Interoperability Framework of Internet of Things (IoT) Food and Farm Systems

Introduction:

This project is to develop an interoperability framework for modelling IoT-based systems in the food and farm systems. The interoperability framework comprises a coherent set of architectural viewpoints and a guideline to use these viewpoints to model architectures of individual IoT-based systems. The framework will be validated with different agricultural stakeholders, particularly organic farming, and different supply chain roles. It will also provide valuable help to the model, in a timely, punctual and coherent way, the architecture of IoT-based systems of this diverse set of use-cases. The framework will serve as a common platform for aligning system architectures and enabling reuse of federated knowledge among multiple autonomous IoT technology in food and farm systems, which will benefit various stakeholders in the long run.

Project Members:

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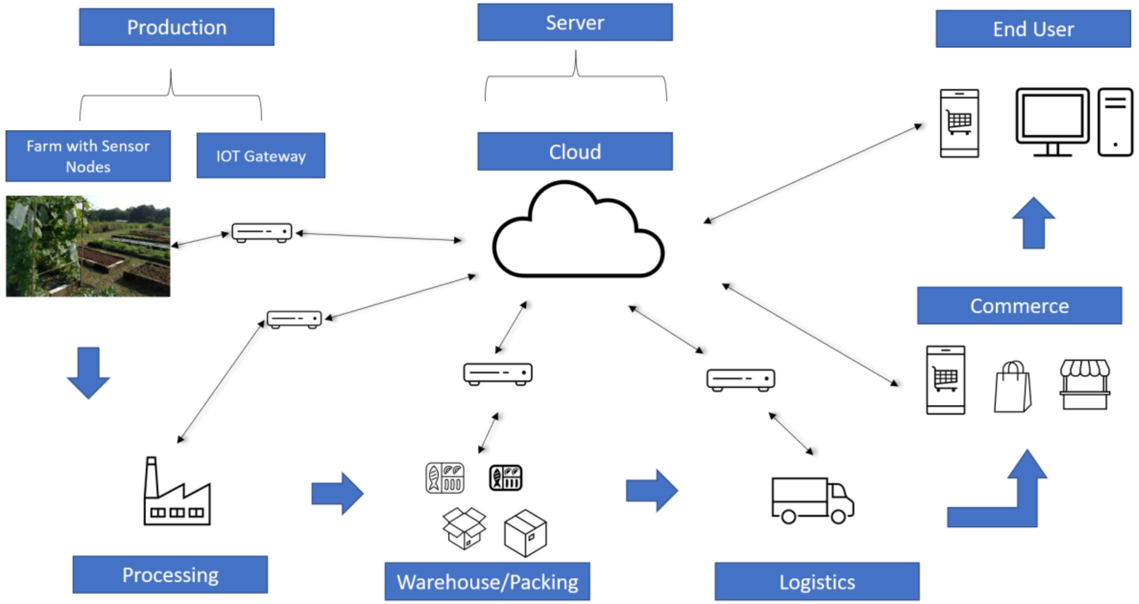


BACKGROUND & CONTENT

Internet of Things (IoT) service provisioning for agriculture and food ecosystem is envisioned to integrate **computation, communication, and control** with the **physical world**. The existing related works are focused on temporal interactions rather than other attributes like spatial and combinational service attributes in their capabilities to support the provisioning process in IoT environment.

These interactions are usually governed by events, generated by physical IoT sensors and should autonomously be reflected in the bespoke service selection, which are taken by the service provisioning as a result of detection of events and certain decision mechanisms.

Both event detection and action decision operations should be performed accurately and timely to guarantee not only temporal but also spatial correctness of the IoT service provisioning. **This calls for a flexible task representation event model to analyse IoT service selections.**

BACKGROUND & CONTENT

Therefore, we propose **an enhanced spatio-temporal interoperability event model** for IoT service provisioning.

Why enhanced spatio-temporal event model for IoT service provisioning?

- The enhancement of the model includes investigating the temporal and spatial properties of events and to develop a layered hierarchical based spatio-temporal event model for IoT service provisioning.

