# Using Multi-Agent Microservices (MAMS) for Agent-Based Modelling

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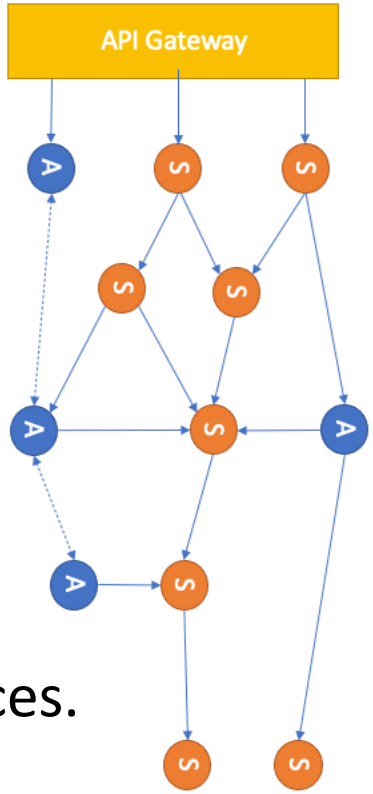
# Multi-Agent MicroServices (MAMS)

(Collier et al., 2019)

- Architectural Style & Framework for embedding MAS technologies within microservices architecture.
  - Enable integration between plain-old microservices (POMS) and agent-oriented microservices (AOMS) **without** the need for the POMS developers to learn MAS concepts.
- Adopts view of agents as **hypermedia entities**.
  - Some (MAMS) Agents are given hypermedia bodies (bodies modelled as a set of resources accessible via the web).
  - External systems use REST to interact with these agents through those resources.
  - The AOMS becomes a black box to the external services.
- Agents are given the capability to interact with other microservices.

