SSN
Semantic Sensor Network 18

SmartEnv Ontology in E-care@home

(Short Paper)

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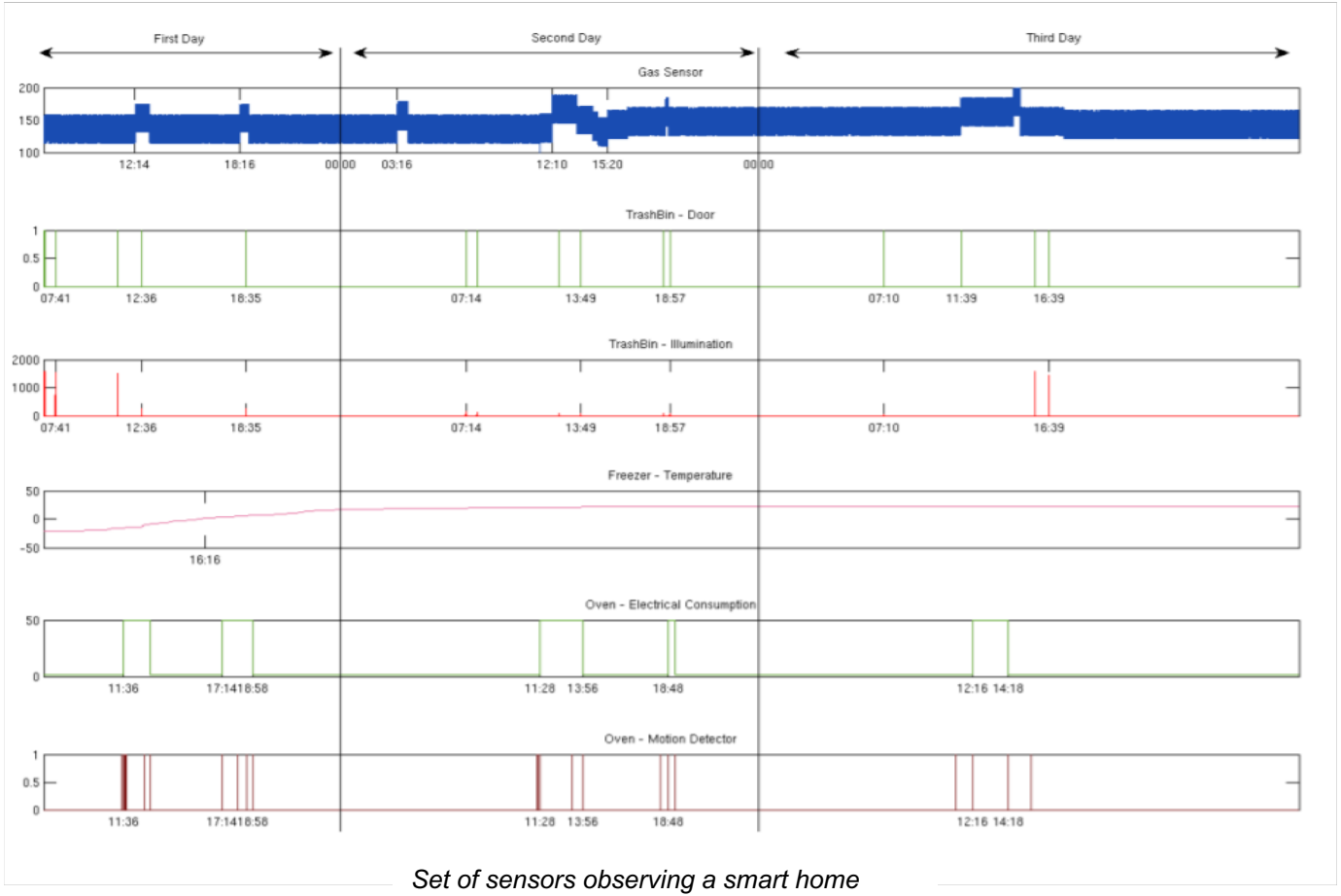
E-care@home Project

- E-care@home aims to
  - achieve **semantic interoperability** between information provided by
    - environmental sensors,
    - medical sensors,
    - public health records
  - take care of **elderly people** at their living place
    - Activity recognition
    - Health state recognition/prediction
    - Recommendation

