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Reference Architecture Model Open Urban Platform (OUP); Text in English

Modèle de référence de l'architecture pour une plate-forme d'urbanisme ouverte;
Texte en anglais

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Foreword

This DIN SPEC has been developed according to the PAS (Publicly Available Specification) procedure. The development of a DIN SPEC according to the PAS procedure is carried out in workshops and does not require the participation of all stakeholders.

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0 Introduction

0.1 General observation and context

Cities are facing the digital transformation as any other organization in the world. The difference is that a city is not a single entity and even the city administration is only part of a much larger ecosystem within the city limit. Therefore, a collective and cooperative approach between various local stakeholders is required to harvest the full potential of the new digital era. Urban data has become a resource of high interest for a number of use cases, namely for urban mobility, energy efficiency, safety and security, as well as climate change and health.

The good news is that quite a large pool of urban data already exists within the various urban infrastructures. The downside is that these infrastructures operate quite independently with little to no integration. Thus, harvesting the urban data has become a cumbersome and difficult task, especially due to the fact that interesting use cases such as autonomous driving in the city or measuring environmental data at various hot spots in the city are not owned by single infrastructure operators but rather require a collective approach.

The European Innovation Partnership on Smart Cities and Communities (EIP SCC) has identified the need for an approach of more integrated infrastructures, which share urban data for re-use and re-purposing it in new use cases. In 2015, the Memorandum of Understanding “Towards Open Urban Platforms” has been initiated by the EIP SCC and since then signed by a large number of enterprises and a related “Letter of Intent” by cities. The intent is to create an open and aligned approach towards harvesting the urban data by avoiding proprietary and thus single vendor dominated infrastructures. Instead, a federated and open approach to exchange and share data for mutual benefits both social and commercial is envisioned.

It is also important to stress the fact that European urban regions are dominated by rather small and medium size cities and thus lacking the Mega Cities and Mega Metropolitan regions often referred to when considering Asia and America. Thus, the challenges of European cities are to find affordable, scalable solutions, which can be tailored to their needs and size as well as having a pluralism of available solutions encouraging the engagement of local providers, SMEs, and start-ups.

The digital transformation of enterprises is often referred to as the 4th industrial revolution. As the word revolution indicates this new era means changes not only on a technological but also on an individual, political and society level. Social acceptance will therefore be next to the technical soundness one of the key factors for quick adoption of digitalization and the new business opportunities. Open Urban Platforms, which are aggregating services and data, act as a central technical urban infrastructure, since horizontalization and the interconnection of services and data are required to tackle successfully the above mentioned use cases. The term open refers specifically towards a design principle, to use open standards and interfaces to guarantee compatibility and interoperability with other systems and other urban platforms.

Other important elements are data governance and data ownership of urban data. If data is the new raw material of the 21st century, how can it be harvested to the benefit of society and citizens creating wealth and prosperity within the urban environment? The design principle of “openness” will create the foundation for these social benefits but needs to be well-aligned with the commercial and financial benefits for those who provide the data as well as for those who create value through new smart services.

Today cities face the situation that digitalization provides a new digital overlay infrastructure on the existing ones, a variety of new services and even more data. The question arises, how to control, manage, work, and provide these services and data. Hence, cities require a logical digital framework like an “urban platform” which aggregates all the different services and connects the data.

The EIP SCC has identified the need to act and established a lead initiative based on the above-mentioned MoU to work on a city needs-led approach. Organized by the Greater London Authority, a group of European cities have collectively created a common specification on how they assume the digital transformation and the harvesting of urban data should be addressed. This specification has served as input for a supply-side driven effort to develop a reference architecture for open urban platforms. The reference architecture should help to address the needs addressed in the specification as well as allowing for a federated and standardized way to exchange and use urban data across the different urban infrastructures.

In 2016, a group of enterprises, cities, and the Fraunhofer group FOKUS came together to underpin the importance of the EIP SCC lead initiative by creating a DIN SPEC consortium to extend the technical view of the reference architecture with the above-mentioned topics of data governance, data provisioning, and how to create an integrated digital urban infrastructure.

0.2 Why a Reference Architecture?

The intent of the Reference Architecture and its belonging design principles is to provide cities and communities that wish to implement Smart City & Communities initiatives a truly mission and vendor agnostic approach that will result in an enhanced interoperable, standards-based architecture and implementation which is specific to a mission when their specific city context is applied. In addition, this Reference Architecture can be used with existing architectures to plan for improving interoperability maturity and functioning of an expanding technology solution for smart city initiatives. This mission and vendor agnostic approach is meant to provide key elements and concepts needed to be addressed to make these resulting solution architectures interoperable.