- The event is represented as a function of attribute-based, temporal, and spatial event conditions using game-theory mechanism.

The proposed work is deemed important to support IoT service provisioning as well as service selection in a federated manner. The enhanced event model relies on a **hierarchical layered structure** which extends spatio-temporal relations is also expected to **solve complex relationships** of the heterogeneous IoT service provisioning. It is also expected the research will significantly **enhance accuracy of previous service provisioning** and provide **near real-time event detection** especially in supply chain mechanism involving food and farm systems

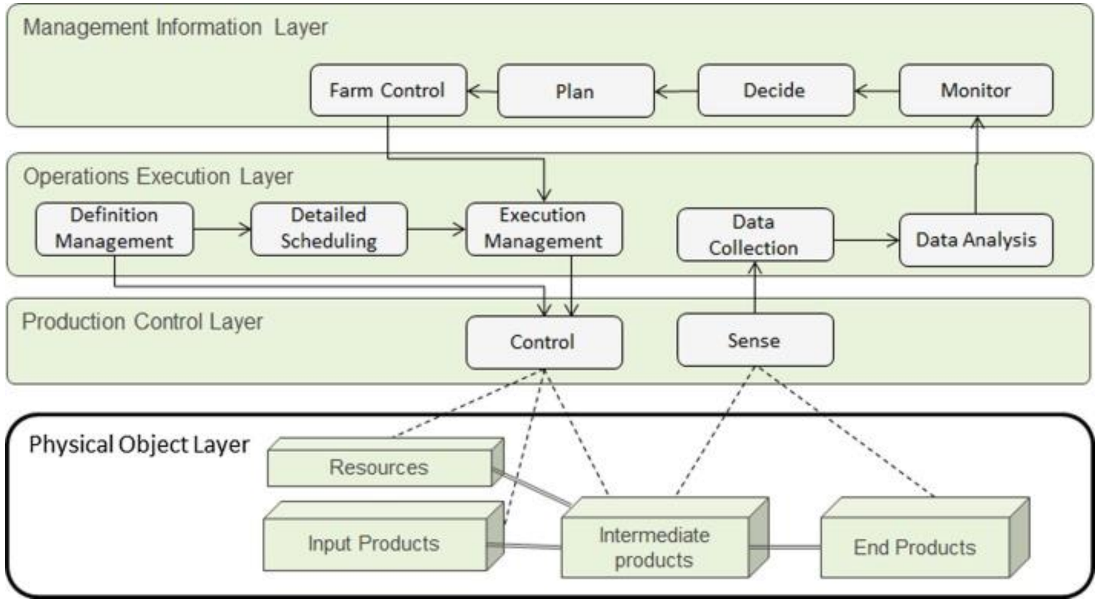
OBJECTIVES

The main **objective** is to propose **an interoperability framework with microservice event model** for managing agriculture food and farm system's service provisioning via IoT objects.

In achieving the main objective, there are some specific objectives that must be fulfilled, which are:

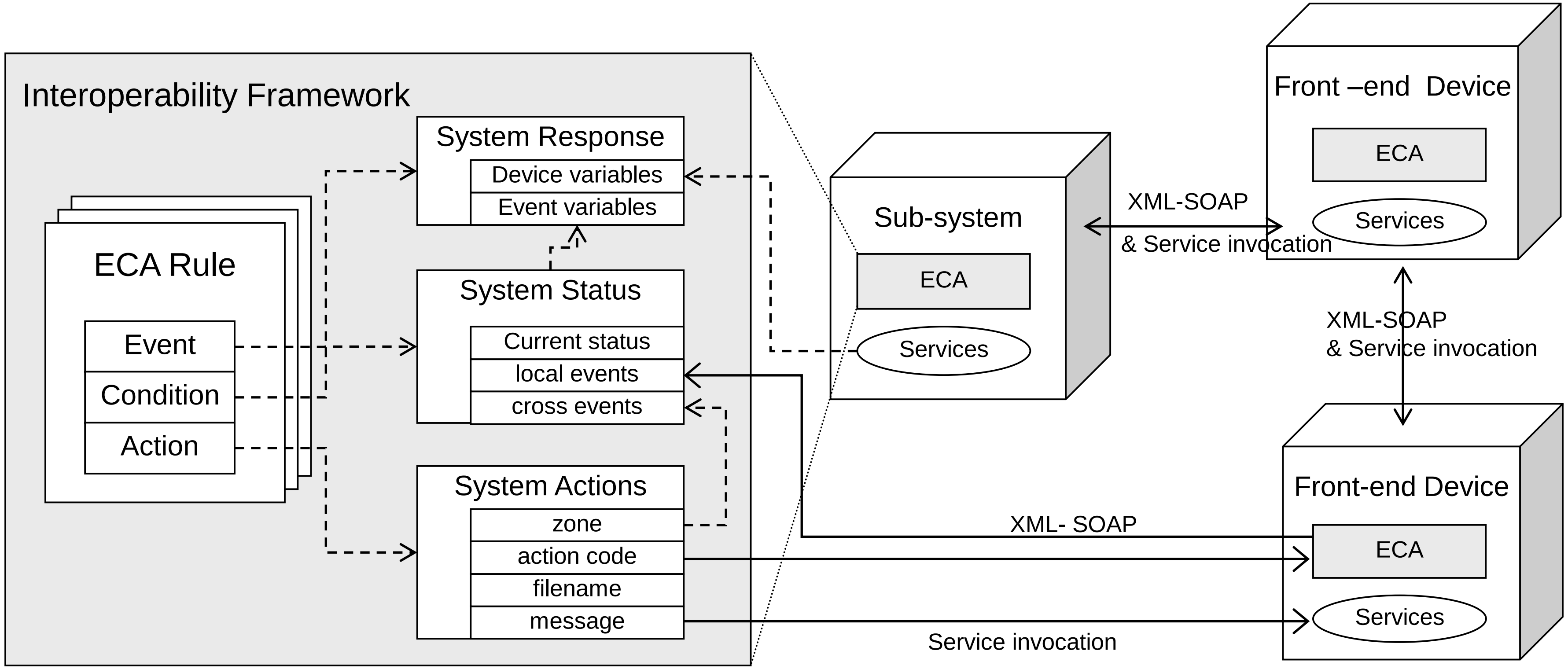
- To construct a **microservice reasoning framework for IoT service management based on ECA mechanism** in food and farm systems that is part of the event model catering efficient service provisioning

- To develop a **prototype** for the service model and to **evaluate the performance** of the service provisioning.



INTEROPERABILITY FRAMEWORK

- ECA Rules
  - Event : local events & cross -events
  - Condition : variables in sub-systems and front-end devices
  - Action : local actions and cross- actions



