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mySMARTLife

Deliverable due date: M36 – November 2019

D3.5 Design and implementation of new concepts of the Urban Platform

WP3, Task 3.5

Transition of EU cities towards a new concept of Smart Life and Economy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Project Acronym	mySMARTLife
Project Title	**Transition of EU cities towards a new concept of Smart Life and Economy**
Project Duration	1st December 2016 – 30th November 2021 (60 Months)
Deliverable	D3.5 Design and implementation of new concepts of the Urban Platform
Diss. Level	PU
Status	☐ Working
	☐ Verified by other WPs
	■ Final version
Due date	30/11/2019
Work Package	WP3
Lead beneficiary	TSY
Contributing beneficiary(ies)	HAM, CAR
Task description	Task 3.5: ICT and Urban Platform developments – ICT & URBAN PLATFORM This task, led by HAM and TSY, will produce a number of services to improve city operation, decision aiding services, citizen engagement, interaction between city and citizens. The detailed scope of the services will be defined in the design phase of the. The services are mainly based on the aggregation and visualization of the collected data. The quality of the analysed data is also based on the location where the sensors will be installed. Improving decision making on urban services by providing functionalities to define KPIs and to monitor these is part of this task as well. - Subtask 3.5.1: New architecture. A new architecture will be defined by HAM and TSY, following the open specification concept will be defined for the Urban Platform City of Hamburg. Four main layers will be described: Field Component Gateways, Field Component Platforms, Smart Middleware and Access. - Subtask 3.5.2: Integration with Smart City ecosystem DTAG. Existing infrastructure and data will be enhanced with new data from city and third-party sensors that will be integrated in the City-Data-Warehouse and the existing web service infrastructure. New processing services will be developed by TSY and HAM, and a new kind of web services in order to allocate (open data) apps and services to authorities, citizens and stakeholders.

Date	Version	Author	Comment
13/06/2019	0.1	Ingo Friese (TSY)	Initial Version
25/06/2019	0.2	Michael Fischer (HAM)	Edits on Initial Version with ToC
28/06/2019	0.3	Ingo Friese (TSY)	Edit chapter 4.1.1. Implementation description of the OGC/STA-to-oneM2M direction
25/07/2019	0.4	Ingo Friese (TSY)	Chapter 4 completed
07/10/2019	0.5	Ingo Friese (TSY)	Chapter 2, 3 completed

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Abbreviations and Acronyms

Acronym	Description
AE	Application Entity
API	Application Programming Interface
CIN	Content Instance
CSE	Common Service Entity
FROST-Server	FRaunhofer Opensource SensorThings-Server
HTTP	Hypertext Transfer Protocol
ICT	Information and Communications Technology
IoT	Internet of Things
ISO	International Organization for Standardization
JSON	JavaScript Object Notation
LPWAN	Low-Power Wide Area Network
REST	REpresentational State Transfer Computing
STA	SensorThings API
MQTT	Message Queue Telemetry Transport
mySMARTLife	Transition of EU cities towards a new concept of Smart Life and Economy
OGC	Open Geospatial Consortium
OSUP	Open Urban Standardized Platform
PaaS	Platform as a Service
W3C	World Wide Web Consortium

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1. Executive Summary

Deliverable 3.5 is a result of subtask 3.5.1 new architecture and subtask 3.5.2 related to the integration with Smart City Eco System. The document describes the technical connection of the Hamburg Urban Data Hub with the Urban Data Core of Deutsche Telekom to a common mySMARTLife Open Urban Platform. To avoid a so-called vendor lock-in, mySMARTLife follows the strategy to focus on the development of an open urban STANDARDIZED platform (OUSP).

Cities all over Europe face similar problems like congestion due to increasing mobility from individuals and logistics on one hand side and missing infrastructure for e-mobility or inefficient governmental processes on the other. These circumstances are a high hurdle to use all kind of resources in an efficient and sustainable manner. To leverage cross dependencies or new services, there is a need for an integration of different specialized domain systems. To avoid a vendor lock in, cities require a standard-based approach to guarantee interoperability today and in the future. To establish such an ICT based urban ecosystem, an IoT-based infrastructure, domain specific IT systems and an overarching urban platform forming a “system of systems” as a horizontal IT layer, are required to bring the concept of an urban ecosystem to life.

The City of Hamburg has an (mostly) OGC/ISO (global standard) based Open Urban Data Platform in operation, which connects different systems of domains like social, energy or mobility infrastructure. Deutsche Telekom T-Labs has an oneM2M based platform to build up an urban eco-system. While cities have an interest in applications and standards with i.e. geospatial background like OGC, many industry players need a standard like oneM2M providing additional features like device or access management. Since both standards have their strengths, it is worth building integration and using the best of both “worlds”. The goal of subtask 3.5.2 is to form a mySMARTLife Open Urban Platform by integrating/connecting both, the Hamburg and the T-Labs platform. This is done through an OGC-to-oneM2M gateway.