A common theme among the definitions within the world regarding the term Reference Architecture is that the primary purpose of such a Reference Architecture is to guide and constrain the instantiations of logical and solution architectures. In addition, a Reference Architecture should:

- provide common language for the various stakeholders;
- provide consistency of technology implementation to solve problems;
- support the validation of solutions against a proven Reference Architecture; and
- encourage adherence to common standards, specifications and patterns.

In general, a Reference Architecture is an authoritative source of information about a specific subject or mission area that guides and constrains the instantiations of multiple architectures and solutions. The Reference Architecture as presented here provides the key elements, aligned to several other EU initiatives and worldwide standards regarding Reference Architectures. It will at least contain a generic yet integral approach including business, infrastructure, data, applications/services, security and performance domains, to which the concepts of interoperability and standards, are applied. The EIP RAD (EIP Reference Architecture Document) addresses various target groups, where not all chapters and elements need to be deeply understood by all readers and users. Both documents have some common target audiences, mayors of a city, the city manager and its policy makers, the administration that need to implement parts of an urban platform and the purchasing department that want to tender solutions. Whilst in many cases current Smart City and Standardization activities are led by bigger companies and big or even mega cities, the reference architecture can be used also in smaller sized cities or even rural areas.

The two-fold approach on infrastructure and open urban platform of the EIP SCC was mirrored by DIN with a DIN SPEC (PAS) process. Following the EIP Humble Lamppost initiative, the DIN SPEC 91347 was published to describe the new role of streetlights as “integrated multi-functional Humble Lampposts – imHLA”, in March 2017. This document complements the standardization of integrated urban infrastructures.

1 Scope

This DIN SPEC (PAS) provides a reference architecture model Open Urban Platform as an integrated data exchange platform in the digital infrastructure of a city or community in the sense of a “match-making” platform.

This document

- offers a catalogue of terms and definitions to unify the language used in this complex interdisciplinary context;
- creates a systemic comparability, which enables the interoperability of systems;
- defines of open interfaces (also known as API), to upload and download data that is their provision and usage;
- clarifies licensing models for open data that is free-of-charge as well as chargeable access and
- provides an overview of current and for this area relevant valid norms and standard in a coherent manner.

This document does not specify requirements for data storage or data processing.

This document is aimed at decision makers, procurer, planner as well as manufactures and operators. Planners are supported for orientation and selection and design of digital urban infrastructure. For decision makers, most importantly in municipalities, the significance of urban data for the digitisation of public space shall be clarified and its provision facilitated.

This document deals with the relevant data privacy aspects; with reference to the respective current legislation.

Essentially, this document describes the usage of so-called urban IoT (internet of things) data for existing and especially to be developed services.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply:

2.1

open data

data sets provided by public authorities and public enterprises to the general public

Note 1 to entry: Often, this term is also used to define the usage of the data sets as “free of charge” using an appropriate open data license agreement. Open data is open if the provided data can be processed and used by anyone and for any purpose. In general, Open data shall adhere to criteria such as “timeliness”, “as close as possible to the data source”, “publication under an open license” such as CC BY 2.0 which was published by the Creative Commons NPO and allows sharing, replication and modification of the data even for commercial purpose.

2.2

open interfaces

interfaces characterized by the fact that the way in which signals are transmitted to or read from an interface is described

Note 1 to entry: Protocols, in turn, describe the rules for interaction with interfaces. Their description is easily accessible to all interested parties and that they can be used and further developed.

2.3

open standard

publically available documentation i.e. as document(s) and/or description(s) enabling multivendor interoperability

Note 1 to entry: Such document(s) called (technical-) specifications, being developed by a community of companies, consortia or Standards Development Organizations (SDO's) for the sake of interoperability among products and systems of different companies.

2.4

quasi standard

product or solution provided by a company having become widely adopted by users

Note 1 to entry: Quasi standards are commonly called standards.

2.5

Internet of Things

IoT

intelligently connected devices and systems to leverage data gathered by embedded sensors and actuators in machines and other physical objects.

2.6

Smart Data

(big) data enriched by analysis, interpretation and by linking with other information

Note 1 to entry: The huge amount of data and especially urban data will become one of the most important resources in the next years which is mandatory to engage with the upcoming challenges of urbanisation and climate change. The mentioned huge amount of data or big data can be analysed and combined with other data to gain more insight about what's happening and will happen in urban space. Following the definition given in the final report of the "*Smart Service Welt*" project from Acatech, the mentioned Big Data can be enriched by analysis, interpretation and by linking with other information to become Smart Data. Based on Smart Data knowledge can be generated which is the basis for new Business models and so called Smart Services.

