

# INTER-IoT-EWS

## Interoperable Situation-Aware Early Warning System

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### Design problem

How to improve the semantic interoperability of emergency services for IoT Early Warning Systems (EWSs)?

### Challenges

- (C1) **Semantic integration of a variety of data sources:** Avoid loss of semantics when multiple ontologies, standards and data models from different and overlapping domains are involved, considering their syntactic and semantic alignments
- (C2) **Processing in time- and safety-critical applications:** Provide the required performance for upstream data acquisition, emergency risk detection and message brokering, in terms of scalability and total transaction time
- (C3) **Data analysis for effective responses:** Enable high quality situation awareness (perception, comprehension and projection) to avoid false positives, and improve decision support based on emergency procedures

### Collaboration (open call)



- Scenario of detecting accidents at the port of Valencia (id.9), interoperating wearable medical devices with IoT platforms to react quickly, reducing time responses during accidents [6]
- Semantic translations between ETSI SAREF and W3C SSN [5]

### Functional requirements

- (FR1) IoT platforms should be able to coordinate with emergency systems
- (FR2) The haulier IoT platform and the port IoT platform should be able to share health information about the driver

### Non-functional requirements

- (NFR1) Semantic and syntactic interoperability among IoT platforms
- (NFR2) E-Health and logistics integration
- (NFR3) Energy consumption (battery level) of the devices should be monitored

### Use cases

- UCo1: Vehicle collision detection
- UCo2: Hazardous health changes
- UCo3: Temporal relations (UCo1 ~ UCo2)
- UCo4: Wrong-way driving
- UCo5: Accidents with dangerous goods

### Solution

Development of INTER-IoT-EWS based on our framework [1-4]

**SEMIOICS** SEmantic Model-driven development for IoT  
Interoperability of emergenCy serviceS

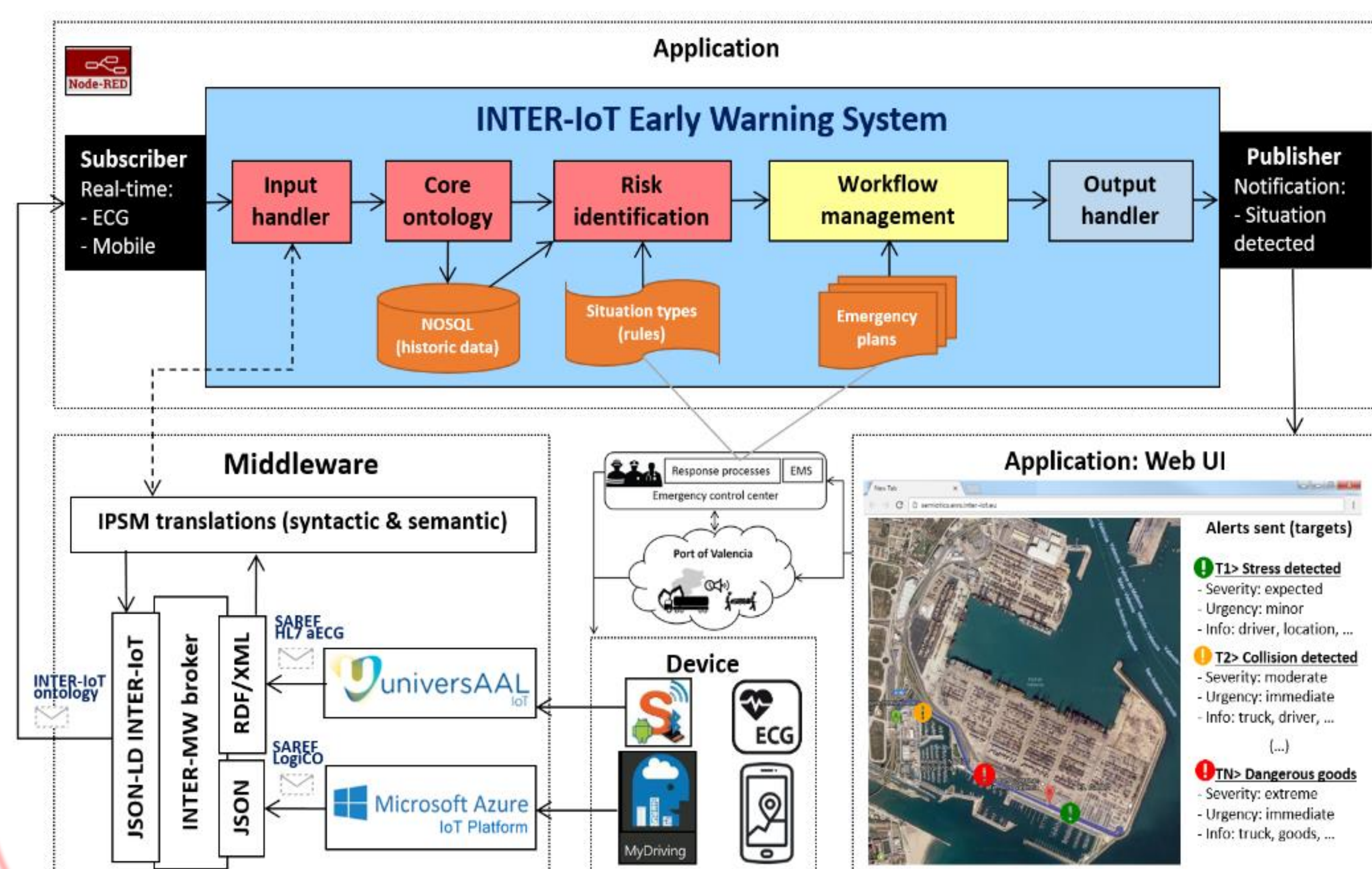


Table 1. Data sources.

External	Health	Logistics
Data	Driver's ECG, HR, accelerometer	Position, speed, accelerometer, goods
Device	Shimmer ECG 3 (Capture), Mobile	Mobile (MyDriving Android or iOS)
IoT platform	UniversAAL	MS Azure IoT
Ontologies	ETSI SAREF, HL7/aECG, FHIR	ETSI SAREF, LogiCO

Table 2. Validation activities.

#	Activity	Description	Addresses
A1	Functional evaluation	Test cases with different levels of severity and urgency, checking emergency procedures	C1, C2, C3, FR1, FR2
A2	Semantic interop.: semantic loss	Transformations: $T(T(x)_{A>B})_{B>A}$ , $T(x)_{A>B}$ represents the semantic translation function from A to B	C1, NFR1, NFR2
A3	Performance eval.: data transfer	JSON x JSON-LD as payload (total transaction time), following the structure of the involved ontologies	C2, NFR3
A4	Performance eval.: data process	Total time to translate; annotate and insert into database; risk identification; and messaging (EDXL)	C2, NFR3
A5	Performance eval.: data brokering	Scalability and resilience measured for single cluster and multi-broker, throughputs of up to 700 msg/sec.	C2, C3, NFR3

- [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.
- [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 conference.
- [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*. BDI4E workshop (I-ESA conference).
- [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 conference.
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- [6] Moreira, J.L.R., Ferreira Pires, L., Sinderen, M. van, Wieringa, R., et al. (2018) *Improving the semantic interoperability of IoT Early Warning Systems: the Port of Valencia use case*. I-ESA conference.

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