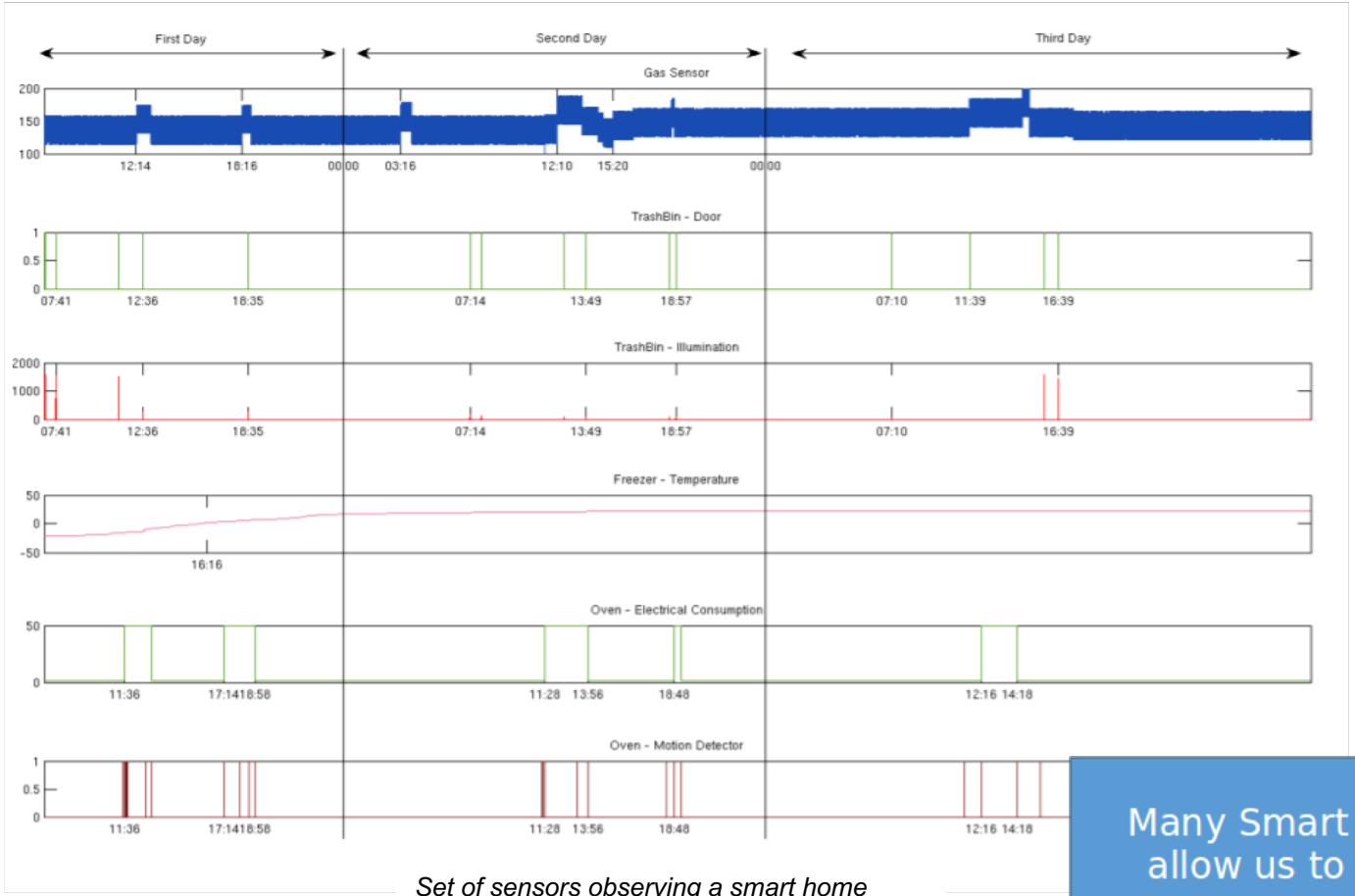
E-care@home Project



Set of sensors observing a smart home

- Q: *Has Göte been **eating** his dinner regularly?*
- Q: *Is this **health** sensor response **OK** for Göte?*
- Q: *What **devices** do I need to **monitor** his nighttime wakings?*

E-care@home Project



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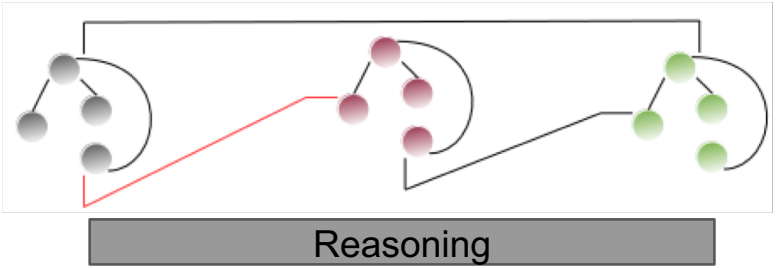
Many Smart Home Setups still do not allow us to answer these questions

