



Federating IoT and cloud infrastructures to provide scalable and interoperable Smart Cities applications, by introducing novel IoT virtualization technologies

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Abstract:	Report on 1 st year project activities related to dissemination, communication and standardization of results.
Keyword List:	Dissemination, communication, standardisation

Disclaimer

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1 Introduction

1.1 Deliverable Rationale

This deliverable reports about dissemination, communications and standardization activities made in the context of the Fed4IoT project. It aims at updating the strategy defined within the project proposal and describe actions undertaken within the first year of the project.

1.2 Quality review

The internal Reviewers responsible of this deliverable is A. Detti (CNIT).

VERSION CONTROL TABLE			
VERSION N.	PURPOSE/CHANGES	AUTHOR	DATE
0.1	Creation	A. Detti (CNIT)	03/06/2019
0.2	Outline update	F. Le Gall (EGM)	05/06/2019
0.3	Initial contributions	A. Detti, G. Tropea, R. Gervasio, D. Tonti, N. Blefari Melazzi (CNIT) P. Cousin, F. Le Gall, S. Ghalem (EGM), A. Skarmeta, J. A. Martinez (OdinS) M. Bauer , M. Honda (NEC) H. Nakazato (WAS) T. Yokotani (KIT) K. Nakamure (PAN) H. Tazaki (IIJ)	20/06/2019
0.4	Overall review and adjustment	F. LE Gall (EGM) G. Tropea (CNIT)	26/06/2019
1.0	Quality check	A. Detti (CNIT)	28/06/2019

1.3 Executive summary

To raise the awareness of the different stakeholders of the project about the Fed4IoT project results, and to increase its impact, the project plans to actively communicate and disseminate its results with specific activities including:

- Communication activities: Web site and Social Networks on Fed4IoT project have been created and are running with continuous update (see section 2.2.2 and 2.2.3).

- Scientific dissemination: key personnel from Fed4IoT are involved in publication of conference and journal papers reporting main scientific finding of the project (see section 2.2.5).
- Organization of dissemination events: personnel involved in Fed4IoT is committed to disseminate results through the participation and organization of academic and scientific and marketing-oriented dissemination events (see section 2.2.6).
- Open source prototypes: Fed4IoT is contributing to the open-source ecosystem (Unikraft-Linux foundation; FogFlow-FIWARE foundation; Linux Kernel Library, etc.) as described in deliverable D1.4.

The following tables report a summary of the Communication and Dissemination activities carried out during the first year of the project.

- Overall project branding has been defined and applied to our communication channels
- A website is online (<https://fed4iot.org/>) since the project start
- Presence in social media is made through Twitter to relay relevant news
- Number of publications (journals and conferences): 24
- Number of participations in events: 11
- Number of contributions to standardisation bodies: 14

2 Communication and dissemination activities

2.1 Overall strategy

2.1.1 Introduction

With a market that will reach \$774.8 billion in 2021 and an annual growth rate of 17.7% from 2016 to 2021, Smart City IoT technologies market is promising. Smart technologies are needed in order to support a sustainable, green, healthy and efficient growth of cities. However, implementing a greater number of IoT devices leading to a significant amount of generated data poses both interoperability and expenditure problems.

Fed4IoT solution faces interoperability issues to improve and integrate mature interoperability solutions for smart city application on different system levels: device, platform and information level. Its unique virtualization method allows the re-use of existing infrastructure and devices to thus increasing their return on investment.

2.1.2 Target audiences

The wide scope of this project enables thus it to target several stakeholders' groups which deserve appropriate dissemination.

- The first group includes the platforms developers and integrators.
- The second group includes the cities and users of the application being allowed through the Fed4IoT virtualisation mechanisms.
- Finally, the third group includes the citizen as well, willing to better understand the realm of IoT based smart city platforms and the way they could interact with it.

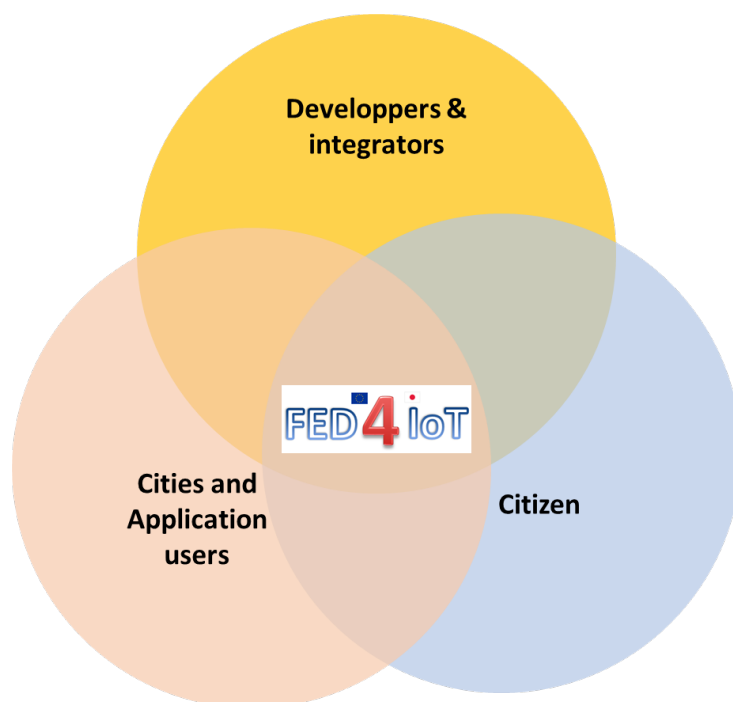


Figure 1: FED4IoT Dissemination targets

2.1.3 Channels

To raise the awareness of the different stakeholders of the project about the Fed4IoT project results, and to increase its impact, the project has identified the dissemination channels to be used. They include:

- Online visibility through a website and presence in social media, for which Twitter has been retained as main platform.
- The presentation of results to the scientific community through presentations of papers at workshops and conference and journals.
- The demonstration of the project vision and results at events such as exhibitions and workshops
- Presence in open-source communities.

In addition, the Fed4IoT project has set high its ambitions in terms of standardisation and contributions to standardisation bodies.

Finally, to increase the dissemination impact, a common look and feel made by a professional designer is applied to all communications channels.

2.2 1st year activity report

2.2.1 Overview

Table 1: Summary of the Communication and Dissemination Activities: first Year

Dissemination and Communication activities	Number	Comment
Organisation of a Workshop	1	Global IoT Summit 2019
Exhibition	2	SIDO Lyon 2019, IoT Week 2019
Flyer	1	Project poster
Training	2	oneM2M industry seminar, On day lesson part of Cloud Computing and Networking course at CNIT
Social Media	1	Twitter
Website	1	https://fed4iot.org
Journal Publication	2	See Annex 1
Participation to a Conference	22	See Annex 1
Participation to a Workshop	2	FIWARE Summit, Global IoT Summit 2019
Participation to an Event other than a Conference or a Workshop	1	Netdev0x13
Participation in activities organized jointly with other H2020 projects	1	7th EU-Japan Symposium on ICT Research and Innovation
Other	1	Meeting with Fondazione Ugo Bordoni (Italian Policy Maker)

Table 2: Estimated number of persons reached, in the context of all dissemination and communication activities

Scientific Community (Higher Education, Research)	750
Industry	around 10.000 in SIDO
General Public	20
Policy Makers	18

2.2.2 Website

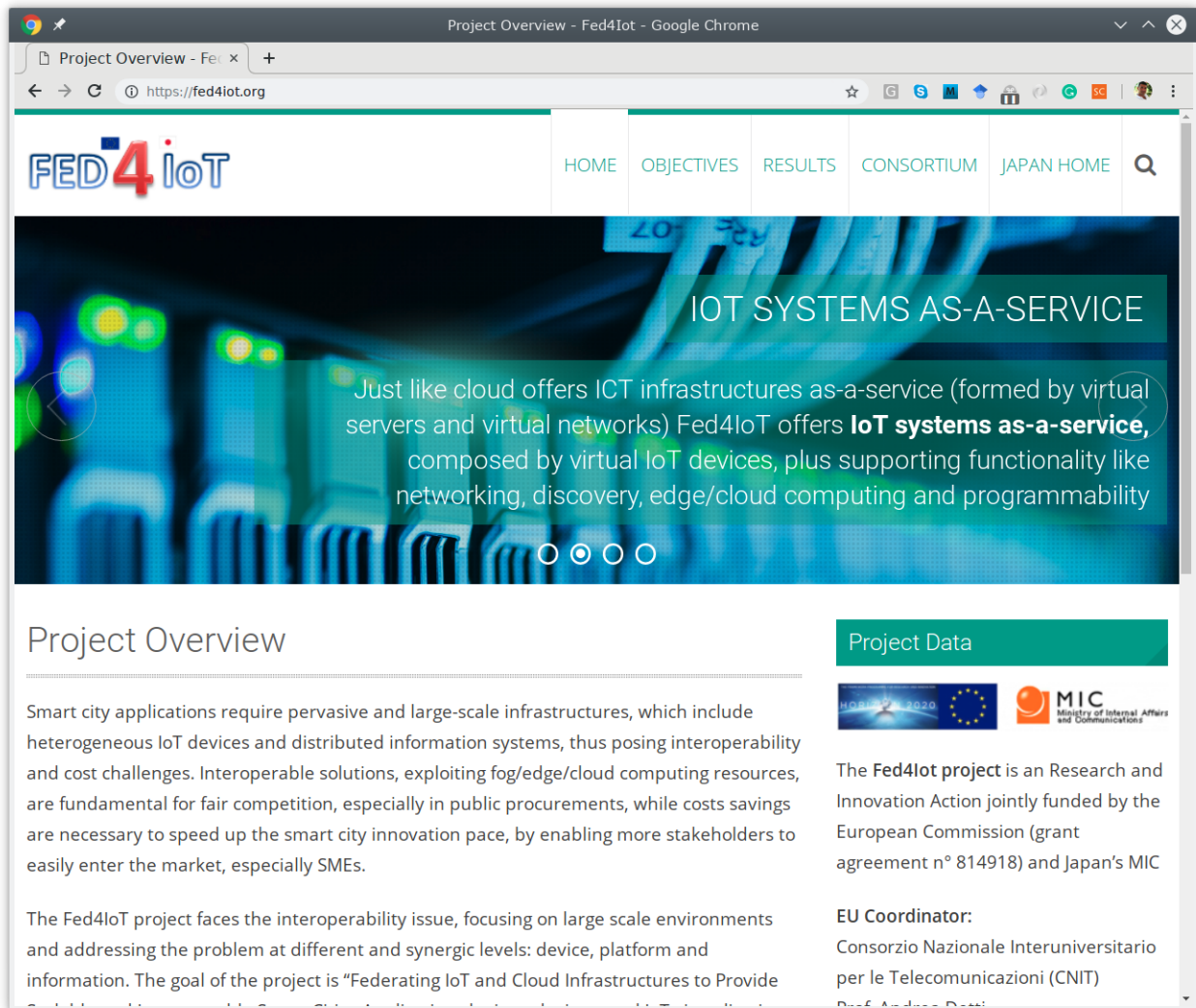


Figure 2: Fed4IoT web site

The Fed4IoT web site is available at www.fed4iot.org. It has been designed with Word Press software and all contents have been published with the collaboration of all the partners.

The main structure of the pages follows the scheme of the Home page: the main field dedicated to the Project content, with a static section of the right side showing official information about the project, Coordinator Organization, Funding and Official EU Acknowledgement.

The footer area contains the Copyright information and references to Twitter social media.

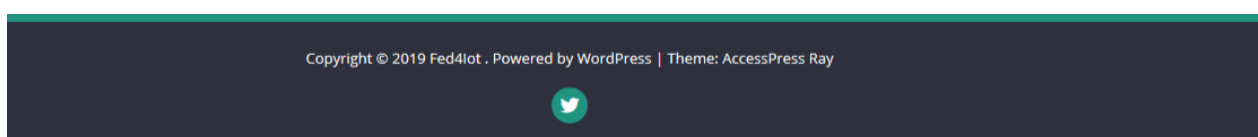
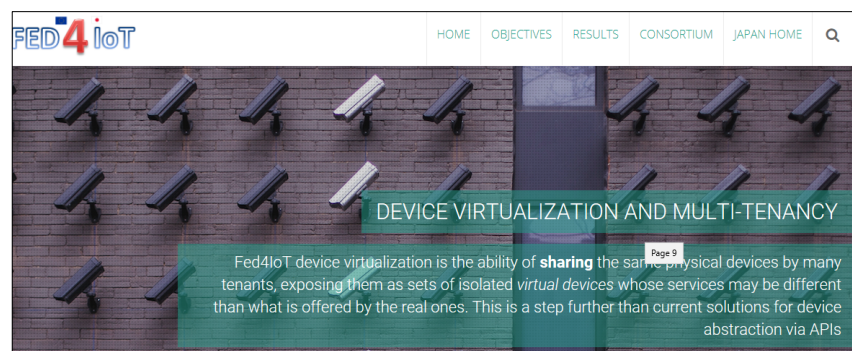
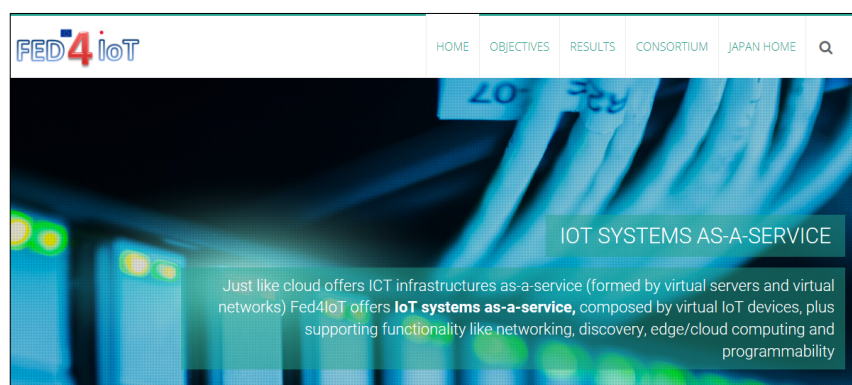
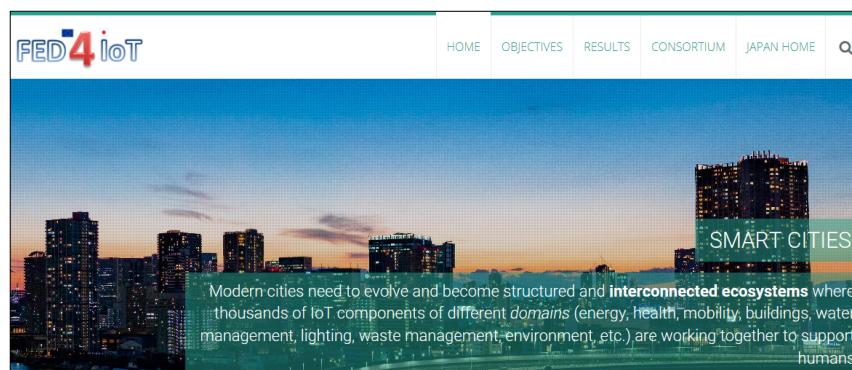


Figure 3: Web Site Footer

The Home page presents four sliding pictures representing different backgrounds and showing four key sentences summarizing in a very short way the main concepts of the project.



