Ontology Summit 2015 Internet of Things synthesis I

TOWARD SMART NETWORKED SYSTEMS AND SOCIETIES – SYNTHESIS I

TRACK D: RELATED STANDARDS & SYNERGIES FOR EMERGING IOT ONTOLOGIES

Track D Session 1 Participants

*William Miller, Chair ISO/IEC/IEEE 21451-1-4

*Geoff Brown (Oasis MQTT Chair, Sec'y)

“The nice thing about standards is that there are so many to choose from.”

--ANDREW TANENBAUM

Reasons to Standardize (Session 2)

Avoid technological dead-ends*

Reduce dependence on vendors* or foreign countries

Promote universality*

Develop competitive edge or partnership, or respond to same

Solve a technical, enterprise or social problem

Bridge previously disparate technologies or disciplines

Incorporate elements from a related, entrenched standard

Lower cost by market-broadening

* Adapted from K. Jakobs, "Information Technology Standards, Standards Setting and Standards Research."

The Standards Semi-verse

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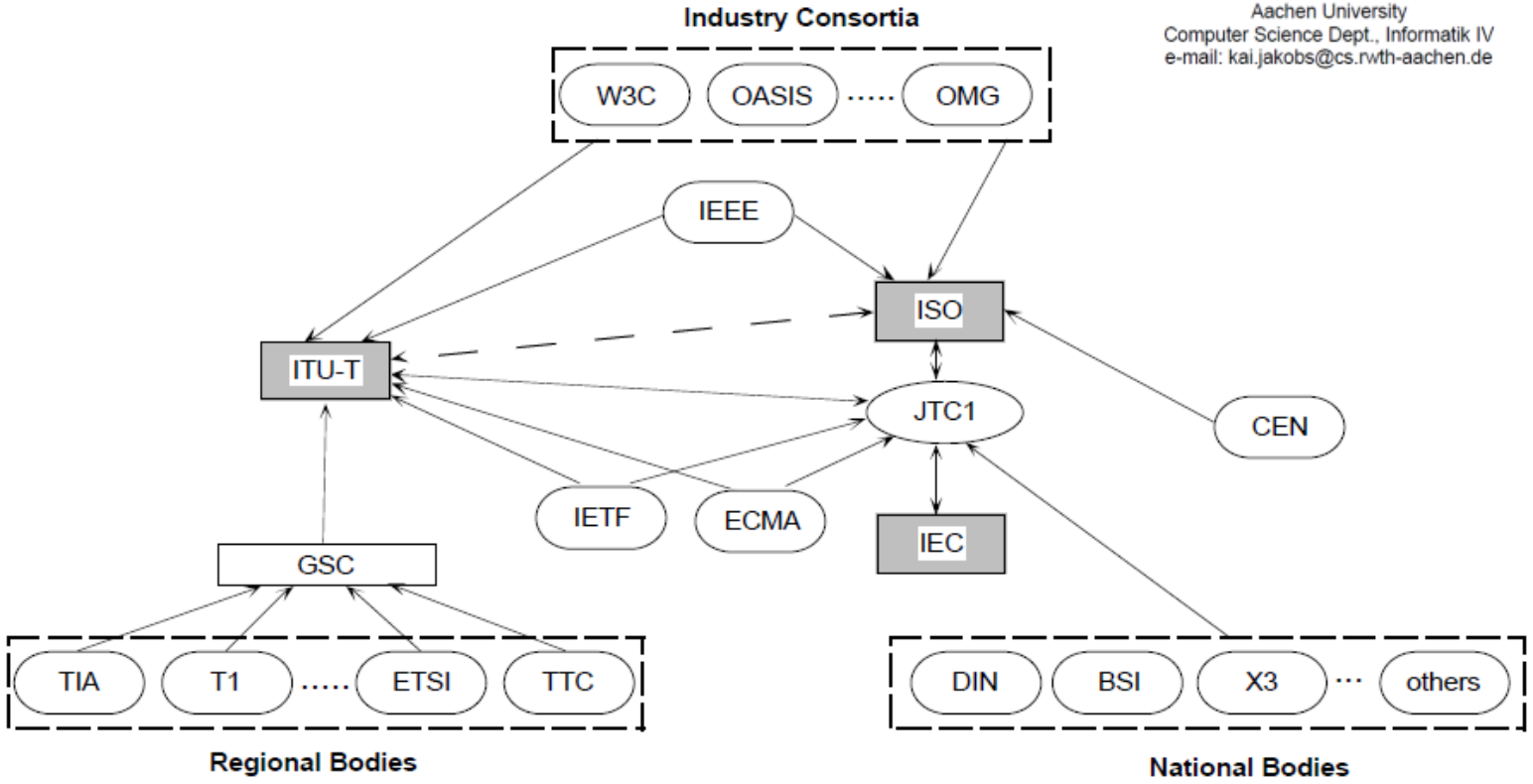

