The symbIoTe Solution for Cross-Domain and Cross-Platform Interoperability

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Reality check

• No. of installed IoT devices worldwide in 2020: 30 billion (source: Statista)
• Cloud-based IoT platforms are predominant
• The lack of interoperable ecosystems
• Existing infrastructure is underutilized
• Users are faced with a multitude of applications within a single domain at various locations

Gartner “Through 2018, half the cost of implementing IoT solutions will be spent integrating various IoT components with each other and back-end systems.”
User needs?

Virtual assistant: an intelligent OS
Source: http://www.imdb.com/title/tt1798709/

Minority Report's gesture-based user interface
Source: https://www.imdb.com/title/tt0181689/
The implementation of cross-platform and cross-domain IoT applications is today cumbersome and requires customized solutions tailored to the involved platforms and infrastructure, due to their semantic and syntactic incompatibilities.

We require dynamic and replicable applications interacting with different platforms and infrastructure.
symbIoTe project

symbiote [sim-bee-oht] noun, biology
an organism living in a state of symbiosis

symbIoTe: Symbiosis of smart objects across IoT environments
H2020 RIA
(2016 – 2018)
symbIoTe offerings

Interoperability for cloud-based platforms

Platform federations

Dynamic smart spaces
Interoperability for cloud-based platforms

• symbIoTe middleware includes
  • software adaptor for IoT platforms
  • IoT portal and search engine (Core Services)
  • library for applications

• Functional offerings
  • unique identifier for exposed resources
  • semantic interoperability
  • security: attribute-based access control
IoT portal & semantic search engine

- simplifies app development across different IoT platforms
- IoT platforms offer access to resources (sensors, actuators, services) through a unified REST-based interface
- IoT portal with Core services: registry and semantic search engine for offered resources
- Domain Enabler: value-added services on top of offered resources, simplifies interactions with various platforms
Semantic interoperability (cross-domain)

Core Ontology
- core concepts (Sensors, Actuator, Services, and Location),
- re-uses concepts defined by the Sensor-Observation-Sample-Actuator (SOSA) ontology, Actuation-Actuator-Effect ontology pattern and the SensorThings API
symbIoTe information models

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Building blocks

Microservices running at e.g. https://symbiote-open.man.poznan.pl/

Microservices running on the platform’s side (only the RAP Plugin in platform specific)
Security aspects

Decoupled Authentication and Authorization
- PKI certificates trust chaining architecture
- Attributes distributed in standardized trusted data structures: JSON Web Tokens (JWT)

Resources protected using the Attribute-Based Access Control (ABAC) paradigm
- Access Policy assigned to each resource
- Management of local certificates
- Management of local actor attributes and attribute mapping functions

Core Services
- Administration of platforms
- Platform and user authentication
- Management of symbIoTe components and platforms’ CA X.509 certificates

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Cross-domain resources in Zagreb

Zagreb: 1,812 entries
OpenIoT: 75
openUwedat: 30
HERE traffic API: 1693
openHAB: 10

Gdi Ensamble
Hebrangova od HNK do Zrinjevca

RotationalSpeed
rpm

AverageSpeed
Speed

HERE API
Andrije Hebranga
Sensor for getting average speed factor of the road

OpenIoT
Virtual sensor based on the H265 API

IoT portal

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Green routes for cyclists and pedestrians

• Tested in Zagreb, Vienna and Porto
Crowdsensing App

Google Play / CUPUS Crowdsensing

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symbIoTe SMEUR Green Routing App

Correlate air quality with traffic (jam factor) and current weather conditions to complement MCS Deployment in another city?
symbIoTe middleware

The Open Source IoT interoperability middleware

symbIoTe ecosystem

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Ecosystem KPIs

1 open centralized: ~4000 resources, 2 federations ~350 resources

20+ symbIoTe ecosystems

~150 symbIoTe-compliant platforms

13 symbIoTe-compliant gateways/devices

13 symbIoTe apps

6 value-added services
symbIoTe consortium

- 15 partners
- SMEs w/ IoT solutions
- research institutes
- universities
- large companies

use cases:
- smart residence
- smart campus
- smart mobility
- smart yachting
- smart stadium
Further information

https://middleware.symbiote-h2020.eu

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github.com/symbiote-h2020