





Horizontal IoT Application Development using Semantic Web Technologies

Soumya Kanti Datta
Research Engineer
Communication Systems Department
Email: Soumya-Kanti.Datta@eurecom.fr

- Introduction
- Challenges
- State-of-the-Art
- Horizontal IoT application development framework
- Conclusion



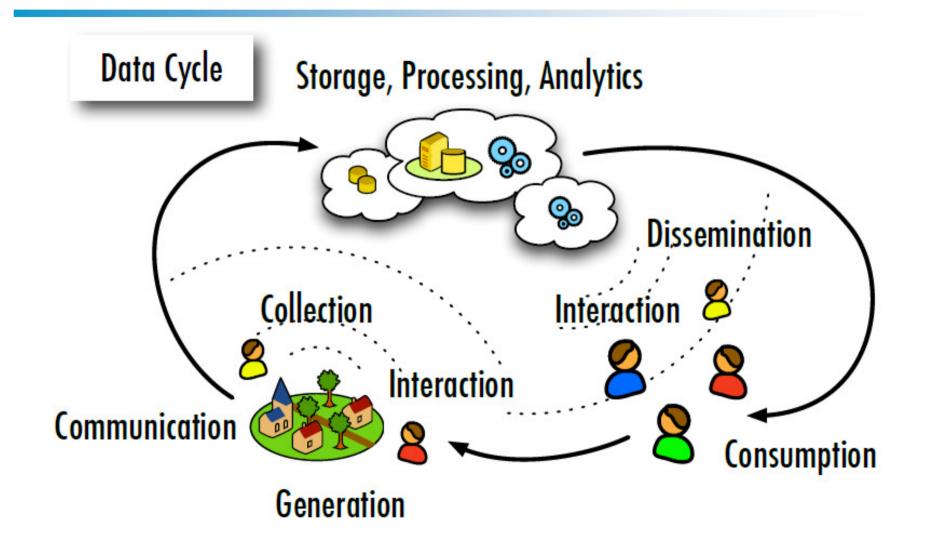
Introduction

loT is highly interdisciplinary

Application development often requires combining data from multiple domains



Data Cycle in IoT





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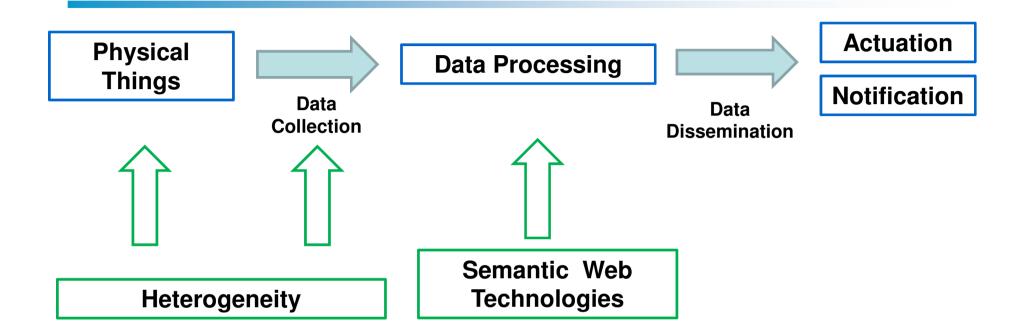


Challenges

- Connecting heterogeneous things
- Combine data from different sensors and domains
- Uniform representation, treatment and interpretation of sensor data for cross domain applications
- Uniform application development framework for any smart home scenario
- Deploy across multiple platforms (cloud, home gateway)
- Derive actionable intelligence allowing humans or things to react
- Support resource discovery, automatic management, provisioning while maintaining interoperability
- Preserve privacy through secure mechanisms



Solution: Semantic Web Technologies



- But semantics along is not sufficient
- Still need components for
 - Resource discovery, provisioning, automatic management of things
 - Deployment platform, support for actuators