Figure 2: The IT standardisation universe today (excerpt)

The Standards Influence Maze

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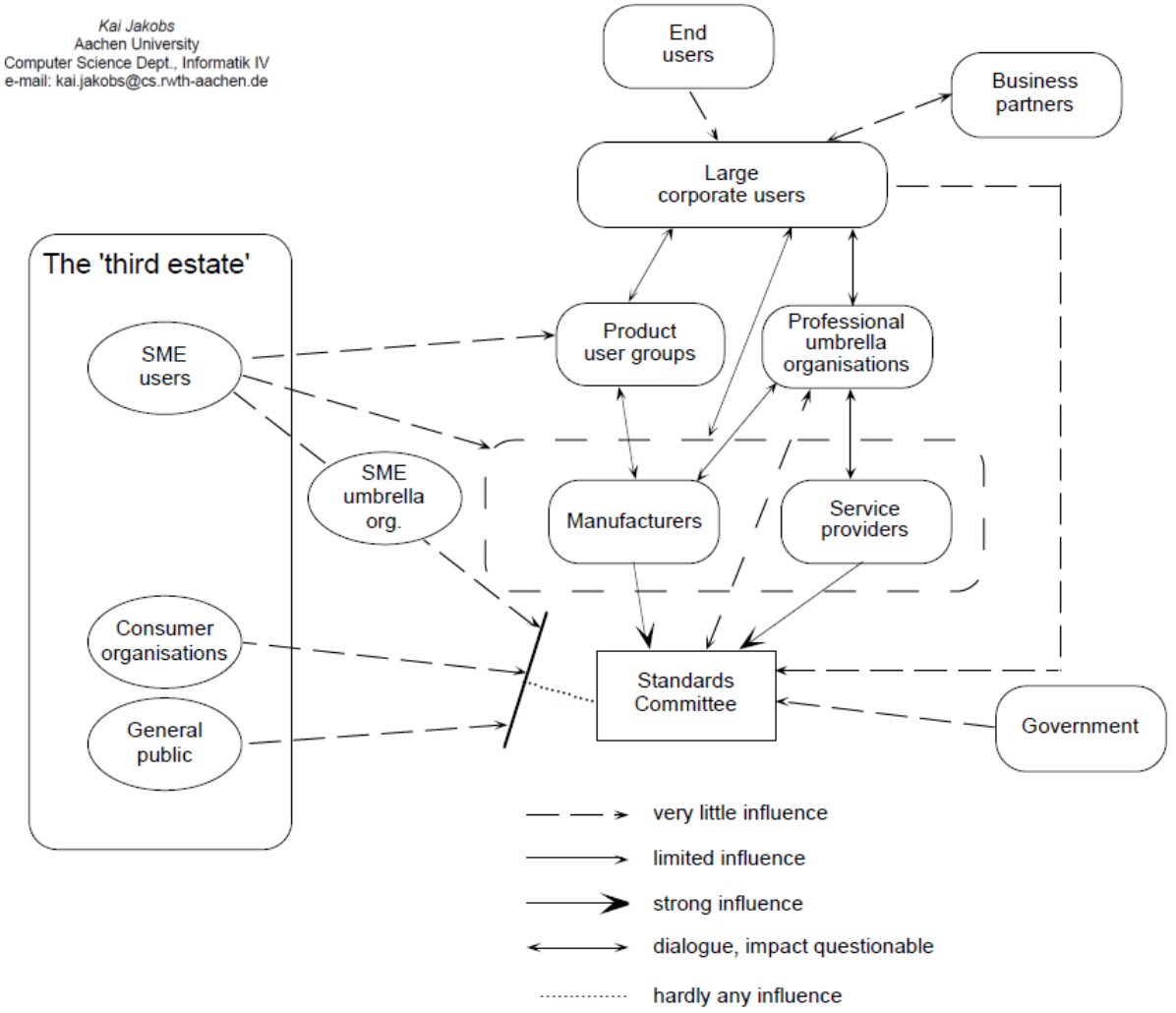


