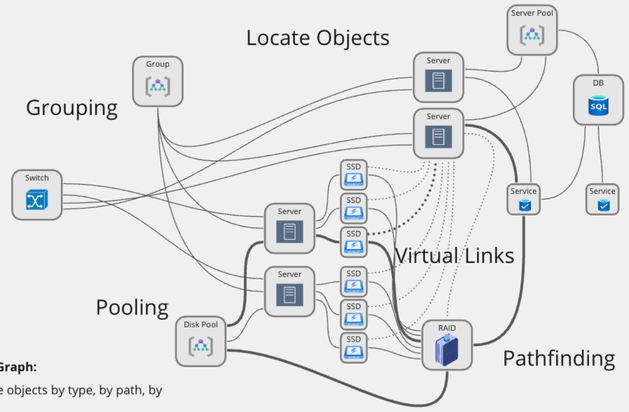
The tool that can predict the impact on object B when object A is acted upon

- Simulations one way or another rely on some kind of circuit or schema
- Prediction accuracy is highly dependent on the data we collect about the system we simulate.
- HPC cluster consists of a huge amount of objects and links between them. Our simulations rely on a graph reflecting HPC cluster





QDSL Query Language

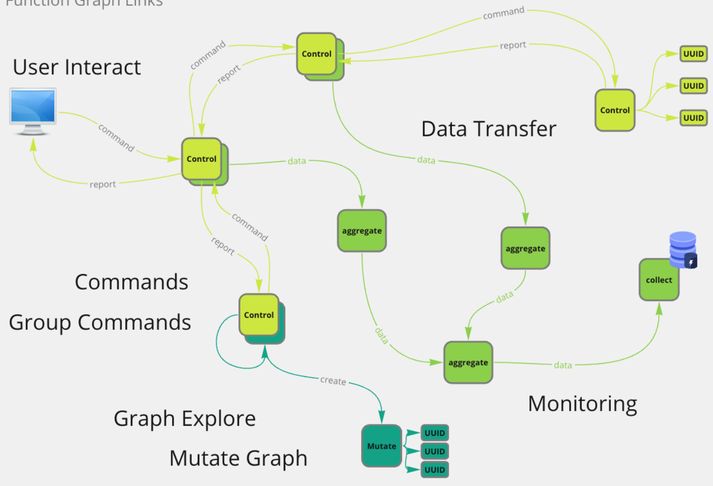


Object and Links Graph:

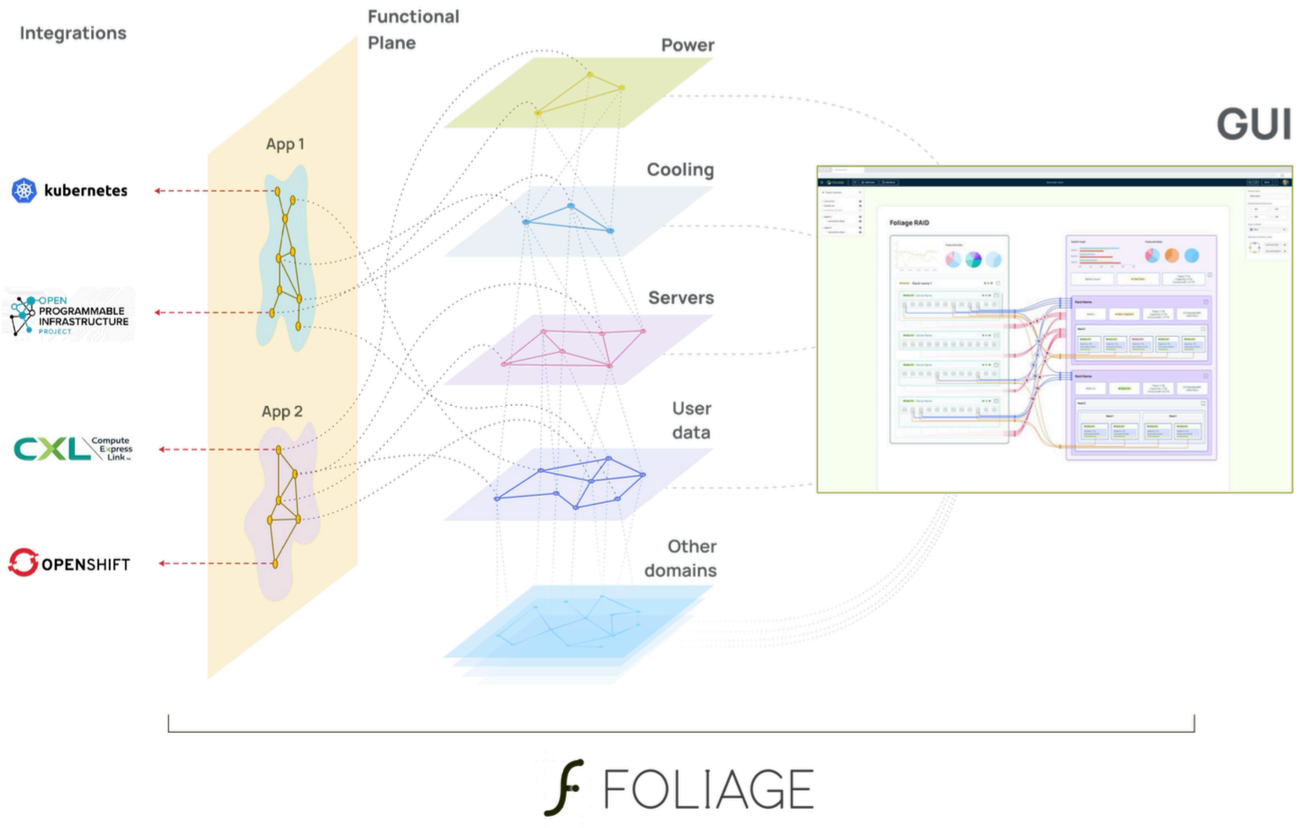
- Find and locate objects by type, by path, by attributes, etc.
- Explore and construct useful paths
- Create virtual links

Any object profile can be used as shared context and information exchange point, between functions, and even between applications

Function Graph Links



Foliage is built on our experience and understanding of this shared environment



Foliage consists of two parts:

- Graph object DB
- App Runtime

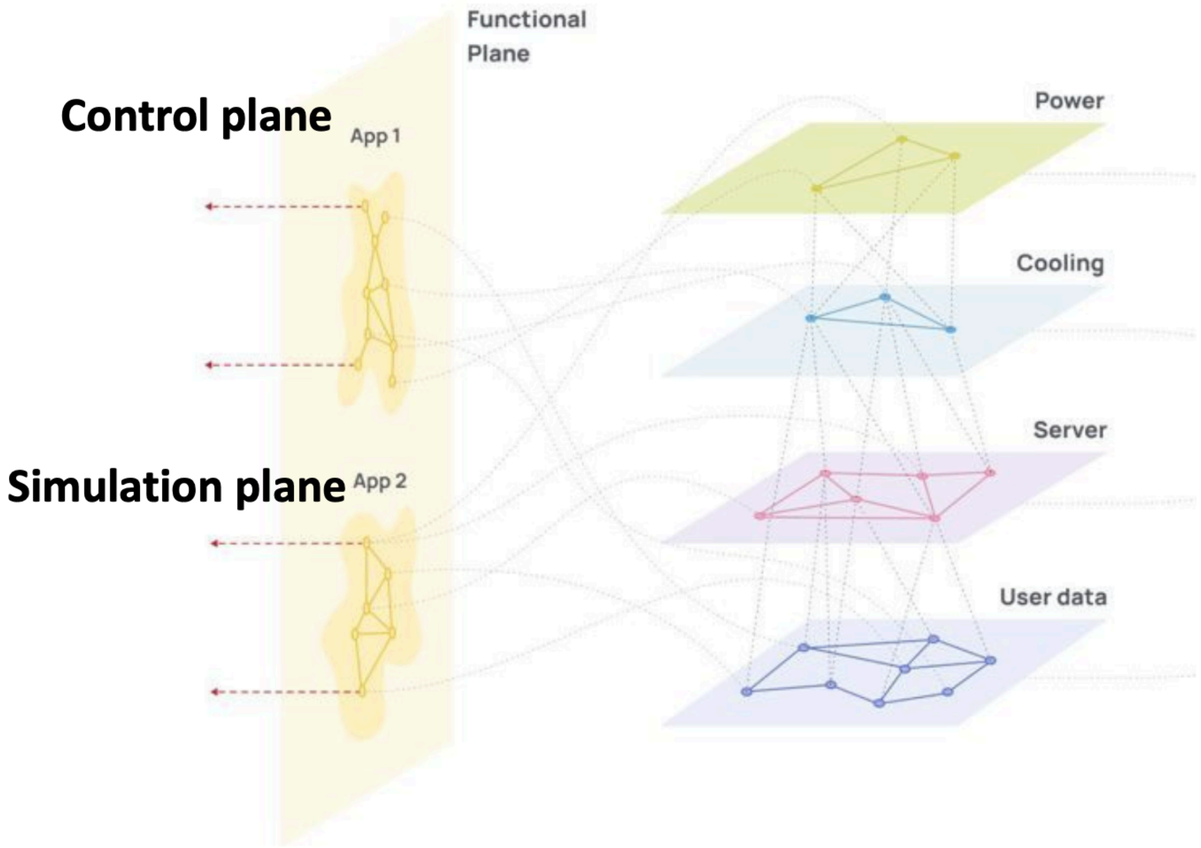
We add hetero-functional graph approach:

- Information pass through edges
- Functions at the vertices process this information

Multi-layer graph becomes functional

System becomes event-driven and asynchronous

Management and simulation systems need to be placed in a shared environment



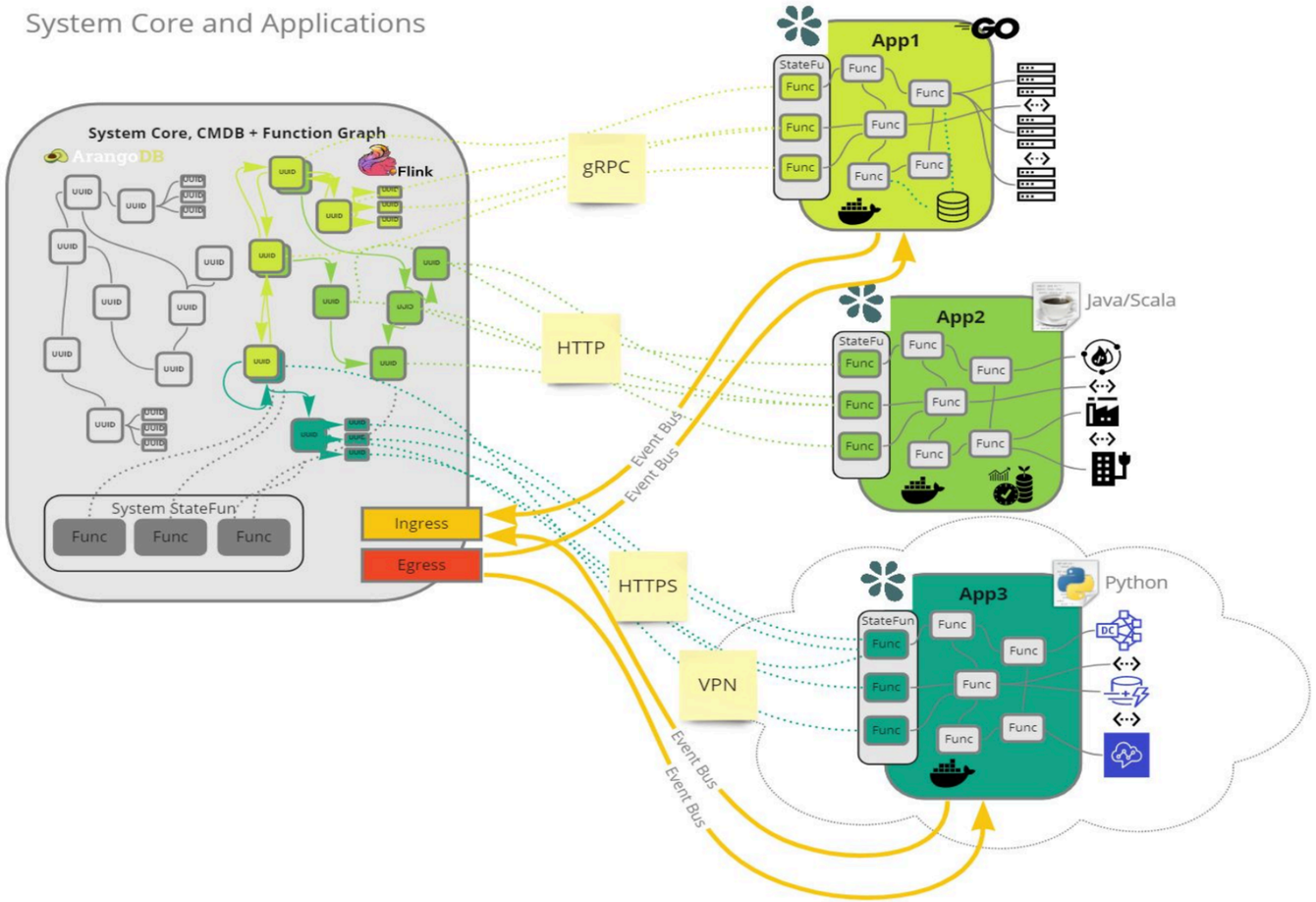
The simulation system (model) needs to be constantly refined. The system prediction is continuously updated.