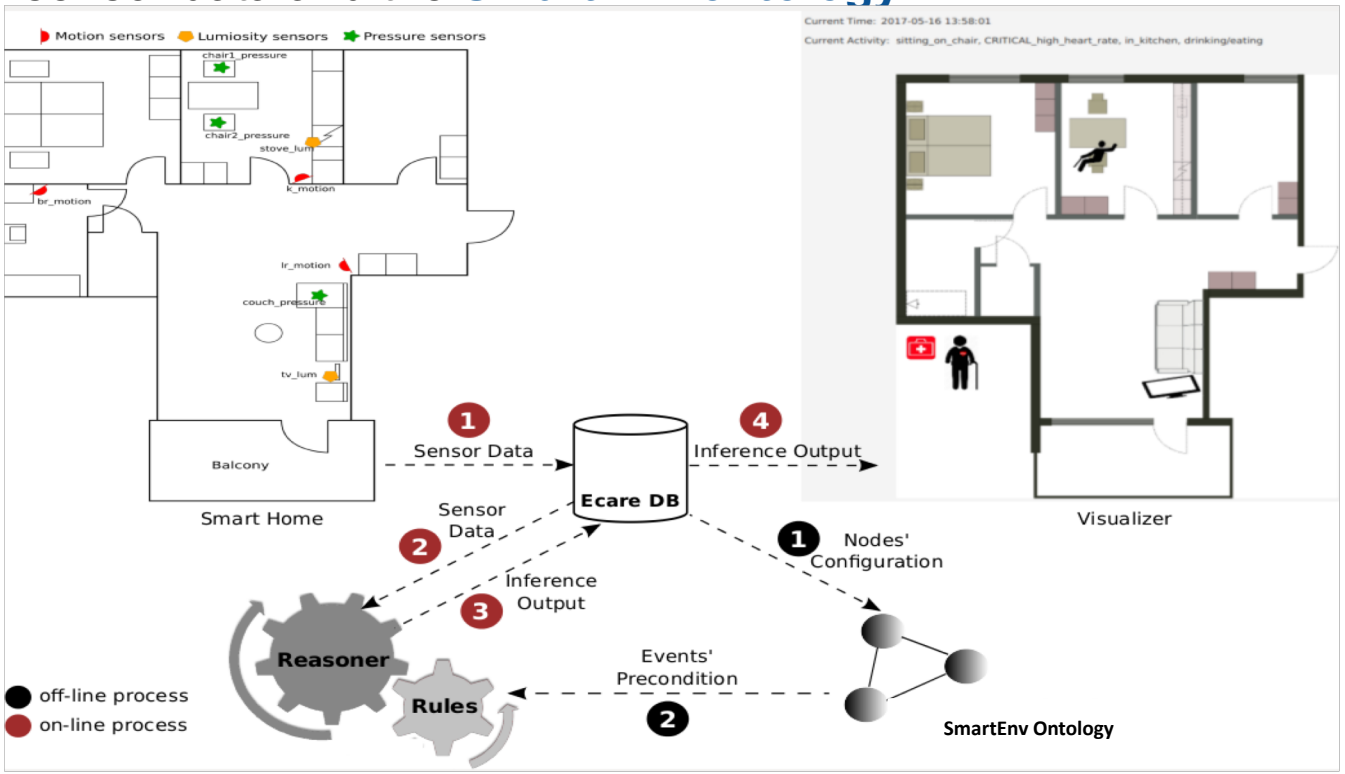
E-care@home Project

- Goal: **Semantic Interoperability**
  - The ability of computer systems to exchange **data** with unambiguous, **shared** meaning



- Ecare@Home combines competences in **AI**, **Semantic Web**, **Internet of Things**, and **Sensor** Technology.

- For this to be possible, we have implemented a **Stream Reasoning** module applied upon both sensor data and the **SmartEnv ontology**



