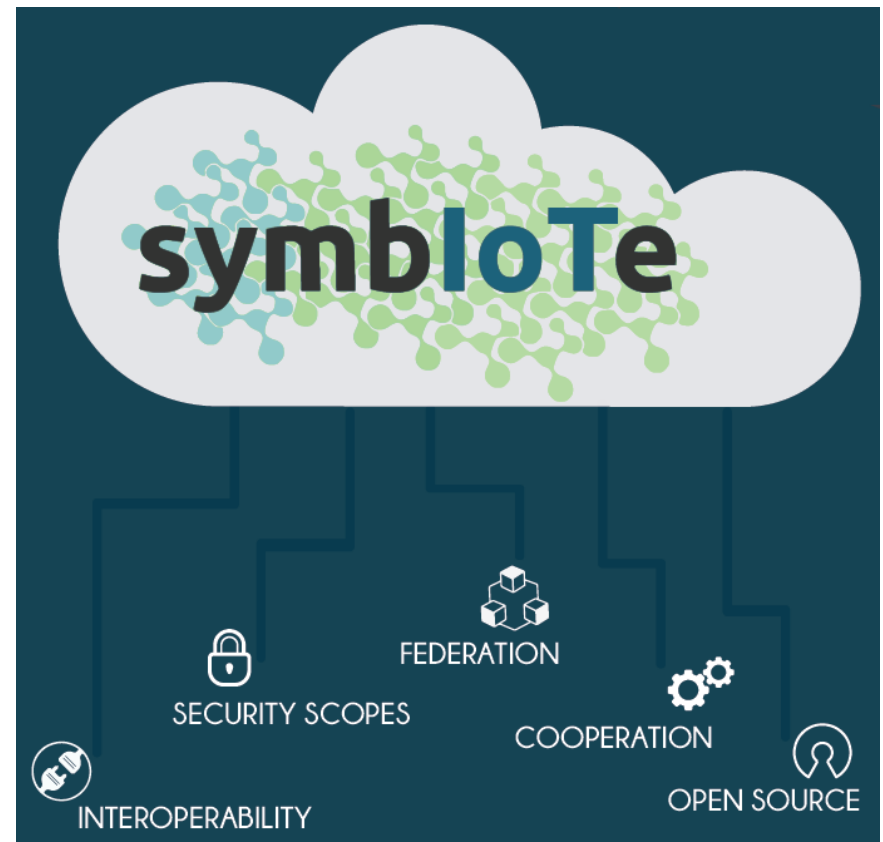# symbIoTe

Towards an IoT Framework for Semantic and Organizational Interoperability

Ivana Podnar Žarko, Sergios Soursos, Ivan Gojmerac, Elena Garrido Ostermann, Gianluca Insolvibile, Marcin Plociennik, Peter Reichl, Giuseppe Bianchi

Global IoT Summit, June 8, 2017

Overview

- symbIoTe in a nutshell
- Architecture: general overview
- Interoperability aspects
- Semantic and syntactic interoperability
- Implementation status

What is symbIoTe?

