CTIT

SEMIoTICS

Semantic Model-Driven Development of Interoperable IoT-based Emergency Services: the INTER-IoT case study

João Moreira, Luís Ferreira Pires, Marten van Sinderen, Roel Wieringa

Services, Cyber-security and Safety group (SCS), University of Twente, Netherlands.

{j.luizrebelomoreira,l.ferreirapires,m.j.vansinderen,r.j.wieringa}@utwente.nl

Design problem: improve interoperability of IoT Early Warning Systems (EWSs) to detect emergency risks

inter iot
interoperability of heterogeneous IoT platforms
European Commission

Collaboration (open call): scenario of detecting accidents at the port of Valencia, interoperating wearable medical devices with IoT platforms to react quickly, reducing time responses during accidents

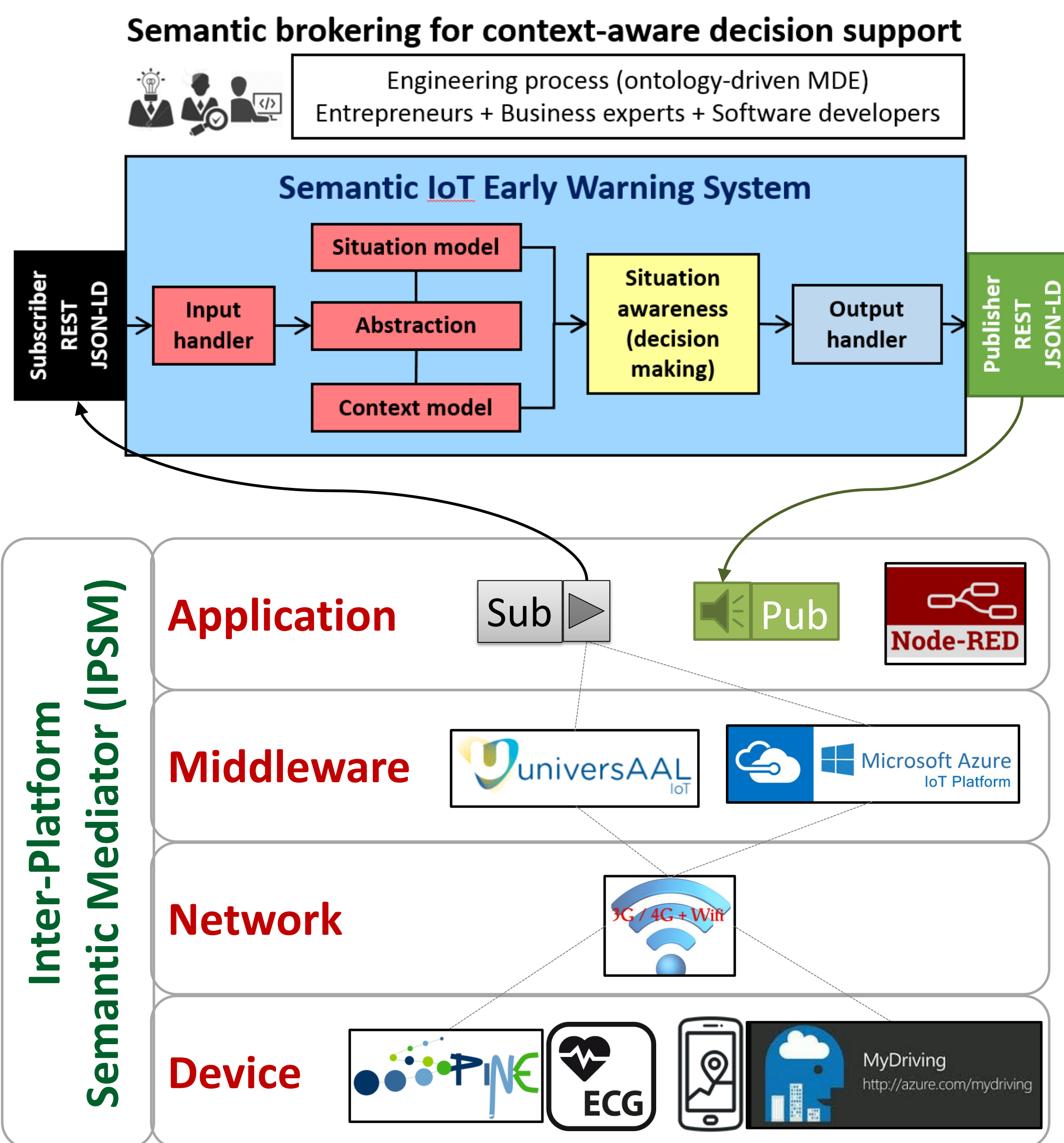| Functional requirements	Non-functional requirements	Use cases
➤ Detect accidents (and risks) with trucks: alert urgency and severity ➤ Detect vehicle collision ➤ Monitor drivers' vital signs (detect stress, tachycardia, bradycardia)	➤ Semantic interoperability among IoT platforms ➤ Coordination of IoT platforms with emergency systems (vicinity) ➤ Integrate e-Health and logistics	**UC01:** Vehicle collision detection **UC02:** Hazardous health changes **UC03:** Temporal relations (UC01 ~ UC02) **UC04:** Wrong-way driving **UC05:** Accidents with dangerous goods

