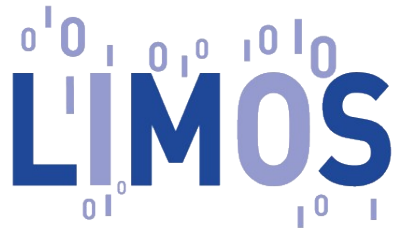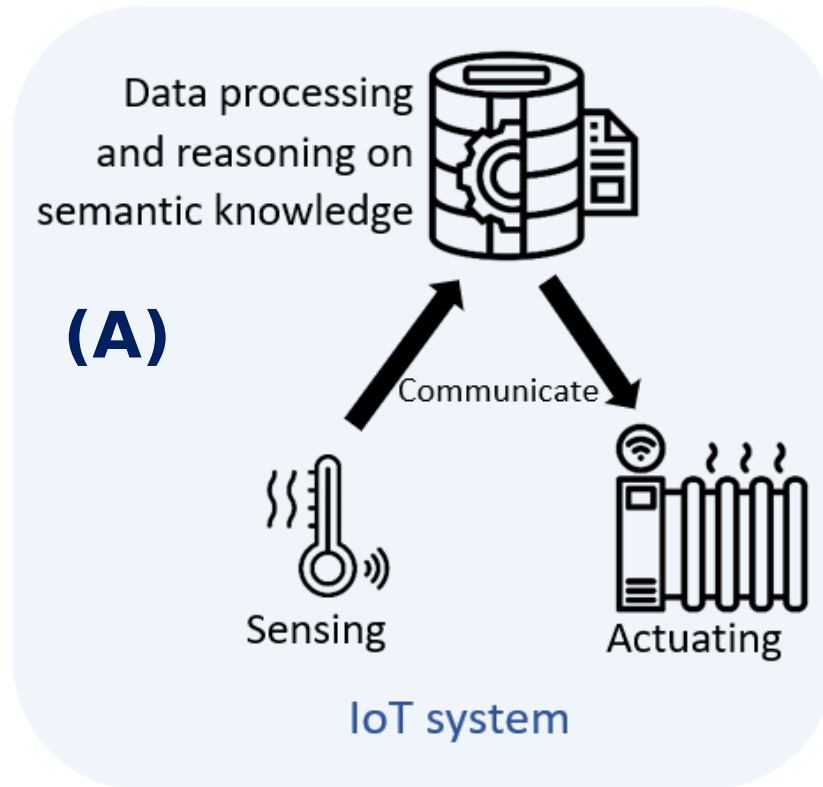# A hybrid approach of semantic modelling and co-simulation for a better consideration of physics phenomena in a smart building

PhD Student: Zehor Thilleli HOUNAS
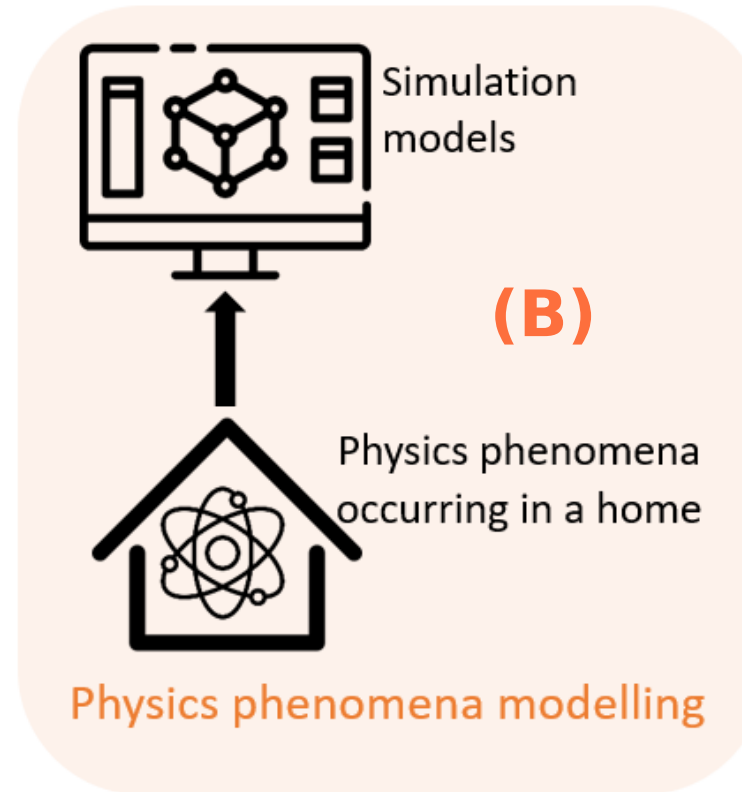
Supervised by : Antoine ZIMMERMANN, Bruno TRAVERSON, Maxime LEFRANCOIS

11/04/2024

Zehor HOUNAS

Context

(A) : in current IoT applications, physics phenomena occurring in a complex and heterogeneous cyber-physical system, such as a smart building, are poorly reflected

(B) : according to the conceptualization of digital twins, simulations of these physics phenomena allow to anticipate the temporal evolution of the cyber-physical system

Main objective

Combination of simulation and semantic knowledge of the physics phenomena will improve decision-making process of IoT systems deployed in smart buildings.