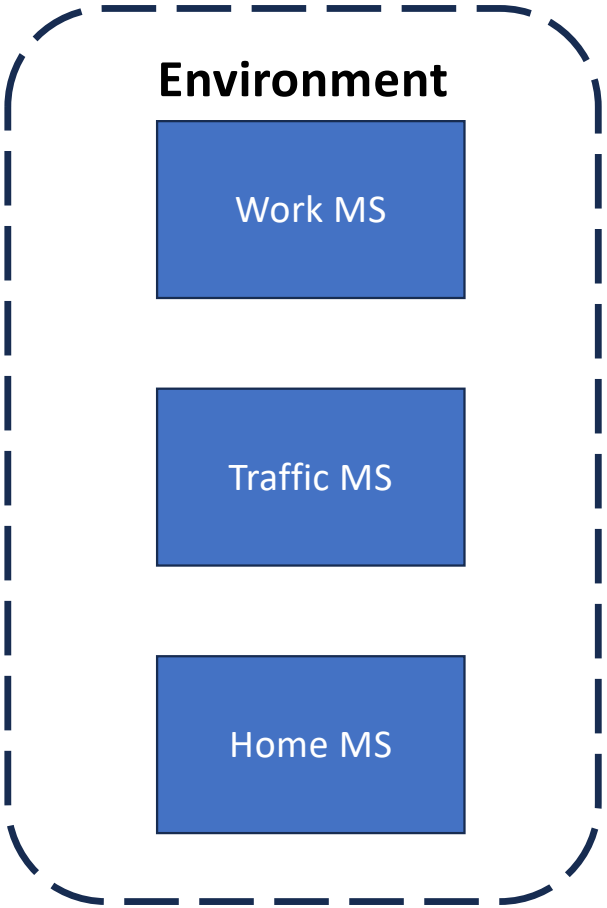


# Hypermedia MAS Simulation

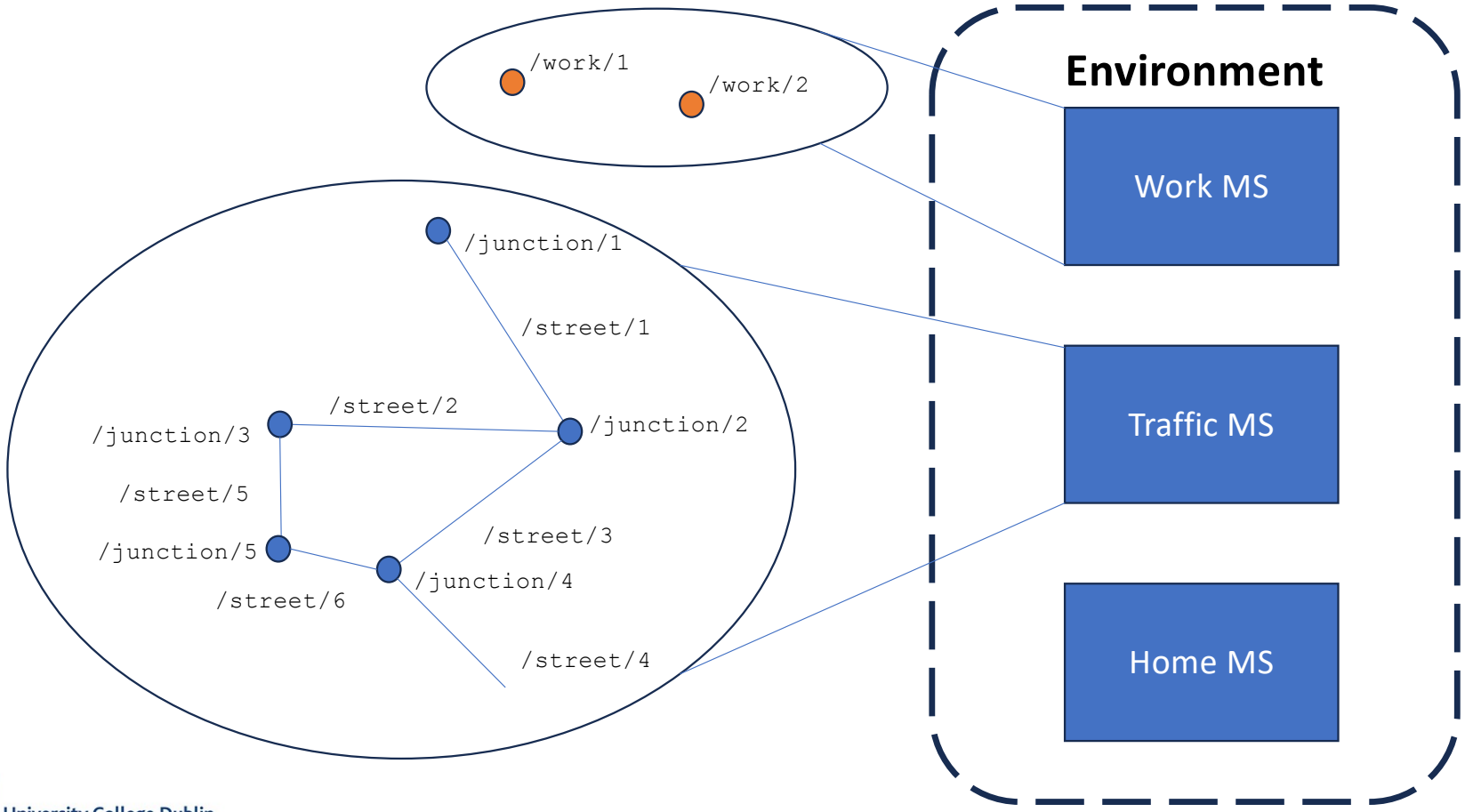
We propose a new framework for the development of **agent-based modelling and simulation** tools that are implemented as hypermedia systems**….**

# The Vision

Decompose the environment into a set of hypermedia resources that are exposed through microservices



# The Vision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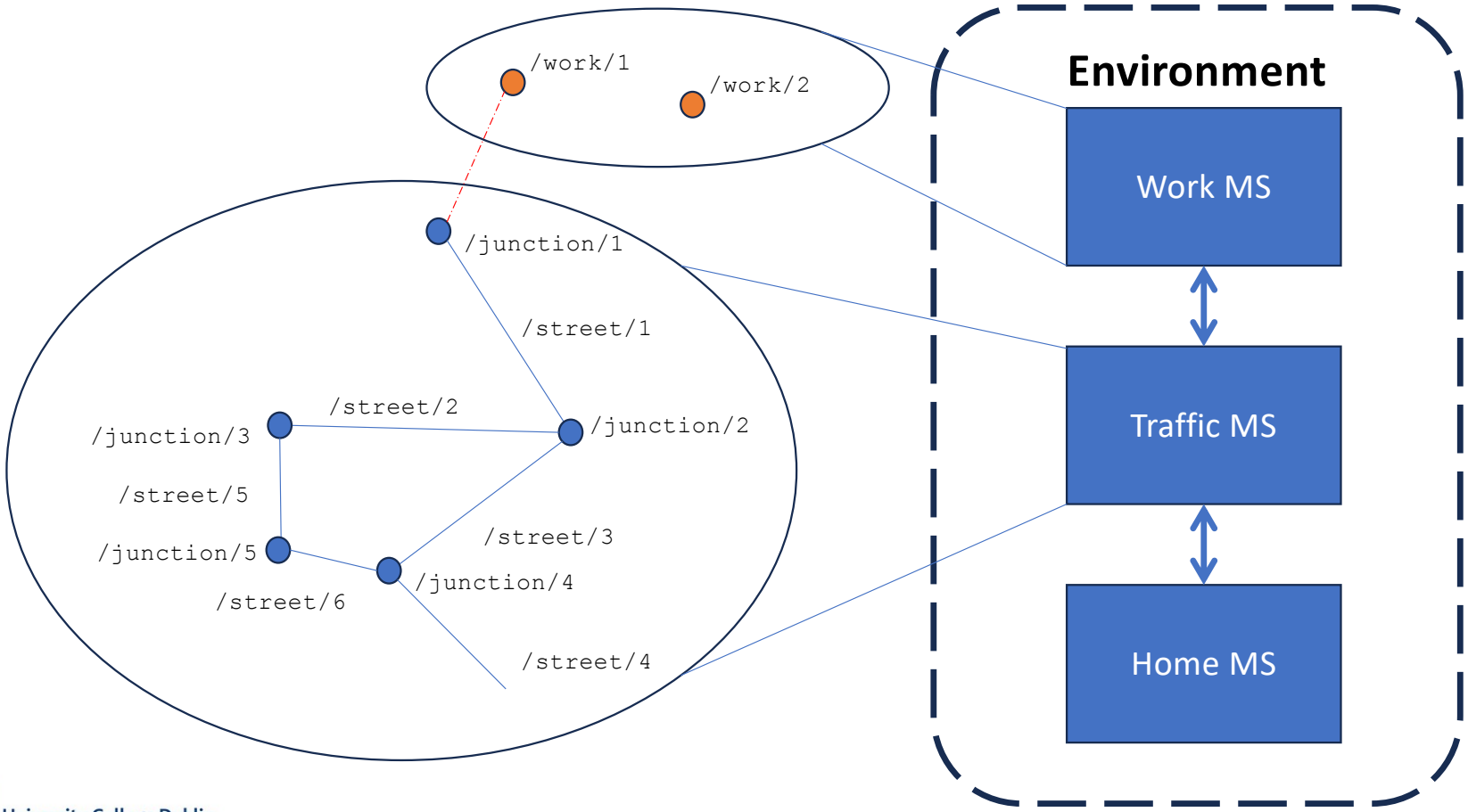
Environment
Work MS
Traffic MS
Home MS

