SYNCHRONICITY

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Main author(s):	Sébastien Ziegler, Anna Brékine, Martin Brynskov, Pasquale Annicchino, Nuria de Lama, Luis Munoz, Eunah Kim, Cédric Crettaz, Renáta Radócz
Internal reviewers:	André Sá Miranda, Kata Börönte, Martin Brynskov
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Executive Summary

This Deliverable provides an overview of the standardisation and pre-standardisation activities of SynchroniCity, the European Large Scale Pilot of Internet of Things in smart cities. It highlights the contributions of the project to standardisation through diverse channels. Globally, SynchroniCity intended to contribute to foster global convergence and interoperability in line with the principles adopted by the Open and Agile Smart City Alliance.

Abbreviations

API	Application Programming Interface
D	Deliverable
EC	European Commission
ECCP	European Centre for Certification and Privacy
EIP-SCC	European Innovation Partnership for Smart Cities and Communities
ETSI	European Telecommunications Standards Institute
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IoT	Internet of Things
ITU	International Telecommunication Union
LSP	Large Scale Pilot
OASC	Open and Agile Smart Cities
OMA	Open Media Alliance
SG	Study Group
WP	Work Package
WT	Work Task

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1 Introduction

1.1 About SynchroniCity

SynchroniCity is a research project (IoT Large Scale Pilot) on smart cities based on the belief that creating a simplified, open and agile digital market across borders will help cities and its citizens to get better services. It will also help businesses of all sizes to compete transparently and to easily scale their products and solutions. These will enable the identification and development of agile city standards that will allow establishing an effective marketplace for all. The research project represents the first attempt to deliver a Single Digital City Market for Europe by piloting its foundations at scale in 11 reference zones – 8 European cities and 3 more worldwide cities – connecting 34 partners from 11 countries over 4 continents. Building upon a mature European knowledge base derived from initiatives (e.g. OASC, FIWARE, FIRE, EIP-SCC) and including partners with leading roles in standardisation bodies (e.g. ITU, ETSI, IEEE, OMA, IETF), SynchroniCity will deliver a harmonised ecosystem for IoT-enabled city marketplace with identified interoperability points and interfaces, and data models for different verticals. This will include tools for: co-creation; integration of legacy platforms; IoT devices for urban services and enablers for data discovery, as well as access and licensing lowering the barriers for participation in the market. SynchroniCity will pilot these foundations in the reference zones together with a set of citizen-centred services in three high-impact areas – cities, businesses and citizens – who are linked directly to the global market. With a running start, SynchroniCity will serve as a lighthouse initiative to inspire others to join the established ecosystem and contribute to the emerging marketplace. SynchroniCity takes an inclusive approach to grow the ecosystem by inviting businesses and cities to join through an open call, allowing them to participate in the pioneering marketplace enabling a second wave of successful pilots. They will strengthen the ecosystem by creating a positive ripple effect throughout Europe and globally by establishing momentum and critical mass for a strong European presence in the global digital single market for IoT-enabled solutions.

1.2 Purpose of T6.2 IoT and Service Standardisation and Ecosystem Management

Standardisation is the process of developing and implementing technical specifications based on the consensus of different parties such as firms, users, interest groups, standards developing organisations (SDOs) and governments.

Standardisation guarantees the safety, interoperability and compatibility of the goods or services.

In this context, and to comply with the task objectives as described in the Grant Agreement, the main purpose of T6.2 on IoT and Service Standardisation and Ecosystem Management is to actively contribute to standardisation processes and SDOs, specifically to ITU-T in the Study Group 20, ETSI, OASC, IEEE, ESPRESSO and EIP-SCC in the framework of the SynchroniCity project.

1.3 Purpose of this Deliverable D6.2

The deliverable D6.2 on 'Internet of Things Standardisation Report' seeks to provide an overview of the various achievements of SynchroniCity in relation with standardisation through diverse activities and channels. It presents both formal contributions to normative and standardisation processes, such as ITU-T in the Study Group 20, ETSI, OASC, ECCP, as well as pre-standardisation activities, including with the IoT Forum (IoT Week), Eurocities, ESPRESSO and EIP-SCC.

2 Collaboration with the European Large-Scale Pilots

SynchronicCity is one of the European Large-Scale Pilots (LSPs) on the Internet of Things financed by the European Commission. As such, SynchroniCity actively closely collaborated with the other LSPs and developed several joint activities related to standardization. The following section provides an outlook of this cross-project cooperation, including cross-LSP activity contributions and the contributions to AIOTI WG3.