The implementation of the OGC-to-oneM2M gateway service covers the scenario of an OGC/SensorThings API (STA) client that is connected to a STA server receiving data coming from an oneM2M sensor. The gateway service is responsible for forwarding the data from the oneM2M server (a.k.a. CSE) to the STA server. The other direction called oneM2M-to-OGC gateway service enables an oneM2M client to receive data coming from a device that is connected initially to a STA server. Chapter 4 describes the technical details.

In mySMARTLife, the cities of Nantes, Hamburg and Helsinki have chosen OGC/STA based infrastructure for their urban data platform. With the mySMARTLife gateway services, cities have the freedom to connect their platform to a powerful major IoT industry standard with low effort. Thus, the protocol gateway saves costs and makes the ICT solutions chosen by the city future-proof.

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2. Introduction

2.1 Purpose and target group

Deliverable 3.5: Design and implementation of new concepts of the Urban Platform is a result of subtask 3.5.1 new architecture and subtask 3.5.2 related to the integration with Smart City Eco System. The document describes the technical connection of the Hamburg Urban Data Platform with the Open Urban Platform of Deutsche Telekom to a common mySMARTLife Open Urban Platform. To avoid a so-called vendor lock-in, mySMARTLife follows the strategy to focus on the development of an open urban STANDARDIZED platform (OUSP). In the specific case of the mySMARTLife project this means the integration of an existing OGC/ISO based urban platform of the City of Hamburg and an oneM2M based Platform of Deutsche Telekom AG. Both systems comply with the idea of an OUSP, were each has its advantages and the combination could take the best of both “worlds”.

The goal of the document is to describe a new architecture that is primarily modular. In most cities, there are already existing verticals (e.g. street lighting systems, charging stations etc.). Therefore, the main goal of the architecture is to be inclusive and to support existing sensors, field components and various kinds of connectivity like LORA, NBIoT or WiFi. The new aspect of the Open Urban Platform architecture is that it completely relies on open standards and furthermore connects two of them. There will be no such thing like “the Smart City Standard”. That is why it is important to support not only one. The mySMARTLife Open Urban Platform shows how to integrate different sub-platforms with different standards to an eco-system, which is able to connect various services and infrastructures. It adds capabilities from two single standards forming a common powerful platform.

The following chapters describe the background of an Open Urban Platform, its single parts as well as the integration in more detail. It shows how sensor live data are sent to a SensorThings API-based platform and forwarded to an oneM2M-based sub-platform (or module) for further processing and usage by oneM2M applications. It is also described how oneM2M sensed data can be transferred to a Sensor Things API based System. The document describes technological processes and standard specific mechanisms as well as additional services needed to ensure interoperability of both standards.

In order to cover the aforementioned objectives, the deliverable has two main sections:

- The first section explains the role of a data platform as a centrepiece of a Smart City. It provides an overview of both systems, Hamburg Open Data Hub and Deutsche Telekom Urban Core and their related standards OGC / Sensor Things API and oneM2M
- The second section describes the technical implementation of the integration for both directions

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2.2 Contributions of partners

The following Table 1 depicts the main contributions from participant partners in the development of this deliverable.

Table 1: Contribution of partners

Participant short name	Contributions
T-Labs (TSY)	Sections1, 2, 3 and 4
HAM	Sections 1, 2, and 3
NAN	Final review and minor modifications
CAR	Final review and minor modifications

2.3 Relation to other activities in the project

The following Table 2 depicts the main relationship of this deliverable to other activities (or deliverables) developed within the mySMARTLife project and that should be considered along with this document for further understanding of its contents.

Table 2: Relation to other activities in the project

Deliverable Number	Contributions
D 3.6	This deliverable provides an overview on the necessity of open standardized APIs within an Urban Data Platform.
D2.16	Definition of the Open Specifications Framework.

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3. The Urban Eco-System

Cities all over Europe face similar problems like congestion due to increasing mobility from individuals and logistics on one hand side and missing infrastructure for e-mobility or inefficient governmental processes on the other. These circumstances are a high hurdle to use all kind of resources in an efficient and sustainable manner.

The current structure of European cities is based on own specialized and separated technical infrastructures and organizational structures. Typical example domains are energy, mobility, public transport, public buildings or -infrastructures. All of these verticals have their own infrastructures and backend systems with domain specific features and functionalities. Nowadays it becomes increasingly important to exchange information in real time based on trusted data.

The idea of a “Smart City” is that new digital technologies like “the Internet of Things”, “Big Data” and “Artificial Intelligence“ will help to make cities greener, more efficient, to stimulate participation and to enhance citizens’ quality of life.

3.1 An Open Urban Data Platform

Smart City scenarios like for example multifunctional streetlights, which enhance current urban infrastructures, e.g. with parking sensors, Wi-Fi or cameras for security reasons or traffic flow monitoring use cross dependencies of different specialised domain systems. It needs IoT-based infrastructure and an overarching urban platform to form a “system-of-systems” across domain specific backend IT systems. Vertical digitization is key to develop enhanced data sets and domain specific efficiency, e.g. synchronized traffic lights for traffic. In order to boost this digital-efficiency in an Urban Eco-System, it needs data harvesting across all domains and new ways of service- and data orchestration as well as enhanced data analytics and usage across all domains.

