Programming Model For IoMT: Observation and Actuation Loops

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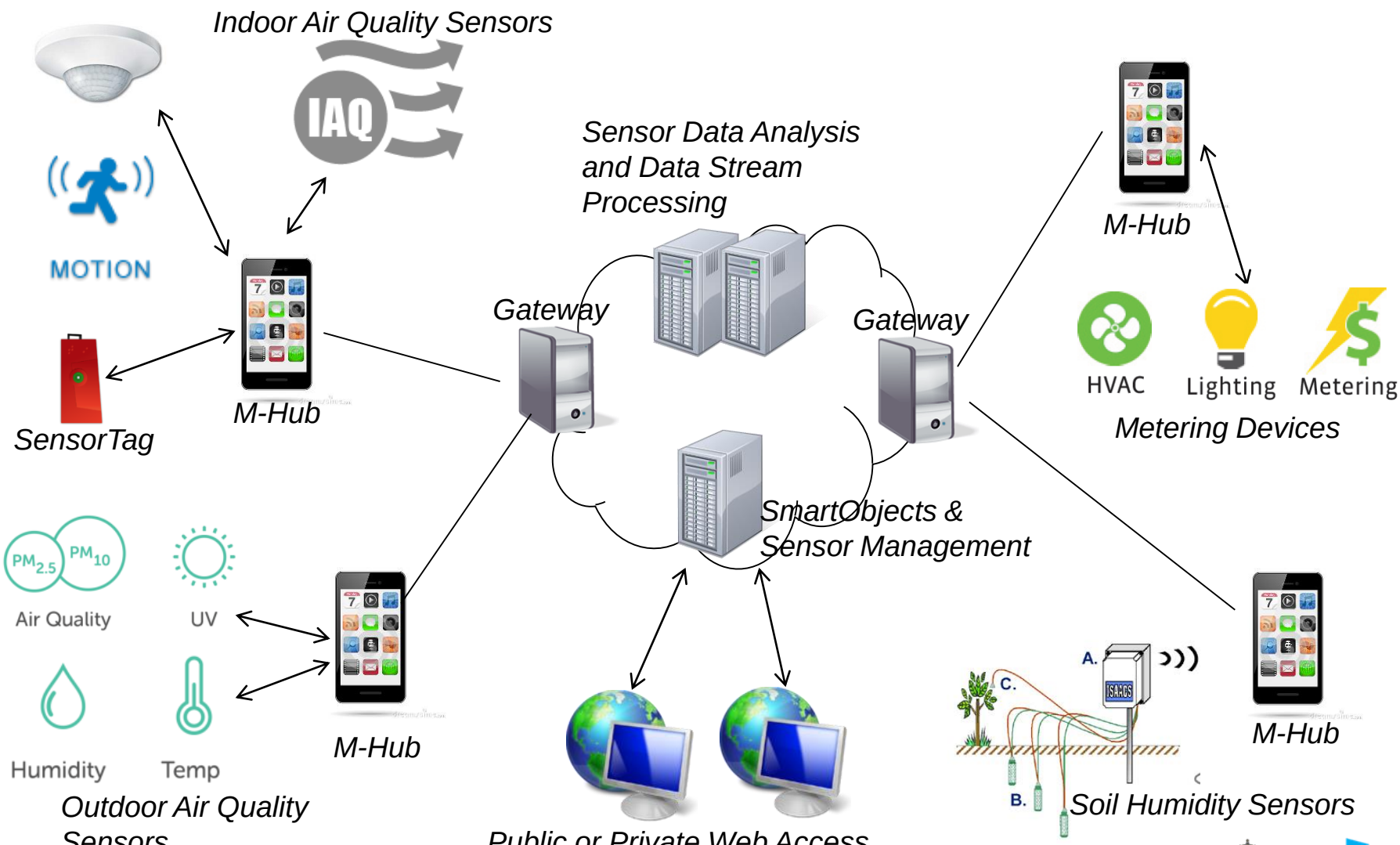
Motivation