1st sub-objective

# Integrating physics phenomena simulation in IoT system
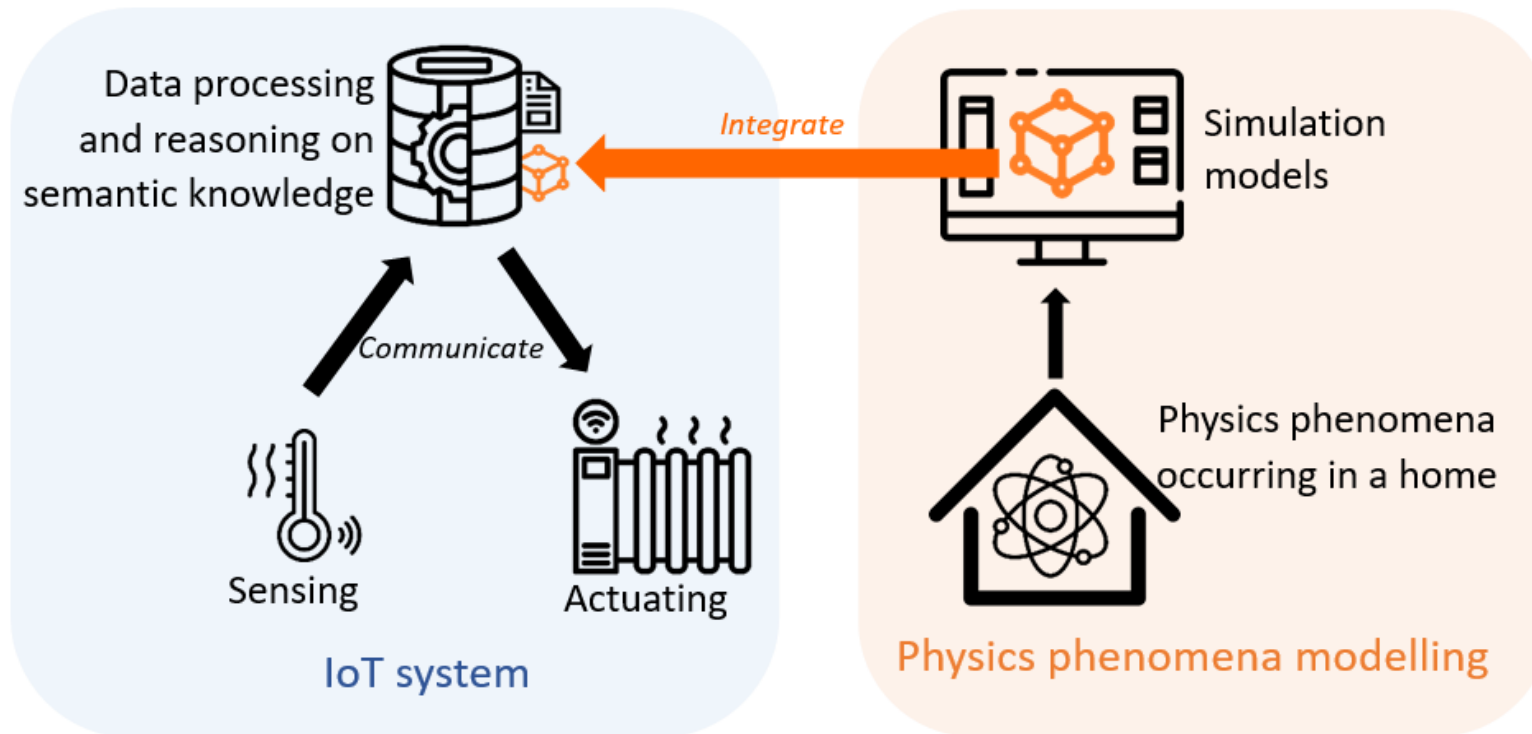
Hypothesis: Integrating physics phenomena simulation in IoT systems would improve the accuracy of the reasoning system and the energy efficiency.

Question: How to enable the interoperability between the simulation model and the reasoning system?