Most cities do not have an overarching digital development strategy. Small and middle-sized cities, which are typical for Europe, often lack the skills and expertise to drive such interdisciplinary effort. By choosing “off the shelf” solutions, cities may become dependent on one technology or a single solution provider, which may limit the interoperability of systems.

Most of the smarty city platforms are focusing on IoT only, since they originate from the industry 4.0. Thus these are not real Urban Data Platforms. Urban Data Platforms handle also static and metadata, while the latter is neglected most of the time anyway. The in-cooperated metadata handling using open international standards allows the harvesting of the Urban Data Platform Hamburg i.e. by the European Data Portal. IoT platforms will help city administrative organizations mostly in a single domain for their specific task. The most important thing would be that these IoT platforms provide open standardized APIs to connect

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easily to the urban data platforms forming a system of system. Since all countries in Europe have to fulfill the INSPIRE initiative [4], a good starting point for an Urban Data Platforms are the spatial data infrastructures which already exists. Having already long-time experiences in data management, using open standardized APIs including metadata handling these spatial data infrastructures can easily be extended for real time data forming an open standardized urban data platform.

3.2 Industry versus Standard solutions

An Industry solution like for example CISCO CKC is technologically a cloud-based Platform as a Service (PaaS) concept, which provides open (not standardized) APIs to the outside, while the platform itself is based on an internal proprietary system. Such a system could create a technical dependency, a so-called vendor lock-in, regarding the urban ecosystem and limits the cities' freedom of architectural changes of the ecosystem or partner selection. The reason is that the connection to the various IoT-systems is available by proprietary not open-standard based interfaces. The connection to other systems can only be fulfilled by the platform provider. It limits the freedom of cities to select their own service providers or even technology.

To avoid a vendor lock in, cities require a standard-based approach to guarantee interoperability today and in future. It enables the development of a standard based "connector catalogue" towards different service providers and systems for data integration and harmonization. Furthermore, it allows for a standardized interface used by applications, services or any third party. This approach addresses the needs of technical service providers, developers and IT-providers.

3.3 Urban Data Platform Hamburg (HH_UDP)

Within this project, the City of Hamburg is represented for the ICT developments by the state-owned entity Urban Data Hub at the Agency for Geoinformation and Surveying. The City of Hamburg has an (mostly) OGC/ISO (global standard) based Open Urban Data Platform in operation, which connects different systems of domains like social, energy or mobility infrastructure (see Figure 1). The core of this system is based on a spatial data infrastructure. This platform is now extended within mySMARTLife with new technologies / services, e.g. spatial IoT. The increasing amount of IoT devices requires connectivity, service and data integration. It has been decided together with Nantes and Helsinki to implement the OGC SensorThings API for this purpose. This will allow an easy management of sensor data while, at the same time, allowing a standardized way of providing real time spatial data on the web using best practices from the web development community and the W3C (JSON-based, HTTP/REST, MQTT).

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Figure 1: Urban Data Platform Hamburg Schema

The SensorThings API (STA) applies, on the one hand, the possibility to store historic sensor data while, at the same time, providing state of the art IoT techniques such as publish-subscribe mechanisms (MQTT) to provide real time capabilities to the Urban Data Platform. The STA relies on a data model consisting of 8 entities (see Figure 6). One of the advantages of the STA is the very small payload for sensor results, since it does not have to send all metadata for a thing and its connected sensors. In comparison to other (mostly industrial) approaches where the complete data set is sent redundantly with every event, this solution is by far more suitable for the IoT where bandwidth and power consumption in LPWANs is limited. By using STA, the Hamburg Urban Platform is now extended with an open standardized API for sensor data acquisition and for searching and accessing open sensor data. While implementing the new capability new technologies such as micro-services and container orchestration with Kubernetes have been introduced. The Urban Data Platform Hamburg with the new real time data infrastructure is now on TLR 9 (https://iot.hamburg.de / mqtt://iot.hamburg.de).

3.4 T-Labs / Deutsche Telekom - Open Urban Platform (DTAG-OUP)

The basic idea of the T-Labs oneM2M based platform is to connect eco-systems. Every city has a number of different self-contained systems such as street light management, traffic management, smart waste, smart energy and many more. These systems are built on domain specific knowledge, capabilities, devices and own sensors or actuators. The T-Labs oneM2M based platform is able to read sensors or provide data or commands to actuators in order to perform certain tasks. The precondition is the availability of an API with each connected system.

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The system is also able to communicate to other platforms e.g. from other cities, regions or different service providers.

On top of the platform Deutsche Telekom, Cities, Partners or some Software Provider might develop applications to get data from the system or control tasking devices. These applications might range from small mobile apps for citizens up to huge web portals for controlling urban infrastructure. The T-Labs oneM2M based platform Figure 2 connects these existing systems to a System-of-Systems and, thus, enables a plethora of new possibilities, usage scenarios and applications, for example, traffic routing by considering environmental data or streetlight might be controlled depending on weather conditions.