Interoperability framework functional pattern

ECA MECHANISM

Structure of ECA algorithm

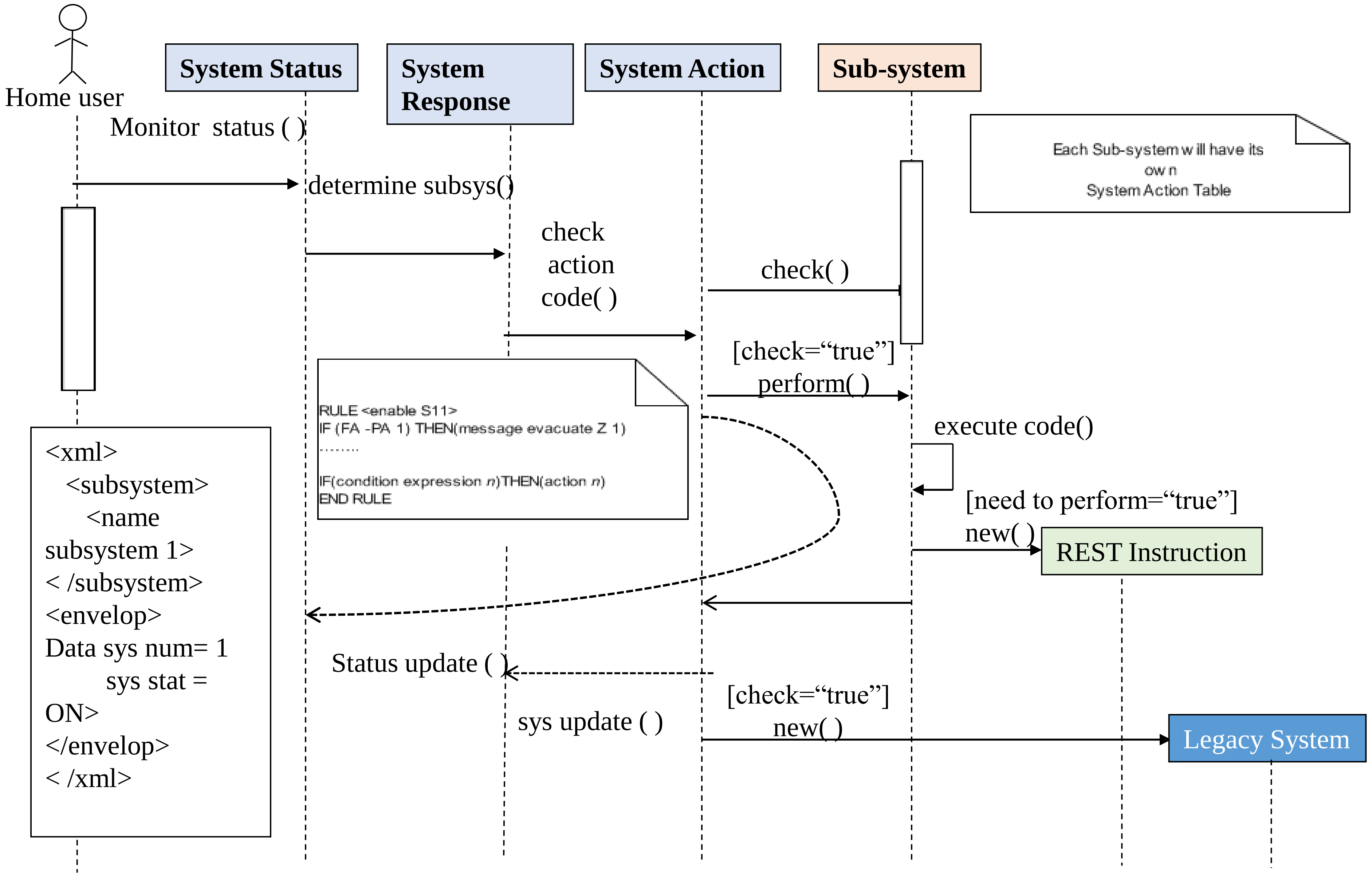
- ECA algorithm consist of :
  - (conditional response)
    - ***on*** e1 ***if*** c1 ***do*** a1
    - ***on*** e1 ***if*** c2 ***do*** a2
  - (transitive property) ***on*** e1 ***if*** c1 ***do***{***on*** e2 ***if*** c2 ***do*** a2}
    - ***Rule 1: on*** e1 ***if*** c1 ***do*** a1 (→e1')

      cf. action a1 generate internal event e1'
    - ***Rule 2: on*** e1'^e2 ***if*** c2 ***do*** a2
  - (logical operation)