Project Data





The Fed4IoT project is an Research and Innovation Action jointly funded by the European Commission (grant agreement n° 814918) and Japan's MIC

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JP Coordinator:
WASEDA University
Prof. Nakazato Hidenori
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Project start date:
July, 1, 2018

Project end date:
June, 30, 2021

Figure 4: Sliding pictures of the Home page and project data

The Home Page provides information about the Project Overview and accounts for additional four tabs on the Header Menu: **Objectives, Results, Consortium** and **Japan Home**.

Project Overview

Smart city applications require pervasive and large-scale infrastructures, which include heterogeneous IoT devices and distributed information systems, thus posing interoperability and cost challenges. Interoperable solutions, exploiting fog/edge/cloud computing resources, are fundamental for fair competition, especially in public procurements, while costs savings are necessary to speed up the smart city innovation pace, by enabling more stakeholders to easily enter the market, especially SMEs.



The Fed4IoT project faces the interoperability issue, focusing on large scale environments and addressing the problem at different and synergic levels: device, platform and information. The goal of the project is "Federating IoT and Cloud Infrastructures to Provide Scalable and Interoperable Smart Cities Applications by introducing novel IoT virtualization technologies" and will be pursued through the following steps:

- select/integrate/improve existing IoT and cloud platforms, including oneM2M, FIWARE and 5G ETSI MEC, so as to establish a reference interoperability solution;
- use such reference solution to build up a pool of federated IoT and fog/edge/cloud resources;
- design novel device-level IoT virtualization technologies to create "IoT slices" formed by virtual IoT devices and computing resources, exploiting the federated resource pool;
- support orchestration and programmability for optimal IoT virtual function deployment and Big Data processing;
- integrate information coming from different IoT domains and other city sources;
- integrate the system components

The project solutions will be technically validated by implementing four specific smart city applications, based on a federated EU/JP platform, deployed in real life systems in two EU and two JP cities.

The Fed4IoT consortium will also actively support standardization activities (ETSI, oneM2M, ITU, ISO, etc.) and EU/JP initiatives (e.g., AIOTI and ITAC), where consortium members are involved.

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Figure 5: Project Overview

The Objective page presents the main objectives of the project:

- Multi-level IoT interoperability for smart-city, large-scale, cross-domain applications
- Support the evolution and the integration of mature interoperability solutions in Europe and Japan
- Reduction of expenditure for large scale IoT deployments
- Simplification of smart-city application development
- A simple and programmable system for IoT application deployment
- A market sustainable system
- Design of novel IoT Virtualization and multi-tenancy technologies

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Objectives

Multi-level IoT interoperability for smart-city, large-scale, cross-domain applications

To integrate in a single framework a high volume of IoT devices of different vendors, different IoT platforms and information coming from different IoT domains, in order to support cross-domain smart city application development

Support the evolution and the integration of mature interoperability solutions in Europe and Japan

To enforce, extend and integrate interoperability solutions deemed as promising in Europe and Japan, rather than proposing other possible interoperability standards

Reduction of expenditure for large scale IoT deployments

To reduce the cost of deploying large scale IoT infrastructure, including cross-border ones, providing IoT infrastructure-as-a-service.

Simplification of smart-city application development

To simplify the access to cross-domain information coming from IoT and other city sources

A simple and programmable system for IoT application deployment

Simplify the deployment of IoT applications exploiting IoT device-level and cloud virtualization technologies

A market sustainable system

The Fed4IoT system is based on a federated pool of resource and information. The system should properly rewards IoT resource providers federating their resources

Design of novel IoT Virtualization and multi-tenancy technologies

Design of technologies for the emulation of IoT devices using real IoT devices and computing resources. Many IoT virtual devices can be based on the same real resources, which are however isolated from the user perspective (multi-tenancy).

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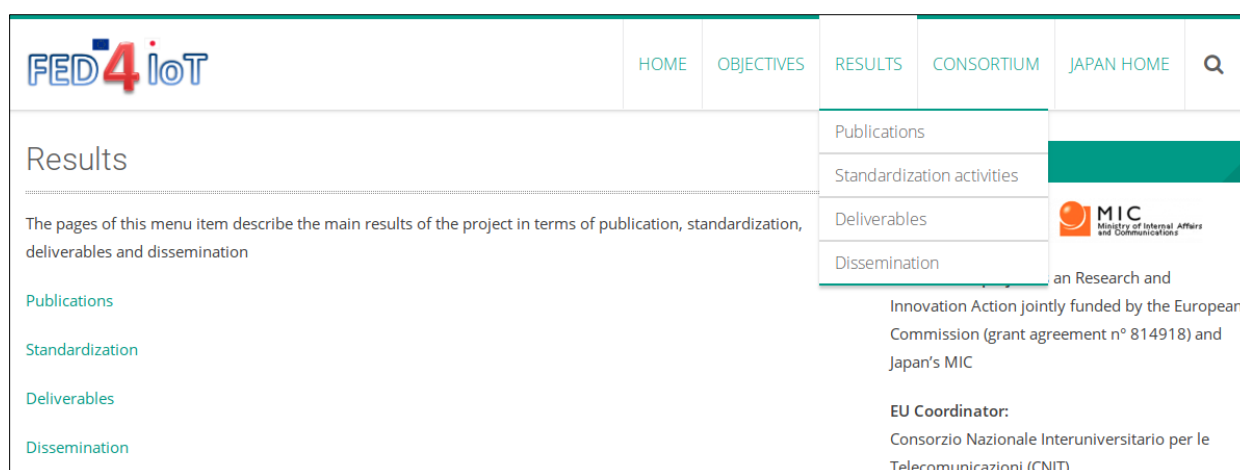
Project end date:
 June, 30, 2021

Figure 6: Fed4IoT Objectives page

The Results page describes the main results of the project in several sub-sections (see figures below) which will be updated from time to time as contents will become available. The sub-sections are:

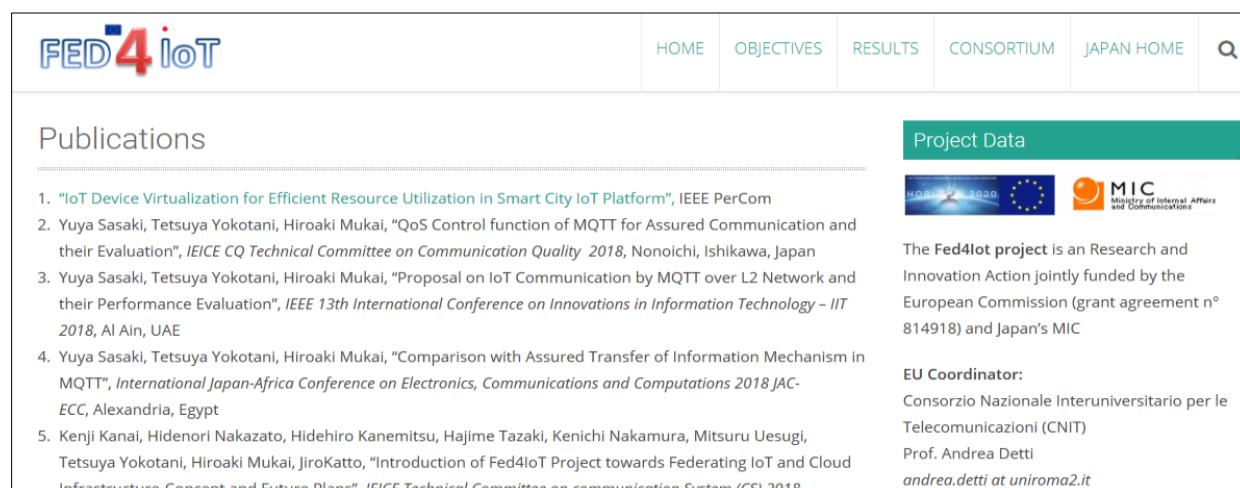
- Publications: shows the detail of scientific publications
- Standardization activities: shows the standardization activity (e.g. ITU, ETSI) of the project

- Deliverables: reports the project deliverables with a download link for public deliverables
- Dissemination: reports the dissemination activities including, conferences, workshops and fairs attendance; networking activities with organizations that are external to the Fed4IoT Consortium operating in the specific topic of the project; presentations held, posters, publication and press release realized in connection with Fed4IoT activities; collaborations established with expertise and projects similar to Fed4IoT topics and exploitable synergies; interesting events, Information and calls for the benefit of Fed4IoT objectives.




The screenshot shows the 'RESULTS' section of the Fed4IoT website. The navigation bar includes links for HOME, OBJECTIVES, RESULTS, CONSORTIUM, JAPAN HOME, and a search icon. The 'RESULTS' section is titled 'Results' and contains a description: 'The pages of this menu item describe the main results of the project in terms of publication, standardization, deliverables and dissemination'. Below this, there are links for Publications, Standardization, Deliverables, and Dissemination. A sidebar on the right contains a menu with 'Publications', 'Standardization activities', 'Deliverables', and 'Dissemination'. Below the menu, there is a logo for MIC (Ministry of Internal Affairs and Communications) and text stating: 'an Research and Innovation Action jointly funded by the European Commission (grant agreement n° 814918) and Japan's MIC'. At the bottom, it identifies the 'EU Coordinator' as 'Consorzio Nazionale Interuniversitario per le Telecomunicazioni (CNIT)'.

Figure 7: Fed4IoT Results page



The screenshot shows the 'PUBLICATIONS' section of the Fed4IoT website. The navigation bar is the same as in Figure 7. The 'PUBLICATIONS' section is titled 'Publications' and contains a list of five publications. A sidebar on the right contains a 'Project Data' section with a logo for MIC and text stating: 'The Fed4IoT project is an Research and Innovation Action jointly funded by the European Commission (grant agreement n° 814918) and Japan's MIC'. Below this, it identifies the 'EU Coordinator' as 'Consorzio Nazionale Interuniversitario per le Telecomunicazioni (CNIT)' and 'Prof. Andrea Detti' with the email 'andrea.detti@uniroma2.it'.

Figure 8: Fed4IoT Publications page



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Standardization activities

The project is actively contributing to standardization activities of ITU-T and ETSI.

ITU-T

The project is proposing enhancements and additions to Study Group 13 on Future Networks and Focus Group on Data Processing Management (DPM).

Concerning SG13 on Future Networks, we have the following:


- Proposal to update clauses 7 and 8 of the draft Recommendation Y.ICN-FnChain, SG13-C-0519, (July 23, 2018 – ITU-T SG13). Specifically, we have clarified the concept of producer initiated function chaining and proposed a pub/sub application of the producer initiated function chaining. Moreover, we formulated a proposal for

Publications

Standardization activities

Deliverables

Dissemination




MIC
Ministry of Internal Affairs
and Communications

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Figure 9: Fed4IoT Standardization activities page



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Deliverables

Show 25 entries

Search:

Deliverable number	Deliverable name	Dissemination level	Delivery date (month)
D1.1	Project Management Manual	CO	2
D1.2	First Communication, Dissemination and Standardization Report	PU	12
D1.3	Second Communication, Dissemination and	PU	24


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Prof. Andrea Detti

Figure 10: Fed4IoT Deliverables page



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Dissemination

Plenary Project Meetings

- Plan of Partners – July 2, 2018, Waseda University on-line
- 1st Plenary Meeting Kick off Meeting, July 18-19, 2018, Rome, Italy
- Management summary of Plenar, information sharing on oneM2M, August 20, 2018, Waseda University
- Progress Report, Management, September 25, 2018, Waseda University on-line
- Progress Report, Use Cases, October 24, 2018, Waseda University
- Progress Report, November 9, 2018, on-line
- Progress Report, Use Cases, November 22, 2018, Waseda University
- Progress Report, December 18, 2018, on-line
- D6.x, Architecture, Progress Report, December 26, 2018, Waseda University
- Plenary Meeting, January 23-24, 2019, Tokyo, Japan
- Progress Report, March 5, 2019, on-line
- Progress Report, May 9, 2019, online
- Plenary Meeting, June 03-04, 2019, Murcia Spain

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Figure 11: Fed4IoT Dissemination page

The Consortium page shows all the logos of the partners of the Consortium as a whole. Clicking on a logo there is the possibility to see the single pages dedicated to Partners' description and related Teams. All the partners provided their own institutional logos, organization profiles, expertise profiles and the pictures of single person involved in the project.



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Consortium


Europe




consorzio nazionale
interuniversitario
per le telecomunicazioni


easy global market





Japan





早稲田大学
WASEDA University






KIT | 金沢工業大学

(click on logo for more information)

Project Data





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Figure 12: Fed4IoT Consortium page

Finally, the web site contains a Japanese version for improving dissemination in Japan.