2.1 Collaboration with the IoT LSP Project Programme

The EU-funded IoT European Large-Scale Pilots Programme consists of a total of seven innovation consortia (5 LSPS: IoF2020, MONICA, Activage, Autopilot and SynchroniCity and 2 Coordination and Support Actions: U4IoT and Create-IoT) which are collaborating to promote the deployment of Internet of Things solutions in Europe and beyond within the European IoT Pilot working group. By tackling societal and industrial issues through the means of IoT, the LSP programme aims at enhancing European competitiveness on the international scene, while simultaneously improving the quality of life of its citizens. SynchroniCity actively collaborated with all the partners of the LSP Project Programme. It is noteworthy that SynchroniCity was built on the belief that creating a simplified, open and agile digital market across borders would help cities and its citizens obtain better services. SynchroniCity's particularity as an LSP resided in its cross-sector approach, indispensable for the successful deployment in smart cities.

2.2 Cross-LSP Activity Contributions

The two coordination and support actions, Create-IoT and U4IoT, supported the coordination among the IoT European Large-Scale Pilots Programme by developing joint activity groups. The ultimate goal of the IoT European Large-Scale Pilots Programme and the coordination/collaboration activities was to increase the impact of the activities and development in the IoT Large-Scale Pilots on citizens, in the public and private spheres, industry, businesses and public services.

With regards to standardization, SynchroniCity was active at the level of Activity Group 2 'IoT Standardisation, architecture and interoperability', coordinated by Create-IoT. The Activity Group 2 sought to provide recommendations on the reference implementation of promising IoT standards serving the interoperability and openness objectives. The participation in the activities allowed for the identification of promising IoT standards and consolidating the standardisation efforts carried out by SynchroniCity. Furthermore, the involvement in the Activity Group 2 work enriched the scope and the content of the present deliverable.

In addition, SynchroniCity also leveraged on the Activity Group 8 'Communication, Collaboration Strategy and Liaison' to organize sessions and other activities related to standardization in the context of events such as the IoT Week. Aligning the communication strategy with the other LSPs and CSAs guaranteed efficient information sharing between programme stakeholders to ensure efficient IoT take-up in Europe.

2.3 Contributions to AIOTI WG3

The five LSPs, including SynchroniCity, contributed to the Alliance for Internet of Things Innovation Working Group 3 (AIOTI WG3) work, reports and events on standards, such as the newly released (October 2019) report on IoT standardisation entitled 'IoT LSP Standard Framework Concepts'. The deliverable aimed at briefly presenting the global dynamics and landscapes of IoT SDO, Alliance and Open Source Software initiatives.

3   ETSI

The European Telecommunications Standards Institute (ETSI) is an independent European standards developing organisation that provides a platform for the development, ratification and testing of globally applicable standards for ICT-enabled systems, applications and services across all sectors of industry and society. ETSI supports European regulations and legislation through the development of Harmonised European Standards.

The standardisation work of ETSI is carried out in different technical groups. One of the most relevant groups is the Technical Committee (TC) that addresses various standardisation activities in a specific technology area. Each committee establishes and maintains a work programme, which is made up of individual items of work. Each 'Work Item' describes a specific standardisation task and results in a single standard, report or other documents. Another group is the Industry Specification Group (ISG), which operate alongside the traditional standards-making committees in a specific technology area. They are designed to be quick and easy to set up, providing an effective alternative to the creation of industry fora. In addition, another important technical group is the Specialist Task Force (STF), which is a team of highly skilled experts. They are brought together to perform specific technical work under the direction of one of the Technical Committees of ETSI. This committee is responsible for approving the standards produced by the STF. STFs enable ETSI to accelerate the standardisation process in areas of strategic importance and in response to urgent market needs.

HOP Ubiquitous as a SynchroniCity partner has participated and contributed to the standardisation work of several technical groups of the ETSI, as described in the following sections.

3.1   ETSI ISG for cross-cutting Context Information Management

Cross-cutting Context Information Management (CIM) is the exchange of information, with proper formal definitions, between vertical applications, so that these applications get the original meaning. The aim of ETSI ISG CIM is to enable interoperable software implementations for Context Information Management. It is about bridging the gap between abstract standards and concrete implementations, especially for use cases related to Smart Cities, but also to be extended later to Smart Agrifood and Smart Manufacturing.

Within this technical group, NEC has been chairing the ETSI ISG CIM and HOP Ubiquitous has participated in the various review and improvement processes that have led to the release of the latest version of its main specification "ETSI Group Specification CIM 009 V1.2.1 (2019-10)" for NGSI-LD API, particularly targeting Smart City applications and government services. Specifically, the following tasks have been carried out:

- Review, correction and improvement of the NGSI-LD API
- Creation, correction and improvement of the specification document illustrations related to the NGSI-LD API
- Definition and implementation of JSON files that define the NGSI-LD API through Swagger (https://forge.etsi.org/rep/NGSI-LD/NGSI-LD), which allows the verification of messages received and sent via the API, as well as code generation for services and implementations that use NGSI-LD.