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State-of-the-Art

- The reasoning engines and semantic algorithms in a mobile app are largely based on internal sensors.
 - No consideration towards external sensors (deployed in smart home).
 - No dynamic discovery of sensors.
- Current initiatives are largely focused on domain specific scenarios.
 - What about cross-domain (horizontal scenarios)
- Interoperability issue
 - No common catalogue exists for sensors, measurements, units, and domain names.
- Not oriented to a standard

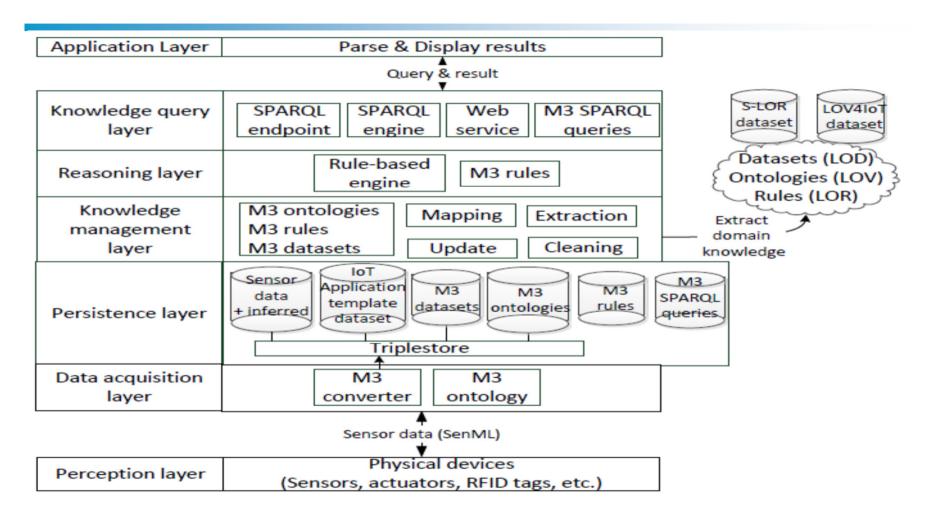
Source: S. K. Datta, A. Gyrard, C. Bonnet and K. Boudaoud, "oneM2M Architecture Based User Centric IoT Application Development," *Future Internet of Things and Cloud (FiCloud), 2015 3rd International Conference on*, Rome, 2015, pp. 100-107



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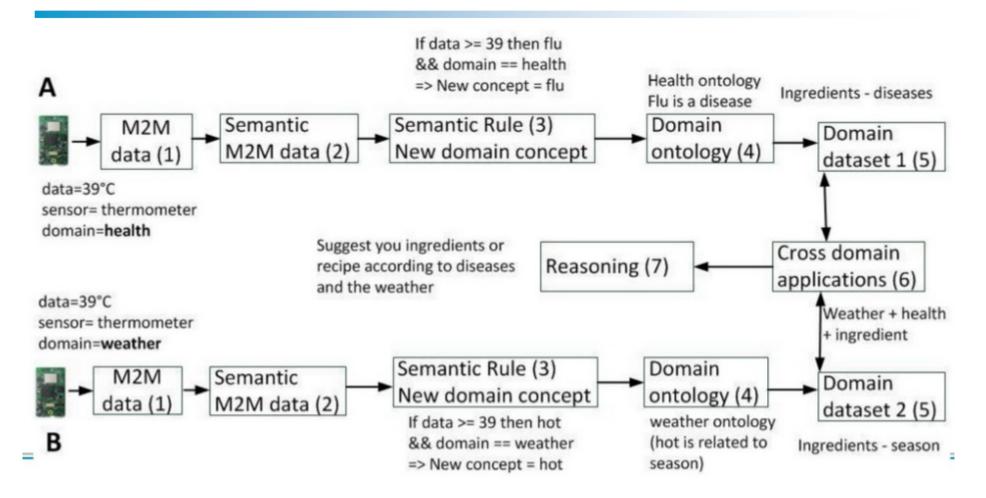
Machine-to-Machine Measurement Framework



Source: A. Gyrard, S. K. Datta, C. Bonnet and K. Boudaoud, "Cross-Domain Internet of Things Application Development: M3 Framework and Evaluation," *Future Internet of Things and Cloud (FiCloud), 2015 3rd International Conference on*, Rome, 2015, pp. 9-16