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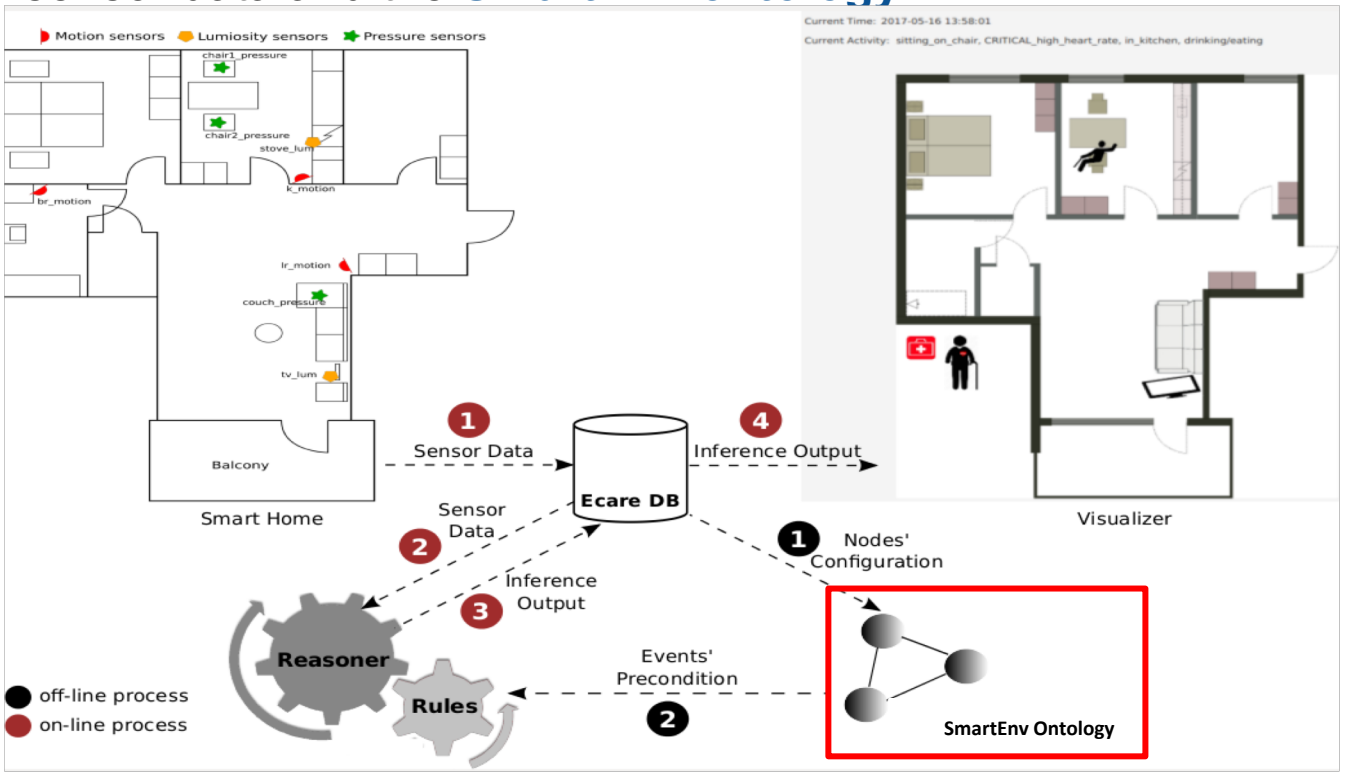
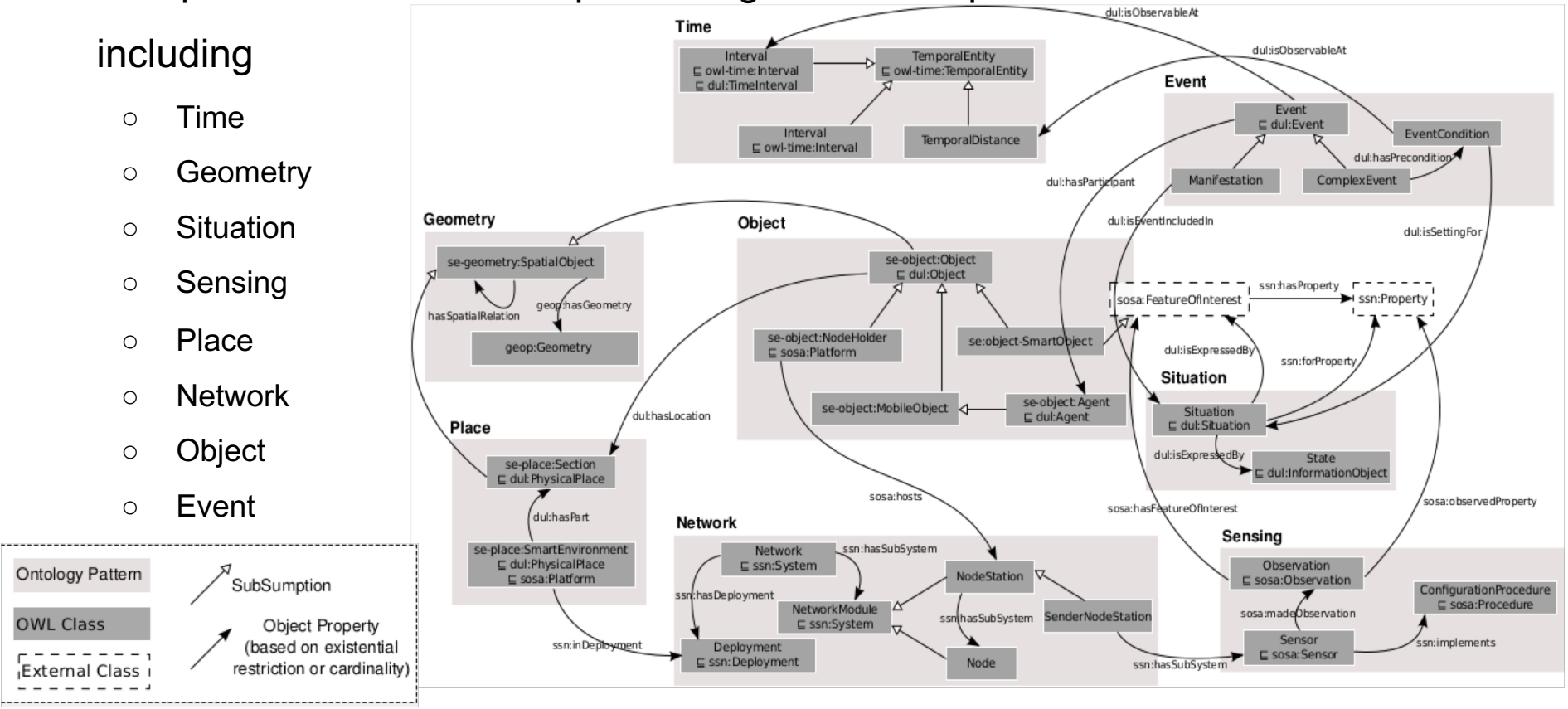