2.7

Smart Service

result of digitisation which enables consumers to configure and to buy individual bundles of products and services based on their needs

Note 1 to entry: Smart Service consumers can expect the right combination of products and services everywhere and every time. Smart Service providers therefore need to understand the customers' requirements and be able to analyse the huge amount of data which will result in Smart Data. These Smart Data can be used by a Smart Service or sold on a digital market place.

2.8

Urban Platform

system that facilitates the exploitation of city data and intelligent monitoring and control of infrastructure and assets in cities, and that enables new and improved services (both for public and private ends and organizations)

Note 1 to entry: Open Urban Platforms, although the term may suggest otherwise, are not concrete off-the-shelf products. Rather they can be seen as platform of platforms, consisting of existing and new elements and evolve over time. We define An Open Urban Platform as a local implementation of a logical architecture that integrates (previously) siloed city infrastructures, data platforms, and services, from different domains within both public and private spheres. To put it more simple, urban platforms integrate IoT enabled infrastructure and assets in cities, make it possible to operate and collect and (re)distribute/use data from these and other sources, and make these available to applications.

Note 2 to entry: Consistent with EIP SCC an Urban Platform is characterized here as follows:

- a) The implemented realization of a logical architecture/content/design that brings together (integrates) data flows within and across city systems;
- b) exploiting modern technologies (sensors, cloud services, mobile devices, analytics, social media etc.);
- c) providing the building blocks that enable cities to rapidly shift from fragmented operations to include predictive effective operations, and novel ways of engaging and serving city stakeholders.

2.9

Open Urban Platform

OUP

urban platform that uses open standards and interfaces to guarantee compatibility and interoperability with other systems and other urban platforms

2.10

European Innovation Partnership on Smart Cities and Communities

EIP SCC

EU initiative to foster the field of Smart City throughout Europe

Note 1 to entry: The EIP SCC gathers together initiatives for meeting the EU's climate targets for 2020. In the areas of sustainable urban mobility, neighbourhood energy efficiency and integrated infrastructures, it has not only established networks in the form of "action clusters", but also has developed and tested innovative solutions as flagship projects as part of the Horizon2020 programme. One of the lead initiatives is the "1 000 000 Humble Lampposts" network, which is working on the introduction of integrated multifunctional street lamps in Europe and has provided great stimulus for the specification DIN 91347.

2.11

integrated infrastructure

infrastructure designed for re-use and re-purpose infrastructure data for multiple services and thus optimizing the overall return on investment

Note 1 to entry: Integrated infrastructure is used as integrated urban infrastructures using IT systems and connect them via the Internet. Integrated infrastructures serve as "systems of systems" for cities to obtain, analyze, and use urban data particularly required for any cross-domain service.

2.12

capability

extent and content of what a city or community does to execute its mission and deliver services that meet the needs of citizens and other stakeholders

Note 1 to entry: It is an abstract representation of what is needed to produce an outcome by an organization or other human collectives — along with goals and metrics for that outcome.

2.13

anonymity of a subject

fact that the subject is not identifiable within a set of subjects

Note 1 to entry: The anonymity set is the set of all possible subjects.

3 Concept of Open Urban Platforms

3.1 General information

Until recently the infrastructures of a city were often developed and provided through stand-alone (silo – vertical) systems, to support scenarios via dedicated services. In many cases the interworking with other scenarios and services is not planned and not possible. To leverage the opportunities of digitalization and the new overlay of a digital infrastructure, enriching smart service interworking across domains in combination with data analytics is required. This interworking across multiple urban infrastructures requires a coordinated approach avoiding that the different management systems are all dealing independently with the same issue over and over, again. This situation calls for a new integrated infrastructure, which helps coordinating the different infrastructure systems within a given city and complementing it with the developing Internet of Things, namely the urban sensors, which are rapidly deployed. This coordination will be provided by so called “Urban Platforms”. Such an urban platform focuses primarily on the local demands and is therefore uniquely bound to the city or region, where the urban data resides and the services should be provided. In addition, the exchange of data with other platforms and also the composition of components within the platform shall be possible, which could also require smart data modelling. Thus, such an urban platform needs to follow an open design approach, e.g. with open interfaces, supporting open standards for exchanging urban data and supporting new urban services in a future-proof way, i.e. extending the scope of the Smart City services over time by an increased use of digitalization.