- **symb**iosis of smart objects across **IoT e**nvironments
- interoperability and mediation framework
- aims at the collaboration of vertical IoT platforms towards the creation of cross-domain applications
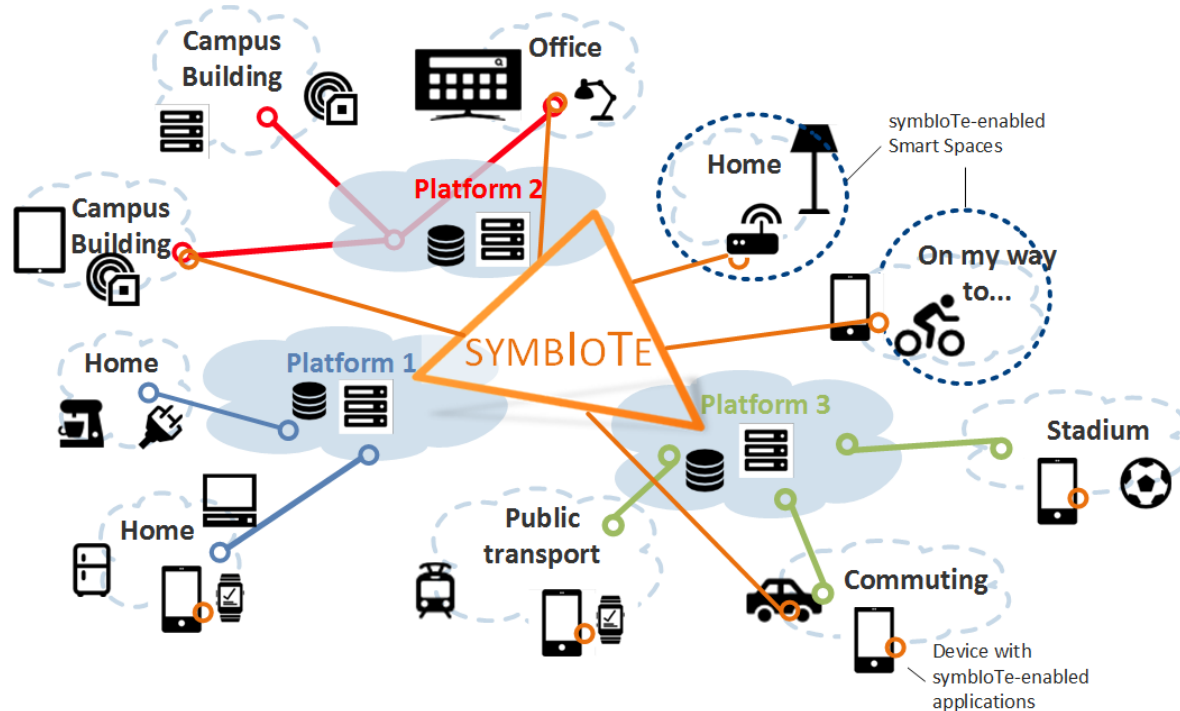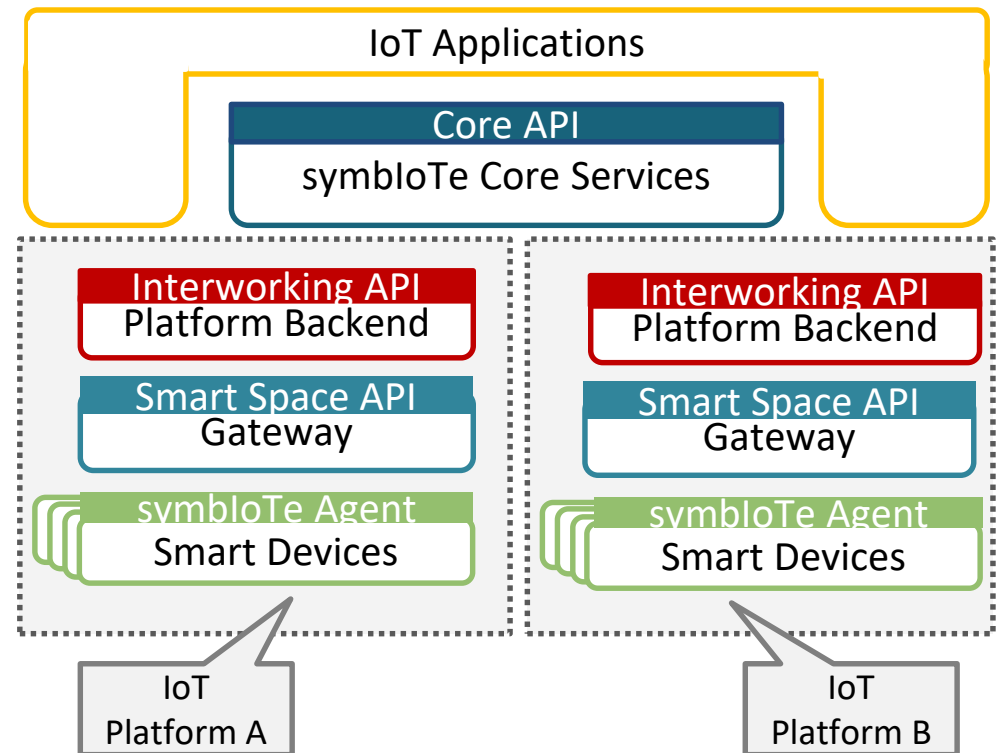
IoT Landscape & Motivation

- IoT platforms offer vertical solutions, closed silos
  - focusing on a single domain, more than 350 platforms on the market
- Absence of cross-domain apps
  - life is multi-dimensional and partnerships are sought
- Collocated platforms within smart spaces
- Maintenance of e2e solutions
  - high market entry barrier
  - will a single standard/technology/protocol prevail?
- End users
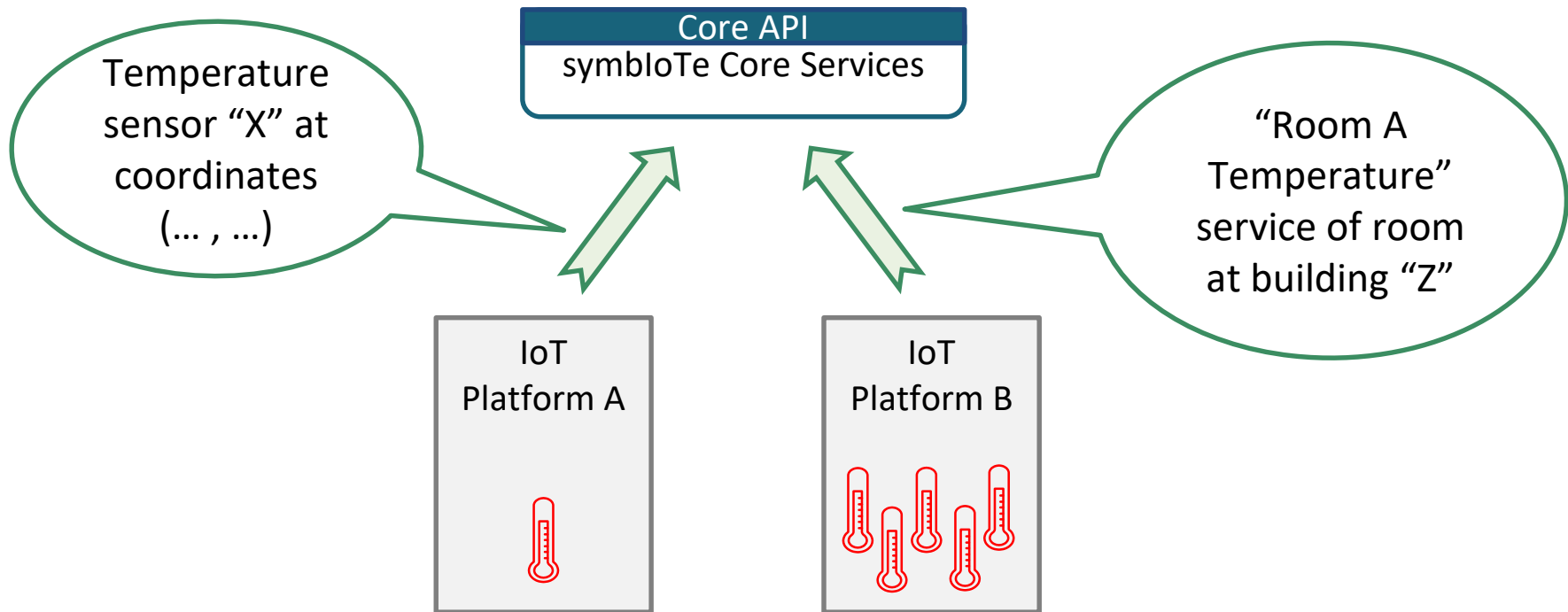 - vendor lock-in; multiple apps for different devices/spaces

