Symbiosis of smart objects across IoT environments

688156 - symbIoTe - H2020-ICT-2015

2nd Open Call - Summary

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Introducing symbIoTe

symbIoTe is an H2020 Research and Innovation Action and member of the IoT-European Platforms Initiative cluster that addresses a challenging objective of creating an interoperable IoT ecosystem. symbIoTe will facilitate the cooperation of vertical IoT platforms, which are today typically offered as closed systems, to simplify the development of cross-domain and cross-platform IoT applications. Within the 2nd Open Call, **symbIoTe is seeking for proposals from legal entities that are developing their own proprietary or open source solutions falling into the category of IoT platforms or IoT applications, as well as user communities available to participate in symbIoTe trials in mid-2018.** .
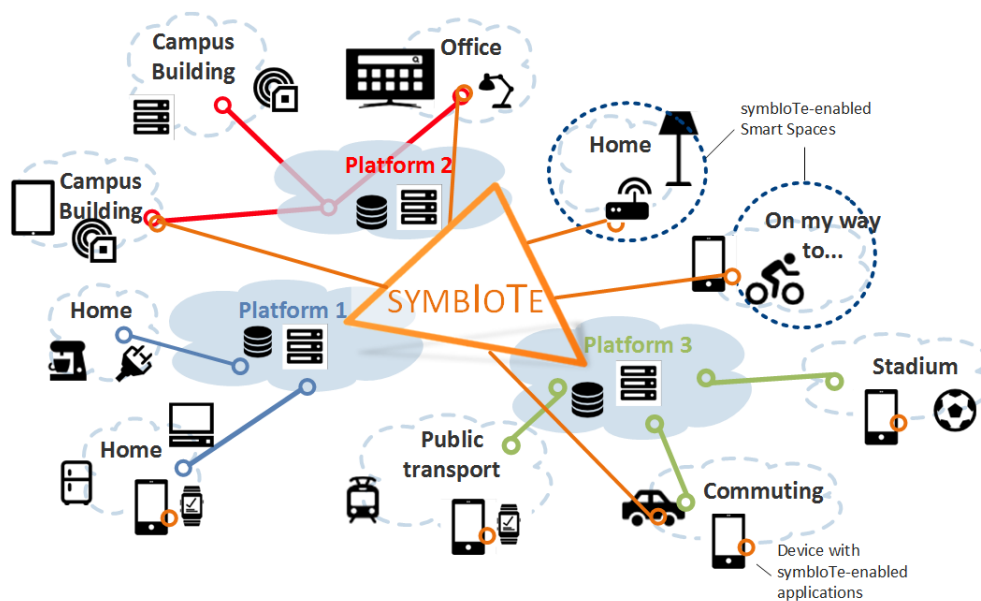
Why symbIoTe? The need for cross-domain IoT applications that can cover multiple aspects of everyday life is becoming more apparent nowadays. Therefore, in order to shape the future with more collaborative experiences, vertically isolated platforms need to be extended in order to cover other domains in which, however, the companies may not have the required expertise. Strategic partnerships are expected to be the only viable option, especially for start-ups and SMEs. Moreover, the collocation of IoT platforms may result in resource inefficiencies, since similar sensors may happen to be deployed by different platforms at the same location. Furthermore, the burden of a single stakeholder deploying and managing the end-to-end infrastructure, from sensors and gateways to back-office servers and platforms, introduces a very high cost and skill barrier for new entrants to the IoT market which may, in turn, hold back the innovation opportunities for SMEs and start-ups. symbIoTe comes to remedy this fragmented environment by 'bridging IoT islands' with an abstraction layer for a 'unified view' on various platforms and their devices/services so that platform resources become transparent to application designers and developers.

Our Vision. symbIoTe is creating an *interoperability framework* to enable IoT platforms to open up access to their devices/services in a controlled and secure manner, aiming to acquire new revenue streams for offering added value services but also to receive missing ingredients that will enrich their business offerings. symbIoTe is not 'yet another IoT platform', as it is not designed to store any sensor-generated data, but rather a mediator

facilitating the exchange of the necessary metadata that describe the exposed IoT devices/services. Thus, symbIoTe provides the required software infrastructure to find and allow for unified and secure access to the necessary IoT devices/services for third party platform owners and application developers.