This however does not mean that all services and their logic shall be moved towards a single platform, rather than having a “System of Systems” approach, where the open urban platform interconnects the various existing management systems, easily. This means, that dedicated domain specific systems are still required to operate the related urban infrastructures and shield complexity. To provide this “System of Systems” like approach it requires openness on all levels as a core principle. The platform is connecting systems of different domains and enabling cross-domain smart services to be established. Different actors will have different roles depending on specific use cases.

3.2 Characterization of Open Urban Platforms

Urban Platforms facilitate the exploitation of urban data and intelligent monitoring and control of infrastructure and assets in cities, to enable new and improved services both for public and private sectors. For now, urban platforms specifically focus on the integration of IoT enabled infrastructure and assets in cities, enable re-use and re-purposing of urban data from these sources by combining them with other urban data from other sources, and make these available to applications, smart services, and other management systems.

Consistent with the view of the EIP SCC, an Open Urban Platform is characterized as follows:

- The implementation of a logical reference architecture following design principles on open APIs that supports data flows within and across city systems as well as enriching the raw data streams to generate smart data as being required by the consuming entities.
- It is exploiting modern technologies to harvest, collect, and analyse the urban data and providing the results to citizens and enterprises, e.g. sensor nodes and other IoT devices, cloud services, mobile connectivity, machine learning for analytics, publishing and sharing via social media and APPs.

- It is providing the building blocks that enable cities to rapidly shift from fragmented and isolated operation of individual infrastructures towards an integrated approach by connecting the systems via the platform, including cross-domain data analytics for predictions, forecasts, or better insight, and novel ways of engaging and serving city stakeholders offering Smart Services, both public and commercial.

This way, an Open Urban Platform should be perceived as the new digital urban infrastructure that facilitates the implementation of the overarching Smart City strategy to support the strategic goals such as climate change goals, increased energy efficiency, reduced traffic congestion and emissions, or creating (digital) innovation ecosystems for growth and wealth of the community.