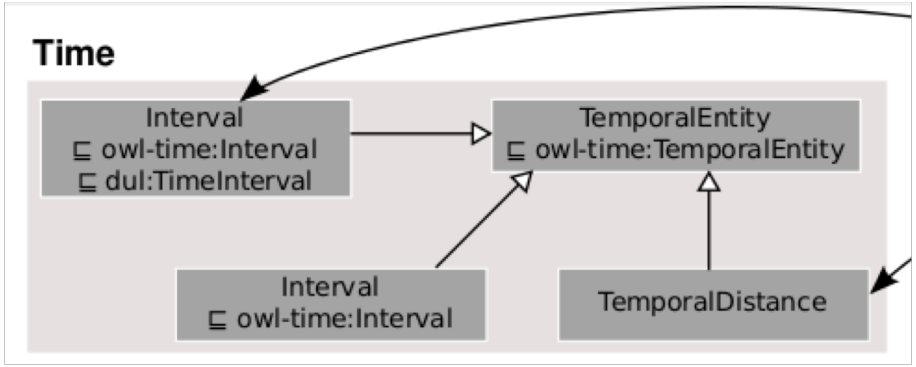
SmartEnv ontology

- Composed of 8 modules representing different aspects of a smart environment including
  - Time
  - Geometry
  - Situation
  - Sensing
  - Place
  - Network
  - Object
  - Event



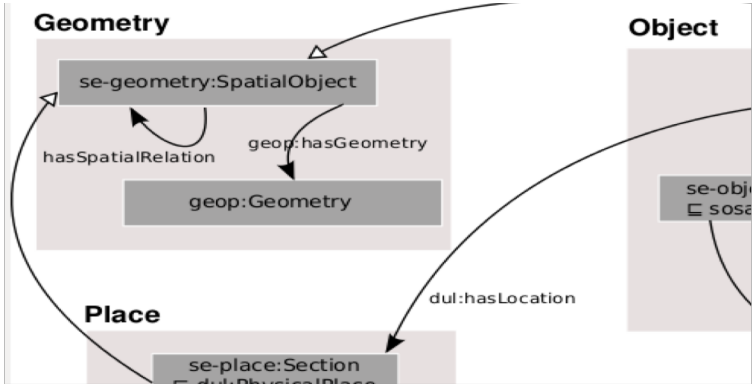
SmartEnv ontology

- Time module:
  - can be found at: https://w3id.org/smartenvironment/patterns/time.owl
  - represents any **temporal** entities that we may use to represent things in a smart environment.
  - has been designed as an extension of the **OWL-Time ontology**
  - is used to
    - answer questions such as **when** the **occurrence of an activity** is realized
    - define **activities**/**events** based on the **temporal relations** with their **preconditions**



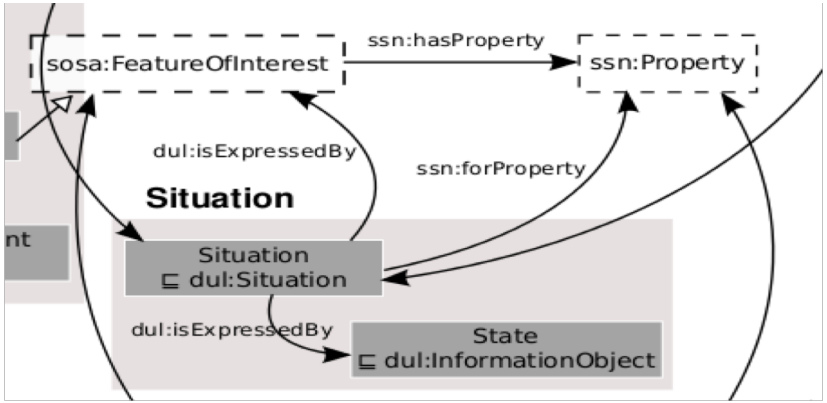
SmartEnv ontology

- Geometry module:
  - can be found at: https://w3id.org/smartenvironment/patterns/geometry.owl
  - represents **spatial** aspects of entities including the topology of objects, rooms, etc.
  - has been designed based on **GeoSPARQL**, and **Open Time and Space Core Vocabularies**
  - Enables **qualitative spatial reasoning** based on geometrical computations