Figure 5: A more realistic view of the relations between stakeholders in standardisation

Mission Statement*

The existence of standards – both official and de facto – can dramatically influence the software development life cycle for ontology projects. This is especially for greenfield efforts, which can peg existing vocabulary, interoperability settings, test harnesses and verification processes to new projects. Standards may be essential for domain-specific data quality assurance. Standards also have a sociotechnical purpose. Communities of Interest (CoI) behind a standards effort can supersede a standard by concentrating expertise and collecting artifacts related to the standard. Because the world of "things" is by definition vast, standards can facilitate connecting software to devices by offering abstractions that impact domain-specific knowledge of the devices. This is helpful for building ontologies. That said, software development is a deregulated engineering process, and many successful software ventures have succeeded by ignoring or incorporating bits and pieces of unacknowledged standards work – sometimes creating new de facto standards in the process. The purpose of this track is to help potential IoT ontology developers understand the standards landscape – both official and de facto.

*Also appears as Abstract

Approach updated

- Survey “official” IoT standards
- Identify de facto standards
- Identify related standards, projects, bodies not officially designed as IoT or WoT
- Highlight domains where ontology efforts:
  - (1) are most needed; (2) have harmonious partnership opportunities; (3) available subcomponents
- Discuss Challenges: Power mgmt., security, signal post-processing, provenance, signal quality, discovery, metadata, network issues, Big Data
- Related work: Modsim (e.g., Yang Song, et al. 2012, Sensor Fusion, Linked Open Data, augmented reality, Software Defined Networks (SDN), Named Data Networks
- Lessons from history: middleware, intelligent agents, CEP, embedded systems, DoD fusion
- Retrospective: Related Lessons from Ontology Big Data 2014 (*G. Berg-Cross)*

Track D Agenda updated

Two Sessions (January 22, February 26)

Session 1

- Speaker Background & Introduction
- Standards Overview
  - "Official" | De Facto
- Current IoT standards state of affairs
  - Strengths, weaknesses, trends
  - IoT standards "Semi-verse"
  - Influencers
- Panel Q & A

Session 2

- Low-hanging Ontology Fruit (=> XMPP, SSN, *per various*)
- ~~Speakers' Favorite Use Cases~~
- Moderator's Puzzles
- Panel Q & A

Add'l Standards / "Models" Cited NEW

Process Specification Language (Gruninger)

Constrained Application Protocol CoAP (Miller)

CEP

Decentralized (edge aggregation or preprocessing)

Abstract Services (from XMPP): Federation, Gateway, "Direct I/O," Concentration

SENSEI & other EU initiatives

IoT Events, Processes NEW

XMPP Events (*Miller et al.*)

XMPP Discovery

XMPP XEP-0325-SN Control

XMPP XEP-0324-SN Provisioning

Error Recovery, Correction (XMPP TEDS)

XSLT for W3C uniformity

Decision framework (*Voas*)

IoT Objects, Things (Examples)NEW

Battery-powered Sensors (XMPP XEP-0000-SN)

Concentrators (XMPP XEP-0326-SN) (*Miller, Voas*)

Actuators

Communication Channels (*Voas*)

Smart Transducers, Transducer Electronic Data Sheets (21451)

- Self-ID, self-describing, time- location-aware, networked, resident metadata
- Require sub-ontologies?