Applications on top can make use of all data and functionalities coming from different systems. Citizens and people working for authorities may use various smart city applications to get information about their city or they want to use services helping them in private or in business life.

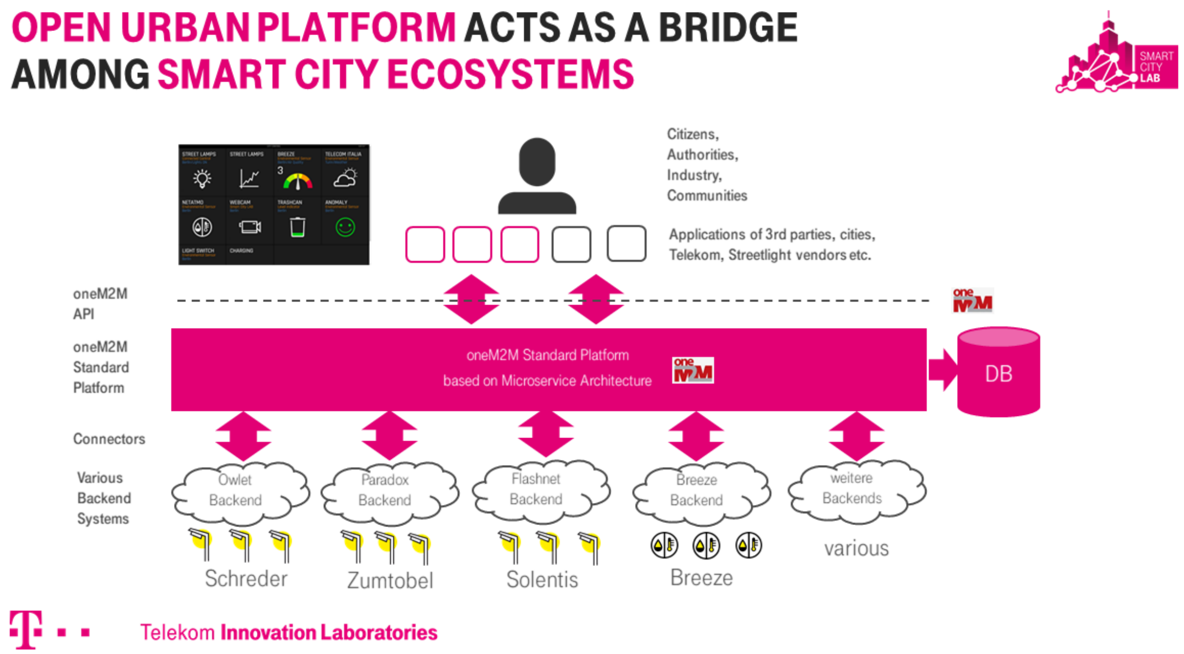

Figure 2: T-Labs / Deutsche Telekom Open Urban Platform

The oneM2M standard is used to implement data routing functionalities. The core of the platform is a so-called oneM2M Common Service Entity (CSE).

Basic functionalities are:

- Data routing: It reads data from the event bus and forwards it to the appropriate data sinks like applications or connected systems

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- Pub/Sub: It supports publish / subscribe communication pattern. An application can subscribe to be informed when new data of a certain system arrive. In this case all subscribed applications gets an notification message
- Enhanced data delivery configuration: The application is able to choose between different options in data delivery (e.g. just a notification or the content along with the notification) (planed feature for future releases)
- Data Scheduling: An application or a backend system is able to attach a schedule to notifications. This feature prevents connected systems to be approached to often (e.g. it might be feasible to allow switching on and off-street lights just with pause of few seconds)
- Data Access Policies: Every data access is checked against detached access policies
- Discovery: It enables to look for certain data structures or sources
- Grouping: it groups several resources in order to send on chunk of data just ones and forward it to several parties.

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4. The Integration of real time (IoT) data into the Urban Data Platform

While cities have an interest in applications and standards with i.e. geospatial background like OGC many industry players need a standard like oneM2M providing additional features like device or access management. Since both standards have their strengths, it is worth building an integration between both. While OGC and its Sensor Things API (STA) are easy to use and provides excellent semantic description through its data model, oneM2M provides access control and data routing mechanisms. Both systems are running on a modern micro-services architecture and comply with the idea of an OSUP, were each has its advantages and the combination uses the best of these two “worlds”.

There is no “one size fits all” ICT solution for smart cities. Cities and communities have different requirements and preconditions when it comes to the handling of life sensor data. Some cities have own IT-departments others do not. In addition, the ICT system landscape is different depending on focus, budgets and younger historical developments. In consequence, cities have different approaches using proprietary software or different standard based solutions. The consequence is the need to bridge different standard based approaches and to exchange events and data. The integration of the T-Labs oneM2M-based platform and the Hamburg Urban Data Platform is a great step towards a heterogeneous collaborative ICT landscape.