3.2   ETSI STF 566

The STF 566 is under the direction of ETSI Smart Machine-to-Machine communications Technical Committee (TC SmartM2M). This committee is looking at the use of a service platform to interface with smart appliances, allowing the interoperability of applications and 'plug and play' connectivity. The Smart Appliances specifications are based on the oneM2M communication framework complemented with Smart Appliance REFerence (SAREF) ontology. In this sense, the STF 566 has the goal of extending the SAREF standard taking into account, for example, eHealth/ageing-well

domain use cases and available existing data models, in close collaboration with AIOTI, the H2020 Large Scale Pilots (e.g. AUTOPILOT, SYNCHRONICITY) and other projects on mobility managed by INEA/EASME, ETSI and oneM2M.

In this task force, HOP Ubiquitous on behalf of SynchroniCity has carried out an active collaboration in several tasks:

- Requirements gathering for the domains interested in a SAREF extension.
- Contribution to deliverable DTS/SmartM2M-103410-8-SRF4EHAW, concerning extension to SAREF for eHealth/ageing-well Domain (SAREF4EHAW).
- Implementation in progress of a mapper/adapter from NGSI to NGSI-LD (including SAREF reference model).

4 Contribution to ITU

The International Telecommunication Union (ITU) is the United Nations agency for information and communication technologies (ICTs). It also functions as one of the three international standards developing organisations as designated by WTO. ITU develops international standards (also known as ITU-T Recommendations) within their technical groups known as Study Groups. Each study group focusses on core areas related to ICTs.

The following section outlines the achievements and contributions to ITU, particularly at the level of ITU-T Study Group 20 on Internet of Things (IoT) and Focus Group on Data Processing and Management (FG-DPM).

4.1 Study Group 20

4.1.1 Communications to SG20

SynchroniCity was presented in March 2017 to ITU-T SG20 by Mandat International (MI) through an official Contribution. The Contribution presented both OASC and SynchroniCity. It highlighted the objective of SynchroniCity *"to develop citizen-centred services and to pave the way towards an integrated and interoperable digital market for IoT-enabled smart city solutions, with a reference architecture, open APIs, and tools for co-creation & integration of legacy."*

The communication also stated that these initiatives *"respond to demands from cities for a more open and interoperable technological environment for ICT solutions."* It stressed the opportunity for the ITU to pave the way to a globally interoperable market for smart cities.

The contribution proposed to *"leverage on the work achieved by the OASC and the ongoing work of the SynchroniCity project to develop, research and specify a standardised API for Open Data services and applications provided and/or used by smart cities."*

4.1.2 SG20 Forum on Data Management

In parallel, in February 2017, MI took advantage of its status of ITU-T sector member and proposed that ITU-T invite Martin Brynskov (in his capacity as SynchroniCity Coordinator and Chair of the OASC Board of Directors) to present the project at the Forum on Data Management: Transforming Data into Value, on March 12 2017, in Dubai, United Arab Emirates.

4.1.3 Open API

In conjunction with its Contribution, MI proposed the creation of a new Recommendation standardizing an Open API for IoT data in smart cities. The proposal explicitly referred to SynchroniCity, as well as other similar and relevant contributions from other regions.

This effort was successful and after several formal consultations with ITU Members' representatives, in September 2017, the ITU Study Group 20 approved the creation of a new work item titled "Open data application programming interface (API) for IoT data in smart cities and communities" with the reference Y.API4IOT. MI was designated as Editor of the draft Recommendation with the support of several international delegations.

The new work item aimed at developing a draft Recommendation that would:

- Study the concept and potential of API, its common characteristics, high-level requirements in the context of IoT deployment and open data in smart cities;
- Analyse the current solutions implemented by Administrations around the world, where applicable, including those adopted by smart cities, to share their data through an open and interoperable interface;
- Investigate and propose open and interoperable API for secured Open Data exchange, as appropriate, as well as for IoT data interoperability for smart cities;
- Map the developed API with relevant work performed by international SDOs and alliances.

As stated in the mandate of the draft recommendation: *"A growing number of smart cities and Administrations are inclined to collaborate and mutualize their efforts and resources for IoT deployments and open data sharing. This proposed Recommendation intends to study the concept and potential of developing a secured open and interoperable API in the context of IoT deployment and open data management in smart cities. It will analyse current solutions implemented by Administrations around the world, where applicable, including those adopted by smart cities, to share their data through open and interoperable interfaces. It will subsequently specify an open and interoperable API for secured Open Data architecture as well as to support IoT data interoperability for smart cities. The work will be concluded by mapping the specified API with relevant work performed by other international SDOs and alliances, which help consolidate the standards developed on the topic."*

Since its adoption, a comprehensive draft document has been developed and already partially approved by ITU-T members. The draft recommendation has been discussed through several ITU meetings and eMeetings during SynchroniCity project lifetime.