Networked IoT Devices NEW

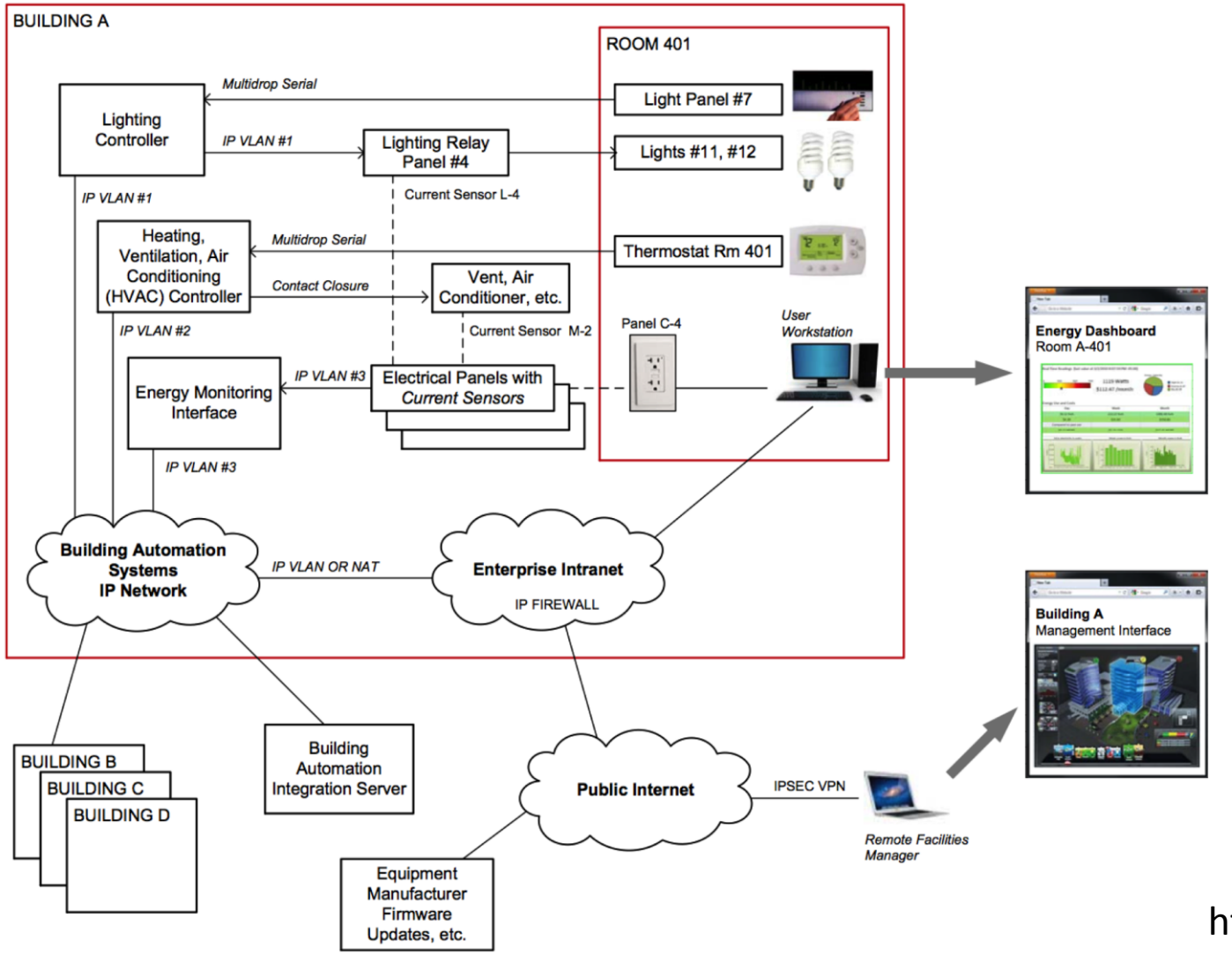
Related work: Named Data Networking http://bit.ly/1BsEZPK

- Conceptual: ACM's "information-centric networking"
- Data-centric security, adaptive routing, in-network storage
- Cite: networked sensors

Software Defined Networks

- TBD

Named Data Network Use Case: Cyberphysical SystemsNEW



http://bit.ly/1BsEZPK

Cross-Cutting Concerns

Temporal measurement, reasoning

Geo-spatial measurement, reasoning

Message parsing, interpretation (XMPP: “IoT Message Channel”)
- Principally rely on work by others?