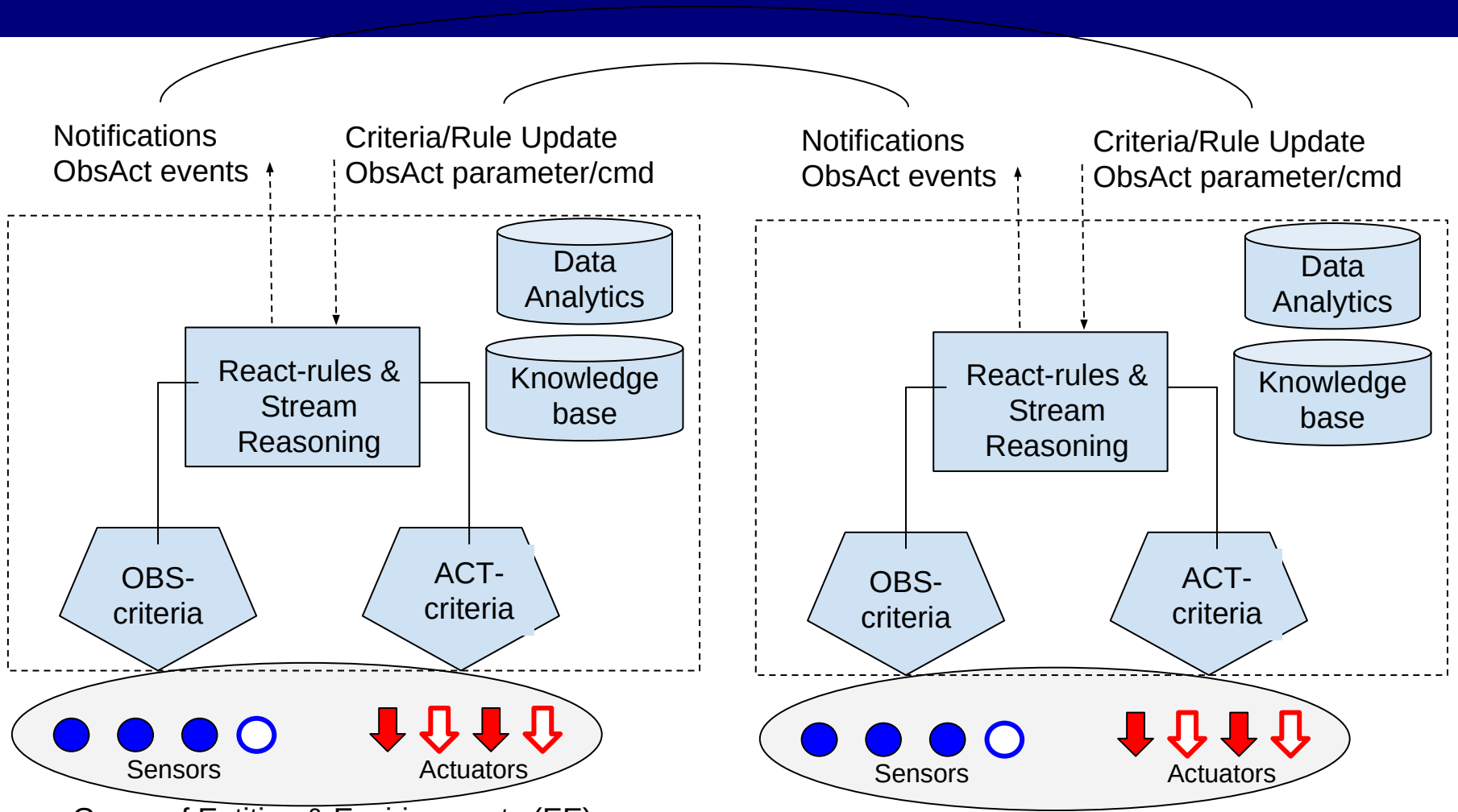
- IoT represents the next significant step in Internet's Evolution[1].
- Early focus of IoT was on communication, interoperability and integration.
- We aim for a truly programmable world involving sensors and actuators.