In parallel, a dedicated task force has been established with SynchroniCity partners to work on the draft development, including:

- Mandat International (Sébastien Ziegler, Mythili Menon, Anna Brékine, Adrian Quesada Rodriguez, Show Senda, Cédric Crettaz)
- Engineering (Martino Maggio)
- University of Cantabria (Luis Munoz)
- Digital Catapult (Andrea Gaglione)
- UDGA (Eunah Kim)
- University of Aarhus (Martin Brynskov)

The task force also engaged with:

- TM Forum (Pierre Gauthier)
- FIWARE Foundation (Olaf-Gerd Gemein)
- Shoichi Senda

While the initial plan was to develop and adopt a single Recommendation, the task force gathered more content than initially planned reaching the conclusion that the initial draft should be split into two documents:

- The core Recommendation focused on the normative elements;
- A supplement (or technical report) gathering the informative content.

4.1.4 A revised draft proposal was presented to the SG20 meeting in November in Geneva to validate the creation of the two work items directly related to SynchroniCity. The plan is to get both documents adopted in 2020. Supplement on Artificial Intelligence and Sustainable Development Goals (SDGs)

A draft Supplement dedicated to the implementation of AI-based technologies across the IoT and smart city ecosystem is being developed under the purview of SG20. This Supplement also links the various AI technologies to attaining the Sustainable Development Goals (SDGs), especially SDG 11 (Sustainable Cities and Communities) and SDG 9 (Industry and Innovation).

The main elements examined in this Supplement are:

- The various technologies from which AI will facilitate smart city transformations;
- The role played by AI in managing the data generated within the IoT realm and urban spaces;
- The main benefits of adopting AI and delving into how this technology could be leveraged to attain the targets stipulated in the recently established Sustainable Development Goals (SDGs).

The draft Supplement also includes the activities of SynchroniCity as an example. This draft Supplement has already been extensively developed by MI and is expected to be finalised in the 1st quarter of 2020.

4.2 Focus Groups

The ITU established a dedicated Focus Group on Data Processing and Management to support IoT and Smart Cities & Communities (FG-DPM). It aimed at *"providing a platform to share views, to develop a series of deliverables, and showcasing initiatives, projects, and standards activities linked to data processing and management and establishment of IoT ecosystem solutions for data focused cities".* The Focus Group on Data Processing and Management to support IoT and Smart Cities & Communities was established by ITU-T Study Group 20 at its meeting in Dubai, 13-23 March 2017.

Mr Martin Brynskov, in his role as chair of the board of Directors of Open & Agile Smart Cities (OASC) was nominated as a Chairman of WG1 on Use Cases, Requirements and Applications/Services.

Mandat International (MI), UDG Alliance (UDGA), and Aarhus University (AU) contributed actively to the writing of some main deliverables, including:

- Technical Report D4.1 Framework for security, privacy, risk and governance in data processing and management. This Technical Report "*addresses concerns regarding data security, privacy and risk for data processing and management in IoT and Smart Cities and Communities require an appropriate governance framework. This report describes these concerns, the key components of the governance framework and the impact on related lifecycles and processes, in particular on risk management processes."* Pasquale Annicchino was one of the main contributors to this report.

- Researchers also contributed with various inputs to the works of other deliverables such as D1.1 "Use case analysis and requriments for Data Processing and Management to support IoT and Smart Cities and Communities, D2.1 "Data Processing and Management Framework for IoT and Smart Cities and Communities" and D0.1 "Data Processing and Management for IoT and Smart Cities and Communities: Vocabulary"

Taking into account the data interoperability, classification, format and security issues that affect various stakeholders, the Focus Group has played a role in providing a platform to share views, to develop a series of deliverables and to showcase initiatives, projects and standards activities linked to data processing and management and establishment of IoT ecosystem solutions for data focused cities.

5 Open & Agile Smart Cities network

Open & Agile Smart Cities (OASC) is a non-profit organisation headquartered in Brussels, Belgium. As a global network, OASC connects 150 smart cities and communities across 30 countries. These cities are brought together by the ambition to improve the quality of life of their citizens through innovation and technology. Among the OASC member cities count the reference zones of the SynchroniCity project – Antwerp, Carouge, Eindhoven, Manchester, Milan, Helsinki, Porto and Santander.

The mission of OASC is to unite cities around the world to agree on common, open standards that enable a global market for urban, data-driven services based on the needs of cities and communities. As a non-profit organisation, OASC facilitates the exchange between cities and communities on technical interoperability and fosters capacity building and exchange of best practices between member cities worldwide.

Together with international partners such as the European Commission, United Nations, and World Economic Forum, OASC supports cities with recommended open and lightweight standards – the so-called Minimal Interoperability Mechanisms (MIMs)[1]. The MIMs are formally adopted by OASC member cities and will be further developed by the community[2].

Moreover, OASC, together with EUROCITIES, European Network of Living Labs, European Commission, European Committee of the Region and Finland's Presidency of the Council of the European Union has developed and supported the declaration "JOIN, BOOST, SUSTAIN"[3] for greater uptake of digital solutions and the creation of the European Way of digital transformation that was kicked-off in Oulu on 10 December 2019. The Declaration aims at defining financial, technical, ethical and legal framework for digitalization in Europe. The input paper of the declaration provides best practices and open technology ready to use. Among these recommendations are the OASC Minimal Interoperability Mechanisms.