# The Vision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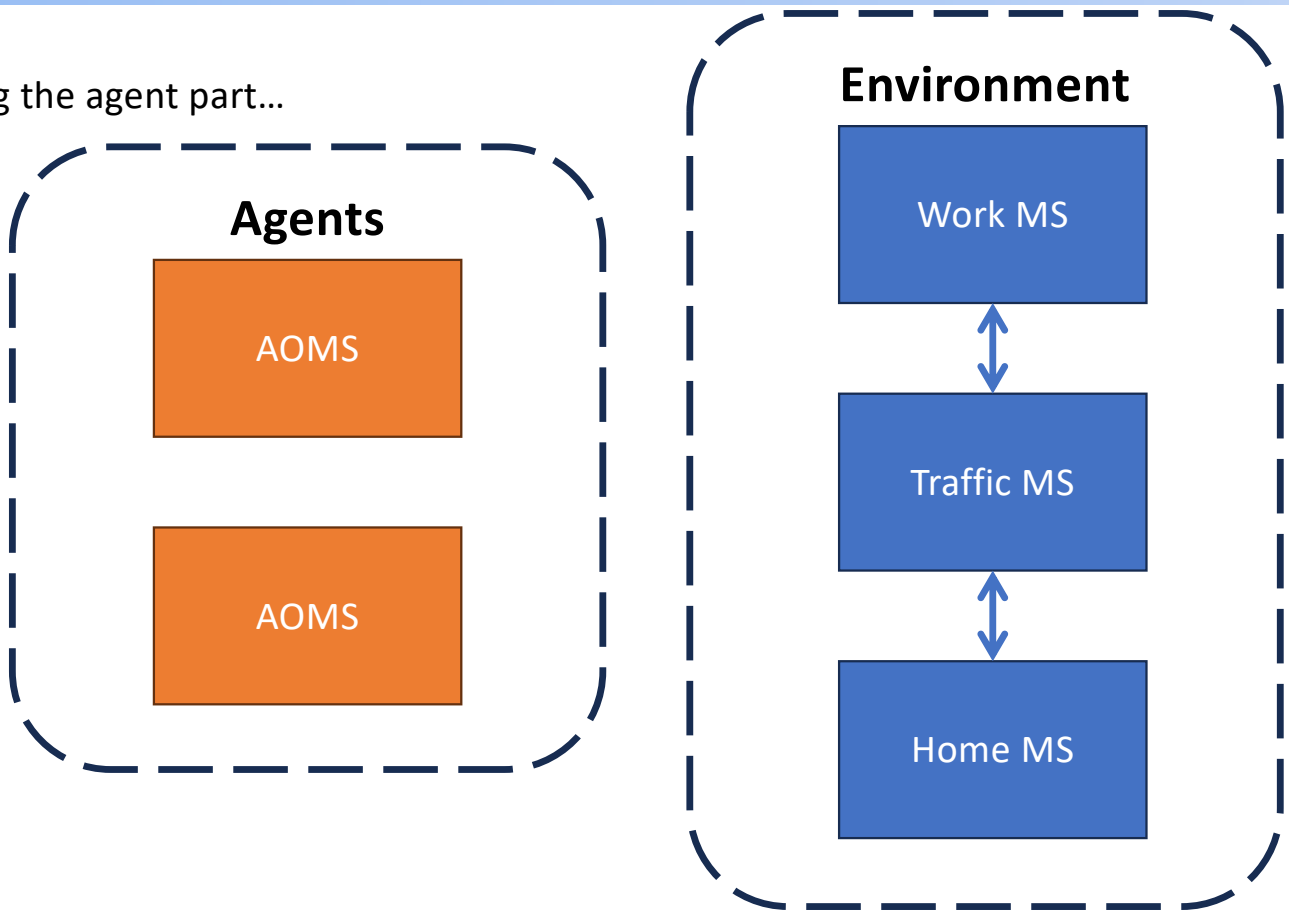
/street/4
Environment
Work MS
Traffic MS
Home MS