- not yet another IoT platform

- a **middleware** that offers a unified way for

  - exposing of IoT resources to third party applications

  - discovery and secure access to IoT resources

  - sharing/trading of IoT resources

  - flexible integration of smart space infrastructure

IoT Applications

Core API
symbIoTe Core Services

Interworking API
Platform Backend

Smart Space API
Gateway

symbIoTe Agent
Smart Devices

Interworking API
Platform Backend

Smart Space API
Gateway

symbIoTe Agent
Smart Devices

IoT Platform A

IoT Platform B

Core API

symbIoTe Core Services

Temperature sensor "X" at coordinates (… , …)

"Room A Temperature" service of room at building "Z"

IoT Platform A

IoT Platform B

- How can platforms monetize the value of their resources? ⇒ new revenue streams!

- How can 3rd parties use the offered resources?

Another Example: Actuation

- ## Universal light switch on your mobile phone
    - switch on/off the lights at home, in the office, in public spaces… wherever you are allowed to do so
    - today we need 3 apps for this, one for each platform

Open source software for flexible IoT ecosystems that will allow the co-creation of added value IoT services

Lower market entry costs for SMEs

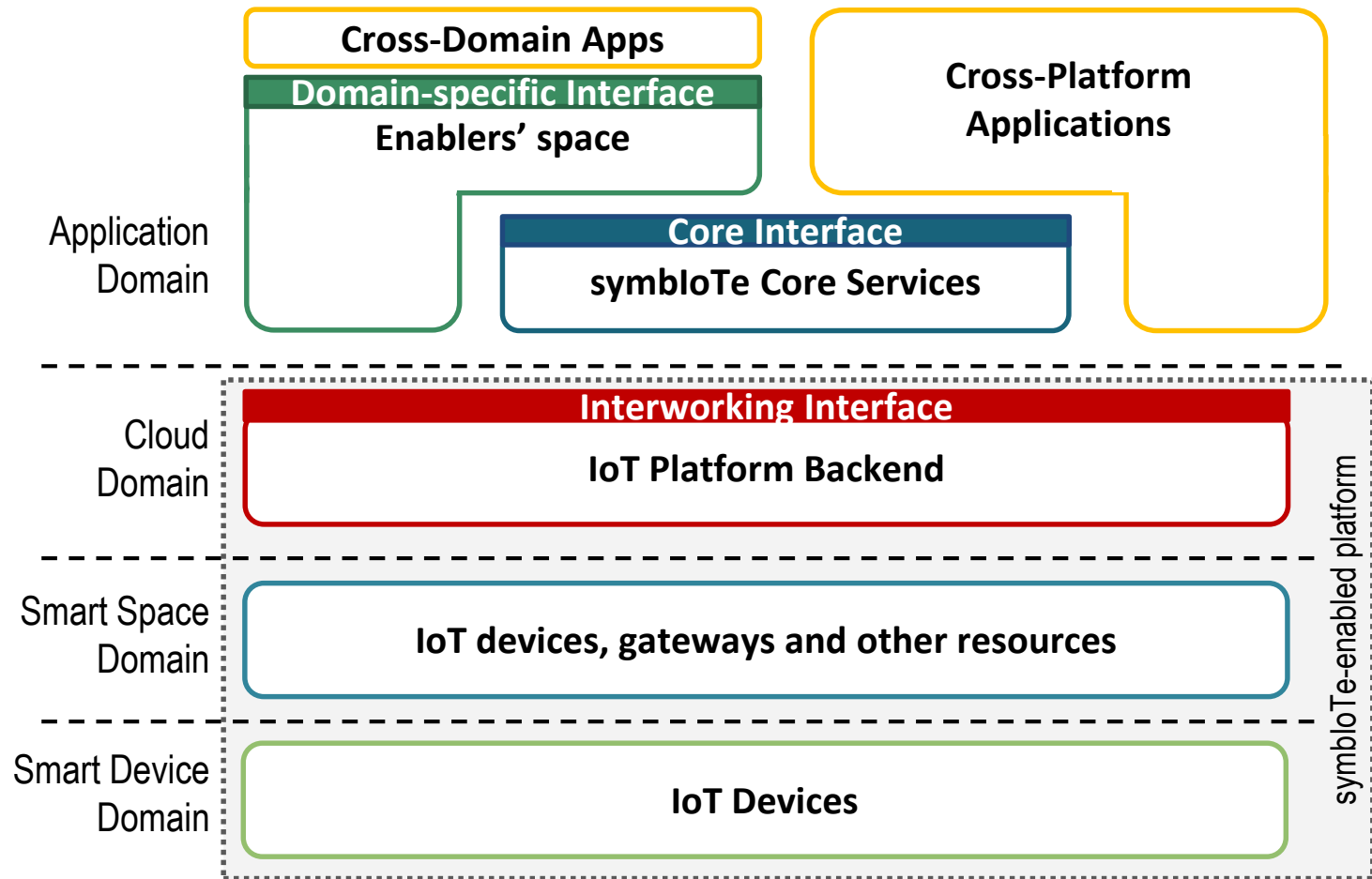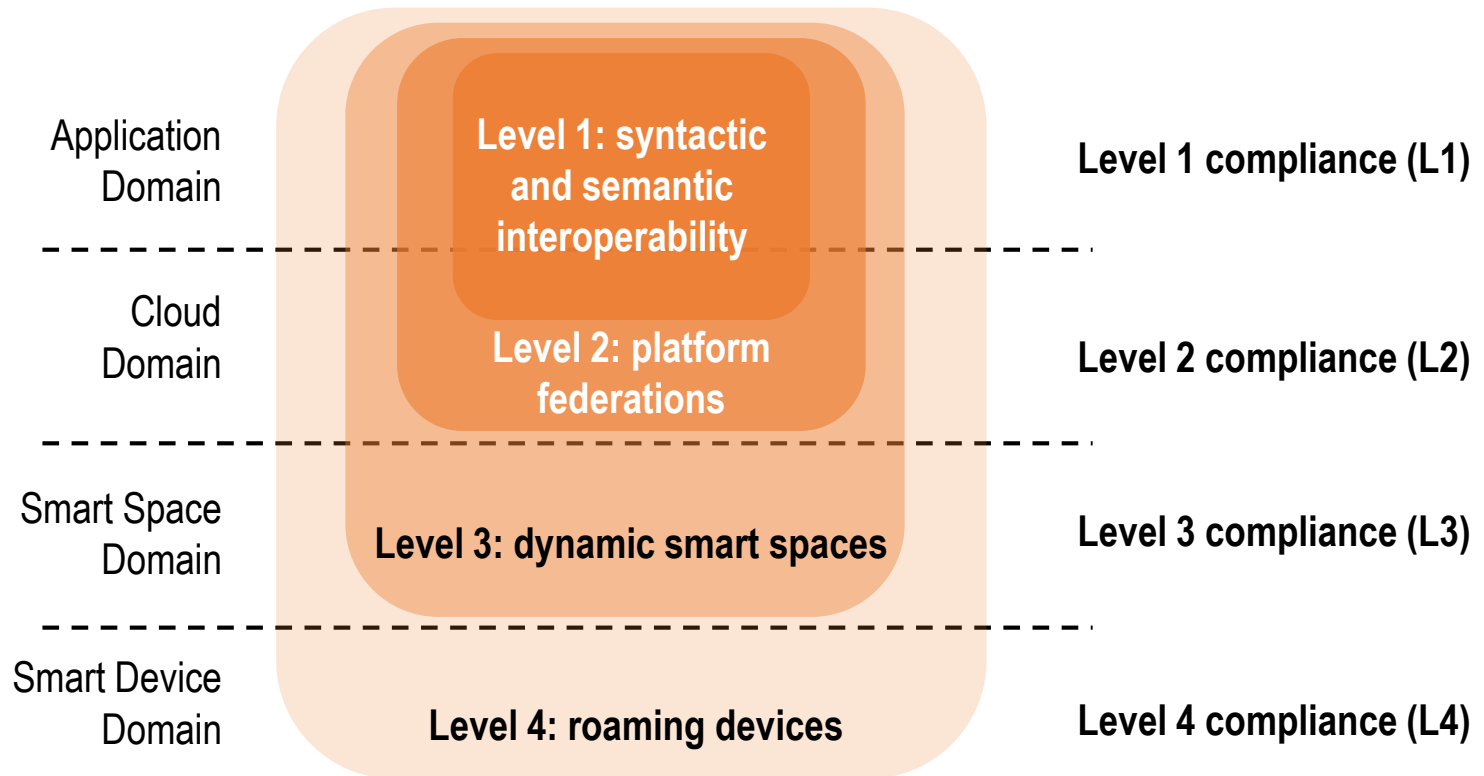| App developers	Infrastructure providers	IoT platform providers	End users
• rapid cross-platform application development to create innovative IoT applications	• simplified (re)configuration of smart environments	• increased user base • new revenue streams • collaboration (platform federations)	• enriched user experience with specialized apps across domains