5.1 Minimal Interoperability Mechanisms (MIMs)

An inclusive set of baselines the MIMs are universal tools for achieving interoperability of data, systems, and services between cities and suppliers around the world. As they are based on an inclusive list of baselines and references, MIMs take into account the different backgrounds of cities and communities and allow cities to achieve interoperability based on a minimal common ground.

The Minimal Interoperability Mechanisms are

- Context Information Management
- Shared Data Models
- Ecosystem Transaction Management

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[1] https://oascities.org/wp-content/uploads/2019/06/OASC-MIMs.pdf

[2] https://oascities.org/international-coalition-of-cities-builds-global-interoperable-smart-cities-market/

[3] https://living-in.eu

The MIMs provide an overview of open standards and references that are already successfully being implemented to enable portability and interoperability of data and solutions. The references have been provided by the SynchroniCity project (see table below) and will be further developed after the project concludes.

MIM	Name	Standards & [Baselines]	Reference
1	OASC Context Information Management MIM	ETSI NGSI-LD API¹, OMA NGSI, ITU- T SG20/FG-DPM [FIWARE NGSI]	Reference Architecture for IoT-Enabled Smart Cities (SC-D2.10)
2	OASC Data Models MIM	[SAREF, FIWARE, GSMA, schema.org, SynchroniCity RZ + partner data models]	Guidelines for the definition of OASC Shared Data Models (SC-D2.2) Catalogue of OASC Shared Data Models for Smart City domains (SC-D2.3; to be released)
3	OASC Ecosystem Transaction Management MIM	[TM Forum Business Ecosystem API, FIWARE Business Ecosystem and Marketplace Enabler API, SynchroniCity API]	Basic Data Marketplace Enablers (SC-D2.4) Guidelines for the integration of IoT devices in OASC compliant platforms (SC-D2.6)

The implementation of MIMs in any existing IT architecture of a city bears, among others, the benefits of choice, flexibility, efficiency, independence, and economic development. Also for vendors, the use of MIMs in their offers has advantages: Solutions can easily scale, while development and deployment remains agile.

For all stakeholders, the MIMs have a significant impact on reducing the risk of investment in smart city technology, which will be followed by increased investments and are more active local innovation ecosystem.

Through active participation of Martin Brynskov, chairman of the OASC Board of Directors, in ITUs FG-DPM (see chapter 3.2), the MIMs have already been successfully introduced as concept to ITU and are now, as part of the contributions of FG-DPM, submitted for review to the ITU SG 20. OASC is committed to support all its member cities in the implementation of the officially adopted MIMs to further stimulate the positive effects thereof.

6 EIP-SCC

The European Innovation Partnership on Smart Cities and Communities (EIP-SCC) is building a community in Europe around the smart cities domain. The European Commission is supporting this initiative. The main stakeholders of EIP-SCC are the cities themselves, the research centres like universities and foundations, the industry, the SMEs and the banks. The main objective of EIP-SCC is the improvement of life quality in the urban environment. The problems addressed by this initiative concern the energy and mobility (public transportation and private vehicles) for instance. Information and Communications Technology (ICT) should help to solve the problems encountered by cities. For example, ICT could provide new solutions for smart cities through innovative software and standards. Indeed, standardisation is one of the priorities defined by EIP-SCC. The initiative has developed a marketplace available here, offering different kinds of services for the smart cities and other stakeholders.

6.1 Contribution to EIP-SCC

SynchroniCity has collaborated with EIP-SCC through the different partners of the project. For example, the city of Eindhoven has developed a framework including the SynchroniCity Context Broker during the project; this framework is shared with the EIP-SCC community as reported here. The members of the EIP-SCC community can reuse the work done in SynchroniCity and put in place the framework provided by the city of Eindhoven in other smart cities.

SynchroniCity and OASC have also given some important and useful inputs to the EIP-SCC community about the digitalisation of the cities, in particular for the reduction of the investment risks. The key points, including standardisation at the top, are listed here.

Based on the experience gained in the Carouge reference zone during the SynchroniCity project, Geneva region is launching a new project concerning a trial with an unmanned drone ambulance as announced here. This new project is fully aligned with the concepts elaborated in the context of EIP-SCC about the mobility and the improvement of life quality.

The standardisation in the frame of EIP-SCC was mostly done by the ESPRESSO project (http://espresso-project.eu/). The ESPRESSO project was designed to study the current standardised frameworks and technologies in the context of smart cities and to provide practical experiences with smart cities using these standards. Both projects, SynchroniCity and ESPRESSO, have collaborated together for the standardisation in the smart cities domain and Martin Brynskov, SynchroniCity Project Coordinator, has been serving on the ESPRESSO Advisory Board.

We provide more details in the next section.

7 ESPRESSO

ESPRESSO was a Coordination and Support Action funded under the SCC EIP looking at – as the acronym says – a systemic standardisation approach to empower Smart Cities and Communities.