Open platform interfaces come as a response to the emerging need for cross-domain IoT applications and services. By leveraging symbIoTe interfaces, developed components and libraries, IoT platforms will be able to offer unified and secure access to their sensors and actuators. The devices remain under full control of platform developers and owners, who define and manage access rights to their infrastructure. On the one hand, this will support application developers to rapidly create and deploy novel IoT applications without the need to own and operate the IoT infrastructure. On the other hand, IoT platform providers and infrastructure owners will be able to increase their user/developer base and create new revenue streams, since their infrastructure is used in innovative cross-domain applications. This will create a vibrant IoT ecosystem with potential to create new business cases for existing IoT stakeholders.

Our Approach. The main goal of symbIoTe is to devise a flexible and secure interoperability middleware across IoT platforms facilitating rapid development of IoT applications across platforms, platform collaborations as well as dynamic and adaptive smart objects and environments. This is accomplished by a series of innovations introduced by symbIoTe. The first innovation refers to building an IoT search engine for connected (virtualized) smart objects (i.e., IoT resources), where IoT platform providers can register their deployed resources and other platforms/applications can search and access them. The second innovation involves an abstraction layer for unified and secure usage of those resources across platforms. A third key ingredient is to implement high-level, domain-specific APIs ("domain enablers") for rapid cross-platform application development. A fourth new feature that symbIoTe introduces is the support for IoT platform federations, i.e., associations between two platforms facilitating their secure interaction, collaboration and bartering of resources. The fifth innovative aspect of symbIoTe is to create dynamic and self-configurable smart spaces through the seamless blending of next generation mobile devices with surrounding environments and host platforms. Finally, all the above are facilitated through a secure interworking protocol between the IoT platforms, gateways and smart devices.

Our Use Cases. The symbIoTe use cases aim at showcasing the introduced innovations and how they can assist people seamlessly while performing their everyday, indoor and outdoor, activities. These environments can range from homes, offices and public spaces (e.g. campuses, stadiums or ports), to smart mobility solutions that assist travellers and commuters. The diversity of the considered environments is optimal to showcase platform interoperability, since it spans over a number of various IoT implementations, which are currently isolated and managed as closed systems. In contrast to the current situation, when a user has to use different applications at home, for public transport, at the university, etc., symbIoTe use cases will demonstrate a completely new type of applications built on top of interoperable platforms. The following use cases are developed within symbIoTe:

- *Smart residence* aims to demonstrate interoperability across different smart home IoT solutions through a generalized abstract model to describe inter-connected objects, providing a dynamic configuration of available services and a natural and homogeneous user experience.

- *Smart campus* develops "eduroam-like" IoT services for visiting students and staff to offer indoor navigation and room/equipment booking.

- *Smart stadium* uses indoor location platforms to be integrated with various context-based information services so that, e.g., visitors can receive promotions on services/products offered in the stadium, as well as perform remote ordering.

- *Smart mobility and ecological urban routing* aims at addressing the problem of inefficient transport and poor air quality that many European cities face nowadays by tracking citizen exposure to pollutants and offering 'green' routes for bicyclists and pedestrians. In addition to in-situ stations, it uses wearable sensors and mobile devices for air quality monitoring.

- *Smart yachting* automates the exchange of information between a boat and the port, operated by two different platforms.

Overview of 2nd Open Call

With this Open Call, symbIoTe aims to enlarge the number of symbIoTe-enabled IoT platforms that wish to become a tangible part of an evolving IoT ecosystem. We are seeking for legal entities that are developing their own or extending open source solutions falling into the category of IoT platforms. It is expected that an IoT platform joining the symbIoTe ecosystem can be used in domains relevant to symbIoTe use cases, in particular Smart Residence/Office/Building/Campus and Smart Cities (including mobility and citizen involvement).

Selected applicants will work on projects (we call them "Extensions") and focus on extending their IoT platforms so as 1) to integrate an open interface defined by symbIoTe with the platform, 2) to integrate the symbIoTe solution for authentication and authorization with the platform and 3) to support registration of selected devices managed by the platform with external symbIoTe services. Note that a platform-specific information model needs to be aligned with the symbIoTe-specific information model during this process. The applicants are expected to adopt the respective innovations introduced by symbIoTe that matches their business needs and domains. These innovations are referred as "symbIoTe compliance levels" and are further explained in the Technical Documentation of this Open Call.