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Japan HOME

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[【コンソーシアム】](#)

プロジェクト概要

スマートシティのアプリケーションの普及には大規模なインフラが必要となるが、それらのアプリケーションでは、異種のIoTデバイスや分散された情報システムが存在するため、相互運用性と低コスト化が要求される。一般市場での公平な競争を実現するためには、フォッグ、エッジ、クラウドといったコンピュータ資源を有効に利用する相互運用ソリューションが必須となる。一方で、より多くのステークホルダー、とりわけ中堅企業の市場参入を促進し、スマートシティの進展を加速するためには低コスト化が必要となる。

Fed4IoTプロジェクトでは、大規模な環境を見据え、相互作用を及ぼすデバイス、プラットフォーム、情報といった異なったレベルについて考察し、相互運用の課題に取り組んでいる。プロジェクトの目標は「新鋭なIoT仮想化技術により、拡張性に富み相互運用可能なスマートシティアプリケーションを実現するための、IoTとクラウドインフラの連携」である。この目標を完遂するために、以下のステップを設けている。

- 既存のIoTとクラウドプラットフォーム（oneM2M、FIWARE、5G ETSI MECなど）を選定・統合・改良し相互運用ソリューションの参照モデルを策定する
- 上記参照モデルを使用して、IoTとフォッグ・エッジ・クラウド等の資源を連携した共同利用資源群を構築する
- 仮想化IoTデバイスと上記の連携モデルを使用したコンピュータ資源からなるIoTスライスが創作できるような、新しいデバイスレベルIoT仮想化技術を開発する
- IoT仮想機能の配置とビッグデータの処理が最適化できるよう、システムの統合・作成に関する支援を行う
- 異なるIoTドメインから来る情報や自治体の持つ情報を統合する
- システムコンポーネントを統合する

日欧の連携されたプラットフォーム上で4件のスマートシティアプリケーションを実現することにより（日本で2件、EUで2件の実証システムを実現する）、本プロジェクトのソリューションを実証する。

Fed4IoTコンソーシアムでは、コンソーシアムメンバーが関係する標準化組織（ETSI、oneM2M、ITU、ISOなど）や日欧の活動推進組織（AIOTI、ITACなど）への支援を積極的に行っていく。

Project Data





The Fed4IoT project is an Research and Innovation Action jointly funded by the European Commission (grant agreement n° 814918) and Japan's MIC

EU Coordinator:
 Consorzio Nazionale Interuniversitario per le Telecomunicazioni (CNIT)
 Prof. Andrea Detti
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JP Coordinator:
 WASEDA University
 Prof. Nakazato Hidenori
 nakazato at waseda.jp

Project start date:
 July, 1, 2018

Project end date:
 June, 30, 2021

Figure 13: Fed4IoT Japan home page

Project Management is responsible for designing, realizing, maintaining and updating the web site. However all partners are involved in content production and all partners will be asked to provide feedbacks, information, documents, news, or any other material they consider useful to disseminate progresses and results through the web site.

The maintenance activity consists of (at least):

- Periodic Backup of the website (monthly);
- Renewing of the domain name and hosting services (yearly);
- Traffic check (accesses, traffic sources, etc.) for security guarantee (monthly).

2.2.2.1 Access Statistics

We added the Google Analytics tracking code in the template of Fed4IoT website, enabling the tracking of statistics of the project's website. In this Deliverable we give a General Overview about analytic metrics in the period July 2018 – June 2019.

Google Analytics measured the Audience data shown in Figure 14. We observe that the 91.1 % of total visiting users (1332) are new ones demonstrating the spreading of the information towards different persons.

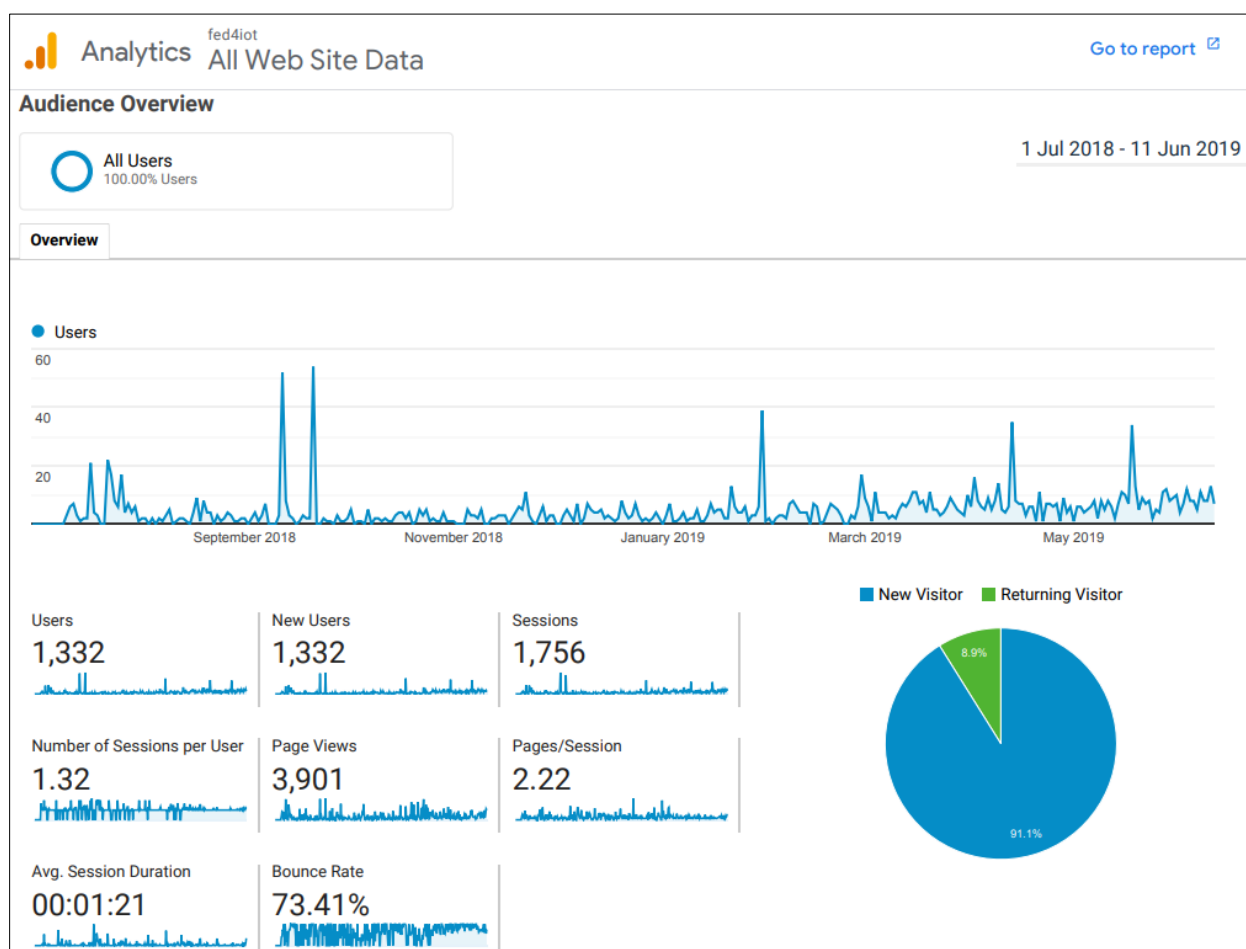
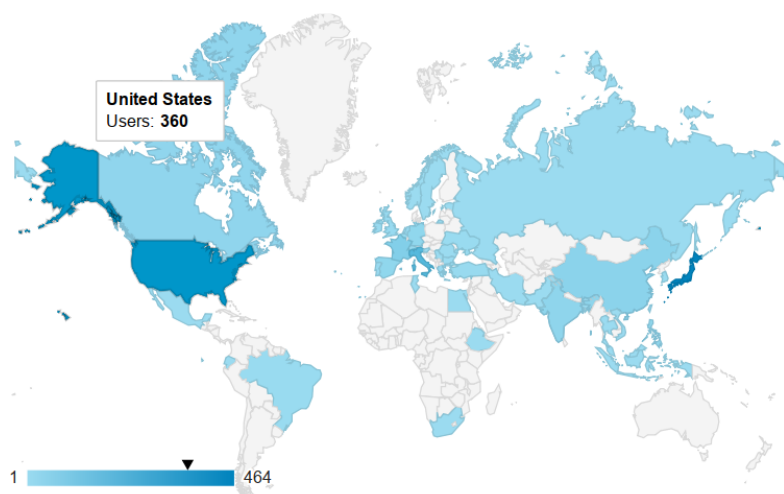


Figure 14: Audience Data

The picture below shows an analytics map about the number of accesses from different countries. We observe that most of the access comes from Japan, United States and Europe.



Country	Acquisition		
	Users	New Users	Sessions
	1,332 % of Total: 100.00% (1,332)	1,332 % of Total: 100.00% (1,332)	1,756 % of Total: 100.00% (1,756)
1. Japan	464 (34.68%)	463 (34.76%)	621 (35.36%)
2. United States	360 (26.91%)	360 (27.03%)	363 (20.67%)
3. Italy	174 (13.00%)	173 (12.99%)	348 (19.82%)
4. France	63 (4.71%)	63 (4.73%)	100 (5.69%)
5. China	40 (2.99%)	40 (3.00%)	43 (2.45%)
6. India	30 (2.24%)	30 (2.25%)	35 (1.99%)
7. Canada	27 (2.02%)	27 (2.03%)	27 (1.54%)
8. Spain	26 (1.94%)	25 (1.88%)	32 (1.82%)
9. Philippines	26 (1.94%)	26 (1.95%)	26 (1.48%)
10. Germany	25 (1.87%)	25 (1.88%)	34 (1.94%)

Figure 15: User locations

The figure below shows pages with the best performing contents. The first most visited sub-page is the Japan Home page while the second best performing contents have been the “Objectives” and the “Consortium” pages.

Pagina	Visualizzazioni di pagina	Visualizzazioni di pagina uniche	Tempo medio sulla pagina	Accessi	Frequenza di rimbalzo	% uscita	Valore pagina
	3.901 % del totale: 100,00% (3.901)	2.996 % del totale: 100,00% (2.996)	00:01:06 Media per vista: 00:01:06 (0,00%)	1.756 % del totale: 100,00% (1.756)	73,41% Media per vista: 73,41% (0,00%)	45,01% Media per vista: 45,01% (0,00%)	0,00 USD % del totale: 0,00% (0,00 USD)
1. /	1.737 (44,53%)	1.379 (46,03%)	00:01:52	1.330 (75,74%)	72,86%	64,36%	0,00 USD (0,00%)
2. /index.php/japan-home/	356 (9,13%)	215 (7,18%)	00:01:03	81 (4,61%)	46,91%	26,97%	0,00 USD (0,00%)
3. /index.php/objectives/	348 (8,92%)	244 (8,14%)	00:01:00	44 (2,51%)	79,55%	29,31%	0,00 USD (0,00%)
4. /index.php/consortium/	307 (7,87%)	211 (7,04%)	00:00:45	24 (1,37%)	52,17%	22,48%	0,00 USD (0,00%)
5. /index.php/publications/	151 (3,87%)	133 (4,44%)	00:00:53	25 (1,42%)	84,00%	30,46%	0,00 USD (0,00%)
6. /index.php/deliverables/	116 (2,97%)	95 (3,17%)	00:01:09	23 (1,31%)	69,57%	26,72%	0,00 USD (0,00%)
7. /index.php/japan-home/results/	107 (2,74%)	52 (1,74%)	00:00:12	7 (0,40%)	57,14%	6,54%	0,00 USD (0,00%)
8. /index.php/dissemination/	82 (2,10%)	69 (2,30%)	00:00:31	9 (0,51%)	88,89%	12,20%	0,00 USD (0,00%)
9. /index.php/publications/	62 (1,59%)	51 (1,70%)	00:00:29	11 (0,63%)	90,91%	41,94%	0,00 USD (0,00%)
10. /index.php/standardization/	48 (1,23%)	42 (1,40%)	00:00:17	18 (1,03%)	88,89%	50,00%	0,00 USD (0,00%)

Figure 16: Best performing contents

2.2.3 Social media

2.2.3.1 Twitter

Twitter is a powerful social network for spreading information with a quick and short message and for reaching a large amount of people and even specific audience by selecting a definite hashtag. Through Twitter the Fed4IoT project is able to inform and update stakeholders, general public and even EU organizations by sharing News published on the Web site, events' organization and participation and relevant news coming from official EU/JP information channels. The Fed4IoT Twitter account has been created in April 2019.



Figure 17: Fed4IoT on Twitter

2.2.4 Poster

CNIT and EGM managed the design of a first version of a project poster (hereafter reported), including also a roll-up version, which is used to present the project to events. The poster can be downloaded from the project website.

EU-JAPAN COOPERATION

FED4IoT

SMART CITIES, THING VIRTUALIZATION AND FEDERATION

**MULTI-LEVEL IOT INTEROPERABILITY
FOR SMART-CITY, LARGE-SCALE,
CROSS-DOMAIN APPLICATIONS**
To integrate in a single framework a high volume of IoT devices of different vendors, different IoT platforms and information coming from different IoT domains, in order to support cross-domain smart city application development.

**SUPPORT THE EVOLUTION AND THE
INTEGRATION OF MATURE INTEROPERABILITY
SOLUTIONS IN EUROPE AND JAPAN**
To enforce, extend and integrate interoperability solutions deemed as promising in Europe and Japan, rather than proposing other possible interoperability standards.

**DESIGN OF NOVEL IOT VIRTUALIZATION
AND MULTI-TENANCY TECHNOLOGIES**
Design of technologies for the emulation of IoT devices using real IoT devices and computing resources. Many IoT virtual devices can be based on the same real resources, which are however isolated from the user perspective (multi-tenancy).

**SIMPLIFICATION OF SMART-CITY
APPLICATION DEVELOPMENT**
To simplify the access to cross-domain information coming from IoT and other city sources.

**A SIMPLE AND PROGRAMMABLE SYSTEM FOR
IOT APPLICATION DEPLOYMENT**
Simplify the deployment of IoT applications exploiting IoT device-level and cloud virtualization technologies.

**REDUCTION OF EXPENDITURE FOR
LARGE SCALE IOT DEPLOYMENTS**
To reduce the cost of deploying large scale IoT infrastructure, including cross-border ones, providing IoT infrastructure-as-a-service.