Some of the concepts supported by the project were:

- Definition of a conceptual framework for smart city standards that takes into consideration a holistic view of the city, i.e., a system perspective, where standards are defined at the different levels, angles and complexities that a city represents, including the various sectors that coexist.
- Openness: many years ago, it was not easy to imagine a context where open standards would be the norm; furthermore, many of the smart city solutions were proprietary systems. ESPRESSO, as many other project and initiatives (e.g. FIWARE) and in alignment with the principles of SynchroniCity, was already promoting the use of open standards as a way to nurture innovation and avoid lock-in.
- Stakeholder-driven processes: defining solutions and approaches in a collaborative manner to avoid imposing solutions. The only way to foster adoption of technologies, standards, etc is making sure that the concerned actors are engaged in all phases of the process, and as such, ESPRESSO was meant to manage the collaboration with different projects and initiatives, notably those under SCC EIP. As it can be seen below, strong connections were also set up with SynchroniCity.

The *modus operandi* of ESPRESSO was based on the definition of city-driven use cases to derive main requirements in terms of standards and then work on the conceptual framework based on those ones. The project covered in particular the emerging (at least at the time of the project) service of smart parking in Rotterdam and the city information modelling in Tartu, this one of extreme relevance to the work developed in SynchroniCity.

Looking at the major results of the project, it is worth highlighting: the "Smart City Information Framework built around CityGML as a reference data model and encoding with data services to integrate and process data efficiently in Smart City enterprise applications" and the "Creation of shared semantics through the establishment of open and shared vocabularies to foster linking data and metadata". It is not by chance that ESPRESSO was already looking at data models as a means to create interoperability between applications and services. The work carried out by this project has been considered as a reference in SynchroniCity in connection with the enrichment of the FIWARE data models in the last years.

ESPRESSO had the mandate to work with many stakeholders, including European Standardisation Organisations (ESOs), National Standardisation Bodies (NSBs), Standards Development Organisations (SDOs), public administrations, industries, SMEs, and other institutions. We all acknowledge the difficulty to create communities that involve everyone and, as a consequence, existing discussion frameworks have to be capitalised and extended as needed. In this context ESPRESSO, together with other initiatives like the standards group in AIOTI have efficiently created a forum where different projects and notably SynchroniCity have contributed. Our project has raised many opportunities for joint work, discussion and planning. See for example Session "Standardisation: Connecting cities to ongoing initiatives" at Connected Smart Cities Conference 2017[4] (Brussels; January 14, 2017) or "Tech track: Global Standards for IoT and Smart Cities & Communities" at Connected Smart Cities Conference 2018[5] (Brussels; January 12, 2018).

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[4] https://oascities.org/full-program-connected-smart-cities-conference-2017/

[5] https://oascities.org/connected-smart-cities-conference-2018-programme/

8   ECCP and Europrivacy

SynchroniCity has actively contributed to the extension of the Europrivacy Certification Scheme on data protection to smart city-specific needs and requirements.

Europrivacy is a certification scheme developed through the H2020 research programme by the Privacy Flag research project. The Scheme aims at certifying the compliance of data processing with the European General Data Protection Regulation (GDPR). Europrivacy Certification Scheme specification and extension is overviewed by an international board of experts in data protection with the administrative support of the European Centre for Certification and Privacy (ECCP).

SynchroniCity started by using the Europrivacy Certification Scheme as one of the resources made available to the cities and was used in the context of Carouge to assess compliance with the European regulation. As Carouge is located in Switzerland, it is not directly subject to the GDPR, but there was an interest to assess and ensure that the smart city deployment in Carouge is compliant with the European regulation too.

In a second stage, SynchroniCity worked with ECCP to extend and adapt the Europrivacy criteria of evaluation to make it applicable to smart city-specific requirements. It also contributed to ECCP work in developing training material for Europrivacy experts and auditors to make sure that smart city use cases and requirements are properly addressed by the training programme.

SynchroniCity evolved in parallel to the entry into force of the GDPR. The project had to innovate in its approach to comply with the new regulation. It developed various original approaches to comply with the data protection regulation, such as the Privacy App (www.privacyapp.info).

Mandat International, as DPO coordinator of SynchroniCity, actively disseminated the SynchroniCity approach towards relevant stakeholders in the data protection domain, including:

- Bilateral meetings with several National Supervisory Authority (Data Protection Authorities), including Switzerland, Luxembourg, France, Hungary, Netherlands, Italy;
- Participation in the International Conferences of Data Protection Authorities, including in Brussels, Mexico (booth), and Tirana (booth);
- Participation in ENISA Privacy conference in Roma (booth);
- Participation in Data Protection related conferences, including CPDP in Brussels, Privacy Summit in Washington, IAPP European Conference in Brussels (booth), Data Protection Days in Berlin (booth);
- Participation in CEATEC in Tokyo (booth);
- Participation and presentation of SynchroniCity privacy by design approach at the World Digital Economy Conference in China;
- Participation in the three IoT Week conferences (Geneva, Bilbao and Aarhus) with contributions to sessions and presentation of SynchroniCity privacy by design approach in the Privacy booth area (more details in the next section);

Figure 1: SynchroniCity presentation at the World Digital Economy Conference in China

9 IoT Week and Workshops on Standardisation Convergence

During the past 3 years, **SynchroniCity** has co-organised a workshop in every edition of the IoT Week with curated sessions on a dedicated track.