4.1 The Integration of an OGC/STA and oneM2M System

The goal of mySMARTLife action 54 is to integrate the OGC/STA based Hamburg Urban Data Platform and the Telekom oneM2M Lab platform. In order to be strictly standard conform we implemented the service in a way that it can be used between any kind of standard conform OGC/STA server and oneM2M CSE regardless of special connectors or adapters.

Figure 3 gives an overview of both systems and how they are connected. On the left side there is the initial Hamburg Urban Data Platform. From the functional point of view, there is a SensorThings API-Server as the core of the new real time data module architecture. A message bus connects sensors to the server either directly or via a domain specific backend.

On the right side the T-Labs oneM2M implementation or extension is shown. The core of this architecture is a oneM2M-Server a.k.a. Common Service Entity (CSE). Sensors and also actuators are connected to the server via connectors, message bus and so-called interworking proxies (IPE). The important aspect of this figure is to show that sensors put their date to their regarded server. Northbound, there are applications that get the data from the server for simply showing it to processing them for other purposes. Important is that these applications use only one sort of API either its OGC/SensorThings API or it is oneM2M.

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The connection of both infrastructures is realized via a so-called protocol gateway. This connection enables basically two scenarios:

1) An OGC/STA client that is connected to the STA-Server shall be able to receive data coming from a oneM2M sensor that send data to the oneM2M-Server. The gateway service is responsible for forwarding the data from the oneM2M-Server to the STA-Server.

2) An oneM2M Client that is connected to the oneM2M-Server shall be able to receive data coming from a device that is connected to the STA-Server. The gateway service forwards the data to the oneM2M-Server.

MySMARTLife Example: The electric facilities of the HAW University Energy-Campus Hamburg publish their status messages into the Hamburg Urban Data Platform. The connector gateway service forwards the observations to the oneM2M side. A client that is connected to the oneM2M-Server is now able to show the current status of various energy sources in Energy-Campus facilities.

Architecture Overview
Interworking SensorThingsAPI – oneM2M

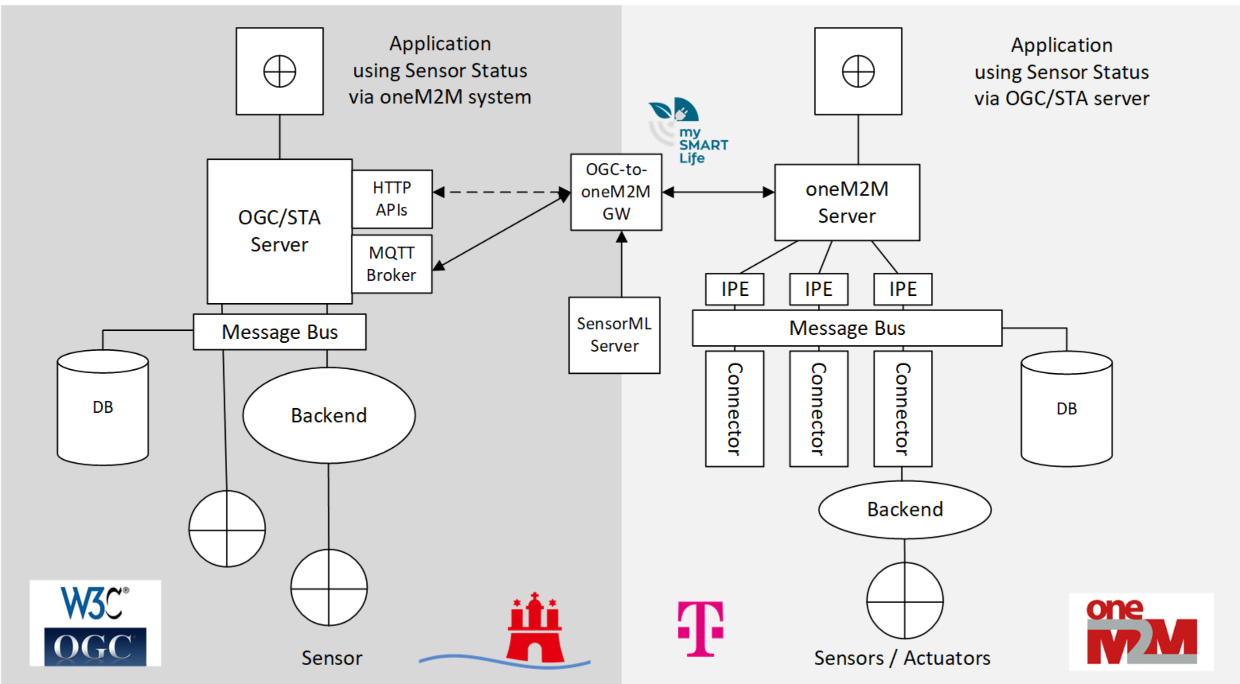

Figure 3: The STA/OGC-to-oneM2M gateway service connects the both architecture parts to a new mySMARTLife Open Urban Platform

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4.1.1 Direction OGC/STA-to-oneM2M

The communication between the OGC/STA server and the oneM2M Common Service Entity can be described in different phases:

The intended data flow for OGC/STA-to-oneM2M direction starts with an STA sensor that pushes its data to the OGC/STA server. This should be the trigger event to forward this data to the oneM2M system. A typical OGC/STA like the FROST server is not able to forward this event in HTTP. However, the server has a MQTT broker where this event is published.