Ambiguities and Weak Definitions
- “Meter” Compare IEC 61968, Multispeak V4.1, IEC 61970, NAESB PAP10 (*Steve Ray*)

Workflow and Orchestration
- Semantic Workflow (*Jack Hodges*)
- Data fusion workflow (*Underwood*)

***Design Patterns (new slide)

Provenance
- SSNO + PROVO-O (*Jenson*), Stale sensor data, failed devices, sensors in motion (*Voas*)

Design Patterns NEW

Stimulus – Sensor – Observation (*C. Henson*)

Sensors as Agent-based or Control Entities (*G. Berg-Cross et al.*)

Middleware adapted / co-opted for IoT (*G. Berg-Cross*)

Big Data ontology solutions, approaches (*G. Berg-Cross*)

Pub/sub, discovery/integration, in-networking “paradigms” (*G. Berg-Cross*)

Updates to Software Development Life Cycles (SDLC) for Real Time / High Velocity Systems (*Underwood*)

Lessons Learned NEW

Lessons from using SSN Ontology

- Semantic annotation issues (Barnaghi)
- Standard-to-standard as model-to-model interop or translation?
- "Model refactoring" (S. Ray)

From DoD Sensor Platforms & Experiments

- CPOF etc.

From Ontology Summits

- May need a knowledge modeling language adapted for IoT scenarios (*G. Berg-Cross)*
- Reusable patterns, modeling granularities, etc. (*G. Berg-Cross)*

Edge Proximity

Taxonomies & Identification: Universal Unique Identifier (*Miller*)

Semantics at the Edge (C. *Henson*)

=> Lessons from distributed computing literature?

- Are old, new or hybrid design patterns visible?

Security, Privacy, Resilience NEW

XMPP – Encryption, service broker “isolation”

XMPP – Private, group, public provisioning; decommissioning

Trust frameworks

Quality of Service (QoS in Oasis MQTT)

Ownership “bundle” *(Voas, Underwood)*

Reference

LISTS, REFERENCES AND RELATED RESOURCES (SYNTHESIS)

Standards Orgs & Initiatives updated

W3C – Web of Things Community Group

Industrial Internet Consortium

ECHONET Consortium (home appliances, LITE spec, cert equip)

Share-PSI 2.0 Thematic Network (EU Open Data initiatives)

ZigBee Alliance (IEEE 802.15)

Oasis Message Queuing Telemetry Transport (IBM, Cisco, Red Hat, Tibco, Facebook)

ISO/IEEE 11073 Health Informatics Devices

OGC Sensor Web Enablement

International Telecommunication Union (IoT-GSI)

European Research Cluster on IoT

Project Haystack

Wi-SUN Wireless smart utility networks

AllJoyn | OPENIoT

ISO/IEC/IEEE 21451-1-4 | XMPP IoT

Eu Lighthouse Integrated Project IoT-A

AllSeen Alliance

OneM2M

Process Specification Language

Open Interconnect

* more at Postscapes.com

Related Standards & Groups updated

OGC Spatial Data (GeoSPARQL, NeoGeo, ISA Locn)

IEEE TC's: Smart Cities, Big Data, Cybersecurity, IoT Communities

Semantic Sensor Web (OGC + SWE specifications)

RFID

W3C Semantic Sensor Networks Incubator Group

BPMN – BPEL: Connect to other enterprise events, workflow

REST (Bosch)

Thread Group (Google, etc.)