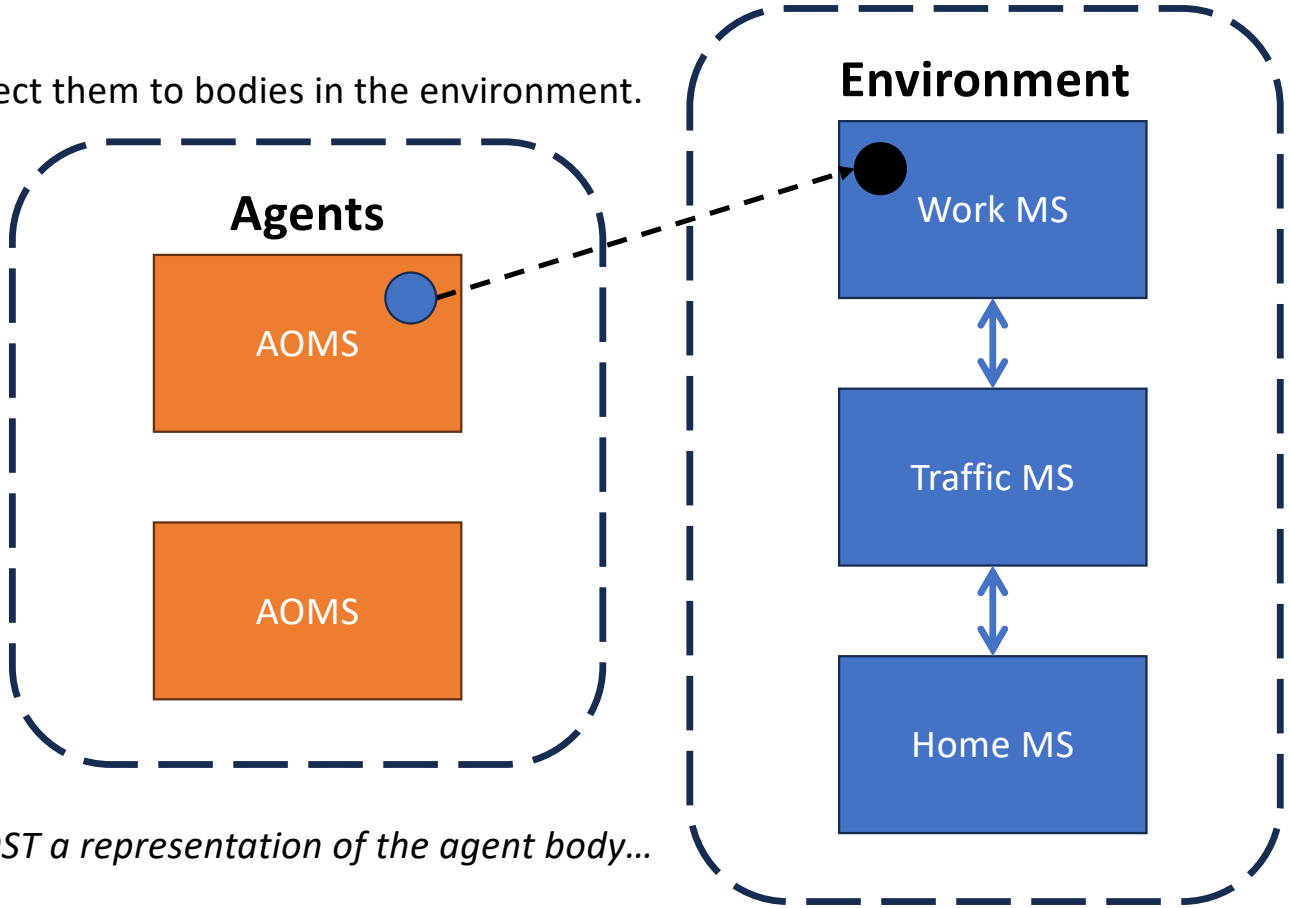
# The Vision

Create AOMS for hosting the agent part…



# The Vision

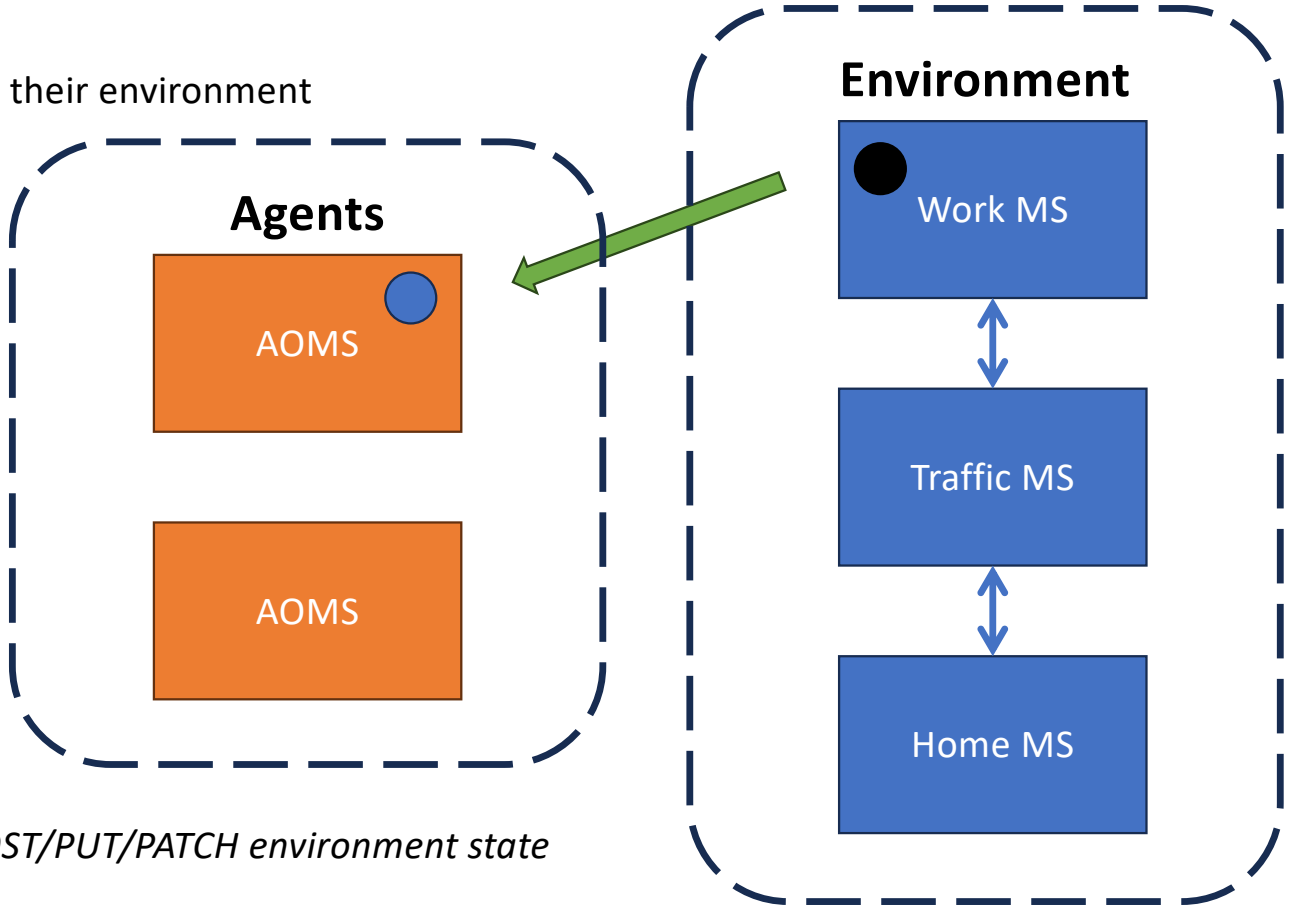
Create agents and connect them to bodies in the environment.