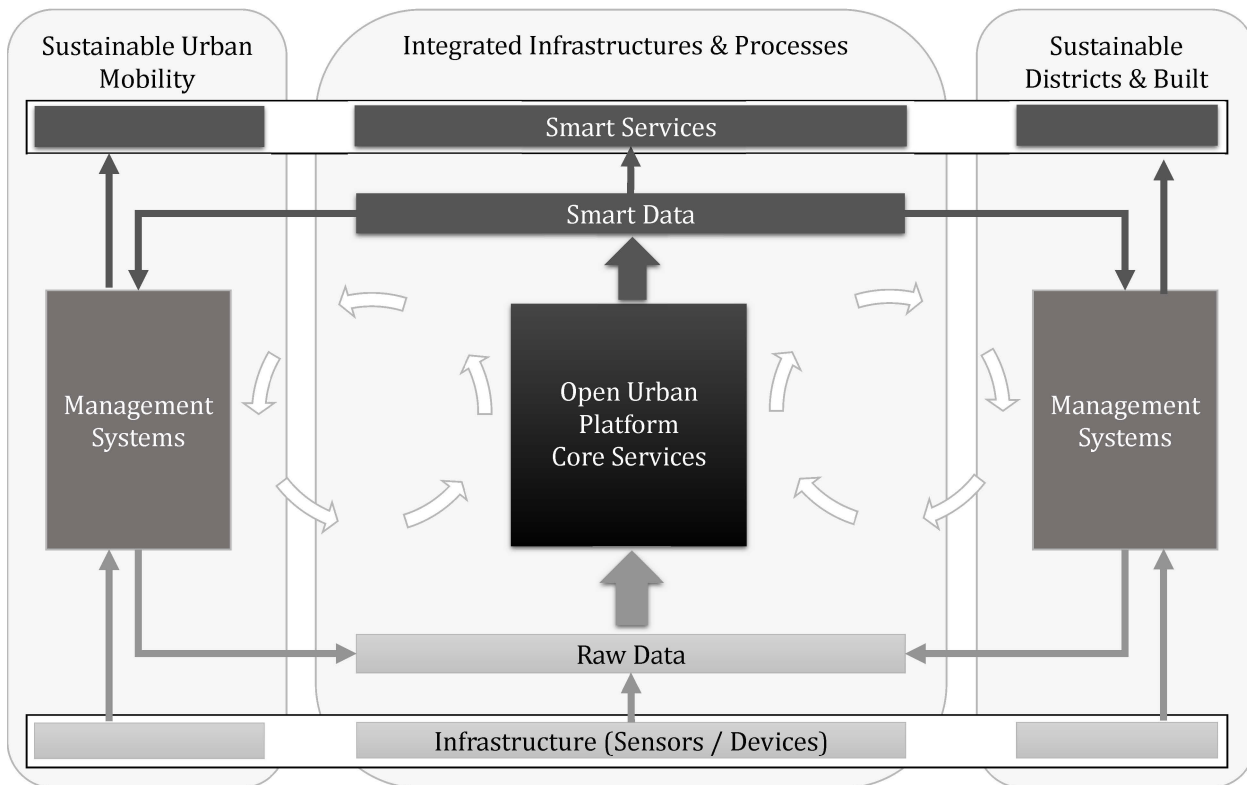


Figure 1 — Schematic picture of an Open Urban Platform

The vertical areas shown in figure 1 above describe the three thematic core areas in the EIP SCC: sustainable urban mobility, integrated infrastructures and sustainable districts & build environments. Typically, without an integrated infrastructure approach, the domains transport and built environment would barely exchange urban data as these are quite distinct domains. For example, assuming a strategic goal of increasing the usage of electrical vehicles in a city will require sharing the information regarding the need of charging among these verticals such that the distribution net can cope with it while securing the mobility capacity needed to serve the demand of the citizens. Open Urban Platforms should not be limited to these three verticals but remain open for further verticals. Certainly, the EIP SCC has demonstrated that there is a clearly defined demand for the integration of infrastructures in these domains. Other verticals such as safety & security, health or water also benefit from such an Open Urban Platform.

The Open Urban Platform concept follows four essential usage scenarios:

- The OUP itself is a (cloud based) system based on the reference architecture (middle block in the graphic) enabling service integration (middle “block” plus a smart service on top);
- an OUP enables the interworking with another domain, e.g. Field Component Platform (FCP), a stage on which different components like Sensors and Actors can be operated, forming a system of systems (middle and left block);

- c) an OUP enables interworking between two similar systems within a city domain, e.g. management systems for traffic control or electric vehicle charging; and
- d) a federated interworking between cities using different OUPs from different vendors.

From a conceptual perspective, an Open Urban Platform shall provide and integrate key IT and infrastructure components forming a digital “backbone”. An Urban Platform can be both a new system introduced to the group of management systems that secures the integration serving as a match maker or a rather flexible logical framework of interconnected systems. New services can be integrated through an open consumption interface, easily. This technical open architecture shall form a reference to compose a Smart City Urban Platform. It will allow for further extensions in the future as new domains and services will be onboarded.

Achieving this vision requires moving beyond current implementations in which the degree of integration of core subsystems within smart cities is often limited by patchworks of legacy and fixed solutions connected by custom integrations, if any. Since a variety of Urban Platforms are under discussion, this document guides towards open and thus interoperable Urban Platforms based on open interfaces and standards to enable easy and quick integration of applications, new services to be explored and data to be shared. Such an approach provides opportunities for a community of service providers and APP developers and thus reduces the risk of “vendor lock-in”, significantly.

Such a future proof hence modular platform enables continuous integration and improvement through easy addition of new services as opposed to a pure system integration effort customizing the management systems, individually. Integrating new domains, components, and systems should be simple by adding them to the existing infrastructure with a minimum of tailoring and rework of existing component interfaces.

Urban Platforms are local implementations, meaning that instances of Urban Platforms will differ per city as local preconditions and starting situation (with legacy systems in place) are different. However, many elements of these Urban Platforms will and should be reusable, especially Open APIs to IoT devices (sensors/actuators) as well as analytics applications and Smart Services, which may be customized or configured to the geographical or regional context. For instance, Smart Services for autonomous driving should work with Urban Platforms in any city.

3.3 Existing concepts and initiatives

There has been some initial work done, already. These efforts reflect the current interest and dynamics in the field of smart cities, with multiple and sometimes overlapping initiatives, and a further increase in the years to come is expected. This document provides with a common reference architecture, assisting cities and other stakeholders in positioning the myriad of existing and new initiatives, understanding how they relate to which aspects or parts of urban platforms. Furthermore, this standard provides clarity in what an urban platform should provide to be future proof.

There are currently different efforts towards reference architectures, for example the EIP SCC MoU, the OASC effort in the context of FIWARE or the Internet of Things-Enabled Smart Cities Framework (IES-City), which was launched by NIST.

One observation is that these efforts are lacking a standard to refer cities and suppliers to, which can serve as a common ground. While the EIP SCC MoU remains an open stakeholder approach, others are more restrictive and require dedicated commitment to specific technologies.