Real IoT Systems

IoT Virtualization Platform

Virtual IoT System

Smart City App Designer

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 544958

www.fed4iot.org

Figure 18 – Fed4IoT Poster

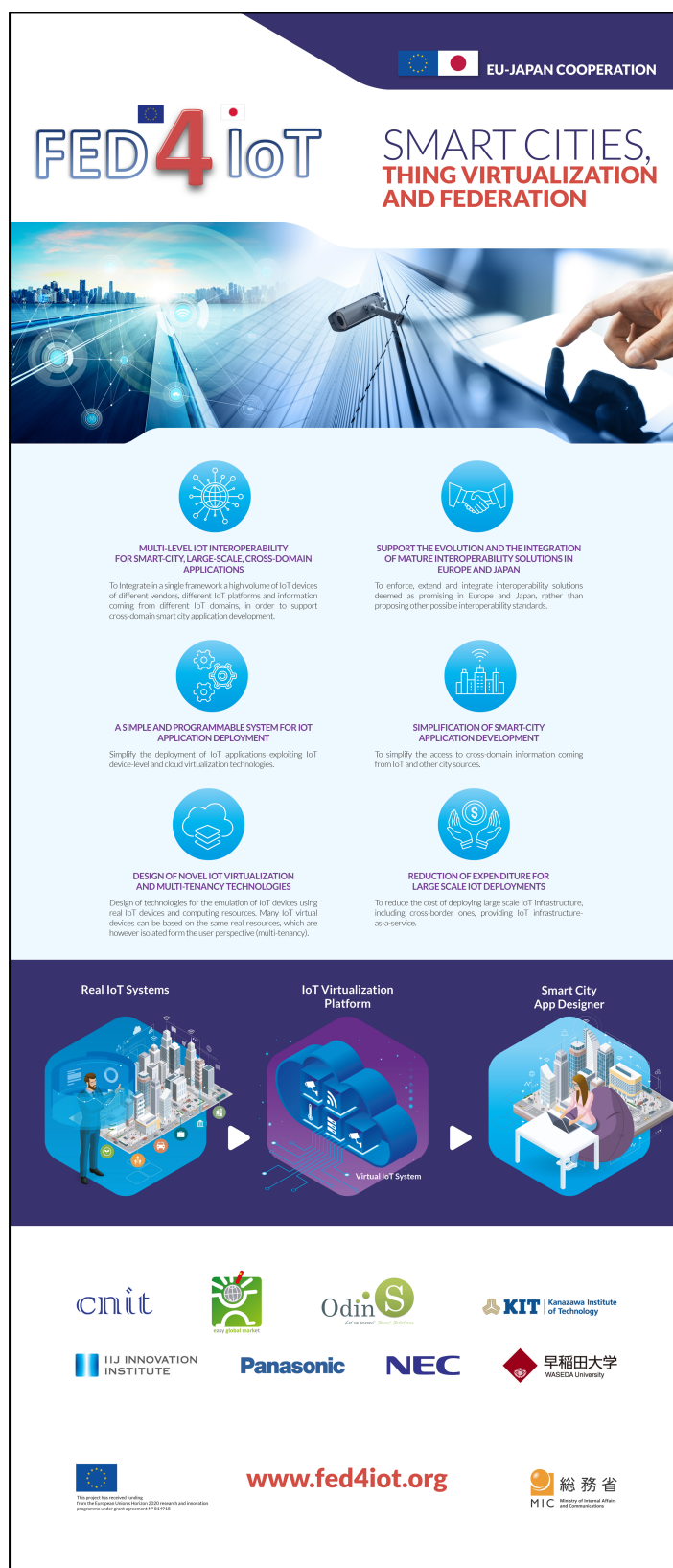


Figure 19 – Fed4IoT Roll-up

2.2.5 Project publications

Fed4IoT partners carried out, since the beginning of the project, 24 publications listed in the following table. Details on each publication are provided in Annex 1.

Table 3: Synthesis of project publications

Type	Conference / Journal / Book Chapter	Title	Partners	Publication Date
Journals / Magazines	Internet of Things Journal	Lightweight Named Object: an ICN-based Abstraction for IoT Device Programming and Management	CNIT	01/2019
	IEICE Transactions on Communications	A highly accurate transportation mode recognition using mobile communication quality	WAS	04/2019
Conference Papers / Reports	2019 Global IoT Summit (GloTS)	Virtual IoT Systems: Boosting IoT Innovation by Decoupling Things Providers and Applications Developers	CNIT, ODINS, WAS	06/2019
	2019 Global IoT Summit (GloTS)	Review of Standard Ontologies for the Web of Things	EGM, CNIT	06/2019
	IEEE International Conference on Pervasive Computing and Communications Workshops	IoT Device Virtualization for Efficient Resource Utilization in Smart City IoT Platform	WAS	03/2019
	IEEE International Conference on Consumer Electronics (ICCE)	Accuracy evaluations of contact-free heart rate measurement methods using 4K facial images	WAS	01/2019
	2019 RISP International Workshop on Nonlinear Circuits, Communications	Clustering-based Allocation of Virtualized Functions for Service Function Chaining	WAS	03/2019

	and Signal Processing (NCSP'19)			
	IEEE International Conference on Innovations in Information Technology 2018	Proposals on IoT Communication through MQTT over L2 Network and their Performance Evaluation	KIT	11/2018
	2018 International Japan-Africa Conference on Electronics, Communications and Computations (JAC-ECC)	Comparison with assured transfer of information mechanisms in MQTT	KIT	12/2018
	2019 International Conference on Information Networking (ICOIN)	Enhancement of MAC Protocol for Power Reduction in LoRaWAN	KIT	01/2019
	2019 International Conference on Cloud Computing (CLOUD2019)	Multiple Workflow Scheduling with Offloading Tasks to Edge Cloud	WAS	06/2019
	2019 Global IoT Summit (GloTS)	Performance Evaluations of IoT Device Virtualization for Efficient Resource Utilization	WAS	06/2019
	IEICE Technical Report	Introduction of Fed4IoT project toward federating IoT and cloud infrastructures — “Virtual Silo” architecture consideration — (in Japanese)	PAN, WAS, KIT	05/2019
	IEICE Technical Report	A study on the availability improvement of communication in wireless sensor networks	KIT	04/19
	IEICE Technical Report	Reliable LPWAN for IoT systems	KIT	05/2019

Netdev 0x13, The Technical Conference on Linux Networking	Is Reimplementation of network stack a good idea or not?	IJ	03/2019
IEICE Technical Report	Accuracy Evaluations of Geolocation Estimation based on Camera Images Using IM2GPS	WAS	03/2019
IEICE Technical Report	Accuracy Evaluations of Emotion Estimation Based on Biological Sensing in Music Content Viewing	WAS	03/2019
IEICE Technical Report	Delay Characteristic Evaluations of IoT Communication Protocols over IoT Networks	WAS	03/2019
IEICE Technical Report	A study on an IoT system for protection from wild animal	KIT	03/2019
IEICE Technical Report	A study on communication networks for wild animal life systems based on IoT	KIT	03/2019
IEICE Technical Report	QoS control functions of MQTT for assured communication and their evaluation	KIT	11/2018
IEICE Technical Report	Introduction of Fed4IoT Research Project for Interoperability of Cross-domain IoT Platforms	WAS, PAN, KIT	12/2018
IEICE Technical Report	Introduction of Fed4IoT project toward federating IoT and cloud infrastructures - Concept and future plans -	WAS, IJ, PAN, KIT	11/2018

2.2.6 Events

This section presents the participation of Fed4IoT partners in various events during the first year of the project. The Table 4 provides a synthetic view of the events whereas details are provided in the forthcoming sections.

Table 4. Participation in events.

Category	Event	Partner	Venue	Date
Exhibitions / Demonstrations	SIDO	EGM	Lyon France	10-11/04/2019
	IoT week	CNIT, OdinS, WAS	Aarhus, Denmark	17-21/06/2019
Workshops	7th EU-Japan Symposium on ICT Research and Innovation	CNIT, WAS	Vienna, Austria	3/12/18
	Global IoT Summit	CNIT, OdinS, EGM, WAS	Aarhus, Denmark	17-21/06/2019
	FIWARE Summit	NEC	Genoa, Italy	21/05/2019
Webinar / Key Note Speaker	oneM2M industry seminar	KIT	Ishikawa, Japan	5/12/2018
	USENIX OSDI 2018	IJJ	Carlsbad, USA	08/10/2018
	IIT'18	KIT	Al Ain, United Arab Emirates	18-19/11/2018
	Cloud computing and Networking, training	CNIT	Roma, Italy	17/12/2018
Small scale focused events	Meeting with Italian Fondazione Ugo Bordoni	CNIT	Roma, Italy	15/01/2019
	Communauté d'agglomération du Pays de Grasse	EGM	Grasse, France	3 meetings

2.2.6.1 SIDO Lyon

During the SIDO 2019 which took place in Lyon, EGM had the opportunity to present the project to the exhibition participants.

The SIDO is the Europe's leading IoT, AI and Robotic Event with more than 450 exhibitors and 10 000 visitors. EGM booth was well located and easily recognizable allowing an efficient dissemination of the project. The communication consisted of a kakemono explaining the ins and outs of the project (Figure 20).



Figure 20 - Sido 2019

2.2.6.2 7th EU-Japan Symposium on ICT Research and Innovation (CNIT, WAS)



Figure 21 – Presentation at 7th EU-Japan Symposium on ICT Research and Innovation

On 3rd December Prof. Andrea Detti (EU) and Prof. Hidenori Nakazato attended the *7th EU-Japan Symposium on ICT Research and Innovation* (Vienna, Austria) in which European Commission, Japanese officials and Researchers involved in research and innovation projects funded by European and Japanese authorities have had the opportunity to exchange views on the topics and establish direct scientific links between these two regions of the world. A session has been dedicated to IoT/Cloud/Big Data during the which Andrea Detti and Hidenori Nakazato presented project ideas, goals and an initial description of the architecture. The participants belonged both to the scientific and to the policy maker communities.

2.2.6.3 oneM2M industry seminar (KIT)

In this event held on December 5, 2018 in Ishikawa prefecture of Japan, we promoted our concepts and activities in a poster session. 80 distinguished attendees and experts of oneM2M are interested in our booth.



Figure 22 – poster at oneM2M industry seminar

2.2.6.4 Meeting with Italian Fondazione Ugo Bordoni (CNIT)

Fondazione Ugo Bordoni (FUB) is a higher education and research institution combining studies in the field of ICT with the design and implementation of innovative services for government bodies, and with the identification of countrywide system policies in the field. On 15th January 2019 Andrea Detti met a FUB delegation presenting them the Fed4IoT project within the framework of oneM2M implementation activity FUB is carrying out.

2.2.6.5 Meeting with CAPG (Communauté d'agglomération du pays de Grasse) (EGM)

EGM hold several meetings with representatives from the local public agency grouping several of the cities in the area of Grasse. Purposes have been to present Fed4IoT progresses and refine the wild waste deposit use case.

2.2.6.6 FIWARE Summit (NEC)

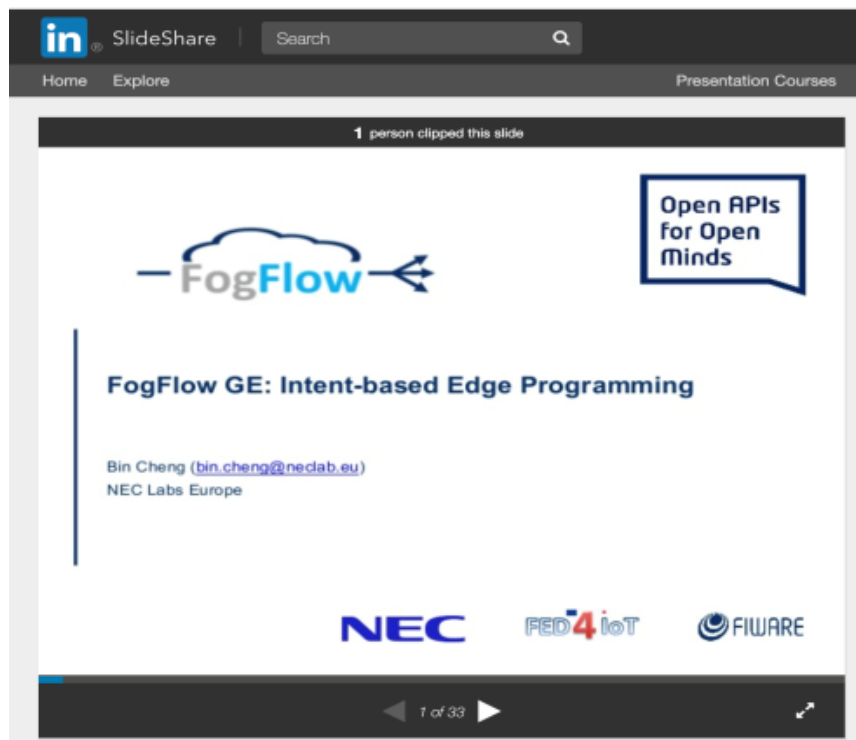


Figure 23 – FogFlow slides presented at FIWARE summit¹

On May 21st, 2019 Bin Cheng gave a presentation on intent-based edge programming, the focus of the FogFlow-related activities in Fed4IoT, during the FIWARE Summit in Genoa to an audience with people from industry, research and the general public. FogFlow has recently become a full FIWARE Generic Enabler as part of the FIWARE Open Source Ecosystem. It has been published under a BSD 4 Clause License.

- <https://www.fiware.org/2019/03/15/fiware-7-6-has-been-released/>
- <https://github.com/FIWARE/catalogue/tree/master/processing#fogflow>
- <https://readthedocs.org/projects/fogflow/>

NEC also had a booth at the FIWARE summit with posters and a demonstration of FogFlow that was also shown to a mixed audience of Industry, Research and General Public.

¹ https://www.slideshare.net/FI-WARE/fiware-global-summit-fogflow-ge-intentbased-edge-programming?qid=9b45db9f-3d9f-4bba-b844-8ffedab0d5b7&v=&b=&from_search=1

Orchestrating a brighter world **NEC**

NEW FIWARE GE

NEC Laboratories Europe

FogFlow GE for Edge AI

Empower IoT Devices with Edge Intelligence via FogFlow GE

"Your IoT devices might be dumb, limited, and difficult to change, but with FogFlow we can easily empower them with adaptive AI pipelines over cloud and edges to make them smart and situation aware"

Users: define serverless fog functions

FogFlow GE: deploy adaptive AI pipelines over cloud(s) and edges transparently

smart cities, smart factories

Key Technologies from FogFlow GE

- Intent-based edge programming model
 - easy design and implementation of elastic IoT services
- Serverless fog computing with data-driven orchestration
 - Automated and data-driven data processing flows over cloud(s) and edges
- Hierarchical architecture with autonomous management
 - high scalability and reliability

Contact Info:
Stefan Gessler
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This activity has received funding by the European Commission (Horizon2020 grant agreement number 814918) and NICT from Japan

Figure 24 – FogFlow poster

As part of the FIWARE Booth Fed4IoT has been presented as one of NEC's H2020 projects in which FIWARE is used, also highlighting NEC's recently developed NGSI-LD Broker Scorpio, which will be used in Fed4IoT in different roles, i.e. in a distributed or federated IoT system that provides input to a ThingVisor and as a Broker in NGSI-LD Virtual Silos. Furthermore, the use of its registry for discovering ThingVisors in Fed4IoT is under discussion.