The gateway service subscribes to this MQTT gateway to get data that are pushed to the FROST server.

A. Initialization of the gateway service

During the initialization phase, the gateway service loads all relevant configurations. It subscribes to the relevant OGC/STA sensor objects in order to get information when new observations arrive. Furthermore, the oneM2M-Server/CSE is prepared by creating a data structure with a dedicated data container (illustrated in Figure 4).

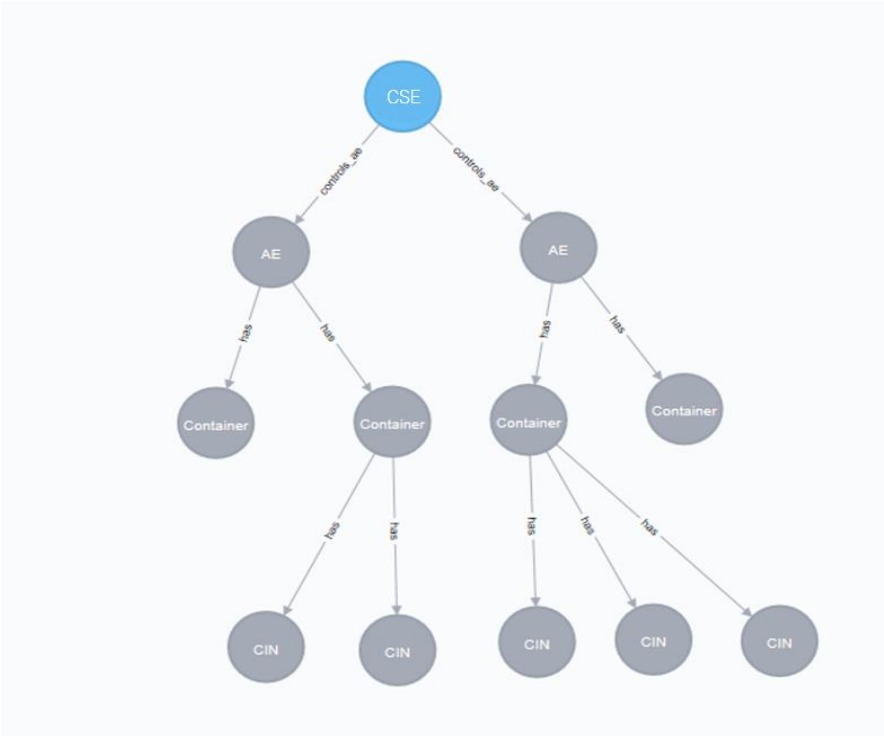

Figure 4: Tree structure of data in oneM2M

B. Application registers for OGC events at CSE

This phase is not a function of the gateway server. It is furthermore an inherent functionality of the oneM2M CSE. A client that is interested in the data coming from the OGC side subscribes itself to the

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appropriate oneM2M data container. As soon as the gateway services puts data to the container an oneM2M notification message including the observation is send to the client.

C. Data provisioning

After preoperational phases the OGC/STA-Server starts to send STA messages to the gateway service. According to the OGC data model (ISO 19156:2011) an observation is sent. This observation message is taken and formed to an oneM2M conform entity, a so-called CIN (Content Instance). The CIN is stored in the data container at the oneM2M-Server/CSE that was created in phase A.