symbIoTe-enabled Ecosystem

Application Domain

Cross-Domain Apps

Domain-specific Interface
Enablers' space

Cross-Platform Applications

Core Interface
symbIoTe Core Services

Cloud Domain

Interworking Interface
IoT Platform Backend

Smart Space Domain

IoT devices, gateways and other resources

Smart Device Domain

IoT Devices

symbIoTe-enabled platform

Application Domain — **Level 1: syntactic and semantic interoperability** — **Level 1 compliance (L1)**

Cloud Domain — **Level 2: platform federations** — **Level 2 compliance (L2)**

Smart Space Domain — **Level 3: dynamic smart spaces** — **Level 3 compliance (L3)**

Smart Device Domain — **Level 4: roaming devices** — **Level 4 compliance (L4)**
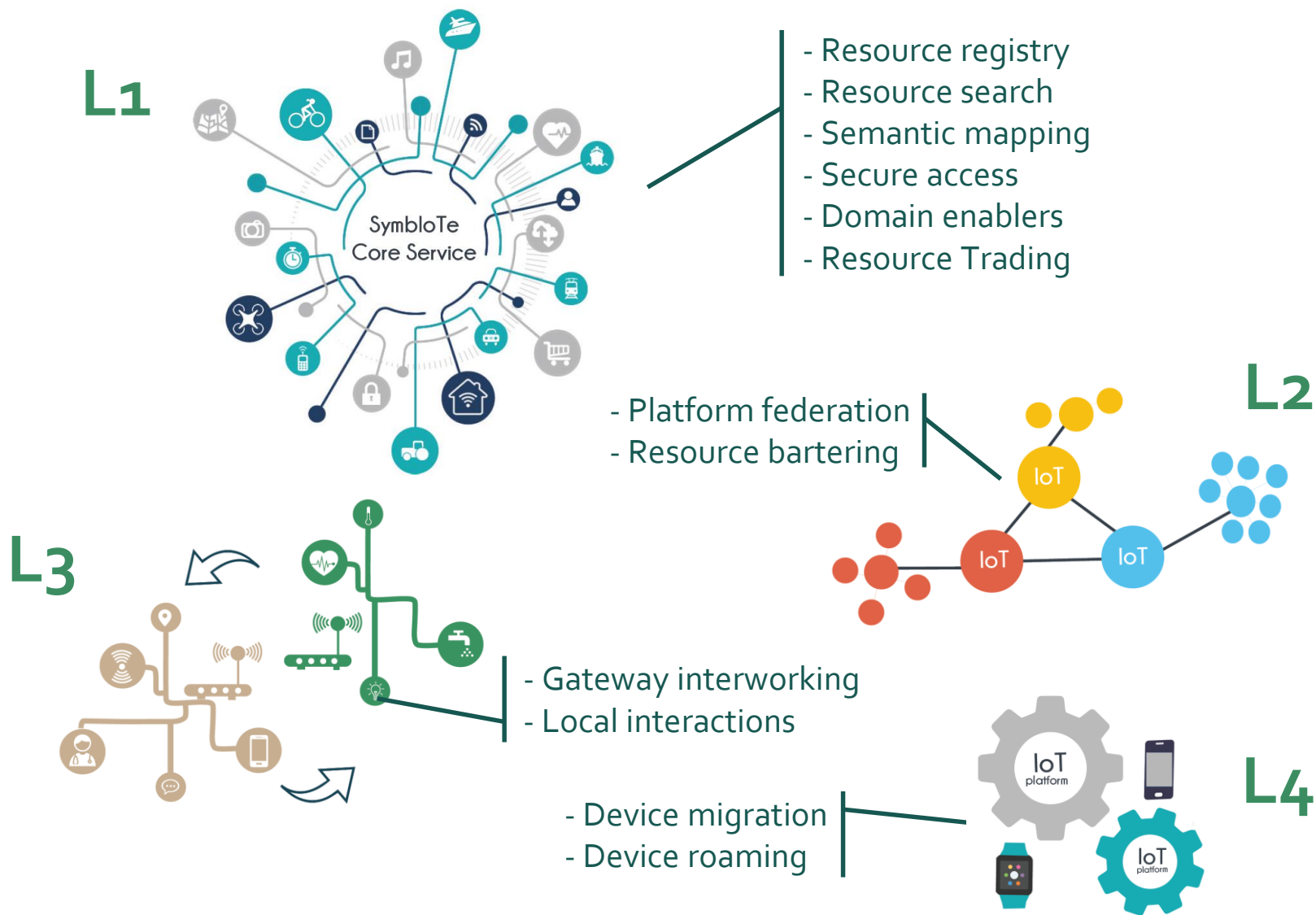
Interoperability aspects:

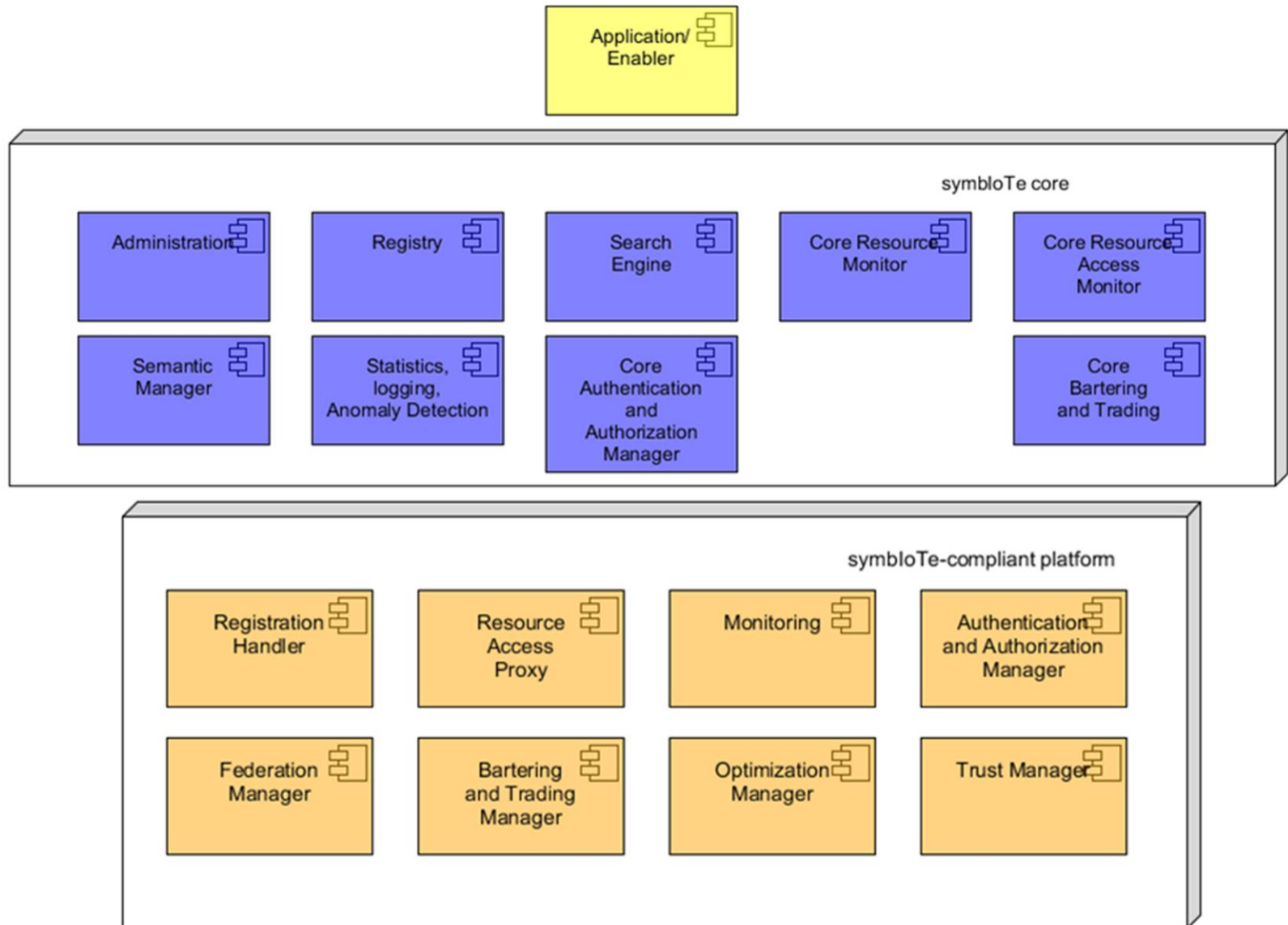- technical, syntactic, semantic and organizational/enterprise interoperability