1. TAIVALSAARI, Antero; MIKKONEN, Tommi. A roadmap to the programmable world: software challenges in the IoT era. **IEEE Software**, v. 34, n. 1, p. 72-80, 2017.

IoMT do ContextNet:
M-Hubs e M-OBJs podem ser móveis



O Modelo ObsAct



Objetivo do Modelo de Programação

- Expressar a essência da maioria das aplicações IoMT – um Control Feedback Loop - sem fazer referência a M-OBJs e M-Hubs, mas sim a Entidades e aos Ambientes que são o foco do controle/manipulação.

- Focar nas informações que a se observar e nas ações (de reação) que se deseja.

- Expressar apenas os critérios de observação (OBS-crit) e os critérios de atuação (ACT-crit) de forma declarativa, que definirão o escopo/foco do controle IoT.

Objetivo do Modelo de Programação

- O resultado do processamento de um OBS será um fluxo de eventos observados, que será processado por um módulo de regras, que irão gerar notificações para clientes ou então gerar comandos de atuação.

- A implementação do modelo ObsAct deverá fazer o mapeamento dos critérios em:
  - Funções de seleção de M-Hubs/M-OBJs,
  - Coleta e pré-processamento de dados,
  - Comandos de atuação em M-Hubs/M-OBJs do escopo.

- Permitir a implementação de uma aplicação IoT complexa como uma rede de ObsAct Loops que interagem entre si.

Components

- **Entity**:
  - An autonomous physical element (artificial or living thing) with well defined and unique identity, which can be mobile.

- **Environment:**
  - A well delimited physical space or region that has a unique ID, may encompass other sub-environments, and may hold a dynamic set of Entities.

Components

- Entities and Environments (ET, EV), may have one or several M-OBJs associated to them.

- The **sensors** in these M-OBJs give information about the current state and/or activity of the ET/EV

- The **actuators** accept commands to perform some action on the ET/EV, or convey some information about them.