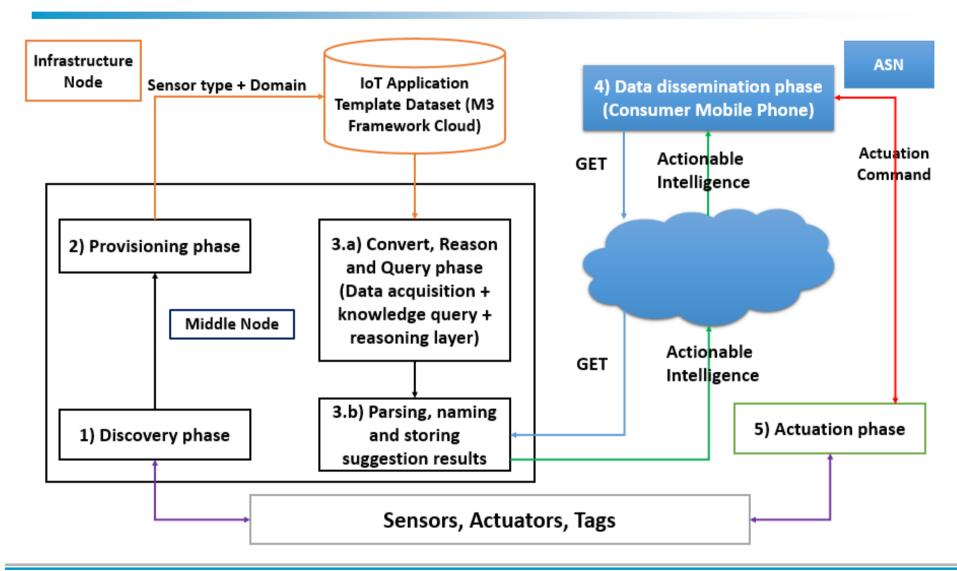
Semantic Reasoning



Source: Gyrard, A.; Bonnet, C.; Boudaoud, K., "Enrich machine-to-machine data with semantic web technologies for cross-domain applications," in *Internet of Things (WF-IoT), 2014 IEEE World Forum on*, pp.559-564, 6-8 March 2014