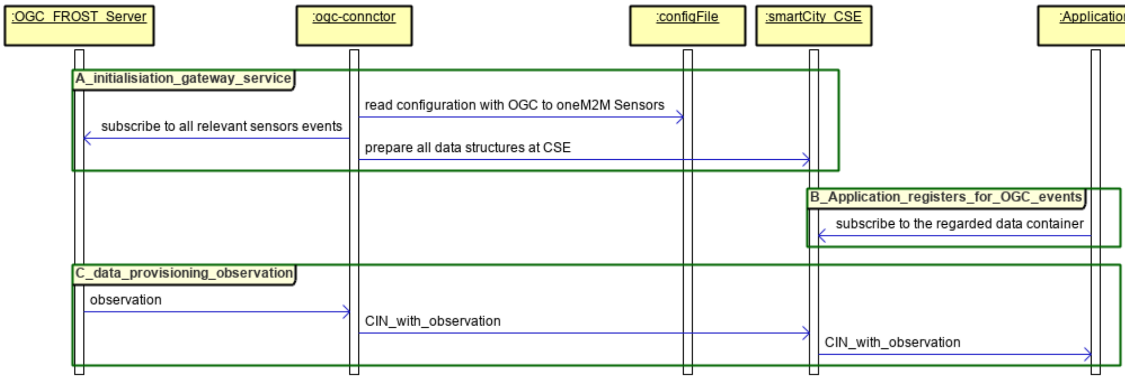

Figure 5: Message flow of the gate service for the OGC/STA-to-oneM2M direction

4.1.2 Direction oneM2M-to-OGC/STA

The intended scenario of this direction is that a sensor that is connected to an oneM2M-Server/CSE provides its data also to the OGC/STA server. Before data can be provided the OGC/STA-Server has to be prepared. Before it is possible to send data to it, it needs the setup of a data model. That is why the direction from oneM2M towards OGC/STA needs an additional support service. For all sensors that are not yet known to the OGC/STA-Server it needs a semantical description. This description is based on SensorML standard [2] and is provided by a SensorML-Server.

The oneM2M-to-OGC/STA direction can also be described in different phases:

A. Read Sensors List and discover already known data models

The gateway service can be configured with a list of those sensors that are connected to the oneM2M-Server/CSE and should publish their values to the OCG/STA-Server. In a second step, the gateway service discovers whether these sensors are already known to the OGC/STA-Server. For all sensors that are not yet known to the OGC/STA FROST Server an OGC data model is created.

The gateway service gets all information for the data model from the SensorML Server, an additional component that is needed to operate the oneM2M-to-STA direction. Here for every regarded sensor a description has to be uploaded.

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B. Creating Subscriptions

In a last initialization step the gateway service creates for all oneM2M containers of the requested sensors a subscription. This ensures that, every time new data arrive at the oneM2M-Server/CSE, a notification message is send to the gateway service.

C. Data Delivery

With all preparation of phases A) to C) the gateway service is now able to send data from oneM2M to OGC/STA. When sensor data are pushed to the oneM2M-Server/CSE a notification message informs the gateway service about this event. The sensor data come along with the notification. The gateway service forms an oneM2M content instance to an OGC observation and sends it to the OGC server.

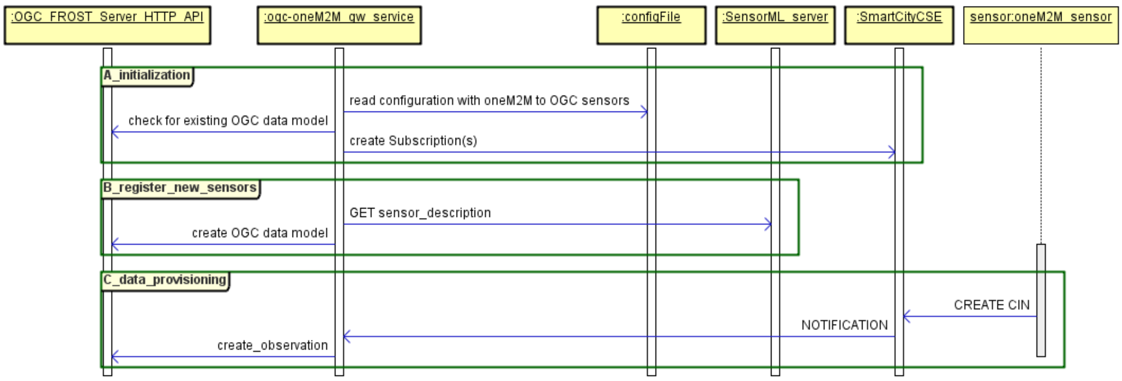

Figure 6: Message flow of the gate service for the oneM2M-to-OGC/STA direction

4.2 Features of an Integrated System

The combination of both standards, OGC/STA and oneM2M, has various architectural advantages:

Advantages of SensorThings API:

- STA is easy to implement: The Sensor Things API [3] in its version 1.0 has ca. 100 pages is not too complex and sensor connectors and other software parts are easy to implement. Since data without spatial information have a much lower value, and may even become meaningless, many cities use the wide range of standards of the OGC family since a long time. The OGC (supported on a global scale by many companies and cities) provides a standardized way in handling spatial data.
- The STA supports both http and mqtt protocol. STA has a standardized and accepted schema (ISO 19156) to describe a sensor, the thing where the sensor belongs to, its location and observations of the sensor. Furthermore, STA uses among others, SI units (Système international d'unités) to describe sensor values. Thus it is addressing the ability for different IoT systems to use and understand the exchanged information. It provides an open and unified way to interconnect the Internet of Things devices, data, and applications over the Web. The OGC

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SensorThings API is an open standard, and that means it is non-proprietary, platform-independent, and perpetual royalty-free. Although it is a new standard, it builds on a rich set of proven-working and widely-adopted open standards, such as the Web protocols and the OGC Sensor Web Enablement (SWE) standards, including the ISO/OGC Observation and Measurement data model. That also means the OGC SensorThings API is extensible and can be applied to not only simple but also complex use cases. SensorThings API is designed specifically for the resource-constrained IoT devices and the Web developers. As a result the SensorThings API adopts the REST principle, the efficient JSON encoding, and the flexible OData protocol and URL conventions. The OGC SensorThings API provides a standardized data model and interface for sensors in the WoT and IoT, offers the following benefits: (1) it permits the proliferation of new high value services with lower overhead of development and wider reach, (2) it lowers the risks, time and cost across a full IoT product cycle, and (3) it simplifies the connections between devices-to-devices and devices-to-applications. The OGC SensorThings API simplifies and accelerates the development of IoT applications. Application developers can connect to various IoT devices and create innovative applications without worrying the daunting heterogeneous protocols of the different IoT devices, gateways and services.