*e.g. POST a representation of the agent body…*

# The Vision

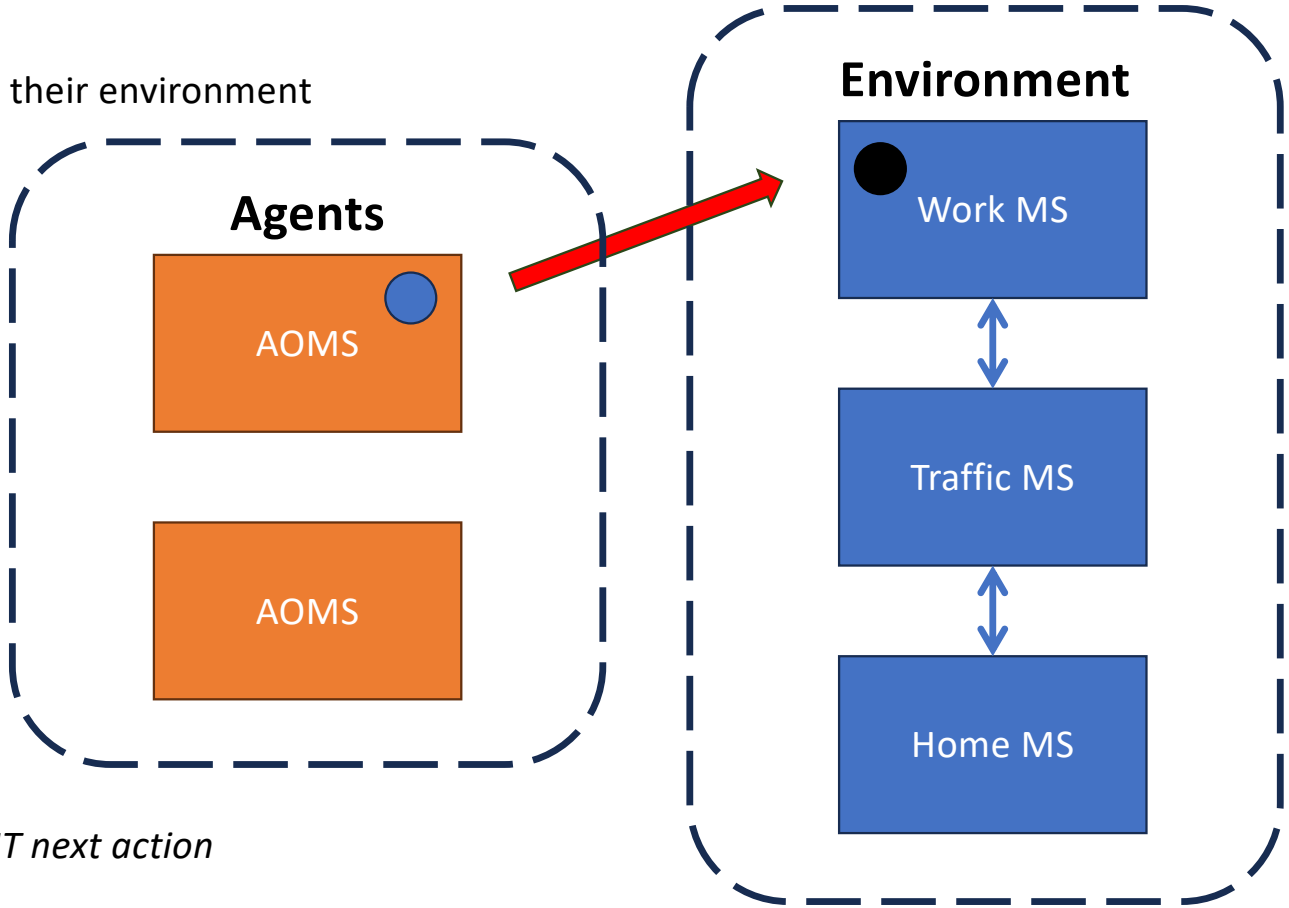
Agents' sense and act in their environment