Solution: apply the SEMIoTICS framework to develop the INTER-IoT-EWS

Semantic brokering for context-aware decision support

Engineering process (ontology-driven MDE)
Entrepreneurs + Business experts + Software developers

Semantic IoT Early Warning System

Subscriber REST JSON-LD

Situation model
Input handler
Abstraction
Context model
Situation awareness (decision making)
Output handler

Publisher REST JSON-LD

1. Input handler: upstream data acquisition (IPSM translations)

2. Abstraction: top-level ontology (UFO/OntoUML)

3. Context model: domain ontology (W3C SSN linked to EDXL)

4. Situation model: complex event processing (FIWARE Cepheus)

5. Situation awareness: big data integration tool (Talend)

6. Output handler: emergency notification services (OASIS EDXL)

Inter-Platform Semantic Mediator (IPSM)

- **Application** — Sub ▶ — Pub — Node-RED
- **Middleware** — universAAL IoT — Microsoft Azure IoT Platform
- **Network** — 3G, 4G + Wifi
- **Device** — PINE — ECG — MyDriving http://azure.com/mydriving

External	Health	Logistics
Data	Driver's heart conditions (ECG), accelerometer	Position, speed, accelerometer, dangerous goods
Device (application)	Shimmer ECG-3 (SPINE TinyOS 2.1), Mobile (Android)	Mobile (MyDriving Android or iOS)
IoT platform	universAAL	MS Azure IoT
Ontologies (domain)	ETSI SAREF (IoT), HL7 FHIR or OpenEHR (health)	ETSI SAREF (IoT), LogiCO (logistics)

Preliminary results

➤ Literature review on semantic interoperability of EWSs for emergency management [1,3]

➤ Framework design and case study: architecture, components and INTER-IoT-EWS solution [2,4]

➤ Ontology mapping specifications for IoT domain: W3C SSN 2.0 and ETSI SAREF 2.0 [5]

Impact

➤ SEMIoTICS framework can be used to develop EWSs for other types of accidents, emergencies and disasters

Current / planned activities

➤ Configuration of semantic translations in IPSM: semantic interoperability measurement

➤ Framework development and validation: unit and functional tests, pilot implementation in the port

[1] Moreira, J.L.R., Ferreira Pires, L., Sinderen, M. van, and Dockhorn Costa, P. (2015) *Towards ontology-driven situation-aware disaster management*. Journal of applied ontology, 10 (3-4).
[2] Moreira, J.L.R., Ferreira Pires, L., Sinderen, M. van, and Dockhorn Costa, P. (2015) *Developing situation-aware applications for disaster management with a distributed rule-based platform*. RuleML.
[3] Moreira, J.L.R., Ferreira Pires, L., Sinderen, M. van, and Dockhorn Costa, P. (2016) *Improving semantic interoperability of big data for epidemiological surveillance*. I-ESA, BDI4E workshop.
[4] Moreira, J.L.R., Ferreira Pires, L., Sinderen, M. van, and Dockhorn Costa, P. (2017) Ontology-driven Conceptual Modeling for Early Warning Systems: Redesigning the SML. MODELSWARD.
[5] Moreira, J.L.R., Daniele, L.M., Ferreira Pires, L., et al. (2017). Towards IoT platforms' integration: Semantic Translations between W3C SSN and ETSI SAREF. SEMANTICS, SIS-IoT workshop.

UNIVERSITEIT TWENTE.

Contact info
João Moreira, MSc
(PhD candidate)
7522 NB Enschede, Zilverling 4074
+31 53 489 4337
j.luizrebelomoreira@utwente.nl