SynchroniCity @ IoT Week 2017 - Geneva, Switzerland

The IoT Week 2017 was chosen for Open & Agile Smart Cities (OASC) and the European Large Scale Pilot on IoT for Smart Cities SynchroniCity to co-organise for the first time a joint workshop, which was a success.

The "IoT Platform Convergence for Smart Cities" workshop sessions were:

- Leading Examples of IoT Enabled Smart Cities
- International IoT Platforms for Smart Cities Initiatives
- Breakout Discussion Groups on Convergence - IoT & Smart Cities: Personal Data Protection Strategy
- Breakout Discussion Groups on Convergence - IoT & Smart Cities: Platform Integration and Interoperability
- Breakout Discussion Groups on Convergence - IoT & Smart Cities: Standardisation Strategy
- Towards Interoperability and Convergence Among IoT Platforms for Smart Cities

In the Smart Cities Track, there have also been 4 specific sessions:

- SynchroniCity I, II, III and IV

The breakout discussion group dealt with "Personal data protection strategy". City representatives, industry and academic experts participated in the discussion. The session revolved around the provisions of the EU General Data Protection Regulation (GDPR) and how SynchroniCity large scale project would work for its implementation.

SynchroniCity was already working in the direction of helping cities to quickly and efficiently implement the GDPR through creating and testing Privacy Impact Assessment templates for cities, establishing a network of Data Protection Officers, at least for the cities that participated in the project.

The City of Carouge, member of the SynchroniCity IoT Large Scale Pilot for smart cities
On the stage at the official conference reception for IoT Week, together with the Mayor of Carouge, OASC chair Martin Brynskov announced the 6th Wave of new members working together with over 100 other cities worldwide to establish a global smart city market based on city needs. Carouge and Geneva were the first cities to join from Switzerland.

At the time, the OASC initiative included 114 cities from 23 countries working together, sharing best practices and shaping technological underpinnings of economic and social benefits that global smart cities can offer.

The IoT Week 2017 program included a Visit to the City of Carouge, where Mayor Nicolas Walder spoke at the reception and stated: "*The City of Carouge, member of the SynchroniCity IoT Large Scale Pilot for smart cities, is leading the Swiss innovation in the smart city area. We are thrilled to join this fantastic group of motivated cities and we really look forward to work together to share experiences from across the globe that will enhance our ability to serve our citizens locally, to increase the sustainability and to protect the climate of our planet.*"

SynchroniCity @ IoT Week 2018 – Bilbao, Spain

The IoT Week 2018 in Bilbao was the relevant occasion for the SynchroniCity project to announce the open call for SMEs, large businesses and cities.

SynchroniCity has been actively involved in the IoT Week 2018 programme by participating in the IOT4SCC Joint Workshops on IoT and Smart Cities & Communities Platform Convergence.

Figure 2: SynchroniCity at the IoT Week 2018, Bilbao, Spain

The IoT4SCC Workshop had 15 sessions on 6-7 June to discuss the potential of converging towards open and interoperable solutions for smart cities:

- Welcome and Introductory remarks
- Insights on Recent Trends and Evolution
- Smart City IoT Convergence: Platform and Solutions Convergence & Interoperability (parts I and II)
- Breakout A: IoT Integration and Interoperability in Smart Cities (Southbound - Parts I and II)
- Breakout B: Cross-Domain Applications (Northbound - Parts I and II)
- Day 1 Wrap-Up Session
- High Level Panel: IOT4SCC IoT SDG and Urban Agendas
- Implementation: Large Scale Pilots and Open Calls
- Breakout C: IoT and Smart Cities: Personal Data Protection Strategies and Guidelines (Parts I and II)
- Breakout D: Open APIs (Parts I and II)

The IoT Week 2018 brought together SynchroniCity with the other two Large Scale Pilots ACTIVAGE and IoF2020.

Besides the sessions on Smart Cities & Communities, SynchroniCity has participated in a specific workshop organised by the Create-IoT CSA on "Iterative Innovation in the Large Scale Pilots. Start-ups, SMEs and the Open Calls". This event has constituted a relevant venue to work directly with potential applicants in co-creating IoT-enabled solutions.

SynchroniCity has discussed with 10 SMEs and start-ups about problems to be solved in the city, stakeholders to be involved, potential solutions, data inputs/outputs, devices to be used, privacy by design policies to be implemented, as well as value created for both the cities and businesses and business models to apply.