*e.g. POST/PUT/PATCH environment state*

# The Vision

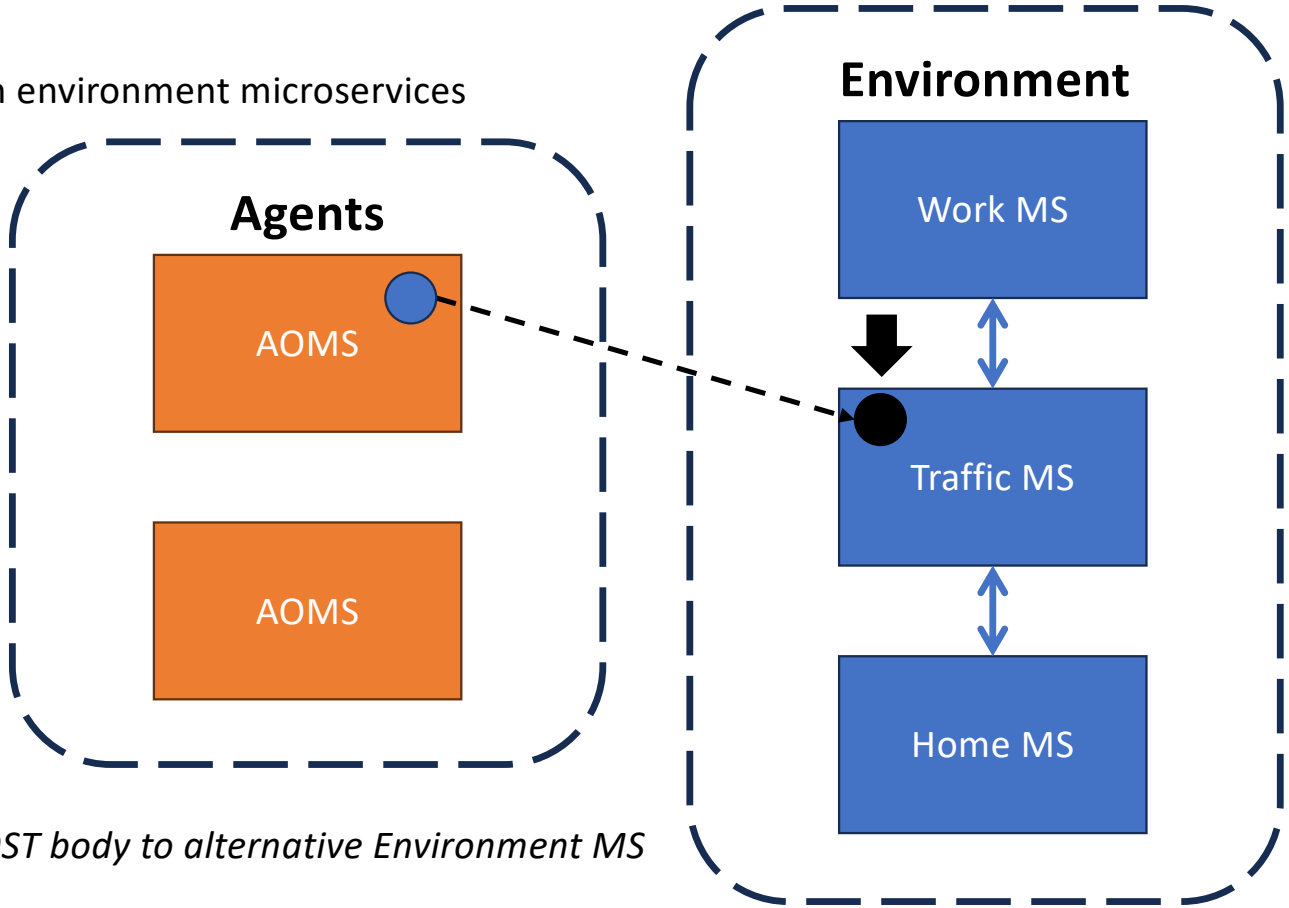
Agents' sense and act in their environment