\Orchestrating a brighter world **NEC**

NEC Laboratories Europe
NEC uses FIWARE in H2020 Projects

SynchroniCity (IoT Large Scale Pilot)		
	IoT Marketplace	Smart City
	<ul style="list-style-type: none"> • FIWARE as standard platform • Global market for data and services • Citizens' lives improvement • IoT- and AI-enabled services 	<ul style="list-style-type: none"> IoT data and services market Multi-stakeholders business Local economies growth
AutoPilot		
	NGSI-LD based IoT Platform	Autonomous Driving
	<ul style="list-style-type: none"> • Digital twins with Scorpio Broker • Semantic-based context ingestion • Federated IoT platform • Vulnerable road user detection 	<ul style="list-style-type: none"> Platooning Valet Parking Route Optimization
Fed4IoT		
	FogFlow + NGSI-LD	IoT Virtualization Platform
	<ul style="list-style-type: none"> • FogFlow for Thing virtualization • NGSI-LD as internal format and for discovery • Scorpio Broker in IoT Slice 	<ul style="list-style-type: none"> Integrate Heterogeneous IoT Orchestration Virtual Silos
BigDataStack		
	Optimized Platform for Big Data Analytics	Data-driven configuration
	<ul style="list-style-type: none"> • Dynamic deployment during runtime for FogFlow • Management of applications and services for smart cities and industries 	<ul style="list-style-type: none"> Data as a Service Distributed Architecture Dynamic Orchestration
Finished projects		
<div style="display: flex; justify-content: space-between; align-items: center;"> <div> <p>Contact Info: Stefan Gessler gessler@nec-lab.eu</p> </div> <div style="text-align: center;"> <p>This activity has received funding by the European Commission (Horizon2020 grant agreement numbers 731993, 732240, 634918, 779747, 723156, 723076, 643943, 609052).</p> </div> <div> <p>Powered by FIWARE</p> </div> </div>		

Figure 25 – NEC presence in H2020 projects

2.2.6.7 Global IoT Summit and IoT Week

OdinS has participated in the organization of Global IoT Summit 2019 (GloTS) in the city of Aarhus, Denmark. This workshop is collocated with the IoT Week so as to put together industry and research with the same scope promoting the exchange of knowledge and new relationships between industry and the academia. GloTS has welcomed to about 160 researchers worldwide. In the following picture, Antonio Skarmeta presented some general results of the workshop.



Figure 26 - GLoTs 2019 General results. Antonio Skarmeta.

Taking advantage of this opportunity, OdinS, WASEDA, EGM and CNIT presented the work carried out during this project period. Specifically:

- Virtual IoT Systems: Boosting IoT Innovation by Decoupling Things Providers and Applications Developers. Juan A. Martinez, OdinS (presenter).
- Performance Evaluations of IoT Device Virtualization for Efficient Resource Utilization. Kenji Kanai, Waseda University (presenter).
- Review of Standard Ontologies for the Web of Things. Giuseppe Tropea, CNIT (presenter)



Figure 27 - Virtual IoT Systems presentation. OdinS



Figure 28 - - Performance Evaluations of IoT Device Virtualization. Waseda University.



Figure 29 - Review of Standard Ontologies, CNIT.

Additionally, Fed4IoT was also present at IoT Week in a booth.

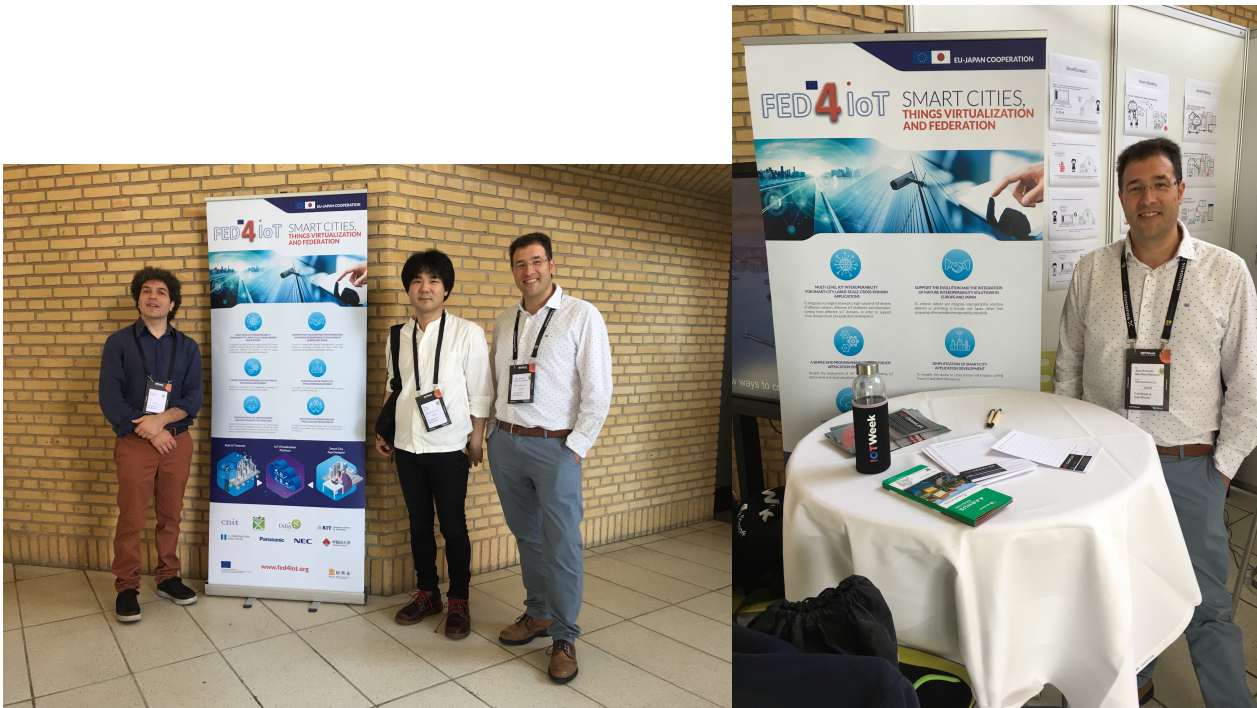


Figure 30 - Booth presence at IoT week 2019

2.2.6.8 USENIX OSDI 2018 (IIJ)

During the USENIX OSDI 2018 held on 8th October, 2018 in Carlsbad, USA, Hajime Tazaki from IIJ presented a poster related to the lightweight virtualization based on Linux Kernel Library. There was huge attention from audience (totally over 500 attendees) including academic researchers and industries (cloud operators/developers).

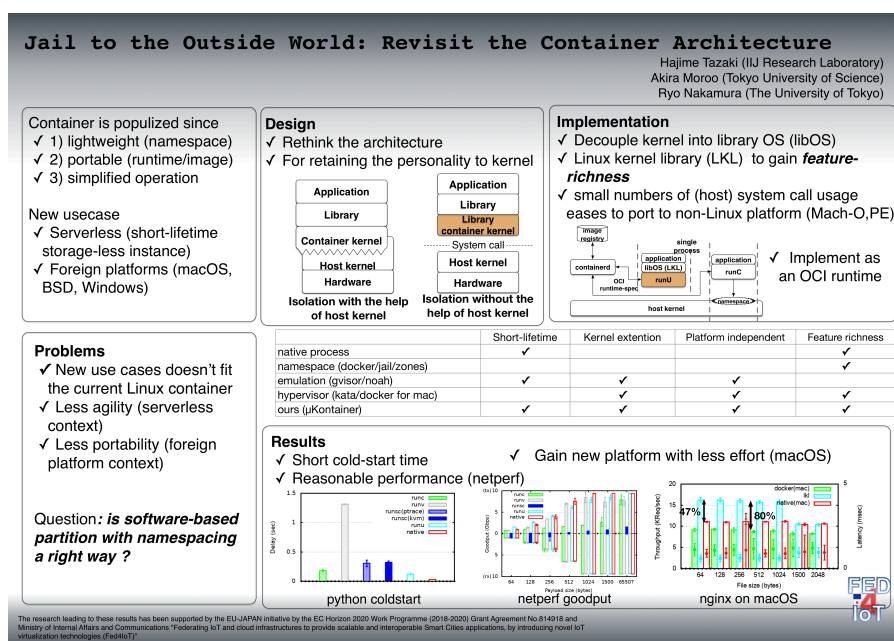


Figure 31 - USENIX OSDI poster on lightweight containerisation

2.2.6.9 IIT'18

In IEEE 13th International Conference on Innovations in Information Technology (IIT'18) held on 18-19, Nov. 2018 in Al Ain, United Arab Emirates, KIT had an oral presentation about network operations using MQTT within the Hakusan pilot (WP5). Through discussion in this conference, we showed purpose and features of Fed4IoT.



Proposals on IoT Communication through MQTT over L2 Network and their Performance Evaluation⁺

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Figure 32 – MQTT presentation at IIT'18. Kanazawa Institute of Technology

2.2.6.10 ICOIN 2019

In the 33rd International Conference on Information Networking (ICOIN 2019) held on 9-11, Jan.2019 in Kuala Lumpur, Malaysia, KIT participated to a poster session. We explained enhancement of LoRaWAN technology we plan to use to within the Hakusan pilot (WP5).

ICOIN 2019

The 33rd International Conference on Information Networking (ICOIN 2019)
January 9-11, 2019, Kuala Lumpur, Malaysia



Enhancement of MAC Protocol for Power Reduction in LoRaWAN

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Abstract— With the increasing use of the Internet of Things (IoT), various LPWA standards are being introduced. The authors focused on the LoRaWAN standard with low power consumption and transmission distance of several kilometers. As ALOHA is adopted for the LoRaWAN MAC protocol, its

II. FEATURES OF LORAWAN

Physical and MAC layer specifications are defined in LoRaWAN [1]. Fig. 1 shows the construction of the

Figure 33 – LoRaWAN presentation at ICOIN 2019. Kanazawa Institute of Technology

2.2.7 Education and Academic dissemination activities

On 17th December 2018 Andrea Detti made a lesson during his course of “Cloud computing and Networking” in which he presented the Fed4IoT project goal and the system architecture with major focus on IoT virtualizations aspects. About 20 students followed the lesson.

3 Standardization activities

3.1 Overall strategy

During its first year of activity, Fed4IoT has **strongly contributed to standardization activities within ETSI and ITU-T**. Actions have been initiated with AIOTI WG3 Subgroup on “Semantic Interoperability”, too.

Throughout year one (Y1), the overall strategy we have followed is to make Task 1.3 (standardization) collaborate with the Task 2.1 (use cases and requirements) during the first six months of Y1, and to make T1.3 collaborate with Task 4.1 (information models) during the second half of Y2.

Both these collaborations produced important contributions to standardization, **the former one (Task 1.3 + Task 2.1) to ITU-T and the latter (Task 1.3 + Task 4.1) to ETSI**.

The goal of the standardization activities carried out during the first half of Y1 was to push Fed4IoT use cases and propose enhancements and additions to Study Group 13 on Future Networks and Focus Group on Data Processing Management (DPM).

The goal of the standardization activities carried out during the second half of Y1 was to base our research on standard and open source IoT platform technologies/architectures (e.g. FIWARE, oneM2M), in order to provide lessons learnt and best practice in implementation, integration and deployment of such reference architectures back to standardization bodies.

Concerning our strategy for selecting the most suitable targets, according to the above goals and timeline, in Y1, we remark that standardization bodies consist of *de jure*, e.g. ITU, ISO, IEC, ISO/IEC JTC1 and ETSI, and *de facto*, which we can also call *fora*, e.g. oneM2M, IEEE, AIOTI, etc. In our strategy of standardization, requirements, concepts and frameworks are, if possible, to be standardized in *de jure* standards, to try to maximise outreach and worldwide impact of Fed4IoT. Detailed technologies, interfaces, and implementation guidelines are best standardized in one or more forums that have the authority of creating *de facto* standards, in order to evaluate the technologies and accelerate R&D. Therefore, we promote standardization of Fed4IoT harmonizing with *de jure* and *de facto* forum standards.

As an upstream strategy, in *de jure* standards, proposals of use cases constitute the first step to join and then discuss requirements, the concept and framework models, as a key member. Only after our use cases are agreed in these bodies, we can propose requirements, the concept and our models, based on these use cases. In standards forums, the idea is to actively propose our technologies in detail, focusing on interfaces that provide interoperability.

As a downstream strategy, in *de jure* standards, we survey trends to orient our general standardization strategies in the project. Concerning use of conventional *de facto* standards,

mainly forum standards, we exploit them to fetch out technical ideas, solutions and technologies that are able to complement what we design and develop in Fed4IoT. Figure 1 shows overview of our standardization strategy.

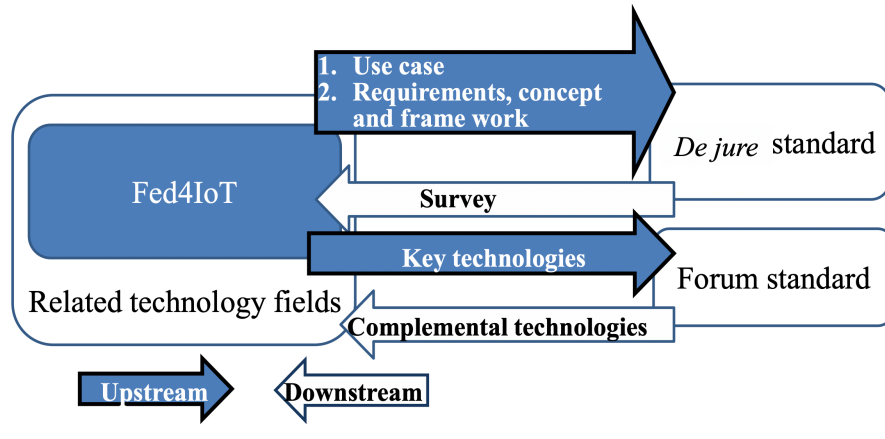


Figure 34 - Overview of standardization strategy

3.1.1 Analysis of standardization on IoT

Standardization on IoT has two aspects, namely the vertical aspect, e.g. the application driven aspect, and the horizontal aspect, e.g. the technology driven aspect, as shown in Figure 2. Recently, most of standard bodies approach both aspects. Figure 35 has been produced by AIOTI and surveys approach of key standard bodies. In Figure 35, the horizontal aspect is focused on ICT (Information and Communication Technologies), telecommunications and the network. In this figure, all columns in the vertical aspect are related to IoT. "Cities" is, for instance, related to Smart Cities standardization initiatives. This figure concludes that ITU, ISO/IEC JTC1 and ETSI, as *de jure*, and oneM2M and AIOTI, as *de facto*, approach both aspects.