Moreover, the applicants need to show potential to deploy the developed solution so as to open up access to a selected subset of IoT devices under applicant's administrative control to the symbIoTe ecosystem. The applicant's ability to test symbIoTe services in real life settings will be considered an asset. In addition, the applicants will be requested to enrich the symbIoTe trials, which are planned at the same period when the Extensions will run, by offering their IoT resources as well to be used within symbIoTe trials.

The symbIoTe consortium will provide the definition of platform interface(s) together with a set of software components providing an implementation of the interface(s) accompanying libraries and plugin components to ease the process of integrating symbIoTe features for interoperability with existing platform implementations. The symbIoTe consortium will provide support and guidance during the learning, design and integration phases of the Extensions. The symbIoTe consortium is developing open source software using a business-friendly license so that proprietary IoT platforms, which become symbIoTe-enabled, remain proprietary.

At the following table, we provide the summary of the topics active in this 2nd Open Call. The first three topics focus on making IoT platforms symbIoTe-complaint. The fourth topic searches for application developers to build innovative mobile apps on top of symbIoTe. The last topic looks for end users to support symbIoTe's planned trials.

Table: Summary of 2nd Open Call topics

Topic Identifier	Topic Description	Type of Applicants	Funding
symbIoTe-OC2-L1	**Purpose:** To make 3rd party IoT platforms L1-compliant, so that they expose IoT resources to the symbIoTe Core Services. Applicants should offer platforms active in the Smart City domain, involving (but not limited to) city-wide IoT platforms for environmental monitoring, traffic/parking monitoring, mobility aspects, etc. **Commitment:** Applicants should make their platforms and their resources available for a demo during the symbIoTe trials (mid/end 2018).	IoT Platform owners / operators	Up to €40,000 per Extension Approx. two (2) Extensions to be funded
symbIoTe-OC2-L2	**Purpose:** To make 3rd party IoT platforms L2-compliant, so that they join platform federations. Applicants should explicitly mention with which symbIoTe platforms they would like to federate with (see list of available platforms at the end of this topic) and what could be the business value out of this federation. A desired feature would be that apart from making their IoT platform L2-compliant, they also extend their native apps to display/access/control federated resources. **Commitment:** Applicants should make their platforms and their resources available during the symbIoTe demos and trials (mid/end 2018).	IoT Platform owners / operators	Up to €50,000 per Extension Approx. four (4) Extensions to be funded
symbIoTe-OC2-L3/4	**Purpose:** To make 3rd party IoT gateways and/or IP native families of devices L3/4-compliant. The proposed Extensions must include at least 10 devices of at least 3 different types. Such devices can be: i) gateway-controlled devices, ii) IP-native smart devices or iii) a mix of the previous. **Commitment:** Applicants must join a challenge event (end 2018) to demonstrate their solution and to pass a set of symbIoTe-defined interoperability tests.	IoT Gateway and/or IP native device manufacturers, system integrators	Up to €40,000 per Extension Approx. four (4) Extensions to be funded

symbIoTe-OC2-Apps	**Purpose:** To build a smart phone application (Android or iOS) that combines resources offered by L1-compliant platforms and/or available Domain Enablers and demonstrates cross-domain features. Proposed applications should focus in the domains of Smart City, Smart Residence and Smart Stadium/Buildings, as well as combination of the above. **Commitment:** Applicants should make their applications available for a demo during the symbIoTe trials (mid/end 2018).	Mobile app companies	Up to €20,000 per Extension Approx. three (3) Extensions to be funded
symbIoTe-OC2-Trials	**Purpose:** To involve end users and citizens that will use our applications and hardware (portable sensors, etc) to support our "Smart Mobility and Ecological Urban Routing" trial. **Commitment:** Support the trials planned in Zagreb, Vienna and Porto (mid/end 2018).	NGOs, municipalities, organizations, companies with end users in Zagreb, Vienna and Porto.	Up to €15,000 per Extension Approx. three (3) Extensions to be funded