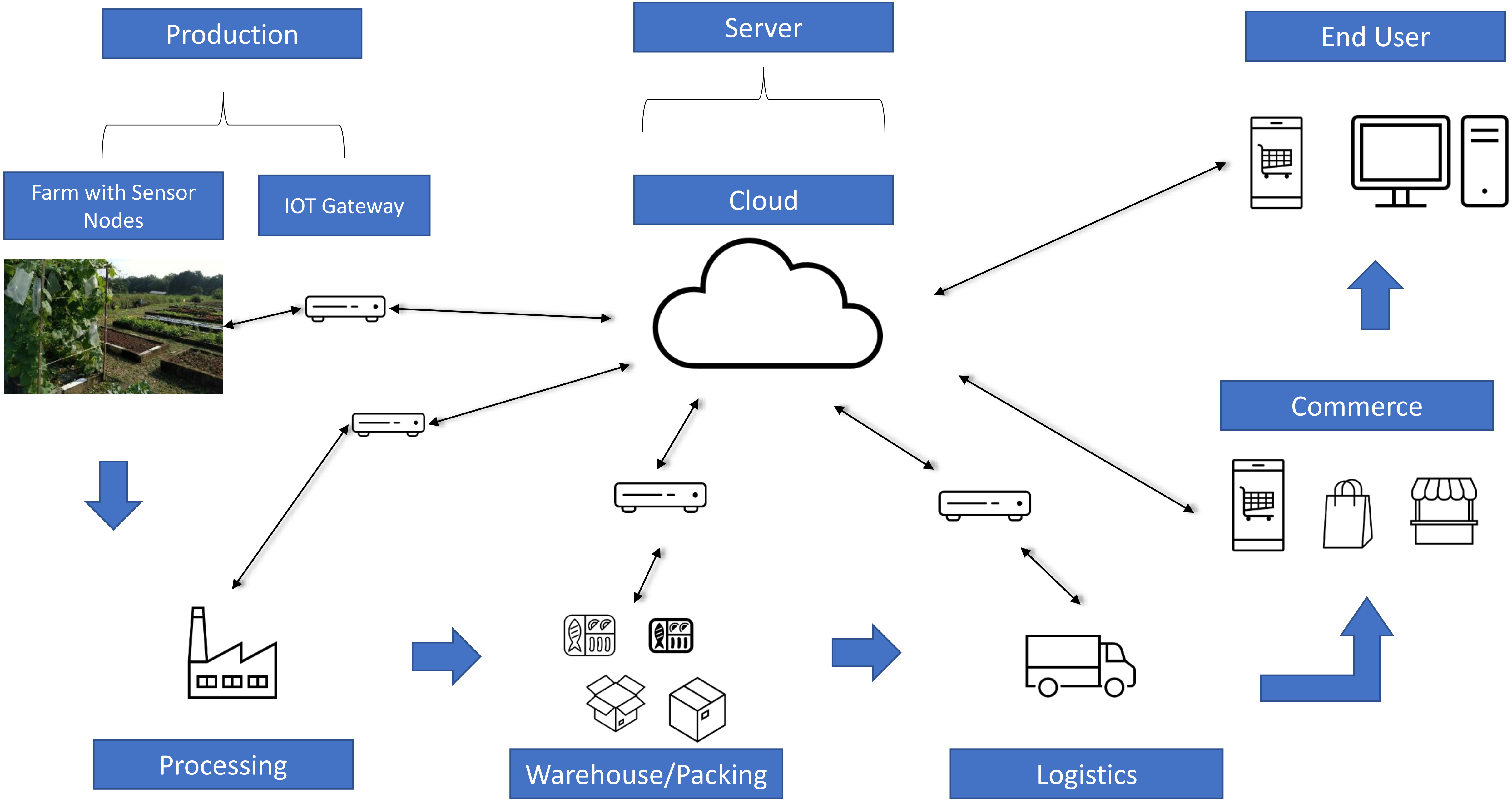
    Event ***on*** (e1^e2) | e3 ***if*** c1 ***do*** a1 { Sub-systems event}

    Condition ***on*** e1 ***if*** c1|(c2^~c3) ***do*** a1 {Conditions of response}

    Action ***on*** e1 ***if*** c1 ***do*** a1|(a2^a3) { Actions to be performed}



ECA Algorithm for Interoperability Framework


Production
Server
End User
Farm with Sensor Nodes
IOT Gateway
Cloud
Commerce
Processing
Warehouse/Packing
Logistics

Test Site

- The test site is located within the vicinity of Ramaiah University of Applied Sciences, India
- In-house farm and food centre within campus that would serve as testbed for the framework deployment

Campus farm site for project implementation

Project collaborators Dr Monica Rajasekar and Dr Thompson Stephan, Ramaiah University of Applied Sciences, India