INTEROPERABILITY CONSIDERATIONS IN IOT

Ashleigh Faith
Taxonomy and Knowledge Manager, SAE International
PhD Candidate, Information Science, University of Pittsburgh

07.MAY.2015
Connecting heterogeneous communication networks with standard protocols has been explored (IEEE 802.15) however tagging the deluge of information from these systems, and addressing unique schemas within domain networks, has yet to be identified.

Whereas data can now be routed through networks, it has become increasingly apparent that database metadata and tagging conventions are lacking. In order to analyze data for intelligence gathering and to support response and decision making standardized communication schema and domain schema mapping is needed.
“Car-makers being early leaders are “driving” the Internet of Things (IoT)... As with all the other “waves” of the Internet, evolving the standards is a key aspect to the adoption of the technology. This is occurring in both the wired and wireless realms... a lot of work has been done, but a lot is still needed.”

-Paul Didier,

*IoT Solution Architect at Cisco*
Situation example

Take for instance the following situation: Connecting multiple vehicle GPS systems to city acoustic monitoring and video surveillance to pinpoint where a gunshot originated and who the suspect is.

Not only are vehicle and vehicle systems receivers of IoT data, they are also roaming data collectors and aggregators.

Vehicle cameras can pick up the movements of the suspect and gather intelligence for emergency responders.

Channeling advanced IoT applications, the suspects phone or health monitoring devise (ex: iWatch) data can be analyzed to identify what state the suspect is in (running, driving, hiding, injured) and where they are (IEEE 11073). This situation could also benefit from vehicle control manipulation if the suspect is in a vehicle (i.e. shutting the vehicle off).
Where does this fit in the stack?

<table>
<thead>
<tr>
<th>Schema Profile</th>
<th>Area</th>
<th>Formality of Logic</th>
<th>Interoperability</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper-level schema</td>
<td>Philosophy</td>
<td>High</td>
<td>High</td>
<td>First-order logic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>OBO</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>OWL</td>
</tr>
<tr>
<td>Heavyweight schema</td>
<td>Information science (inference)</td>
<td>High</td>
<td>Medium</td>
<td>OWL</td>
</tr>
<tr>
<td>Lightweight schema</td>
<td>SME and information scientists</td>
<td>Medium</td>
<td>Low</td>
<td>RDFs Html</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>JASON</td>
</tr>
</tbody>
</table>

Who else is interested in schema mapping and interoperability?

*Examples include:*
- Academia
- BioPortal
- DARPA
- DCMI
- DoD
- NATO Terminology Programme
- Schema.org
- W3C
Top considerations for IoT schema interoperability:
(in order of least to most resource allocation)

• **Architecture:** Continue with protocol specs; Machine learning and artificial neural networks; Governance

• **Collaboration:** Early IoT users/designers; Industry; OpenStand

• **Adoption:** MasterKey API; Data visualization; HMIs; Security

• **SME:** Vehicle system, subsystem, method, process and component domain experts
SAE International is the largest knowledge base for transportation, making it the perfect partner for transportation SME schema input. The SAE Ground Vehicle standards alone number in the hundreds. Of which the documents and committees can provide rich SME input for schema standardization, alignment, and mapping.

A cluster analysis reveals that the transportation offerings from IEEE are lacking the depth of technological detail and technological coverage to properly address schema mapping for vehicle IoT integration.
With projections of IoT-enabled devices and processes growing exponentially, it is imperative that our organizations come together to form a cohesive standard collection.

Data intelligence for response and decision making support requires data to be tagged, analyzed, aggregated, and disseminated to leverage Smart Devices, Vehicles and Cities.

**Without adding intelligence through schema, IoT will be like the internet in the 1990s:**

**A promising technology without a vehicle to drive it.**