While this document focuses on the overall reference architecture of Open Urban Platforms and related open API characteristics, the detailed specification of individual components will be left to existing standards or best practice. This is in line with the view of the EIP SCC and the European Commission, who has chartered the ESPRESSO Consortium to explore these standards in more detail. The ESPRESSO consortium developed a common language/shared vocabulary and a city information and indicator platform which can be adopted by cities.

A number of challenges is addressed:

- IoT and in general M2M communication covers a wide field of possible applications and devices. Each purpose of use can have very different requirements and it is impossible to cover all those requirements with one standard in particular because of possibly different framework conditions like e.g. legal frameworks, existing applications etc. As a result, we need to contextualize the IoT requirements. Best example is the use of Smart Meter data in Germany that has to adhere to the BSI Data Protection Schema, which is only valid for Germany.
- Developing standards for a Smart City environment is currently a very dynamic process. Several Standard Developing Organizations (SDOs) are considering standardization projects in the realm of urban data platforms. However, tangible projects have yet to be launched. As a result, this document serves as a first draft to an International standard related to open urban platforms.
- An OUP shall integrate legacy systems and a wide range of different technologies, especially in the IoT device arena. This requires an open and vendor neutral approach allowing for diversity rather than single vendor solutions.

4 Ecosystem of an Open Urban Platform

4.1 General information

Since each city / region constitutes an individual ecosystem or is part of one, it requires a dedicated digital infrastructure and transformation strategy. The OUP is a master piece of the digital transformation of cities towards smart(er) cities providing the basic infrastructure for new smart services across a wide range of sectors and domains. While a significant amount of data will be provided by urban infrastructure operators, both public and private entities, there will be also more and more data provided by IoT devices of citizens and enterprises. Thus, the OUP is a mediator among a wide range of stakeholders, which also shall ensure appropriate governance, roles, and responsibilities.

In Clause 6 different use cases of OUPs are presented, each of it may lead to a different business model. The nature of the OUP should be independent of who operates it but governed by common rules. The EIP SCC lead initiative on OUP has specified such common rules. This standard will therefore focus on how to support different business models through technical and commercial governance as well as related roles and responsibilities.

4.2 Business models

As in any other urban infrastructure, cities and communities shall specify the business model on how to operate the OUP. As of today, there are no regulatory frameworks on how an OUP shall be operated beyond those known for any Internet-based software system.

Therefore, the OUP shall support different business and operating models and should not pre-determine this by the way it is designed. As operating an OUP is a new requirement for local governments and related urban infrastructure operators, business decisions regarding investment, budgeting, and operation are required.

Next to budgets and financial aspects, operational processes across the different organisations and (re-) skilling the workforce to either operate or at least connect to an OUP need to be established.

Some cities and communities have already hired a Chief Information Officer (CIO) or even lately a Chief Digital Officer (CDO) to kick off digitalization processes within the administration and across the different urban stakeholders. The OUP serves as the foundation for digitalization processes within a smart city and should therefore be directly linked to the responsibilities of the CIO or CDO. Hereby, the City CIO/CDO should orchestrate the development of OUP with key stakeholders and its horizontal expansion across all urban infrastructures, both for digitizing the public services of local government, as also making the OUP an enabler for new private services.

Dependent of the size and power of a Smart City there are different kind of business models and operation possible to run an OUP. Therefore, an organization needs to investigate the different relevant criteria as this is city specific and not the same for every organization:

- Business Model of data provisioning: Introducing an OUP, the organization needs to have clarity if data should generate a new revenue stream. Data can be sold direct or indirect. The revenue can be maximized, or the risk could be minimized on guaranteed income. Alternatively, a strategy to enable only open (thus meant as “free of charge” can be added. The decision on the commercialization of data impacts the service level by which the data shall be provided, i.e. availability and quality of the data. This business model decision has an influence on the design and operational model of the OUP with respect to system availability, performance, and persistency.
- Business Model of services enablement: Should the organization in charge of the OUP also provide the enabled services or only enable 3rd parties to provide the services, both public and private entities. Is the OUP itself the service to offer or just the basic “plumping” for a flourishing service offering? The impact of the business model of service enablement on the design and implementation of the OUP relates to well-known functionalities for Internet service provisioning such as billing, accounting, customer relationship management, and the like. This leads almost to the distinction of an OUP for B2C/G2C services or an OUP for B2B/G2B services.
- Business Model of data ownership: Who owns the data transferred and eventually stored within the OUP? One could assume that the data created and used in the existing urban infrastructures belong to the owner or operator of the related management systems. So, sharing the data via an OUP needs to include a decision on who owns the transferred (aka copy) of the data? While this is mainly a business decision, the implication on the design and implementation of the OUP remains a technical issue. Different governance and ownership model may co-exist in a single OUP. This includes the governance on “how long” the data should reside within the OUP when provided to 3rd parties and thus, what are the operational procedures and related technical functionalities to remove data in a consistent, non-discriminatory, and non-disruptive way.
- Management Framework: According to the management framework to maximize value from city data of the EIP SCC lead initiative on OUP, cities and communities should specify a vision, strategy, and a related roadmap on how to introduce and expand the digitalization using the OUP as underlying core infrastructure. The result of this is a clear mandate of the OUP to be an integration tool for any of the sectors addressed by the cities and communities and the design and functionality should not be limited to the use of data and services in selected sectors, only. While this so called “horizontal” integration capability is mandatory for an OUP, one needs to acknowledge that cities and communities may start with a very limited set of sectors / domains to cope with the complexity. The OUP architecture, design, and implementation shall therefore support the ability to extend the OUP over time, integrating new functions and linking to other OUPs serving other sectors / domains. Extensibility is a must for OUPs. The management framework includes also the need to include the political leadership understanding and endorsing the vision, strategy, and roadmap as representatives of the citizens.
- Knowledge and Capacity: Introducing an OUP requires cities and communities to have appropriate knowledge on how to harvest urban data, both technically as well as contractually. In addition, knowledge and skills about the different characteristics of data and the implication for re-using and repurposing it are required. What kind of data is classified and in which way? What kind of data should be perceived as “raw material (aka raw data)” vs. “processed data (aka smart data)”? With respect to the operation of the OUP, is the organization capable in running an OUP on their own or is there a 3rd party operator? The latter issue should be related to similar procedures and business models when introducing new eGovernment services including issues such as IT infrastructure, data security, interface design, or user experience.

There are four types of business models on how to operate an OUP in a city:

- a) **City runs an OUP on their own:** This means that the City is responsible for the whole architecture and value chain. Updates, upgrades, adoption of legal requirements and integration of the different data sources would be in the ownership of the city itself. This kind of business model would require an own department of “digital data and services” with a cross-functional responsibility regarding any public data source within the city. This way, the city ensures ownership and control on how data and services will be provided. Different to the existing IT departments, the department of “digital data and services” must be considered as a business line rather than a support function, as attractive digital services require cross-organizational re-use and repurposing of data, which may not always fit to existing department structures. Certainly, extending roles and responsibilities towards these digital data and services, makes existing IT departments obvious candidates.
- b) **City builds an own legal entity to run an OUP:** A city-owned legal entity operates the OUP and is responsible for the provisioning of the digital data and services. This way, the offering can be further commercialized and extended both to private enterprises as well as to other cities and communities. This way, the city could benefit from the scale-up in terms of revenues and cost-efficiency. City utility companies have demonstrated the value of such a business model for other existing urban infrastructures. This way, the city keeps the control through shareholder relationship while allowing for a broad take-up of the OUP as a commercial public offering.
- c) **City contracts a service provider to run an OUP and transfers full responsibility:** The service provider takes over the full responsibility about availability, performance, legal requirements on behalf of the city. The city grants the commercialization of the urban public data to the service provider under a license agreement, which defines the boundary conditions of commercialization including open data provisioning as well as license fees to be paid by the service provider, when commercializing the urban data. The city would not be liable anymore about the service delivery. The service provider could use the data to build new digital services and commercialize them. This way, a city will benefit from the scaling assuming the service provider operates OUPs for a number of cities and communities. Digital services may be less customized to individual cities and communities in order to leverage the scaling opportunity.
- d) **Collaboration of local councils (de: “interkommunale Zusammenarbeit”) sharing the operation of an OUP:** Creating own scale-up by teaming up sounds like another worthwhile business model. Several cities and communities agree to a joint venture. The new entity would operate on behalf of the cities similar to the business model described above in section b). The major issue relates to the overall ability of the communities to collaborate and act as a team. The terms of reference will be crucial as it has to provide the necessary freedom to act, especially in cases, where individual councils disagree to the overall offerings. The autonomy of the entity and how it can manage and operate on the different urban data pools of the communities are crucial success factors. On the other hand, the councils have to decide the trade-off of owning and controlling their own urban data versus the financial benefit of sharing the entity with others. This business model is also attractive for metropolitan regions, where both larger cities and smaller communities share common interest and services such as public transport, already.

4.3 Governance

Industry and politicians have been addressing the relevance of data for the digital transformation. Some have called “data” the new raw material of the 21st century. Thus, cities and urban infrastructure providers have to consider, how they are harvesting the data and how should the data become available. A governance structure is required adhering to the overarching goals and ambition of the cities and communities.