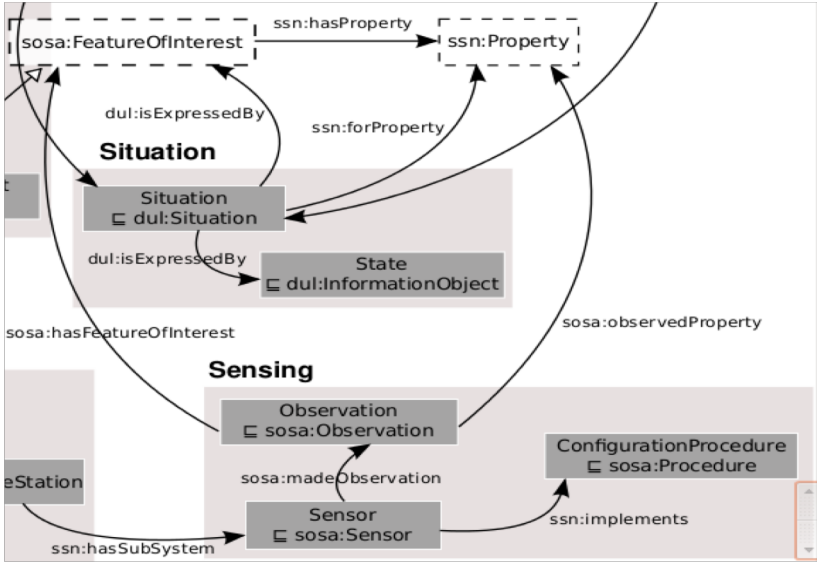
SmartEnv ontology

- Situation module:
  - can be found at: https://w3id.org/smartenvironment/patterns/situation.owl
  - illustrates a specific **state** of a **feature of interest**
    - e.g., the **temperature** of the **living room** is **warm**
  - **Feature of interest:** Borrowed from **SSN** as object which is the **interest** of an **observation** process
  - representation of a **situation** is **time-independent**
  - A situation can be augmented with the concept of time in other patterns such as event pattern



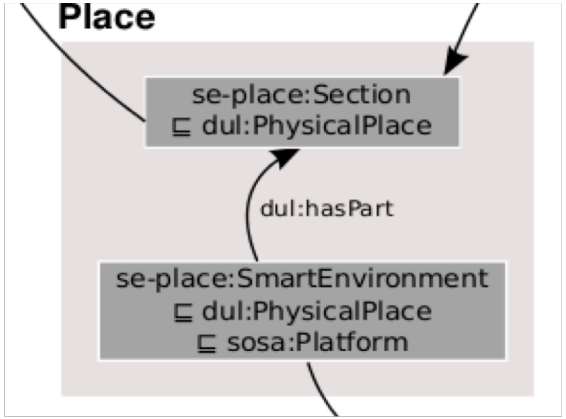
SmartEnv ontology

- Sensing module:
  - can be found at: https://w3id.org/smartenvironment/patterns/sensing.owl
  - represents a process of monitoring a **property** of a **feature of interest** using a **sensing device**.
  - Is highly relying on the **SSN** ontology allowing us to model establishment of a sensing process.



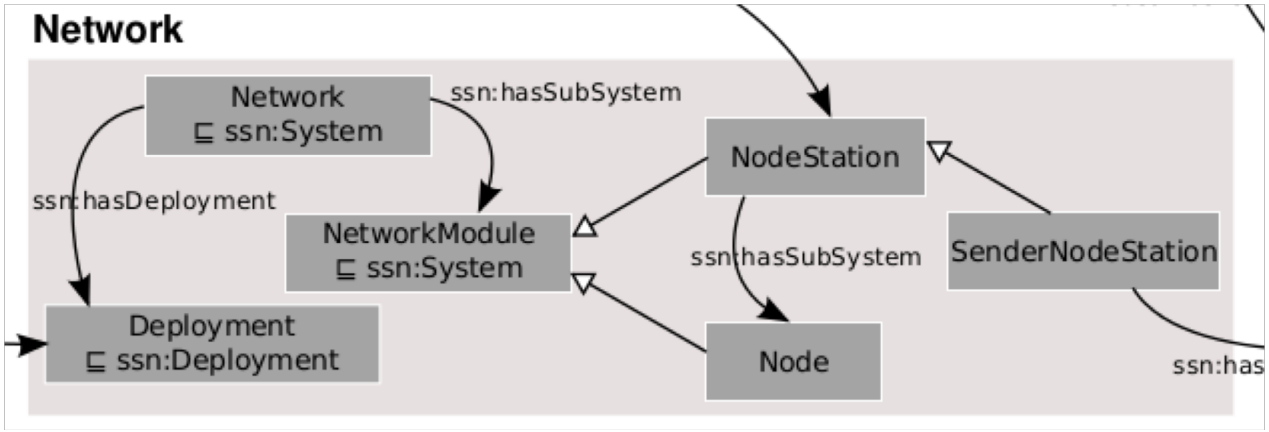
SmartEnv ontology

- Place module:
  - can be found at: https://w3id.org/smartenvironment/patterns/place.owl
  - represents both:
    - The **smart environment** holding the **deployment** of a sensor **network** and is composed of several sections
    - **each section** of the main place that can be seen as a **location** of an **object**
  - is designed based on DUL ontology (dul:PhysicalPlace)