Heterogeneous System Architecture Foundation

Micro Electro Mechanical Systems (MEMS) Industry Group

Marine Metadata Interoperability Project

City Pulse Project | Knoesis

Temporal Abstractions Ontology

Temporal Ontologies (e.g., SWRLTO)

JSON (Steve Ray)

Apple HomeKit

Ontology Developers or Standards NEW

Quantities (qudt.org) (*J. Hodges*)

Human Health: Anatomical parts, symptoms, diseases (obofoundry.org) (*J Hodges*)

ZigBee Ontology (Chien et al., 2013)

W3C Semantic Sensor Network XG Final Report (June 2011)

SENSEI, SemSorGrid4Env (*G. Berg-Cross*)

CHALLENGES

- Ontologies have dissimilar design (*J. Hodges*)
- Ontology-to-ontology mapping is difficult, impossible or manual *(J. Hodges)*
- Manufacturer-driven "ontologies" (e.g., Siemens, Vandrico)
- Need for ontology-based standards (*G. Berg-Cross)*

De Facto Standards and Influences

Intel Edison Embedded Processor, HDMI Compute Stick, Stick Computing (Android)

Activity Streams (Slides by C. Messina @Google)

Alliance for Wireless Power (Rezence)

Misc Resources for Communique

Web of Things Meeting Report (June 2014)

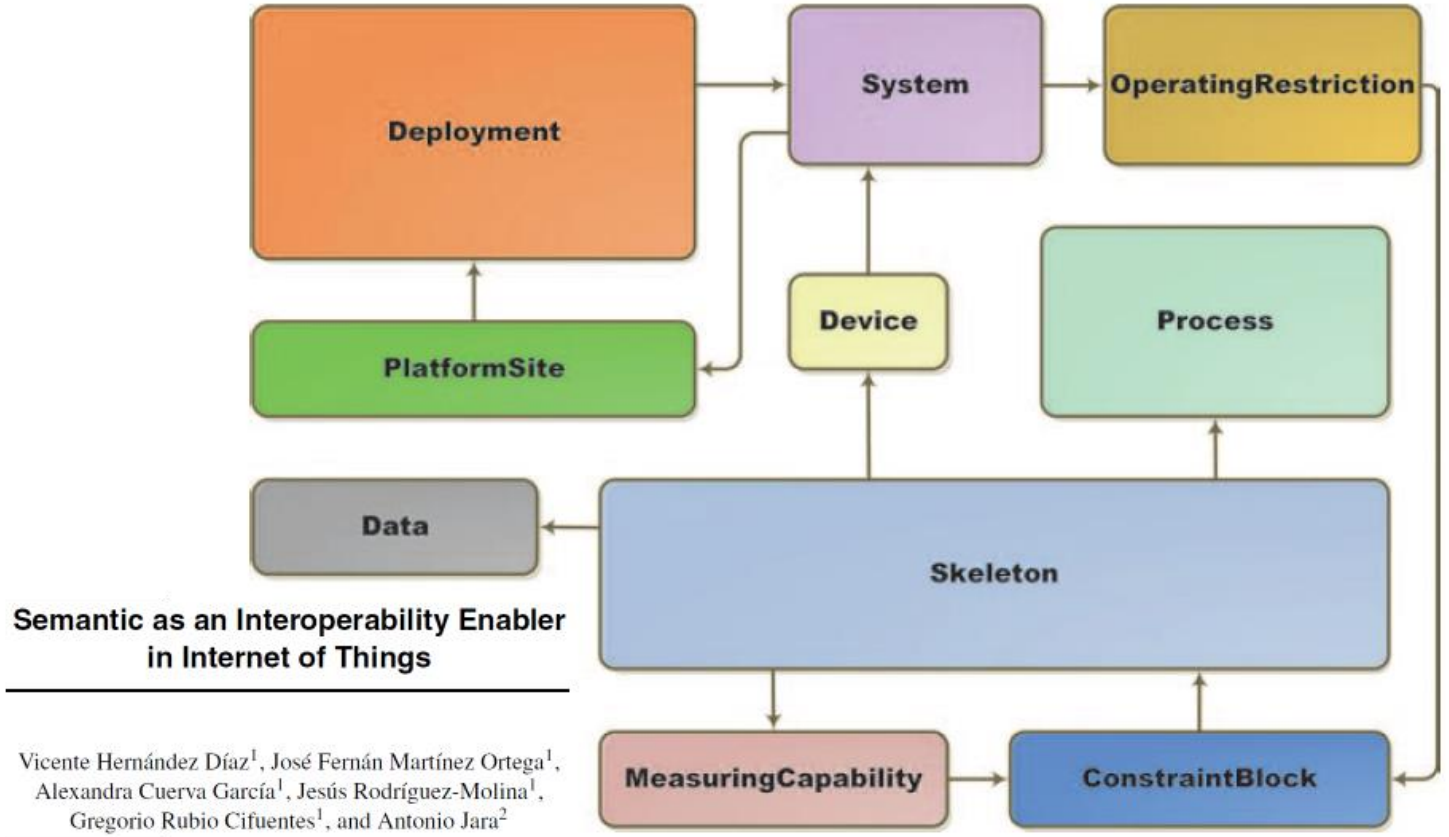
SeeControl (Cloud IoT)