Source: H. van der Veer, A. Wiles, "Achieving Technical Interoperability – the ETSI Approach", ETSI White Paper No.3, 3rd edition, April 2008
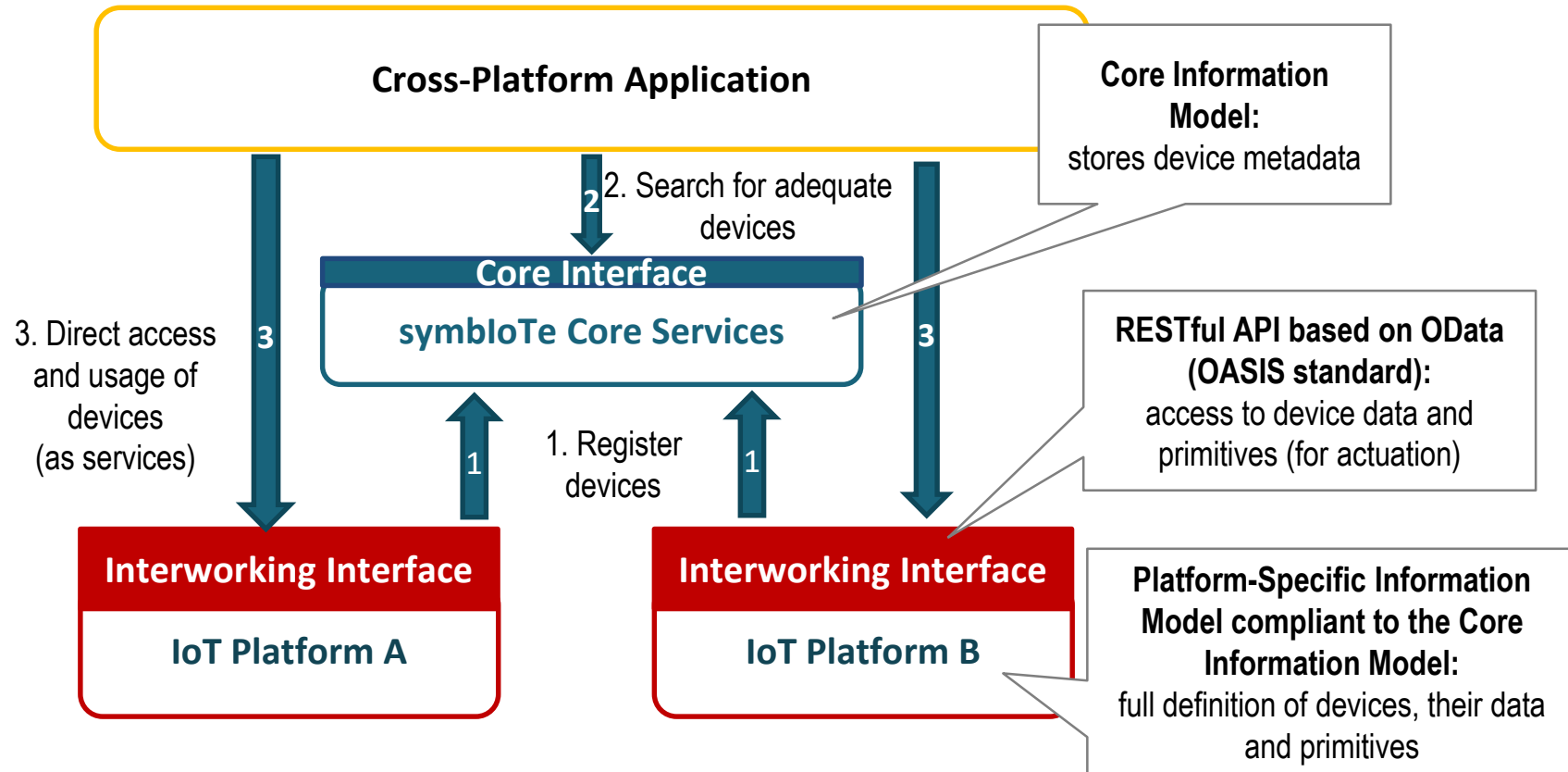
L1

SymbIoTe
Core Service

- Resource registry
- Resource search
- Semantic mapping
- Secure access
- Domain enablers
- Resource Trading

L2

- Platform federation
- Resource bartering

IoT

IoT

IoT

L3

- Gateway interworking
- Local interactions

L4

- Device migration
- Device roaming

IoT platform

IoT platform

L1 and L2 components

Cross-Platform Application

Core Information Model: stores device metadata

2. Search for adequate devices

2

Core Interface

symbIoTe Core Services

3. Direct access and usage of devices (as services)

3

3

RESTful API based on OData (OASIS standard): access to device data and primitives (for actuation)

1

1. Register devices

1

Interworking Interface

IoT Platform A

Interworking Interface

IoT Platform B

Platform-Specific Information Model compliant to the Core Information Model: full definition of devices, their data and primitives

- symbIoTe
  - does not interfere with the transfer of resource data
  - enables the secure exchange of authorization tokens
  - establishes trust between platforms
- light footprint on IoT platforms

Main security rationale

- Attribute Based Access Control

- Adoption of tokens (JSON Web Tokens)

- Decoupling between Authentication and Authorization

- Attribute mapping function
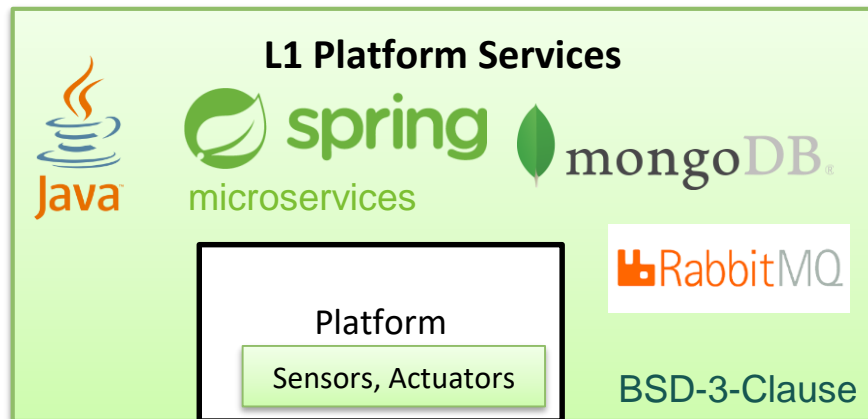
- Resource tokens provided by platforms