Both the control system and the simulation system rely on the same data model - they share the same framework.

The control system and the simulation system exchange signals with each other through the data model.

The control system performs virtual actions that are read by the simulation system, which then makes predictions.

Foliage allows integration of arbitrary applications by using adapters



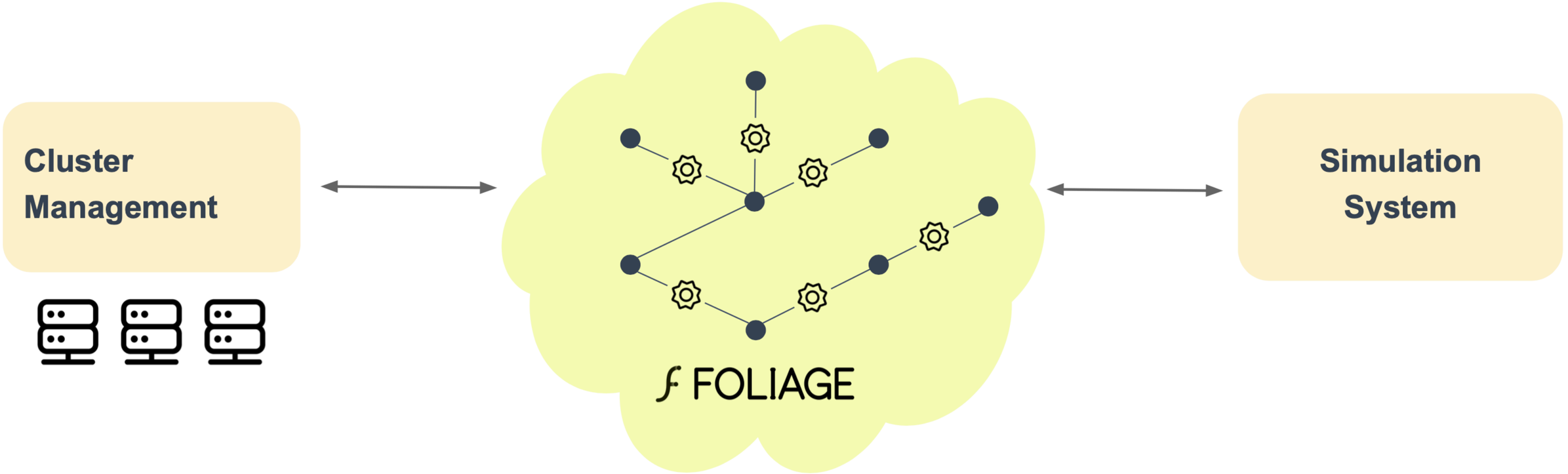
Foliage SDK allows to integrate APIs of any services and all their data structures and entities into a single functional graph space