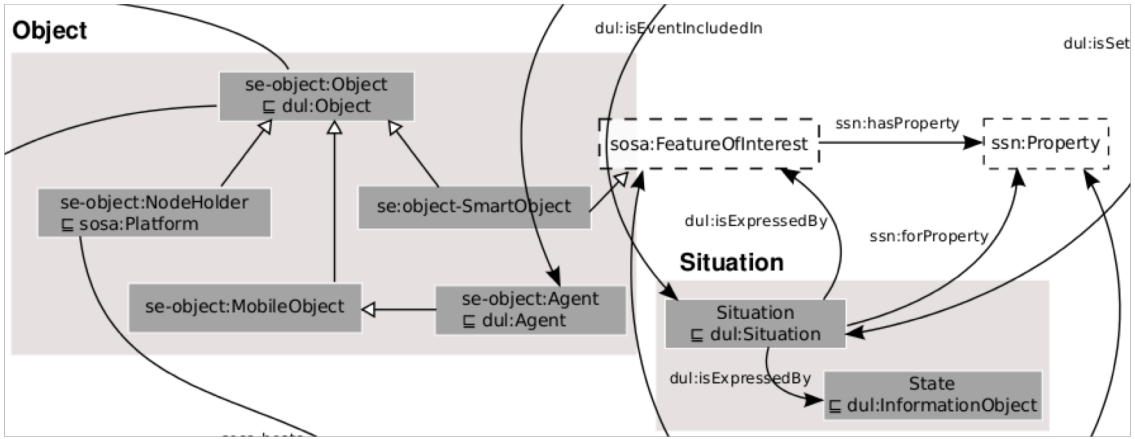
SmartEnv ontology

- Network module:
  - can be found at: https://w3id.org/smartenvironment/patterns/network.owl
  - represents as a system containing different types of devices such as **nodes** and **node stations**.
  - **node:** is a **communication module** indicating either a sending or a receiving data module
  - **node station:** contains a node along as well as sensors, power supplies, batteries etc.



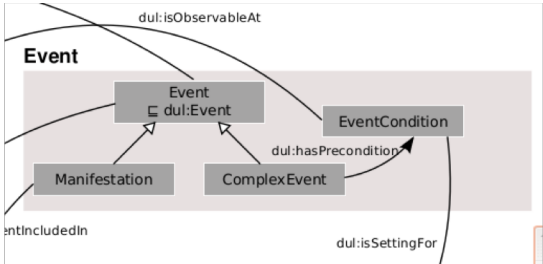
SmartEnv ontology

- Object module:
  - can be found at: https://w3id.org/smartenvironment/patterns/object.owl
  - Is defined based on the concept **dul:PhysicalObject** representing two different object types:
    - smart objects:
      - the interest of an observation process (i.e, feature of interest)
    - node holders: hosting / holding sensors