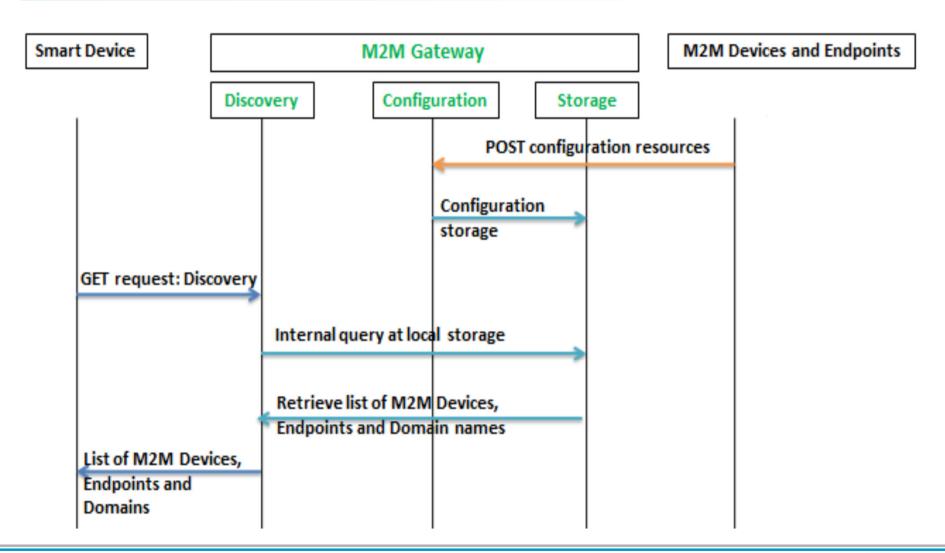


Horizontal Framework



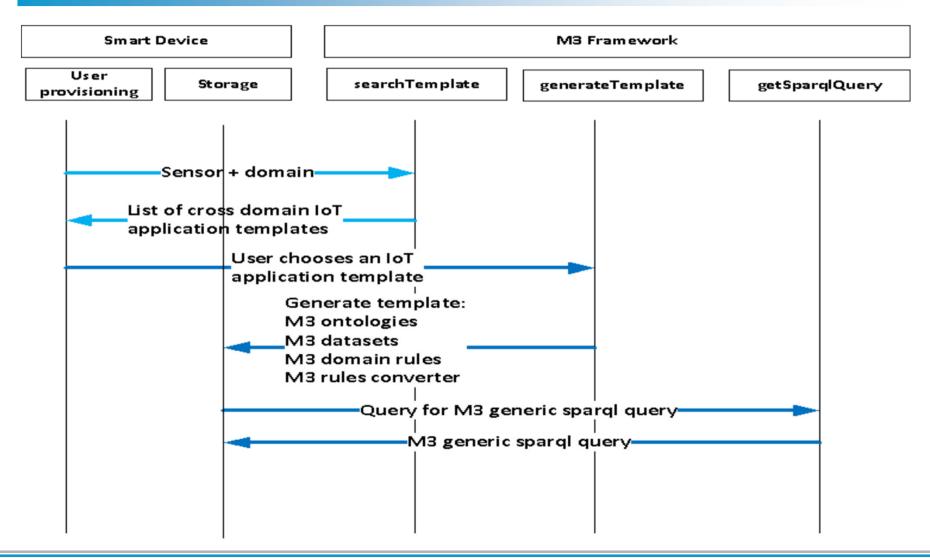


Discovery Phase



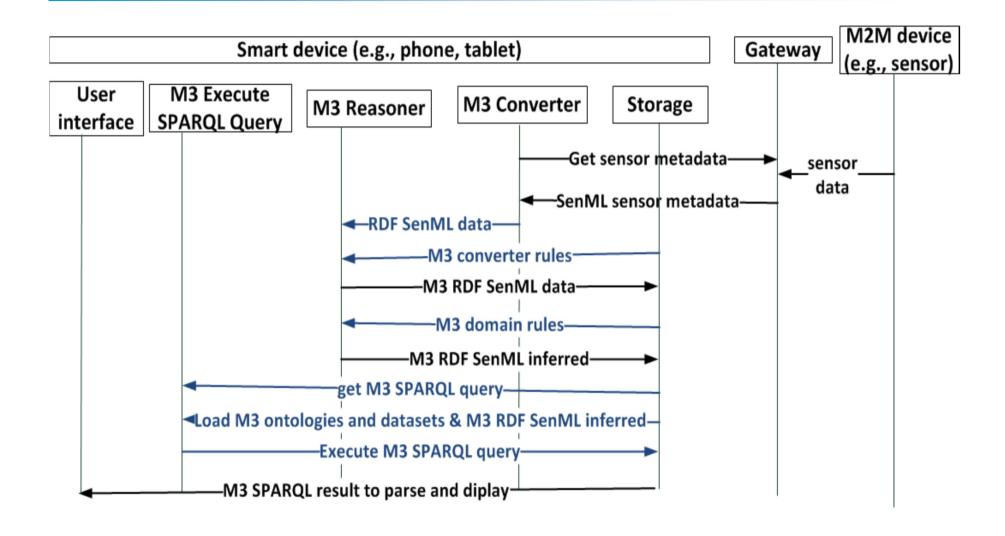


Provisioning Phase





Convert, Reason and Query Phase





Data Dissemination Phase

Based on HTTP GET

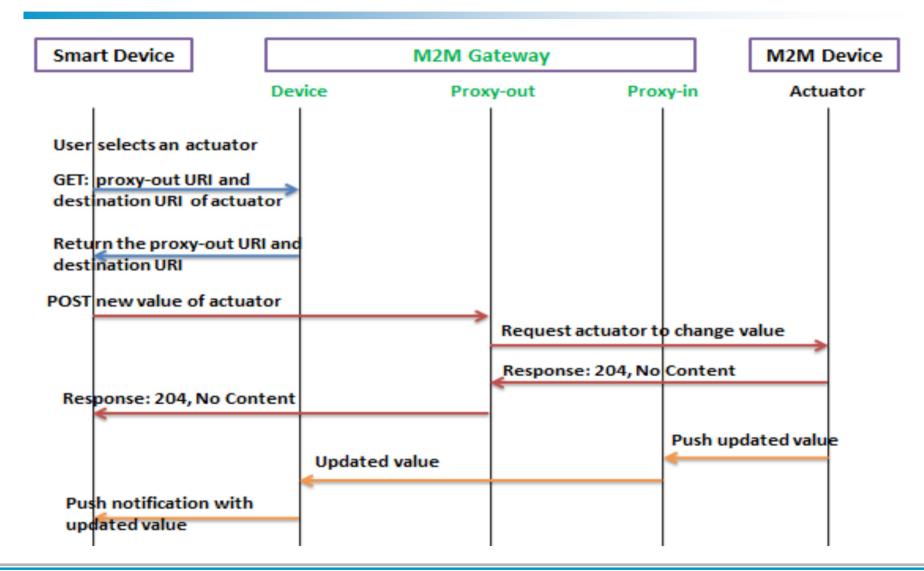
Consumer mobile phone request for actionable intelligence from Middle Node.

Based on Push notification

- Middle node uses Google Cloud Messaging platform to push actionable intelligence into Android powered devices.
- Apple Push Notification platform is used for iOS powered devices.



Actuation Phase





Deployment and Prototype

M3 Framework – Cloud

- Developed using Jena Framework
- Available at http://sensormeasurement.appspot.com/
- Cross domain IoT application development framework
 - Android powered device acting as a home gateway
 - Developed using Android SDK and AndroJena