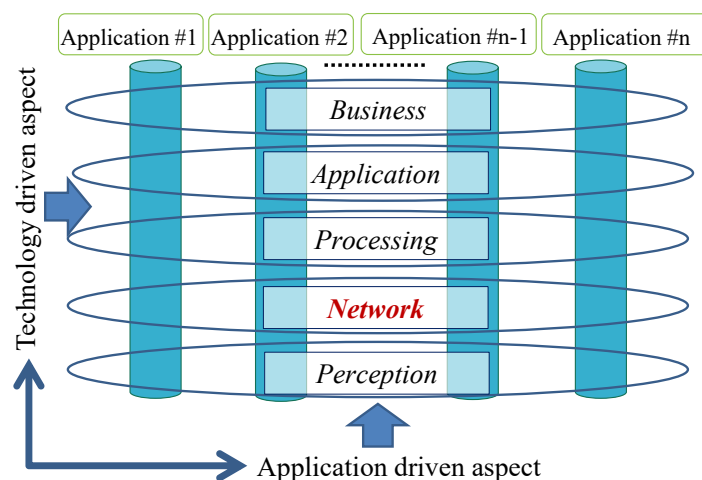


Figure 35 - Aspects of standardization

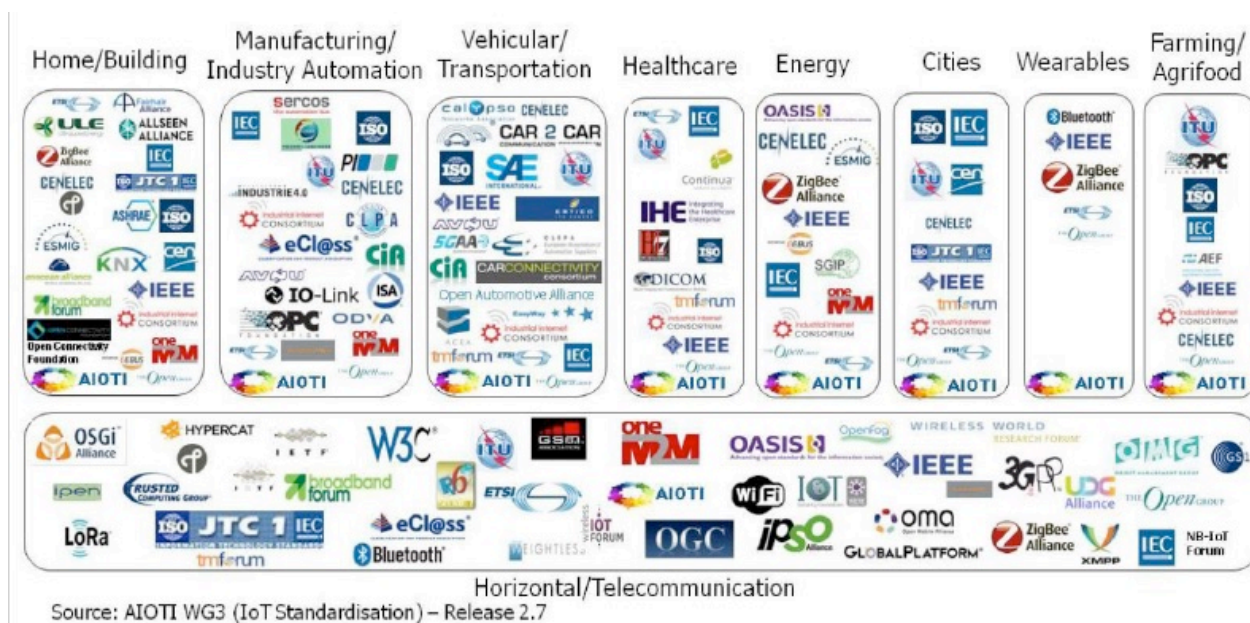


Figure 36 - Overview of approach in standard bodies

3.1.2 Strategic up/downstream activities

In line with standardization trends described in 3.1.1, and following our plan for Y1 (see Section 3.2), we promoted and achieved the strategic activities for standardization as summarized in Table 5. The detailed activities are described in Section 3.3.

We also attended all the relevant meetings, for instance we participated the 10th plenary meeting of ETSI ISG CIM in Sophia Antipolis with OdinS, NEC, EGM, and CNIT.

Table 5: Summary of strategic activities for standardization

	<i>de jure</i> standards	<i>de facto</i> , forum standards
Upstream activities	<ul style="list-style-type: none"> • Proposal of use cases to ITU-T FG-DPM (*) • Picking up requirements and concept of our use cases • Transferring requirements to ITU-T SGs, e.g. SG13 and/or SG20, as new work items through project partners with ITU membership. • Contributions to several ETSI ISG CIM work items 	<ul style="list-style-type: none"> • Contacts with AIOTI WG3 Subgroup on “Semantic Interoperability”
Downstream activities	<ul style="list-style-type: none"> • Survey of trends on IoT and related areas in ITU-T and ISO/IEC JTC1 • Participation to ETSI meetings and liaisons with other ETSI ISGs and TC CYBER on security, to capture the ongoing trends within ETSI 	<ul style="list-style-type: none"> • Contacts with oneM2M developers to track the evolution of the oneM2M standard and APIs • Survey and making use of complementary technologies concerning security and networking

(*) FG-DPM (Focus Group on Data Processing and Management) is the opened pre-discussion stage of international standardization. It collects and analysis IoT and Smart C&C use cases, and then identifies requirements and framework. After gap analysis, output is transferred to ITU-T SGs and other standard bodies.

3.2 Action plan

This section reports the standardization action plan for Y1 we defined during the initial project meetings, updated according to the current achievements.

3.2.1 Action plans on upstream activities

3.2.1.1 ETSI ISG-CIM

From the point of view of the Fed4IoT project, ETSI ISG CIM is a cornerstone because it is responsible for releasing the future standard in context information representation. The

standardization group has adopted JSON-LD as a common format and has defined a common vocabulary, called NGSI-LD, comprised by entities, properties and relationships. For this reason, Fed4IoT will continue actively collaborating in this Industry Specification Group with all its EU partners CNIT, EGM, NEC and OdinS.

Our plan is to promote and endorse NGSI-LD as the future standard for Cross-cutting Context Information representation in its different Work Items. As a matter of fact, OdinS is also rapporteur for the Work Item 7 related to security and privacy in this domain. NEC and CNIT have contributed to Work Item 6 on the NGSI-LD cross-cutting context information.

We will continue attending all online and face2face meetings of ETSI ISG CIM.

3.2.1.2 ITU-T

ITU-T SG13 is one of the standardization body discussing about Information Centric Networking (ICN). In our work in Fed4IoT, we are applying ICN to efficiently collect IoT data within some local IoT systems forming the Root Data Domain. Moreover, ICN can also be used to implement specific distributed ThingVisors. We believe this application of ICN is a potential killer application for IoT. Since ITU-T Y.3073 “Framework for Service Function Chaining in Information Centric Networking” is expected to be an international standard soon, we intend to initiate another work item regarding the application of ICN service function chaining to federation of IoT systems as an outcome of Fed4IoT.

3.2.2 Strategy for outreach

In addition to punctual standardization activities, we plan to outreach activities of Fed4IoT, through organizing events, and participating trials.

3.2.3 Action plans on downstream activities

3.2.3.1 ETSI ISG-CIM

The effort put in ETSI ISG-CIM is also returned to our project in the form of an open and standard API which is the new NGSI-LD LD to which NEC has significantly contributed as part of Work Item 9. This is the core of our neutral format for representing virtualized sensors in our architecture. From this point of view Fed4IoT is making a solid bet upon this technology which allows for semantic annotation, linking different entities and provide a uniform representation of information.

In the same way, thanks to the effort of NEC on adopting NGSI-LD, NEC will provide its new Scorpio NGSI-LD Broker allowing us to increase the variety of systems that can be placed at origin

or as destination for producing or consuming information. The Registry part of the Scorpio Broker can be used for discovering which Things can be provided by ThingVisors in the Fed4IoT system.

3.2.3.2 ITU-T

Concerning ITU-T, the focus of SG13 is future networking including network softwarization, cloud computing, and trustworthy networking. Network slicing discussed in network softwarization can be applied to deploy Virtual Silos and other components of the Fed4IoT virtualization architecture (VirIoT). Trustworthy networking discussed in ITU-T SG13 includes interworking of different networks and that knowledge may be exploited to federate different IoT networks.

3.2.3.3 AIOTI WG3 Subgroup on “Semantic Interoperability”

AIOTI is a forum that brings together a wide range of stakeholders that seek to contribute to IoT thought leadership in Europe. It works on strengthening the integration across the digital value chain, promoting global cooperation and collaboration in the area of IoT. AIOTI Working Group 3 focuses on the standardization landscape, bringing together experts from different standardization organization to identify gaps and encourage collaboration and convergence. AIOTI WG 3 has a sub-working group on “Semantic Interoperability”, which is led by Martin Bauer (NEC). This group is important for Fed4IoT as Semantic Interoperability is a core working topic. The working group is studying topics on how to achieve semantic interoperability in IoT. During the IoT week, the working group presented and discussed its activities. Several members from standardization bodies like oneM2M, ETSI ISG CIM, W3C Web-of-Things, IEEE P2413, OASC, and others are participating. For Fed4IoT semantic interoperability is an important topic, indeed the architecture provides that information from different IoT systems of the Root Data Domain need to be mapped to NGSI-LD as neutral format and finally into target formats. This requires understanding the semantics of the information. An explicit representation of the semantics of information is required as in the virtualized environment information is to be widely reused and there is no strong coupling between applications and original sources. Thus, information needs to be discovered and understood throughout the different components of the Fed4IoT system.

3.2.3.4 Open and Agile Smart Cities

OASC, is a network of cities promoting the world’s largest innovation ecosystem. This network takes advantages of the city point of view to express needs of cities and communities. Additionally, OASC is contributing to the European and worldwide need of a common Smart City framework which is essential for the creation of a market that enables communities to turn the benefit of new technologies into jobs and growth in urban environment.

3.3 Achieved standardisation contributions

3.3.1 Synthesis of Fed4IoT standardisation contributions

Table 6: Synthesis of Fed4IoT standardisation contributions

Date	Committee	Title	Short description	Partner
January '19	ETSI ISG CIM	NGSI-LD Status	Update on the Status document of NGSI-LD	OdinS, NEC, EGM, CNIT
April '19	ETSI ISG CIM	CIM-008-NGSI-LD	CIM created and early draft of the Work Item, providing an introduction to developers on how to use the NGSI-LD API and the underlying information model. Martin Bauer (NEC) is the rapporteur of this WI.	NEC
April '19	ETSI ISG CIM	CIM-007-SEC	CIM released the early draft 0.1.2 of this Work Item which address the topics of security and privacy in the domain of context information. Juan A. Martinez (OdinS) is the rapporteur of this WI.	OdinS, CNIT
July '19	ETSI ISG CIM	CIM-006-IM	This specification is finished and is going to be published in July 2019	NEC, CNIT
January '19	ITU-T FG-DPM	Proposals of new IoT use cases and requirements for smart city	First proposal of five use cases	All
April '19	ITU-T FG-DPM	Proposals of general requirements in D1.1	First proposal of requirements	All
April '19	ITU-T FG-DPM	Proposed text to incorporate new use cases in D1.1	Draft text to incorporate ITU-T FG-DPM output document	All

April '19	ITU-T FG-DPM	Draft Technical Specification "Use case analysis and general requirements for DPM" (D1.1)	Draft output document (Technical Specifications) including use cases and requirements	KIT (as an editor of ITU-T FG-DPM WG1)
May '19	ITU-T FG-DPM	Technical Specification "Use case analysis and general requirements for DPM" (D1.1)	Update version of draft output document (Technical Specifications) including use cases and requirements	KIT (as an editor of ITU-T FG-DPM WG1)
July '19	ITU-T SG13	Proposal to update clauses 7 and 8 of the draft Recommendation Y.ICN-FnChain	Draft Recommendation ITU-T Y.ICN-FnChain is a draft international standard on the framework of service function chaining in Information Centric Networking. In this contribution, additional communications among functional components, communication clarification models for service function chaining, and message content requirements are proposed.	WAS
October '18	ITU-T SG13	Proposal to fill the missing text in clauses 3, 4, 5, 8, 9, 10, and 11, and to improve clause 7 of the draft Recommendation Y.ICN-FnChain	This contribution proposed to update draft Recommendation ITU-T Y.ICN-FnChain in the following points: <ul style="list-style-type: none"> ● additional definitions of terms, ● clarification of the interaction related to "Process scheduling and coordination function. "I update in the description of message content ● proposal on procedures for 	WAS

			service registration and usage.	
March '19	ITU-T SG13	Clarification of Y.FnChain to finalize the document for consent	This contribution proposed additional definitions, assumed service function chaining scenarios, and clarification on mandatory part of the specification in the draft Recommendation ITU-T Y.ICN-FnChain.	WAS
June '19	ITU-T SG13	Additional use cases to complete Y.ICN-FnChain for consent	This contribution proposed additional use cases for the scenarios assumed in the draft Recommendation ITU-T Y.ICN-FnChain. At the time of this writing, we are expecting for this draft Recommendation to be consented after this meeting.	WAS

3.3.2 Detailed contributions

3.3.2.1 ETSI ISG-CIM

Fed4IoT is committed with the adoption of standard and open interfaces. This can be noted because project partners are actively contributing to the ETSI ISG CIM, attending their periodic online and plenary meetings.

Additionally, NEC and OdinS are responsible for different Work Items (WI) according to the figure of rapporteur.

- WI-007-SEC: Juan A. Martinez (OdinS)
- WI-008-NGSI-LD-Primer: Martin Bauer (NEC)

We are actively and extensively contributing to the following CIM work items (WIs):

A new WI has been defined in order to deal with interworking (WI10) whose ToC was agreed during last plenary meeting in Sophia Antipolis which will allow our partners to introduce

solutions for integrating oneM2M with NGSI-LD, which is highly relevant for Fed4IoT as oneM2M and NGSI-LD-based platforms are both used in Fed4IoT and interworking is required.

- **This new report** on NGSI-LD Interworking (WI10) just started
- ToC agreed upon during last f2f CIM meeting in Sophia Antipolis
- Strict collaboration with oneM2M
- Work on interoperability with oneM2M, W3C WoT
- Explore affinity with GraphQL, Node-Red, Apache Spark
- Include solutions from projects
 - Fed4IoT
 - Others...

ETSI GS CIM-009 V1.1.1 (specification was published 2019-01). This is the Context Information Management; NGSI-LD API specification work item. The API evolves the former OMA NGSI 9 and 10 interfaces and FIWARE NGSIv2 to incorporate the latest advances from Linked Data.

Work has been carried out thanks to the effort of NEC and EGM. It was published at the beginning of the year (2019-01) which can be checked in the following URL: <https://docbox.etsi.org/ISG/CIM/Open>.