As public data is a common good, one needs to ensure that the access to the data is non-discriminatory. The rules should be specified by the city authorities as the regulatory framework in Europe and Germany is still quite vague on this. Non-discriminatory shall not imply “free of charge” or “one fits all” but should ensure that those who have a valid case to gain access to the data, can get it. Thus, business models shall be specified as further described, below.

So far, urban infrastructures are already operated under well-defined governance structures but the related data often has not been considered as an asset by itself, which may require a different governance schema. The EIP SCC talks about “integrated infrastructures” and recommends a much closer cooperation across these infrastructures for re-use and repurposing them. “Data” will be the dominant asset to be re-used for different purposes by different service providers. Thus, an overall public data and even further urban data governance schema has to be introduced to which the OUP shall adhere to.

Transparency and protecting the public good through governance is essential to prevent abuse of power. Therefor there is a need to create transparency on the data being collected and re-used in which way by whom for what purposes. Moreover, there may be a need to monitor usage of data and services of Open Urban Platforms to detect violations and be able to act on that. Data and services need to be secured by well-known technologies as used in online shops or other related online portals and market places.

A related governance topic is the use of public space for installing future IoT devices in order to collect additional data. DIN SPEC 91347 on integrated multi-functional Humble Lampposts has addressed this issue with respect to lampposts as a means of street furniture.

The governance schema shall include also the protection of data against misuse as well as preventing unauthorized access to the urban infrastructures themselves. Again, well-known Internet security standards shall be adopted within the OUP.

Different user groups need to be addressed and related service models need to be supported by the underlying business model. Hereby, the integration of data sets from different data providers to enable new digital services is the underlying governance model. User groups to be addressed include the citizens, local businesses, public and private service operators, local and regional administration as well as the general public.

While almost any smart city strategy refers to the citizens as main target, the reality check shows that this user group has not been well addressed. Successful business models of so called B2C or G2C urban services remain a challenge and if successful then the business model at best ignores the role and responsibilities of the public administration or even contradicts existing strategies and guidelines. Thus, OUPs should provide the ability to link the different service providers and their services in a way that service provisioning is non-discriminatory and adheres to the local strategies and guidelines as set out and overlooked by the local authorities.

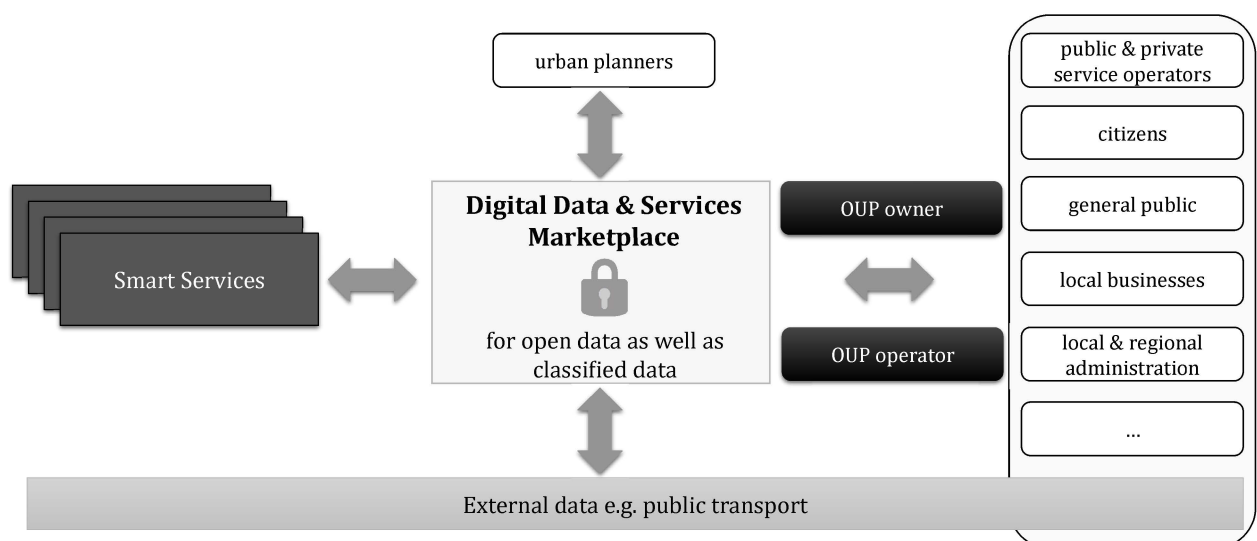


Figure 2 — Digital Data and Services Marketplace