Initial testing performed with

- Combining weather and vehicular sensors data
- Combining eHealth and home automation sensors data



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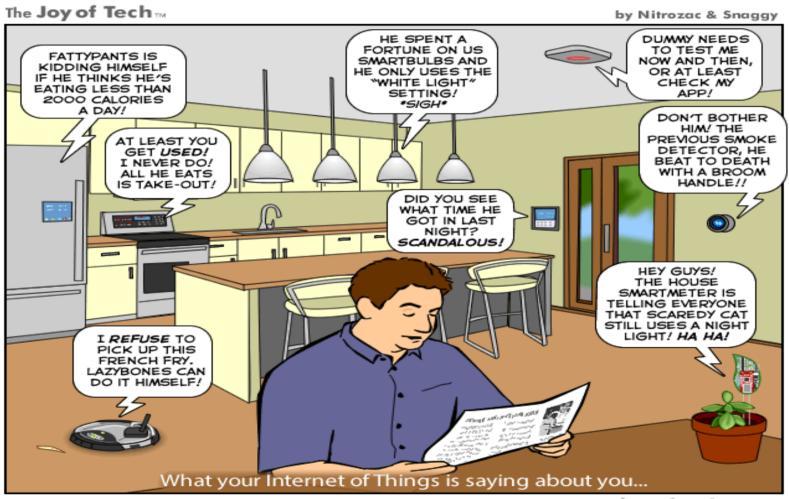
Conclusion

In a nutshell,

- Challenges towards cross domain IoT application development framework in smart home
- Limitations found in state-of-the-art
- > A semantic based framework for such development



Sometime Soon ...



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감사합니다 Natick Danke Ευχαριστίες Dalu Thank You Köszönöm Спасибо Dank Gracias らいい Seé り かとう



Connect with Me ...

Dankie Gracias

Cπαςμδο Merci Takk

Köszönjük Terima kasih
Grazie Dziękujemy Dėkojame
Ďakujeme Vielen Dank Paldies
Thank You Tak

感謝您 Obrigado Teşekkür Ederiz

アロスロスロスロスロングルと

Bedankt Děkujeme vám
ありがとうございます
Tack



- Email: Soumya-Kanti.Datta@eurecom.fr
- Telephone: +33658194342
- Twitter: @skdatta2010