Figure 3: Session on Internet of Things and Smart Cities and Communities Platform Convergence, IoT Week 2018, Bilbao, Spain

Finally, SynchroniCity contributed to sharing the experiences around co-creation of the 8 pilot cities involved in our project with the U4IoT CSA in a workshop on "End-user Engagement Tools and Methods for IoT Projects". U4IoT presented the relevant toolkit created in the previous year for the smart cities involved in the Large Scale Pilots. Together with the SynchroniCity team, U4IoT has drafted a plan for co-organizing co-creation workshops in the next phase of the project.

SynchroniCity @ IoT Week 2019 – Aarhus, Denmark

SynchroniCity played an active role in the IoT Week 2019 held in Aarhus, Denmark, by co-organizing the two-days track "Smart Cities & Communities" with Open & Agile Smart Cities (OASC).

The "Joint Workshop: Internet of Things for Smart Cities & Communities (IoT4SCC)", had the following sessions:

- IoT for Smart Cities & Communities Welcome
- CONVERGENCE: Smart City Standardisation – Mapping the Landscape and Capacity
- INTEROPERABILITY: Towards Common Architectures and APIs
- IMPLEMENTATION: Cities on the Forefront of Market Creation
- Procurement and Marketplaces
- High-Level Panel: IoT and Smart Cities & Communities for SDGs and Urban Agendas
- Fair and Open Smart Cities: Growing the Local IoT Data Infrastructure Partnerships
- Privacy by Design Smart Cities - Right to Privacy in Smart Cities
- IoT Standards Trends and Convergence

Figure 4: Joint Workshop: Internet of Things for Smart Cities & Communities (IoT4SCC) at IoT Week 2019

Half of those sessions looked at issues of standardisation, interoperability and implementation. *Standardisation* specifically when driving the convergence of standards for smart cities & communities through market action. *Interoperability* as the bridges that can allow different parts or systems to work together. Finally, *implementation* from the viewpoint of Cities as drivers of change and at the natural forefront of IoT market creation.

The other sessions looked at the other side of the debate; not at the "how to do it" but to the "why do it". These debates brought together officials from public institutions in cities, countries, and the EU and UN structures. Their perspective was paired with that of entrepreneurs, business leaders and other organisations close to citizen-innovation such as Living Labs.

SynchroniCity was also represented with a booth in the inside area of the conference and for the first time, in the last edition in Denmark, the IoT Week was complemented by a Public Expo – a platform to engage with the public and to disseminate IoT solutions.

Being in the pilot-phase of SynchroniCity, the Public Expo was a perfect platform for the pilots to showcase their solutions. The SynchroniCity presence was therefore also notable on the outside area of the conference where participants could meet:

- Noiseability
- Quamtra Smart Waste Management
- Leapcraft /Clean Air School Districts – IoT Solutions for Clean Air School Districts
- Kissmybike – Smart Tracking for Smart Cities
- Blue Alpaca – U-hopper Srl – A Chatbot for Smart Cities
- Neighbourly: A Smart City Platform

Figure 5: SynchroniCity booth at IoT Week 2019, Aarhus, Denmark

WasteHero, an SME part of the Neighbourly pilot was also recognised by winning both the "Sustainable Cities & Communities" as well as the overall start-up competition.

The Public Expo was a melting pot for both the conference participants and the general public, where they had the chance to experience and learn more about the work that the SynchroniCity pilots are doing, not to mention to actually touch and see the devices that the pilots are using. For the pilots, the Expo was a great opportunity to engage with different stakeholders – with the overall goal to increase the general knowledge of IoT and SynchroniCity. The set-up with the Public Expo generated a lot of attention in the local media in Denmark, as well as from the IoT experts attending the conference.

10 Conclusion

As illustrated by the report, SynchroniCity has been successful in using and impacting several standardisation processes from ETSI to ITU. It directly contributed to pre-standardisation work such as OASC, ESPRESSO and EIP-SCC.

SynchroniCity is one of the few H2020 research projects that had a direct impact at the global standardisation level. First of all, SynchroniCity leveraged on and supported the work of the Open and Agile Smart City Alliance. With its global coverage, OASC enabled to interact with a large diversity of smart cities. The contribution to the ITU Focus Group and to the ITU-T Study Group 20 with the creation of new work items is another substantial result. If adopted, the work item on "Open data application programming interface (API) for IoT data in smart cities and communities" with the reference Y.API4IOT will have a global impact.

Finally, the active engagement of SynchroniCity in the IoT Week programme enabled to support open dialogue and cooperation among different IoT related standardisation processes and initiatives. It effectively contributed to support dialogue and convergence towards common and interoperable IoT platforms for smart cities.

A key lesson learned by Synchronicity is the ability of a European research project to directly impact global standardization. For the future, the project recommends to maintain continuous support and collaboration with global standards development organizations such as the ITU, ISO and IEC.