Metadata behind the interoperability of Wireless Sensor Network

Daniela Ballari
Monica Wachowicz
Miguel Ángel Manso

Technical University of Madrid
Introduction

Sensors are revolutionising the way in which geospatial information is collected and analysed (Stefanidis and Nittel 2004).

Nowadays, the sensor interoperability challenges increase this transformation through:

– sensing integration of heterogeneous sensor networks,
– expansion of their individual functionalities,
– reutilisation of their data and resources.

in real time.
The interoperability of WSN

Data interoperability
- Exchange sensing data among distributed heterogeneous sensors and with other kinds of information systems (Lee and Reichardt 2005; Balazinska et al. 2007).

Network interoperability
- Exchange and act on information provided by other components or external networks.
- Share their memory, energy, communication and sensing resources (Moe et al. 2007; Chang and Gay 2005).
The interoperability of WSN

How to **achieve** the interoperability?
Standardisation → IEEE and OGC

WSN → highly dynamic

How to **maintain** the interoperability?

In WSN there is a current need **not only to archive**, **but also to maintain** the interoperability.
Dynamic Interoperability

Allows the monitoring of different system operations and their response to change (Manso et al. 2008).

It is necessary to know the changes of status of the WSN at different periods of time.
Our Premise

Metadata
Can generate the knowledge of the status of the sensing system in order to maintain the dynamic interoperability of WSN.

Need for explicit metadata:
• Generated and maintained automatically.
• Describe dynamically the changes of network status.
• Report it back to other components and systems.
• Preserve the context of the collected data.
Our approach

Define a context-aware model based on metadata elements in order to:

→ Describe the dynamic context of interoperability and,

→ Handle such metadata elements to
  – make an explicit representation of the current WSN status,
  – infer the response needed to deal with WSN status changes.

Maintain the interoperability over time.
Context-aware model

**Context-aware levels**
- Sensing
- Node
- Network
- Organisational

**Self-aware tasks**
- Capturing
- Reasoning
- Acting
Context-aware levels

- Sensing
- Node
- Network
- Organisational Context

- Describes the sensing conditions and operations, and helps to evaluate and understand the potential sensor data (Campbell et al. 2008).

- Sensing metadata: spatial, temporal and thematic information (Sheth, 2008).
Context-aware levels

Sensing
Node
Network
Organisational

• Describes each individual node.
• Node metadata: state of memory, communication devices, sensors, actuators, and processor.
Context-aware levels

Sensing
Node
Network
Organisational

- Describes the current configuration and topology of interoperable networks.
- Network metadata: composition, organisation, mobility, distribution, topology, residual network energy and memory, sensing coverage area, communication coverage area, in-network process capacities.
Context-aware levels

- Sensing
- Node
- Network
- Organisational

- Describes how organisational aspects have an impact on dynamic interoperability.
- Organisational metadata: goals, restrictions, security, and privacy issues.
Context-aware levels

Sensing
Node
Network
Organisational Context

To compute the network coverage area
→ is necessary to know the position of the nodes

For security reasons only authorised systems have access allowed
→ to certain sensing functionalities
Self-aware tasks

Capturing
→ Metadata of the current WSN status.

Reasoning
→ Decision-making, policies and rules.

Acting
→ Self-adapting and self-organising processes.
Self-aware tasks
Self-aware tasks

**Metadata**
- Sensing capacities
- Node position
- Residual energy
- Security level

**Capturing**

**Reasoning**
- Both WSN are sensing the same phenomena.
- Two nodes are too close.
- **Rule**: “If the nodes are closer than 5 meters away, then must continue sensing from only one of them”.
- Choose the node with more energy.
- Allows modify the network configuration.

**Acting**
- Trigger a self-adaptive process to sleep the node for 10 minutes.
Conclusions and future work

We provide the description of a context-aware model to maintain the dynamic interoperability in WSN.

Metadata elements in the context model:
- Key factor to maintain the interoperability.
- Currently they are focused mainly on the capturing task.

Further research
- Will be focused on extending the metadata elements for the reasoning and acting tasks.
- Implement the context model as a proof-of-concept.
Thanks for your attention!

daniela.ballari@upm.es
m.wachowicz@topografia.upm.es
m.manso@upm.es