2nd sub-objective

## Integrating simulation in constrained IoT device
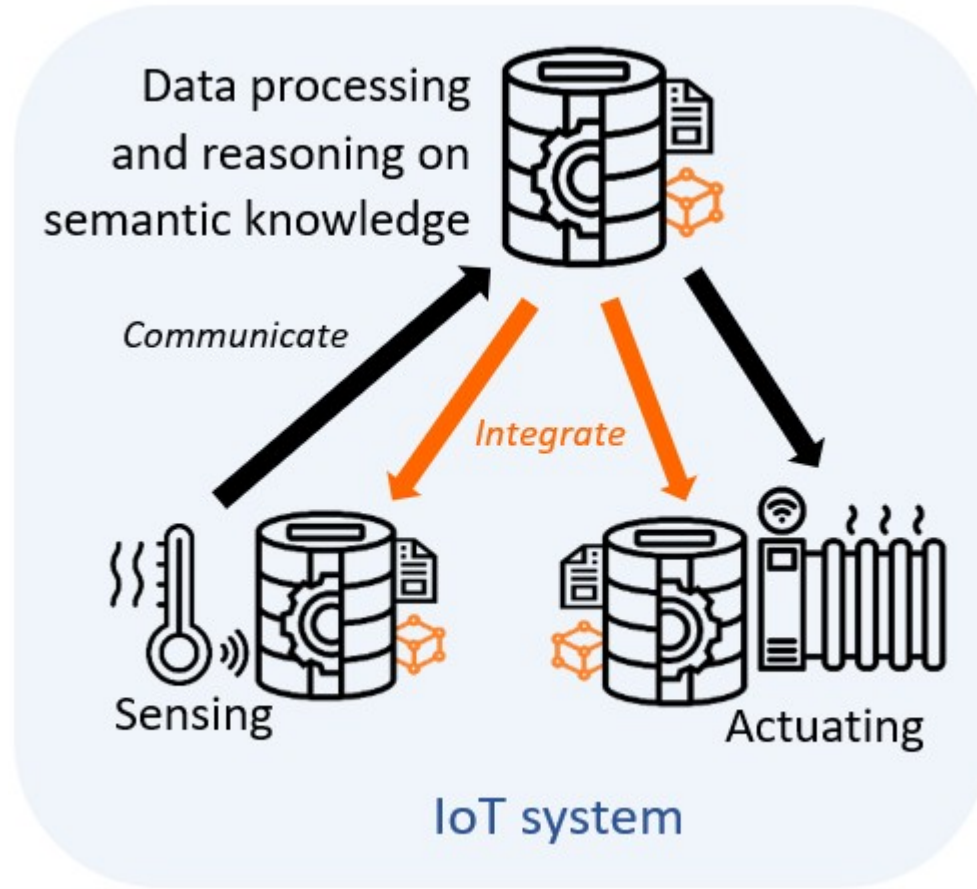
Hypothesis : Embedding the simulation in the constrained IoT devices would reduce the response time and ensure the minimum system operation in case of communication problems.

Question : How to make the simulations tailored to constrained device resources and architecture?