*e.g. PUT next action*

# The Vision

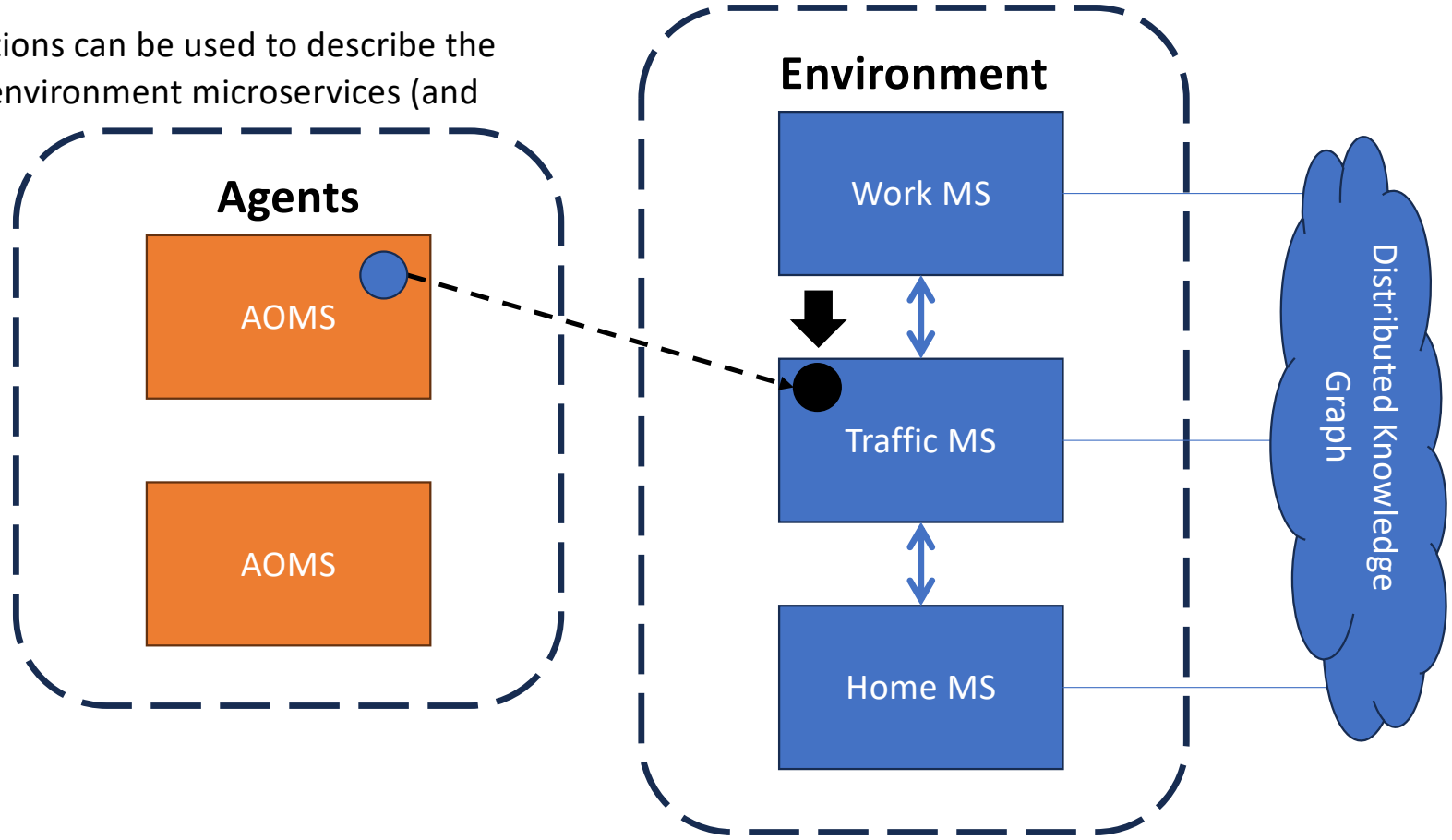
Agents migrate between environment microservices