Automated Buildings columnists

Libelium 50 Sensor Applications for IoT

IoT: Converging Technologies for Smart Environments (Ontology discussions, bibliography)

Semantic Sensor Network Ontology

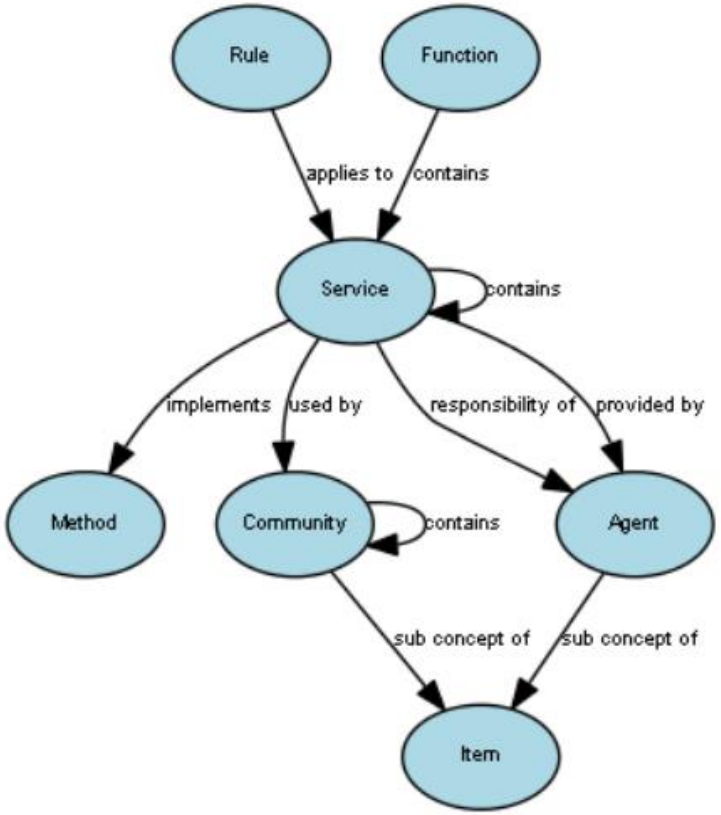


Semantic as an Interoperability Enabler in Internet of Things

Vicente Hernández Díaz[1], José Fernán Martínez Ortega[1], Alexandra Cuerva García[1], Jesús Rodríguez-Molina[1], Gregorio Rubio Cifuentes[1], and Antonio Jara[2]

Fig. 9.4 Overview of the Semantic Sensor Network ontology classes and properties.

Phil Archer phila@w3.org



Keynoter Candidates

Roberto Minerva (IEEE IoT)

Joseph Bradley (Cisco IoE Evangelist and VP)

William Sennett, Alex Wahl (?) (IBM Watson)

Rex St. John (Intel IoT Evangelist)

Carla Diana (Ted Talk)

Richard McElhinney Project Haystack