- This main NGSI-LD API (WI9) **specification** work item is now re-opened
- The goal is to revise published version according to comments from inside and outside ETSI, including enhancements which are backward compatible with current V1.1.1
 - Already several contributions and discussion are discussed
 - Fed4IoT specially focused on introducing:
 - Provenance/original source of data
 - Who provides data

ETSI GR CIM-007 (working draft). This is the Context Information Management; Security and Privacy report work item. It deals with security and privacy issues concerning the API, the platforms, and the context data items themselves.

- Stable draft target date is September 2019
- It refines the use cases/include new use cases
- It benefits from liaisons with CYBER Technical Committee
- Fed4IoT working on
 - Model for certified provenance
 - Data-centric verification of attributes
 - Transparent proxy for sign/verify functionality
 - Data-model extension for GDPR compliance

– Blockchain

ETSI GS CIM-006 (working draft). This is the Context Information Management; Information Model specification work item. The goal is to define a cross-domain data model compatible with the NGSI-LD API.

- This **specification** is going to be published in July 2019
- We contributed to finalize the extensive System Composition, able to model the structural description of an environment in terms of physical network, both for decomposition of self-contained systems into subsystems “top-down” (example: wheels are part of a car), and to define physically-distributed systems (example: a city).

ETSI GR CIM-008 (working draft). This is the Context Information Management (CIM); NGSI-LD Primer report work item. The goal is to explain with examples the usage of NGSI-LD information model and API.

- Date for a stable draft target July 2019
- Publication target October 2019
- Goal is to explain with examples the usage of NGSI-LD information model and API
 - Very important for easy adoption of NGSI-LD
 - To be published in the CIM open area

3.3.2.2 ITU-T

Concerning SG13 on Future Networks, project partners have made the following contributions

- Proposal to update clauses 7 and 8 of the draft Recommendation Y.ICN-FnChain, SG13-C-0519, (July 23, 2018 – ITU-T SG13). Specifically, we have clarified the concept of producer initiated function chaining and proposed a pub/sub application of the producer initiated function chaining. Moreover, we formulated a proposal for contents of messages for function chaining.
- Proposal to fill the missing text in clauses 3, 4, 5, 8, 9, 10 and 11 and improve clause 7 of the draft Recommendation Y.ICN-FnChain, 16885-C84 (181022), (October 30, 2018 – ITU-T SG13). Specifically we defined relations and interactions among the functional components of service function chaining.

Concerning FG on DPM, we have proposed new IoT use cases and requirements for smart cities (January 2019 – ITU-T, Focus Group on Data Processing Management, DPM-I-214). Specifically, we conveyed a set of use cases to be included in the use case output document of FG-DPM.

Details follow on our ITU-T FG-DPM contributions:

- Proposals of new IoT use cases and requirements for smart city, #DPM-I-214
- Five use cases and their requirements are described as the first contribution. It is accepted that five use cases are incorporated into ITU-T Technical specifications. However, requirements shall be edited.
- Proposals of general requirements in D1.1, #DPM-I-248
- Updated requirements are described. It is accepted that these requirements are incorporated into ITU-T Technical specifications.
- Proposed text to incorporate new use cases in D1.1, #DPM-I-247
- Draft text of five use cases is described with alignment of ITU-T document structure.
- Draft Technical Specification “Use case analysis and general requirements for DPM” (D1.1), #DPM-O-158
- Draft text of ITU-T Technical specifications is produced including to Fed4IoT use cases and requirements. This is editors' document. Prof Yokotani of KIT is joined as an editor.
- (e) Draft Technical Specification “Use case analysis and general requirements for DPM” (D1.1), #DPM-O-158R. It is the updated version of (d) for conclusion of ITU-T FG-DPM.

4 Conclusion

During its first year of activity, the Fed4IoT project successfully deployed its communication, dissemination and standardisation activities, which led to the definition of a global project branding, to on-line presence via the web site, to a relevant number of publications (24), to the organisation and participation to events (11), as well as to a strong presence in the standardisation area in relation with smart city platforms, IoT interoperability, security, data and privacy protection.

This effort will be pursued and enhanced during the second year of the project where actual implementations and deployments will provide further ground for dissemination.

5 Annex 1 – Detailed list of publications

Publication information	
DOI	To appear
Type of publication	Publication in conference
Repository Link	https://ieeexplore.ieee.org
Link to the publication	http://netgroup.uniroma2.it/Andrea_Detti/papers/conferences/GIoT2019-VirIoT.pdf
Title	Virtual IoT Systems: Boosting IoT Innovation by Decoupling Things Providers and Applications Developers
Authors	Andrea Detti, Giuseppe Tropea, Giulio Rossi, Juan A. Martinez, Antonio F. Skarmeta, and Hidenori Nakazato
Abstract	This paper proposes the VirIoT platform that enables virtualization of IoT systems, formed by virtual things and brokers. Our goal is to decouple developers of IoT applications from providers of things. VirIoT allows owners of IoT infrastructures to share them with many IoT application developers, which can simply rent the virtual things and the brokers their applications need. VirIoT can be useful for small stakeholders whose applications require large-scale IoT infrastructures, who are nevertheless unable to handle the infrastructure deployment. VirIoT can also be useful for owners of IoT infrastructures, in order to create isolated development environments where to run experimental services, before final deployment in the production system.
Title of the Journal/ Proceedings/Books	Proceedings of IEEE Global IoT Summit 2019
Number, date or frequency of the Journal/Proceedings/Book	Not available
Relevant Pages	Not available
ISBN	Not available
Publisher	IEEE
Place of publication	Aarhus, Denmark

Year of publication	2019
Is this publication available in Open-Access, or will it be made available?	Yes
Is this a peer-reviewed publication?	Yes
Is this a joint public/private publication?	Yes

Publication information	
DOI	To appear
Type of publication	Publication in conference
Repository Link	https://ieeexplore.ieee.org
Link to the publication	http://netgroup.uniroma2.it/Andrea_Detti/papers/conferences/GIoT2019-Review_of_Standard_Ontologies_for_the_Web_of_Things.pdf
Title	Review of Standard Ontologies for the Web of Things
Authors	Wenbin Li, Giuseppe Tropea, Ahmed Abid, Andrea Detti, Franck Le Gall
Abstract	This paper proposes the VirIoT platform that enables virtualization of IoT systems, formed by virtual things and brokers. Our goal is to decouple developers of IoT applications from providers of things. VirIoT allows owners of IoT infrastructures to share them with many IoT application developers, which can simply rent the virtual things and the brokers their applications need. VirIoT can be useful for small stakeholders whose applications require large-scale IoT infrastructures, who are nevertheless unable to handle the infrastructure deployment. VirIoT can also be useful for owners of IoT infrastructures, in order to create isolated development environments where to run experimental services, before final deployment in the production system.
Title of the Journal/ Proceedings/Books	Proceedings of IEEE Global IoT Summit 2019
Number, date or	Not available

frequency of the Journal/Proceedings/Book	
Relevant Pages	Not available
ISBN	Not available
Publisher	IEEE
Place of publication	Aarhus, Denmark
Year of publication	2019
Is this publication available in Open-Access, or will it be made available?	Yes
Is this a peer-reviewed publication?	Yes
Is this a joint public/private publication?	Yes

Publication information	
DOI	10.1109/JIOT.2019.2894969
Type of publication	Article in Journal
Repository Link	https://ieeexplore.ieee.org
Link to the publication	http://netgroup.uniroma2.it/Andrea_Detti/papers/journals/iotICN.pdf
Title	Lightweight Named Object: an ICN-based Abstraction for IoT Device Programming and Management
Authors	L. Bracciale, P. Loreti, A. Detti, R. Paolillo, N. Blefari Melazzi
Abstract	The expected dramatic growth of connected things raises the issue of how to efficiently organize them, in order to monitor and manage functions and interactions. Information Centric Networking (ICN) is a communication paradigm that provides content-oriented functionality in the network and at the network level, including content routing, caching, multicast, mobility, data-centric security and a flexible namespace. Thus, it is a viable solution for supporting

	IoT services without requiring any centralized entity. In this work we introduce the Lightweight Named Object solution: a convenient way to represent physical IoT objects in a derived name space, exploiting ICN. We show that this abstraction can: i) increase the programming simplicity; ii) offer extended functionality, such as augmentation and upgrading, to cope with the “software erosion”, and iii) implement a common interaction logic involving mutual function invocation. We present some proof-of-concept implementations of the proposed abstraction dealing with challenging IoT test cases; we also carry out a performance evaluation in a simulated network scenario.
Title of the Journal/Proceedings/Books	Internet of Things Journal
Number, date or frequency of the Journal/Proceedings/Book	Not available
Relevant Pages	Not available
ISBN	Not available
Publisher	IEEE
Place of publication	Not available
Year of publication	2019
Is this publication available in Open-Access, or will it be made available?	YES
Is this a peer-reviewed publication?	YES
Is this a joint public/private publication?	NO

Publication information	
DOI	10.1587/transcom.2018SEP0013
Type of publication	Article in Journal
Repository Link	http://search.ieice.org/bin/index.php?category=B&lang=E&curr=1
Link to the publication	http://search.ieice.org/bin/summary.php?id=e102-b_4_741&category=B&year=2019&lang=E&abst=
Title	A highly accurate transportation mode recognition using mobile communication quality
Authors	Wataru Kawakami, Bo Wei, Kenji Kanai, and Jiro Katto
Abstract	<p>To recognize transportation modes without any additional sensor devices, we demonstrate that the transportation modes can be recognized from communication quality factors. In the demonstration, instead of using global positioning system (GPS) and accelerometer sensors, we collect mobile TCP throughputs, received-signal strength indicators (RSSIs), and cellular base-station IDs (Cell IDs) through in-line network measurement when the user enjoys mobile services, such as video streaming. In accuracy evaluations, we conduct two different field experiments to collect the data in six typical transportation modes (static, walking, riding a bicycle, riding a bus, riding a train and riding a subway), and then construct the classifiers by applying a support-vector machine (SVM), k-nearest neighbor (k-NN), random forest (RF), and convolutional neural network (CNN). Our results show that these transportation modes can be recognized with high accuracy by using communication quality factors as well as the use of accelerometer sensors.</p>
Title of the Journal/Proceedings/Books	IEICE Transactions on Communications
Number, date or frequency of the Journal/Proceedings/Book	Vol. E102-B, No. 4, April 2019
Relevant Pages	741-750
ISBN	Not available
Publisher	The Institute of Electronics, Information and Communication Engineers

Place of publication	Tokyo, Japan
Year of publication	2019
Is this publication available in Open-Access, or will it be made available?	To be available
Is this a peer-reviewed publication?	Yes
Is this a joint public/private publication?	No

Publication information	
DOI	10.1109/PERCOMW.2019.8730806
Type of publication	Publication in conference
Repository Link	https://ieeexplore.ieee.org
Link to the publication	http://www.nz.comm.waseda.ac.jp/papers/OgaKanNak2019IoT%20Device.pdf
Title	IoT Device Virtualization for Efficient Resource Utilization in Smart City IoT Platform
Authors	Keigo Ogawa, Kenji Kanai, Kenichi Nakamura, Hidehiro Kanemitsu, Jiro Katto, and Hidenori Nakazato
Abstract	To develop and interoperate smart city applications efficiently, smart city IoT platforms require efficient handling of various types of sensor devices, networking and computing resources, and different domain applications. To address this fact, in this paper, we introduce an IoT device virtualization that enables efficient utilization of computing resources. The proposal applies a micro-service sharing and dynamic resource scaling. In the performance validations, we implement an early prototype using Docker, Kubernetes, and Apache Kafka. Through the preliminary experiment, we confirm that the proposal can improve the application processing time by appropriately sharing and scaling micro services.

Title of the Journal/Proceedings/Books	Proceedings of 2019 IEEE International Conference on Pervasive Computing and Communications Workshops (PerCom Workshops)
Number, date or frequency of the Journal/Proceedings/Book	11-15 March 2019
Relevant Pages	419-422
ISBN	978-1-5386-9151-9
Publisher	IEEE
Place of publication	Kyoto, Japan
Year of publication	2019
Is this publication available in Open-Access, or will it be made available?	Yes
Is this a peer-reviewed publication?	Yes
Is this a joint public/private publication?	No

Publication information	
DOI	10.1109/ICCE.2019.8662095
Type of publication	Publication in conference
Repository Link	https://ieeexplore.ieee.org
Link to the publication	https://ieeexplore-ieee-org.ez.wul.waseda.ac.jp/document/8662095
Title	Accuracy evaluations of contact-free heart rate measurement methods using 4K facial images
Authors	Masaki Yasumaru, Zhengxue Cheng, Ryota Yohoyama, Kenji Kanai, and Jiro Katto
Abstract	Recently, with the spread of Internet of Things (IoT), video surveillance system is widely used to detect abnormal activity using cameras and sensors. In such video surveillance system, contact-free

	heart rate measurement is a highly required technology to predict the occurrence of abnormal activities and suspicious humans. In this paper, our main contributions can be summarized by two aspects. First, we compare the accuracy performance of heart rate measurement using six heart beat waveform acquisition methods and two heart rate calculation methods. Second, we discuss the influence of image resolutions of RGB cameras on accurate performance, to investigate the requirement of surveillance cameras in actual scenarios.
Title of the Journal/Proceedings/Books	Proceedings of <u>2019 IEEE International Conference on Consumer Electronics (ICCE)</u>
Number, date or frequency of the Journal/Proceedings/Book	January 2019
Relevant Pages	Not available
ISBN	978-1-5386-7910-4
Publisher	IEEE
Place of publication	Las Vegas, NB, USA
Year of publication	2019
Is this publication available in Open-Access, or will it be made available?	To be available
Is this a peer-reviewed publication?	Yes
Is this a joint public/private publication?	No

Publication information	
DOI	Not available
Type of publication	Publication in conference
Repository Link	http://www.risp.jp/NCSP19/

Link to the publication	http://www.nz.comm.waseda.ac.jp/papers/KanHanNak2019Clustering-based.pdf
Title	Clustering-based Allocation of Virtualized Functions for Service Function Chaining
Authors	Hidehiro Kanemitsu, Masaki Hanada, and Hidenori Nakazato, “”, NCSP2019, Mar. 2019
Abstract	Network Function Virtualization (NFV) has been widely spread for software-level network configuration. Such functionalities interact each other to achieve data-flow processing, named as Service Function Chaining (SFC). In SFC, each execution unit, named as Virtualized Network Function (VNF), has dependencies with others. Such configuration is realized by allocating each VNF to a VM. Conventional approaches mainly focus on how to allocate each VNF to a VM, or how to select a VNF and they are resolved separately. In this paper, we propose a VNF clustering algorithm, called Clustering for Minimizing Worst Schedule Length for VNF (CMWSL-VNF) to resolve both VNF allocation and VNF selection simultaneously. CMWSL-VNF can greatly reduce the data communication latency and maintains the degree of parallelism by the clustering algorithm. Experimental results show that CMWSL-VNF can utilize vCPUs to minimize the response time.
Title of the Journal/Proceedings/Books	The 2019 RISP International Workshop on Nonlinear Circuits, Communications and Signal Processing (NCSP'19)
Number, date or frequency of the Journal/Proceedings/Book	4-7 March, 2019
Relevant Pages	Not available
ISBN	Not available
Publisher	Research Institute of Signal Processing (RISP)
Place of publication	Honolulu, Hawaii, USA
Year of publication	2019
Is this publication available in Open-Access, or will it be made	Yes

available?	
Is this a peer-reviewed publication?	Yes
Is this a joint public/private publication?	No