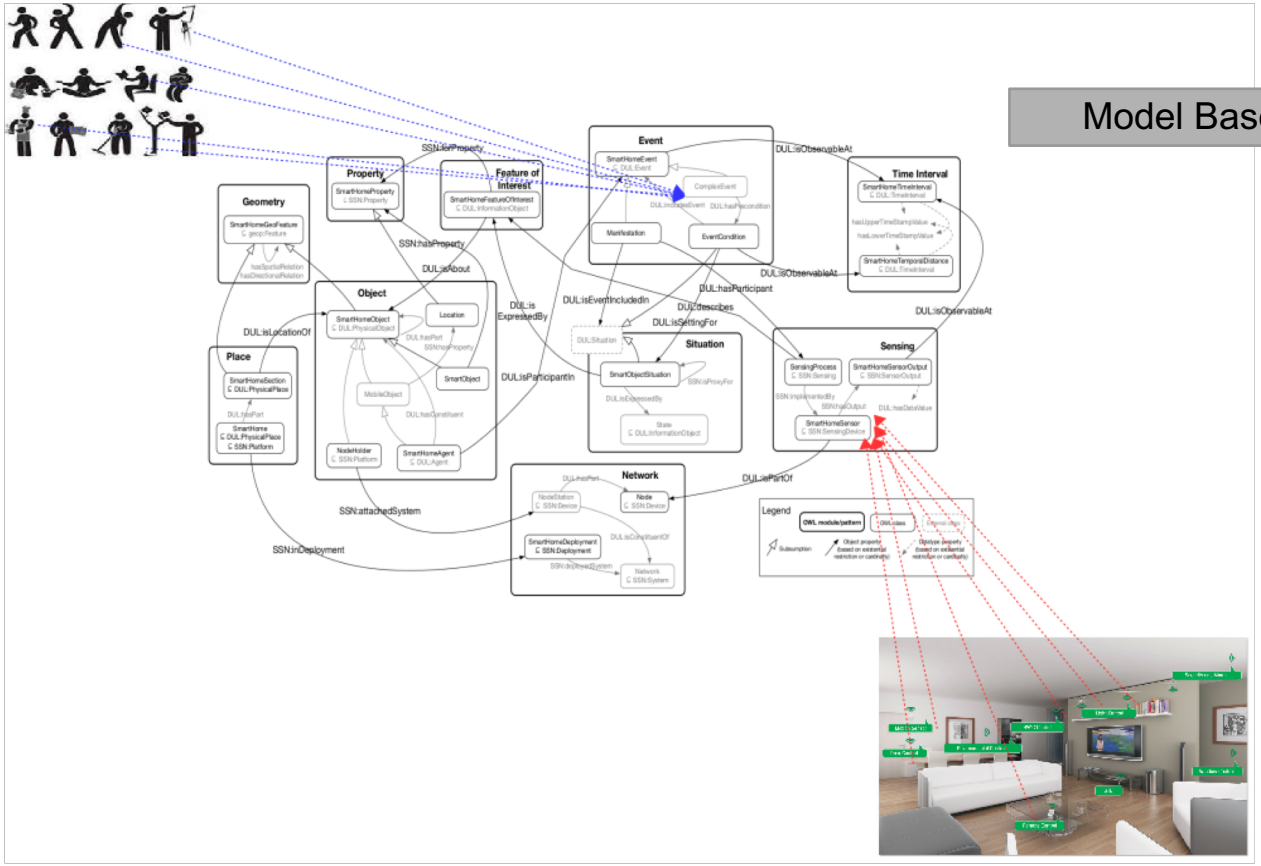
SmartEnv ontology

- Event module:
  - can be found at: https://w3id.org/smartenvironment/patterns/event.owl
  - is extension of the representation of **events** in **DUL**.
  - Two different types of events
    - **Manifestation**: can be **directly** captured from **sensor data** and represent the occurrence of a smart environment situation through a sensing process
    - **complex event**: represents more complicated events whose occurrence **depends** on several **preconditions**
      - **precondition**: represents a **specific situation** assumed to be observed within an **interval** with a **specific temporal distance** to the event's occurrence time.



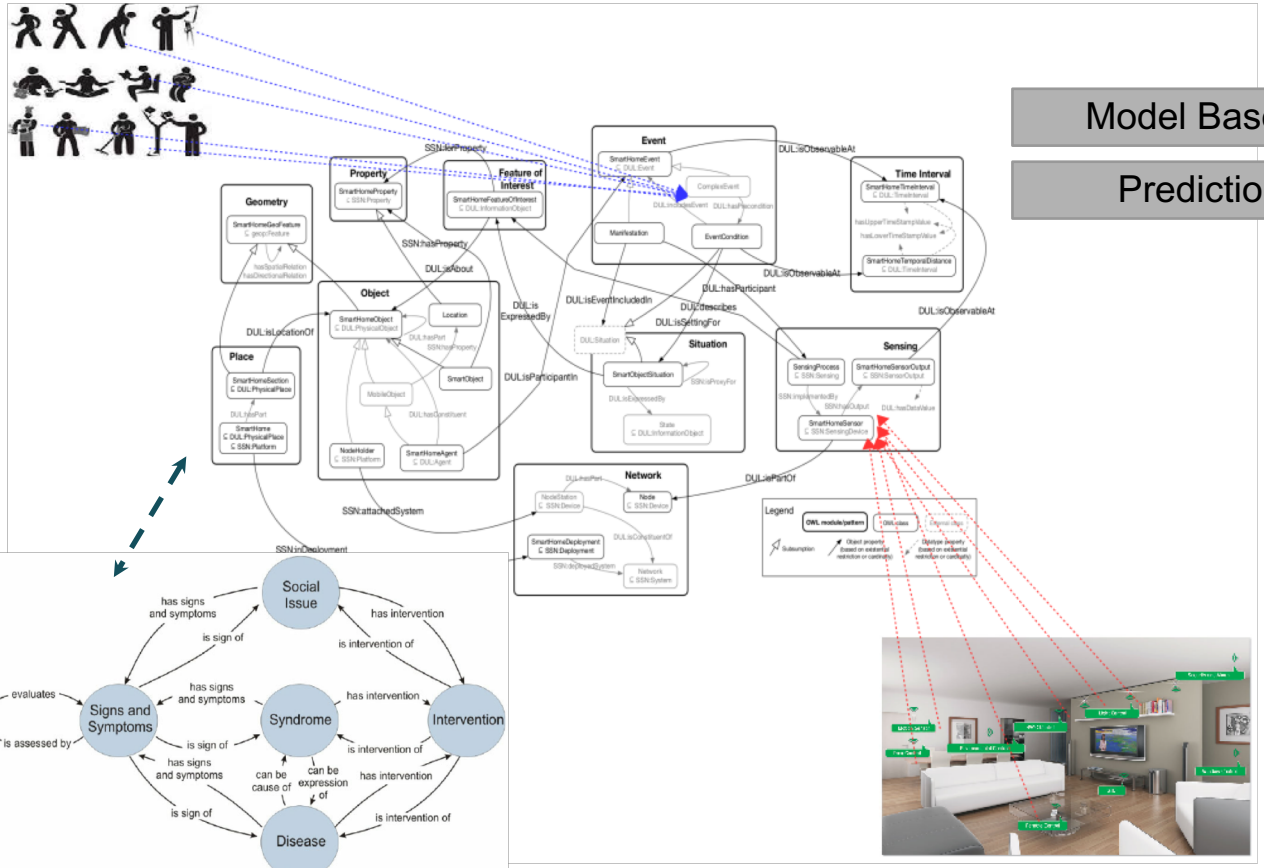
Current Step:

- Using only SmartEnv ontology to do activity recognition



Next Step:

- Towards Semantic interoperability
- Developing medical related ontology and integrate it with SmartEnv



Towards Semantic Interoperability

- The current version of **SmartEnv** allows us to represent the context in terms of environmental settings.

- To achieve semantic interoperability, **SmartEnv** needs to be extended and linked to other ontologies including those that represent **health profile** of elderly users (e.g., PHR/EHR) or **general medical knowledge** e.g., SNOMED CT