3rd sub-objective

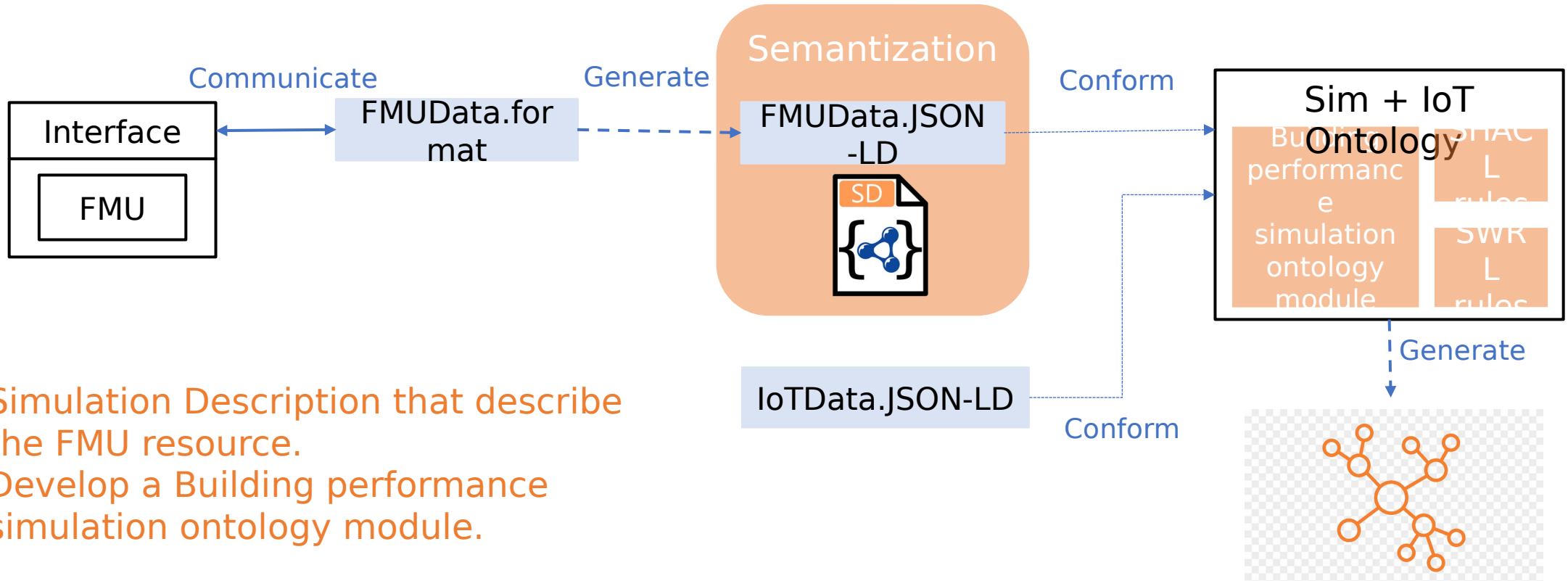## Co-simulating distributed simulations in IoT system
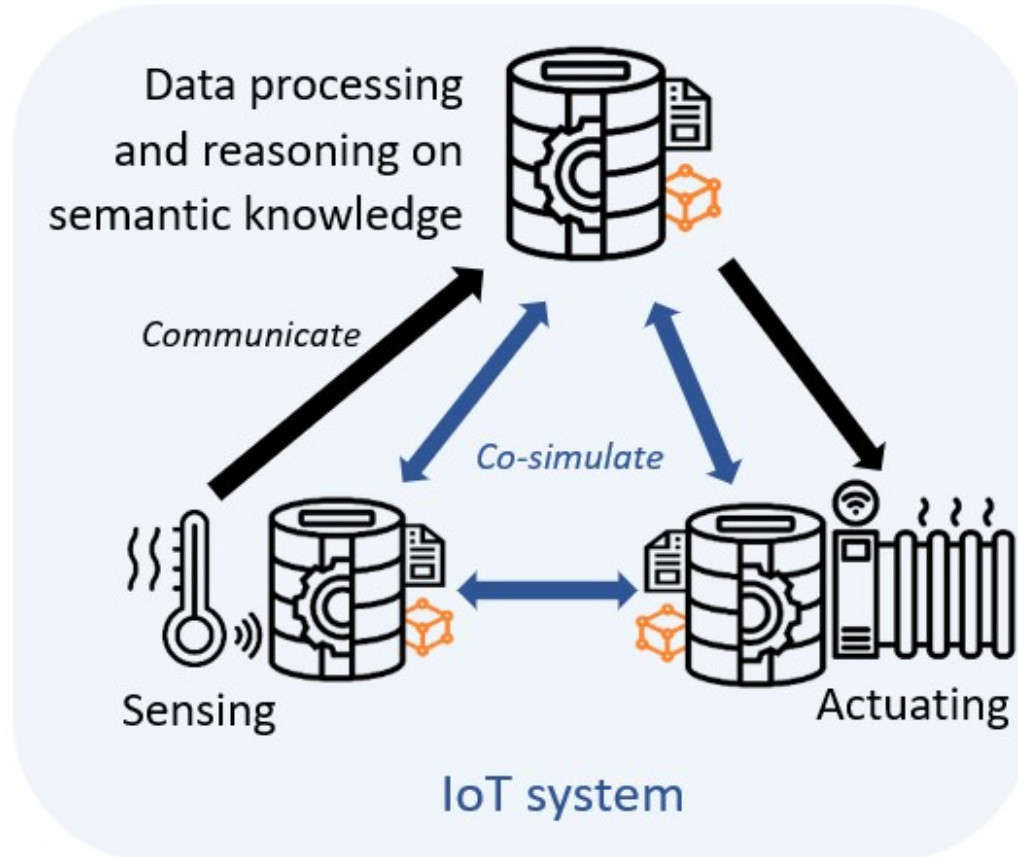
Hypothesis : Co-simulating distributed simulations using semantic web technologies would improve the interoperability of the IoT system.

Question : How to handle the data exchange between interdependent simulations using semantic web technologies?

Approach for 1ˢᵗ sub-objective

ed approach to integrate physics phenomena simulation in IoT

Semantization

Interface — Communicate → FMUData.format — Generate ⤏ FMUData.JSON-LD — Conform → Sim + IoT Ontology

FMU

SD

IoTData.JSON-LD — Conform

Building performance simulation ontology module

SHACL rules

SWRL rules

Generate ⤏

- Simulation Description that describe the FMU resource.
- Develop a Building performance simulation ontology module.

Knowledge Graph of IoT and Simulation D

Merci

Zehor HOUNAS