Savio Sciancalepore, Michal Pilc, Svenja Schroder, Giuseppe Bianchi, Gennaro Boggia, Marek Pawlowski, Giuseppe Piro, Marcin Plociennik, and Hannes Weisgrab. **Attribute-Based Access Control scheme in federated IoT platforms**. In *Interoperability and Open-Source Solutions for the Internet of Things (InterOSS-IoT) 2nd International Workshop*, LNCS 10218, April 2017

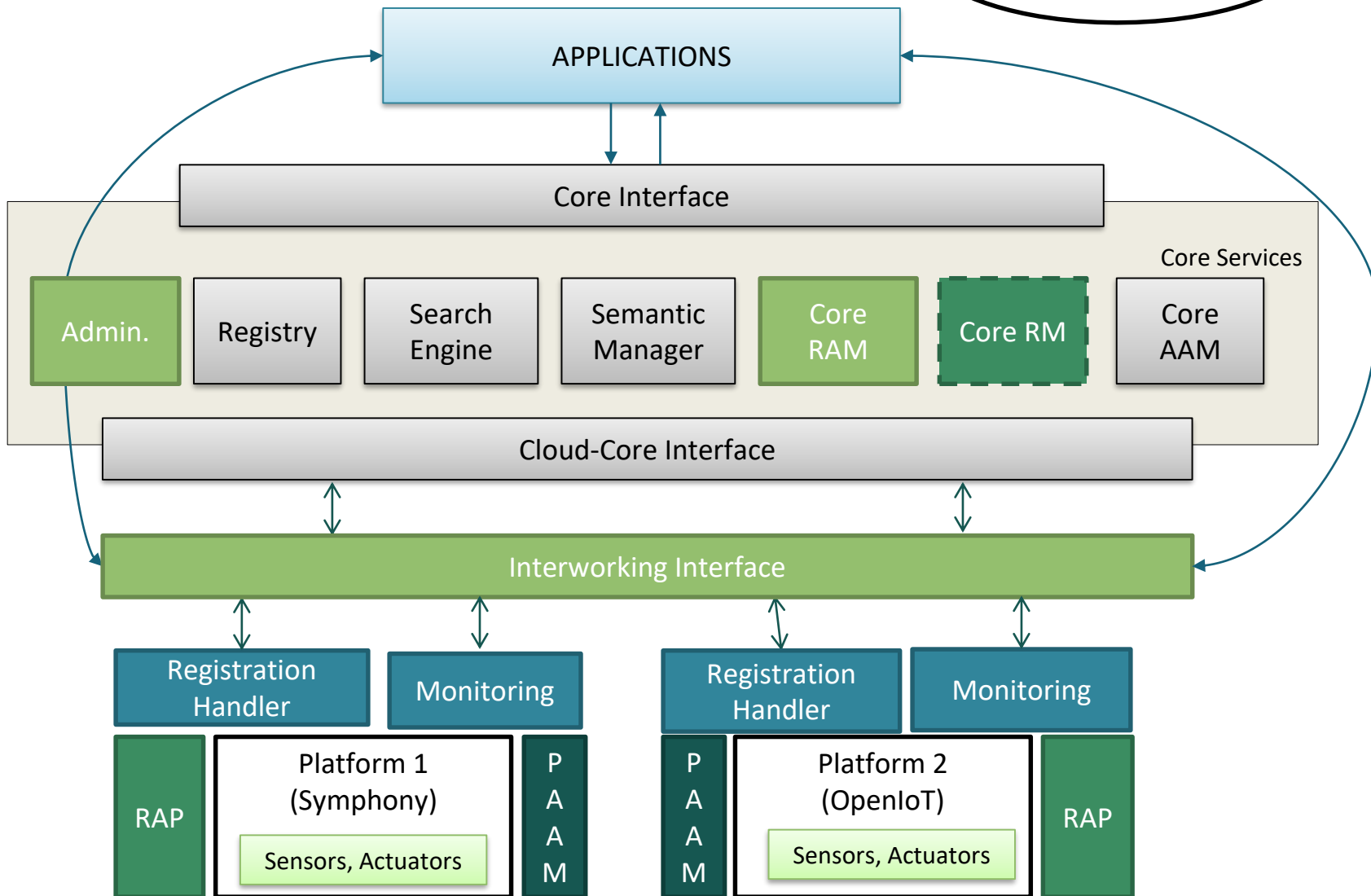symbIoTe is open source: https://github.com/symbiote-h2020

Core Services

Java · spring microservices · mongoDB · Jena

Eureka · ZIPKIN · RabbitMQ

LGPL-3.0 license

RESTful {JSON}(-LD)

L1 Platform Services

Java · spring microservices · mongoDB

Platform

Sensors, Actuators

RabbitMQ

BSD-3-Clause

GitHub · Gradle · Atlassian JIRA · Travis CI

Components developed in R2

Live demo in booth 16

Thank you!

Questions?

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H2020 symbIoTe

github.com/symbiote-h2020

Member of **IoT** European Platforms Initiative