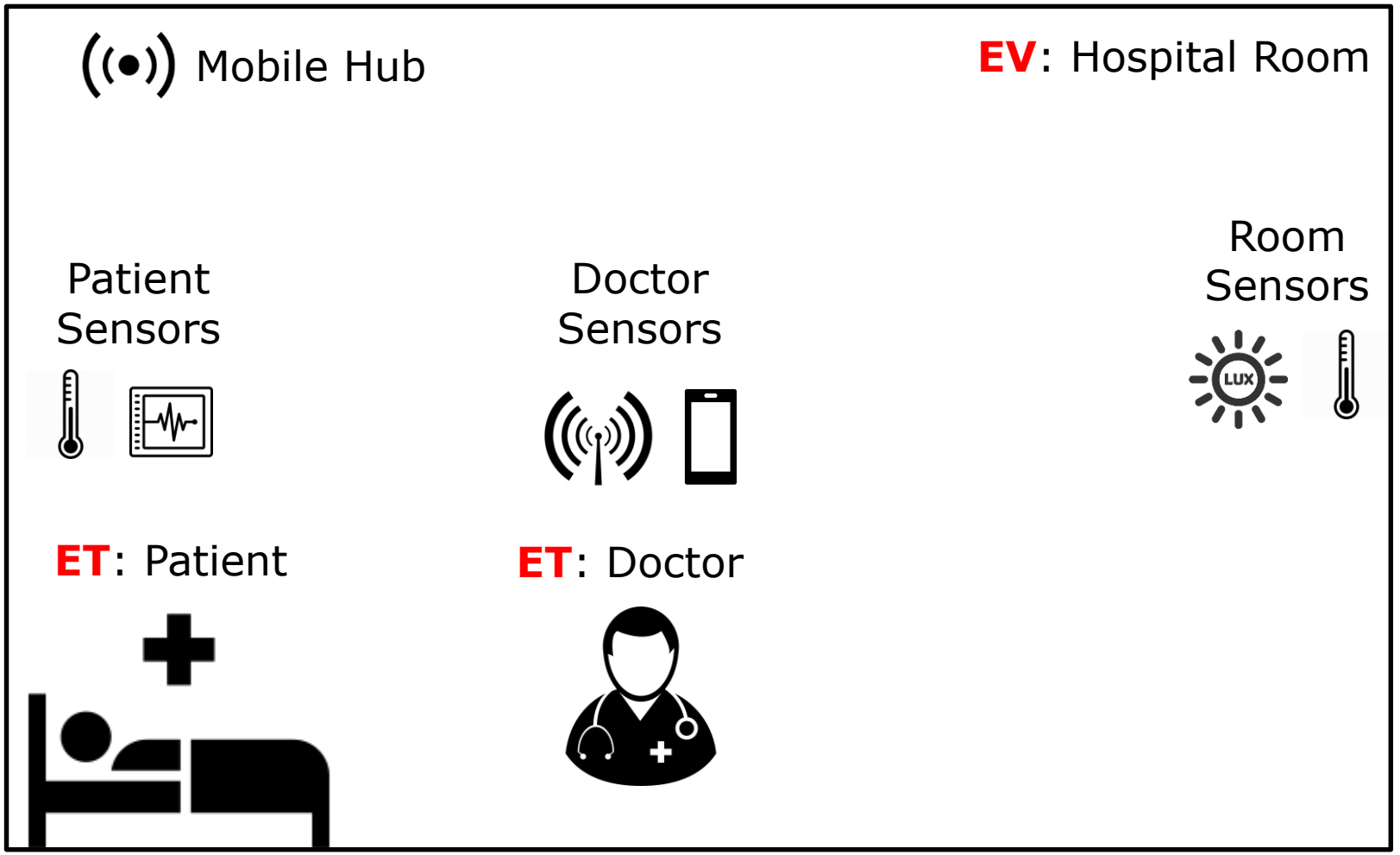
Scenario – Hospital Monitoring

- Hospital rooms are EVs equipped with sensors and actuators, and medical staff are ETs moving around in the EVs with their gadgets and beacons.

- The ContextNet access to M-OBJs is through M-Hubs.

- We assume that either all the Target Environments of Interest (TEv) and the Target Entities of interest (TEt), have at least one M-Hub associated to them. This association is permanent and is characterized by an Et-ID/Ev-ID.

Scenario


Mobile Hub
EV: Hospital Room
Patient Sensors
Doctor Sensors
Room Sensors
LUX
ET: Patient
ET: Doctor

Scenario - Entities

```
{
    entities: [
        { “name”: “patient”,
          “sensors: [
              { “sensor_name”: “temperature” },
              { “sensor_name”: “heart monitor” }
          ]
        },

        { “name”: “doctor”,
          “sensors: [
              { “sensor_name”: “location beacon” }
          ],
          “actuators” : [
              { “actuator_name”: “alert monitor” }
          ]
        }
    ]
}
```

Scenario – Obs Rule

```
obs_rule: { "id": "rule01",
            "sensor_obs": [
            {
                "sensor_name": "temperature",
                "value": 36.5,
                "logical_condition": "GREATER_THAN"
             }
             ]
            "scope": {
                "entities": [ "name": "patient" ],
                "location": { "location_tag": "hospital01"
                              OR
                              "latitude": "-22.958947
                              "longitude": "-43.175444,
                              "radius": "500 meters"
                }
            }
}
```

Scenario – Act Rule

```
act_rule: { "id": "rule02",
            "act_obs": {
                "actuator_name": "alert monitor"
            },
            "scope": {
                "entities": [ "name": "doctor" ],
                "location": { "location_tag": "hospital01"
                              OR
                              "latitude": "-22.958947
                              "longitude": "-43.175444,
                              "radius": "500 meters"
                }
             }
}
```

Scenario – ObsAct Rule

```
obs_act_rule: { “id”: “obsActRule01”,
                “obs_rule”: { “condition”: “rule01” },
                “act_rule”: { “trigger”: “rule02” }
}
```