Advantages of oneM2M:

- oneM2M is complex and a whole framework of different architectural layers. oneM2M supports an advanced publish/subscribe mechanism in HTTP/HTTPS. Any client can set one or more subscriptions to a dedicated data container. When data arrive, the CSE notification is sent. The notification contains the data or just a notification that data are arrived. It can be configured in conjunction with data volume or other parameters. In STA a client needs to subscribe to an MQTT Broker in order to get information about incoming data.
- oneM2M has also an inherent access management. It is possible to control access to every single data container with a dedicated access policy. The format is part of the oneM2M standard. STA has no access policy mechanism.

4.3 Operational Consideration

The oneM2M service is implemented as a Java Spring Boot Microservice. After putting it to a Docker container, it can be managed in a Container Management Environment like Kubernetes. Kubernetes is able to manage one or more (n) instances of this service at the same time. When there are too many request Kubernetes starts a new additional instance of the service. This is necessary to ensure horizontal scalability, but causes also race-conditions. When the MQTT Broker of the OGC/STA Server publishes a sensor-value, it is distributed to all running instances of the gateway service. Finally, the oneM2M-Server/CSE gets the value (n) times. In order to prevent this effect, the gateway service is equipped with a concurrent locking mechanism.

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5. Conclusions

The mySMARTLife Open Urban Platform consist of two parts that are using different protocol standards. The integration of OGC / STA with oneM2M connects two major standards for data routing and orchestrating. It broadens the spectrum of potential applications that can use mySMARTLife integrated platform. Application developers can decide whether they want to connect by using oneM2M-APIs or SensorThings API.

On the other hand, both standards cover together more different technology layers of an IoT system than one standard alone. STA focuses on collecting observations in a dedicated data model in a geospatial-enabled way. The standard oneM2M also covers lower layers for instance oneM2M also defines for example also interworking with connectivity technologies defined in 3GPP.

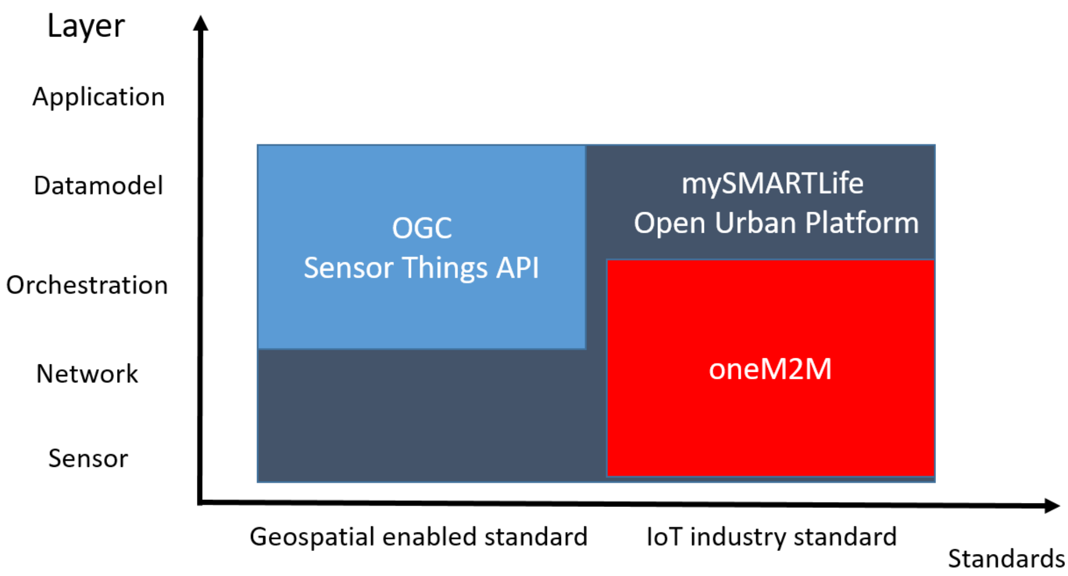

Figure 7 : OGC / STA and oneM2M cover together more layers than alone

In mySMARTLife the cities of Nantes, Hamburg and Helsinki have chosen OGC /STA based infrastructure for their urban data platform. With the mySMARTLife, OGC-to-oneM2M gateway service cities have the freedom to connect their platform to a powerful major IoT industry standard with low effort. Thus, the protocol gateway saves costs and makes the ICT solutions chosen by the city future proofed.

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6. References

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