*e.g. POST body to alternative Environment MS*

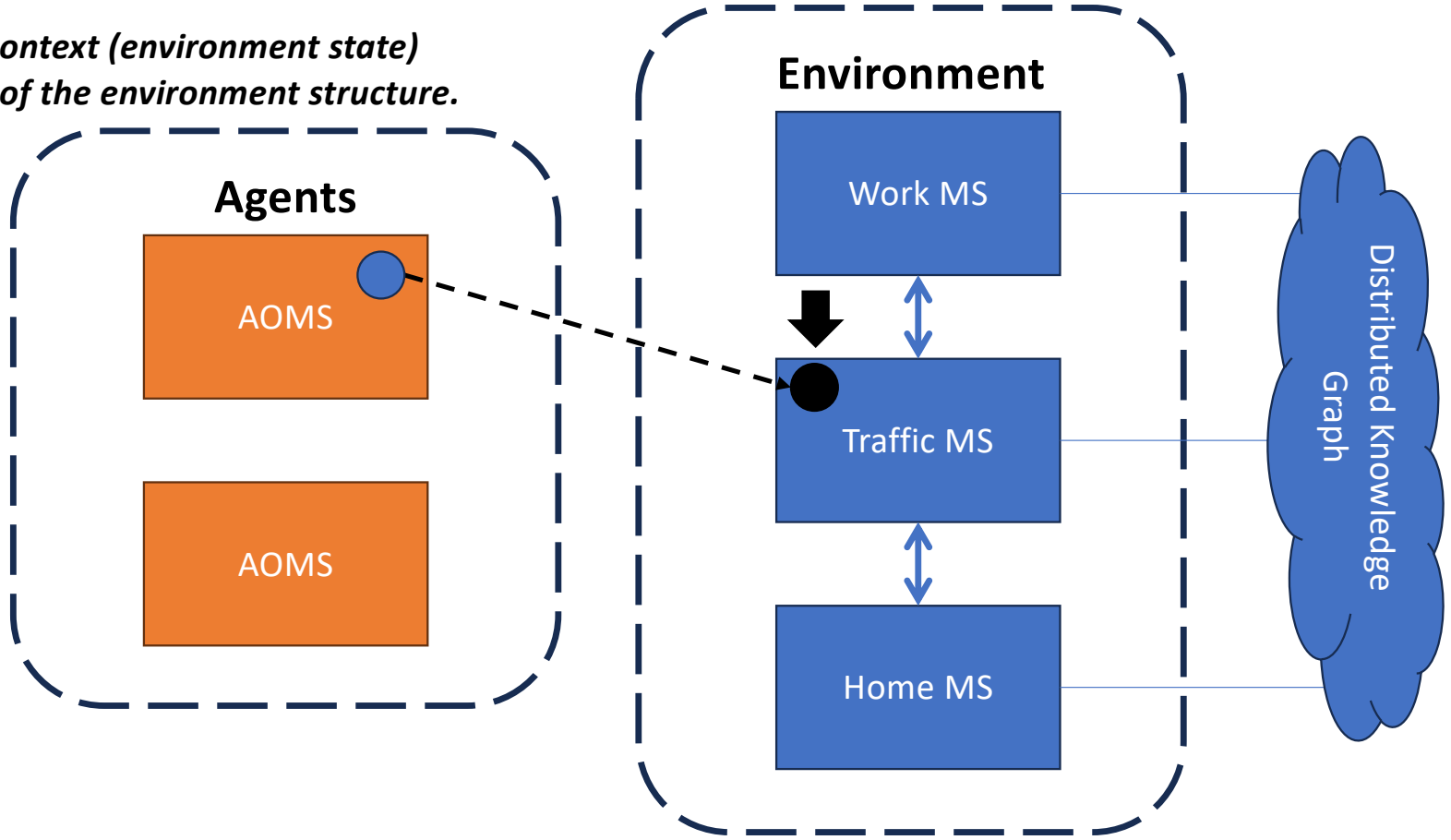
# The Vision

Linked Data representations can be used to describe the relationships between environment microservices (and potentially agents)

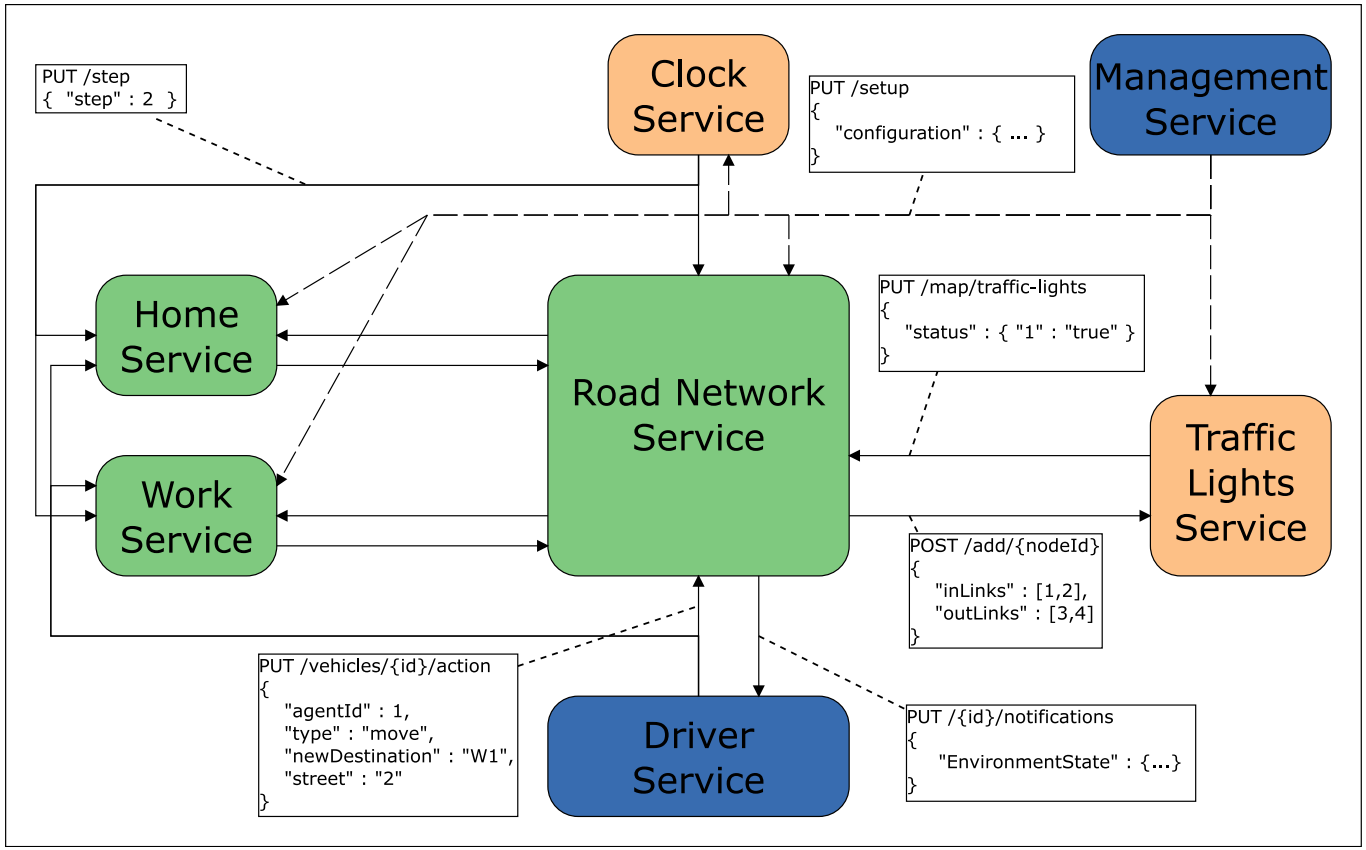


# The Vision

***Agents' combine local context (environment state) with global knowledge of the environment structure.***



# The Demo

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# Benefits of Approach

- The ability to build a **distributed knowledge graph** that integrates global knowledge with the traditional local context offered to agents in ABM.

- Microservices supports **polyglot computing** which allows different languages and frameworks to be used to implement different parts of the environment **and** different types of agent.

- Changes to/extensions of the environment are easy – create and link to more microservices.
  - Allows incremental development of simulations.
  - Potential for truly massive simulation environments hosted across multiple organisations/institutions.

# Thank You!

# Questions?

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