Such integration will allow services and applications to work directly with each other in a uniform way

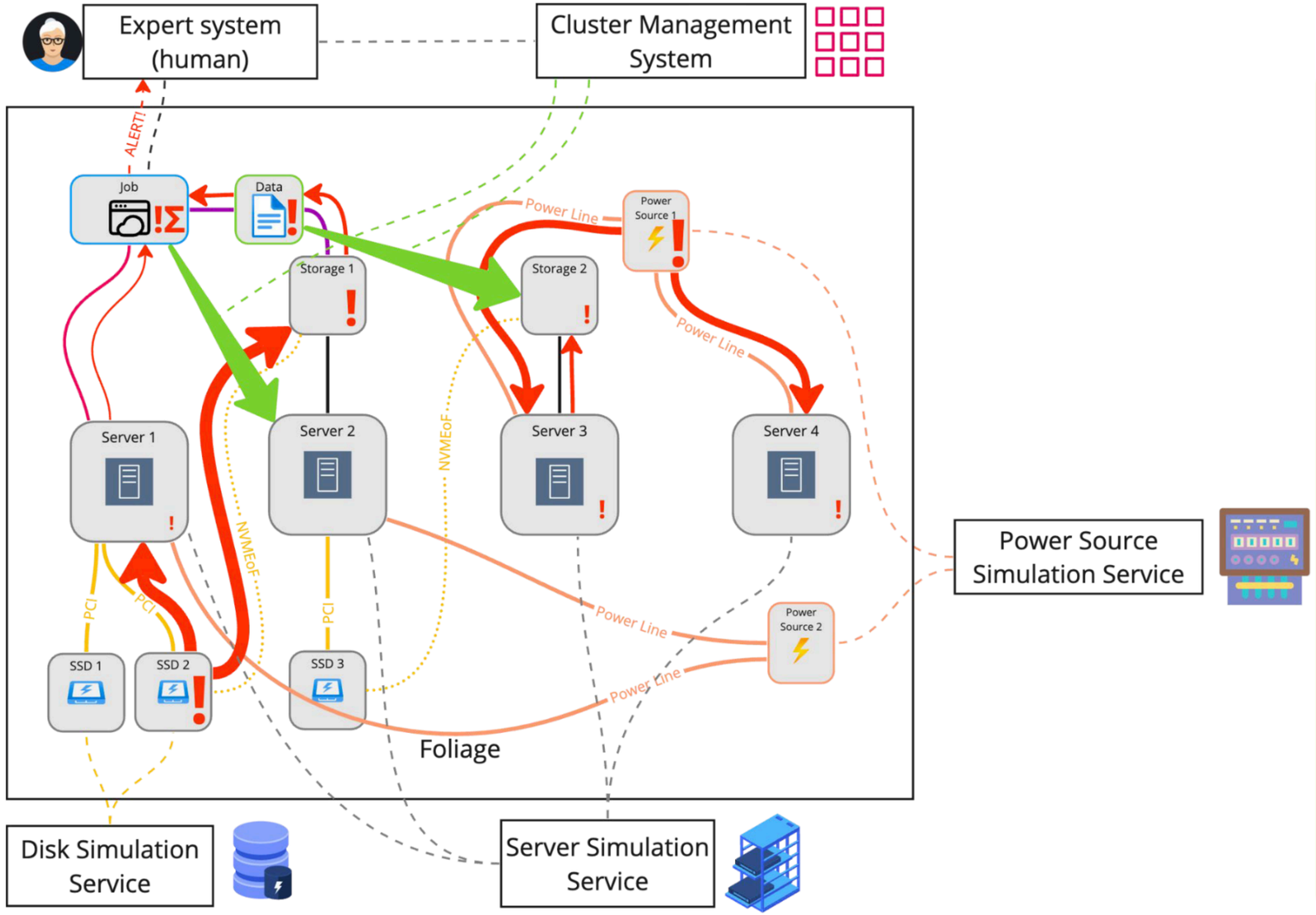
If orchestration is needed it can be achieved by plugging an orchestration service also into the Foliage

Another way is to use the functional environment of the platform that is capable to implement any arbitrary business logic.

We propose to create and connect two types of graph-based applications using Foliage



Uniqueness of the proposed solution on a simple example



Each power supply unit, server, and disk is tied to a simulation service

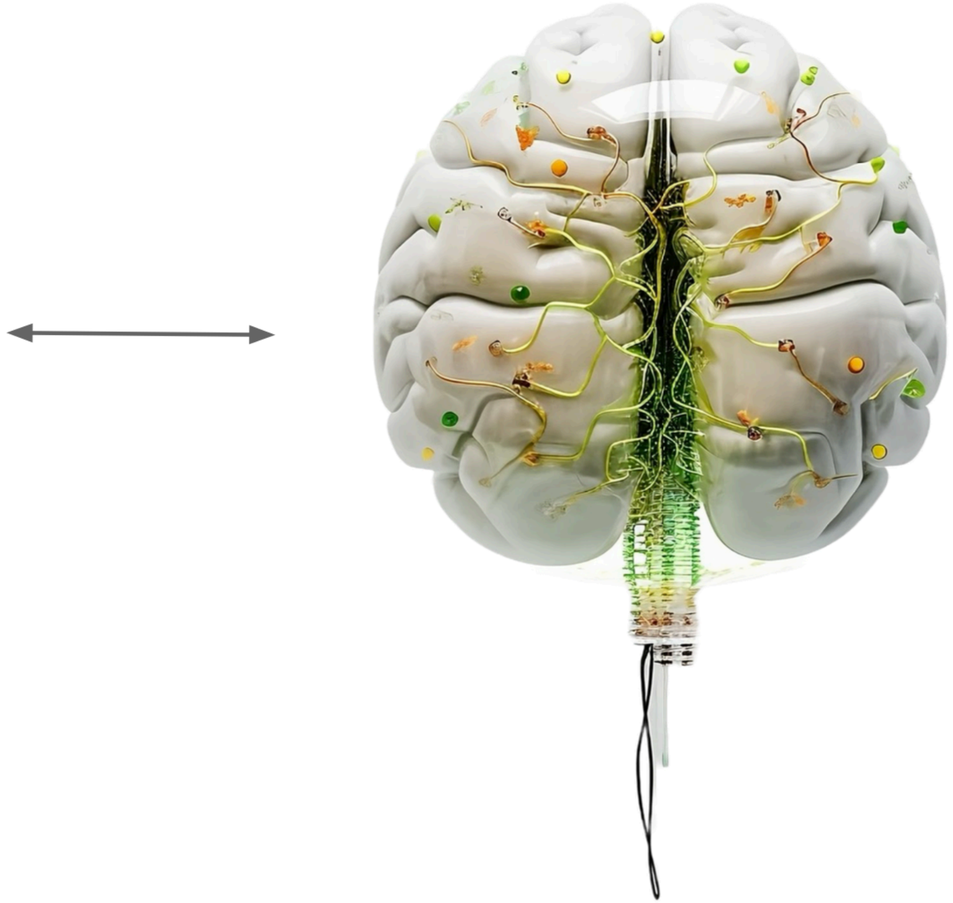
The simulation service predicts the future state of the device

After the prediction, corresponding signals are spread out inside the simulation.

Eventually the running job's reliability is being affected. And its total unreliability is calculated as the sum of unreliability of all objects it depends on

The next stop is a full-fledged AI inside Foliage for better prediction and automation

Cluster Management



FOLIAGE

When a request for next cluster state prediction is made, a corresponding signal will be propagated through the graph, asking each object to evaluate its state at the next moment in time

When that moment comes, the real behavior of objects and the predicted one will be compared and the resulting discrepancy will be used to backpropagate the error