Publication information	
DOI	10.1109/INNOVATIONS.2018.8606029
Type of publication	Publication in conference
Repository Link	https://ieeexplore.ieee.org
Link to the publication	https://ieeexplore-ieee-org.ez.wul.waseda.ac.jp/document/8606029
Title	Proposals on IoT Communication through MQTT over L2 Network and their Performance Evaluation
Authors	Y. Sasaki, T. Yokotani, and H. Mukai D1S2-1、 2018
Abstract	<p>The development of the Internet of Things (IoT) has been accelerated. The Internet is based on the internet protocol (IP), which is applied to most Internet communication. Communication through IP requires the physical location of the connected devices. In IoT, communication based on the IP cannot be optimized because data blocks in the IoT are transferred from various locations. Moreover, if IoT communication is invoked on the current Internet, it may be inefficient because large numbers of connections must be established and communication sessions released. Therefore, IoT requires a new concept of a communication system, which is referred to as an Information Centric Network (ICN). An ICN should be co-operated with IP-based communication. Therefore, we propose a new simplified communication scheme using Message Queuing telemetry transport (MQTT), which is a type of ICN, and evaluate its performance.</p>
Title of the Journal/ Proceedings/Books	Proceedings of IEEE International Conference on Innovations in Information Technology 2018
Number, date or frequency of the	18-19 November 2018

Journal/Proceedings/Book	
Relevant Pages	30-35
ISBN	978-1-5386-6673-9
Publisher	IEEE
Place of publication	Al Ain, United Arab Emirates
Year of publication	2018
Is this publication available in Open-Access, or will it be made available?	To be available
Is this a peer-reviewed publication?	Yes
Is this a joint public/private publication?	No

Publication information	
DOI	10.1109/JEC-ECC.2018.8679550
Type of publication	Publication in conference
Repository Link	https://ieeexplore.ieee.org
Link to the publication	https://ieeexplore-ieee-org.ez.wul.waseda.ac.jp/document/8679550
Title	Comparison with assured transfer of information mechanisms in MQTT
Authors	Y. Sasaki, T. Yokotani, and H. Mukai
Abstract	Various protocols for IoT services are widely discussed currently. One of these protocols is message queuing telemetry transport (MQTT), which is an approach based on the information centric network (ICN) technology. However, MQTT must be operated over IP and its related protocols; therefore, the co-operation between MQTT and these protocols is an interesting topic of study. One of the issues related to the above-mentioned study is the mechanism to transfer information assuredly. MQTT provides some mechanisms for the assured transfer of information such as “Quality of Service

	(QoS) classes” with several options such as QoS0, QoS1, and QoS2. TCP also provides a re-transmission scheme for this purpose. This study surveys the mechanism based on MQTT QoS classes, and discusses transmission performance with comparisons among TCP based and MQTT QoS class-based approaches. It concludes that the QoS1 in MQTT can be invoked to perform an assured transfer of information with small delay.
Title of the Journal/Proceedings/Books	Proceedings of 2018 International Japan-Africa Conference on Electronics, Communications and Computations (JAC-ECC)
Number, date or frequency of the Journal/Proceedings/Book	17-19 Dec. 2018
Relevant Pages	95-98
ISBN	978-1-5386-9230-1
Publisher	IEEE
Place of publication	Alexandria, Egypt
Year of publication	2018
Is this publication available in Open-Access, or will it be made available?	To be available
Is this a peer-reviewed publication?	Yes
Is this a joint public/private publication?	No

Publication information	
DOI	10.1109/ICOIN.2019.8718148
Type of publication	Publication in conference
Repository Link	https://ieeexplore.ieee.org
Link to the publication	https://ieeexplore-ieee-org.ez.wul.waseda.ac.jp/document/8718148

Title	Enhancement of MAC Protocol for Power Reduction in LoRaWAN
Authors	K. Terada、 H. Mukai、 T. Yokotani
Abstract	With the increasing use of the Internet of Things (IoT), various LPWA standards are being introduced. The authors focused on the LoRaWAN standard with low power consumption and transmission distance of several kilometers. As ALOHA is adopted for the LoRaWAN MAC protocol, its communication collision increases as the number of nodes increases. Therefore, a back-off process becomes necessary, and the power consumption is increased by the back-off process during its operation. In this paper, we propose an enhancement to the LoRaWAN MAC protocol, which enables communication collision avoidance and sleep control of the end nodes.
Title of the Journal/Proceedings/Books	Proceedings of 2019 International Conference on Information Networking (ICOIN)
Number, date or frequency of the Journal/Proceedings/Book	9-11 Jan. 2019
Relevant Pages	324-326
ISBN	978-1-5386-8350-7
Publisher	IEEE
Place of publication	Kuala Lumpur, Malaysia, Malaysia
Year of publication	2019
Is this publication available in Open-Access, or will it be made available?	To be available
Is this a peer-reviewed publication?	Yes
Is this a joint public/private publication?	No

Publication information	
DOI	10.1007/978-3-030-23502-4_4
Type of publication	Publication in conference
Repository Link	https://www.springer.com/gp/computer-science/lncs
Link to the publication	http://www.nz.comm.waseda.ac.jp/papers/KanHanNak2019Multiple0.pdf
Title	Multiple Workflow Scheduling with Offloading Tasks to Edge Cloud
Authors	Hidehiro Kanemitsu, Masaki Hanada, and Hidenori Nakazato
Abstract	<p>Edge computing can realize a data locality among a cloud and users, and it can be applied to task offloading, i.e., a part of workload on a mobile terminal is moved to an edge or a cloud system to minimize the response time with reducing energy consumption. Mobile workflow jobs have been widely used due to advance of computational power on a mobile terminal. Thus, how to offload or schedule each task in a mobile workflow is one of the current challenging issues.</p> <p>In this paper, we propose a task scheduling algorithm with task offloading, called priority-based continuous task selection for offloading (PCTSO), to minimize the schedule length with energy consumption at a mobile client being reduced. PCTSO tries to select dependent tasks such that many tasks are offloaded so as to utilize many vCPUs in the edge cloud; in this manner, the degree of parallelism can be maintained. Experimental results of the simulation demonstration that PCTSO outperforms other algorithms in the schedule length and satisfies the energy constraint.</p>
Title of the Journal/Proceedings/Books	Proceedings of 2019 International Conference on Cloud Computing (CLOUD2019)
Number, date or frequency of the Journal/Proceedings/Book	25-30 June 2019
Relevant Pages	Not available
ISBN	Not available
Publisher	Springer-Verlag
Place of publication	San Diego, CA, USA

Year of publication	2019
Is this publication available in Open-Access, or will it be made available?	Yes
Is this a peer-reviewed publication?	Yes
Is this a joint public/private publication?	No

Publication information	
DOI	To appear
Type of publication	Publication in conference
Repository Link	https://ieeexplore.ieee.org
Link to the publication	http://www.nz.comm.waseda.ac.jp/papers/OgaSekKan2019Performance.pdf
Title	Performance Evaluations of IoT Device Virtualization for Efficient Resource Utilization
Authors	Keigo Ogawa, Hibiki Sekine, Kenji Kanai, Kenichi Nakamura, Hideohiro Kanemitsu, Jiro Katto, Hidenori Nakazato
Abstract	To develop and interoperate smart city applications efficiently, smart city IoT platforms require efficient handling of various types of sensor devices, networking and computing resources, and different domain applications. To address this fact, the authors of this paper proposed a research project named “Fed4IoT”, which is an acronym for federation of IoT and cloud infrastructures, to provide scalable and interoperable smart city applications. The project primarily proposes two key technologies: IoT device virtualization and context-information sharing. In this paper, we introduce the IoT device virtualization (one of key technology in Fed4IoT) that enables efficient utilization of networking and computing resources by applying a micro-service sharing and dynamic resource scaling. In the performance evaluations, we implement three micro services, such as object detection, garbage detection and road damage detection, as

	smart city applications and dynamically and flexibly allocate computing resources to three micro services by using Docker and Kubernetes. Through the evaluations we validate that the proposed IoT device virtualization achieves the efficient computing resource utilization and reduction of networking resources.
Title of the Journal/Proceedings/Books	Proceedings of 2019 Global IoT Summit (GloTS)
Number, date or frequency of the Journal/Proceedings/Book	17-21 June 2019
Relevant Pages	Not available
ISBN	Not available
Publisher	IEEE
Place of publication	Aarhus, Denmark
Year of publication	2019
Is this publication available in Open-Access, or will it be made available?	Yes
Is this a peer-reviewed publication?	Yes
Is this a joint public/private publication?	No

Publication information	
DOI	Not available
Type of publication	Publication in workshop (in Japanese)
Repository Link	https://www.ieice.org/ken/program/index.php?instsoc=&tgid=&year=&region=&schkey=&sch1=1&pskey=&ps1=1&ps2=1&ps3=1&ps4=1&ps5=1&search_mode=&pnum=0&psize=2&psort=0&layout=&lang=eng
Link to the publication	http://www.nz.comm.waseda.ac.jp/papers/NakUesKan2019Introduction.pdf

Title	Introduction of Fed4IoT project toward federating IoT and cloud infrastructures — “Virtual Silo” architecture consideration — (in Japanese)
Authors	Kenichi NAKAMURA, Mitsuru UESUGI, Kenji KANAI, Hidenori NAKAZATO, Hidehiro KANEMITSU, Tetsuya YOKOTANI, Hiroaki MUKAI
Abstract	The Fed4IoT project aims at federating IoT devices, edge/fog/cloud computing infrastructures to provide scalable and interoperable smart cities applications by applying novel IoT virtualization technologies, not only network and computing resources, but also IoT devices themselves. In this paper, we introduce “Virtual Silo” architecture, including IoT device virtualization, virtual silo concept with multi-tenant approach, security and privacy protection
Title of the Journal/Proceedings/Books	IEICE Technical Report
Number, date or frequency of the Journal/Proceedings/Book	16-17 May 2019
Relevant Pages	7-12
ISBN	Not available
Publisher	IEICE
Place of publication	Tokyo, Japan
Year of publication	2019
Is this publication available in Open-Access, or will it be made available?	Yes
Is this a peer-reviewed publication?	No
Is this a joint public/private publication?	No

Publication information	
DOI	Not available
Type of publication	Publication in workshop (in Japanese)
Repository Link	https://www.ieice.org/ken/program/index.php?instsoc=&tgid=&year=&region=&schkey=&sch1=1&pskey=&ps1=1&ps2=1&ps3=1&ps4=1&ps5=1&search_mode=&pnum=0&psize=2&psort=0&layout=&lang=eng
Link to the publication	https://www.ieice.org/ken/user/index.php?cmd=download&p=fEIJ&t=IEICE-CS&l=654da858775747c4be4dde7568e4a04ea9c22bcfe06db1698613655b9f2746f4&lang=
Title	A study on the availability improvement of communication in wireless sensor networks
Authors	Keitaro Terada, Hokuto Watanabe, Katsuki Fukuhara, Hibiki Yamada, Hiroaki Mukai, and Tetsuya Yokotani
Abstract	In recent years, deployment of IoT technology is proceeding in various fields such as environmental monitoring, disaster prevention, plant, logistics, security, and so on. It is expected that the deployment of the wireless sensor networks with LPWA will proceed for the outdoor sensing applications. In outdoor wireless sensor networks, there are problems regarding the communication stability and difficulty of device maintenance. In this paper, end-node remote management scheme and hybrid LPWA are proposed for the purpose of improving the communication availability in wireless sensor network.
Title of the Journal/Proceedings/Books	IEICE Technical Report
Number, date or frequency of the Journal/Proceedings/Book	18-19 April 2019
Relevant Pages	vol. 119, no. 6, CS2019-9, pp. 45-50
ISBN	Not available
Publisher	IEICIE
Place of publication	Osaka, Japan
Year of publication	2019

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Is this a peer-reviewed publication?	No
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Publication information	
DOI	Not available
Type of publication	Publication in workshop (in Japanese)
Repository Link	https://www.ieice.org/ken/program/index.php?instsoc=&tgid=&year=&region=&schkey=&sch1=1&pskey=&ps1=1&ps2=1&ps3=1&ps4=1&ps5=1&search_mode=&pnum=0&psize=2&psort=0&layout=&lang=eng
Link to the publication	To be available
Title	Reliable LPWAN for IoT systems
Authors	Hiroaki Mukai, Keitaro Terada, and Tetsuya Yokotani
Abstract	In recent years, deployment of IoT technology is proceeding in various fields such as environmental monitoring, disaster prevention, plant, logistics, security, and so on. It is expected that the deployment of the wireless sensor networks with LPWAN will proceed for the outdoor sensing applications, however there are still difficulties in the communication reliability. In this paper, end-node remote management scheme and TDMA based multiple access scheme are proposed for the purpose of improving the communication reliability in LPWAN.
Title of the Journal/Proceedings/Books	IEICE Technical Report
Number, date or frequency of the Journal/Proceedings/Book	30-31 May 2019

Relevant Pages	vol. 119, no. 62, SR2019-7, pp. 43-48
ISBN	Not available
Publisher	IEICE
Place of publication	Tokyo, Japan
Year of publication	2019
Is this publication available in Open-Access, or will it be made available?	To be available
Is this a peer-reviewed publication?	No
Is this a joint public/private publication?	No

Publication information	
DOI	Not available
Type of publication	Publication in conference
Repository Link	https://netdevconf.org/0x13/index.html
Link to the publication	https://netdevconf.org/0x13/session.html?talk-reimp-stack
Title	Is Reimplementation of network stack a good idea or not?
Authors	Hajime Tazaki
Abstract	<p>While playing with a userspace network stack implementation derived from Linux Kernel Library (LKL), we are always wondering how LKL is different from a custom, full-scratch based implementation of userspace network stacks. The goal of LKL is to preserve Linux functionalities as much as possible, but it is not clear how others are far from mature, feature-rich network stack until people started to play with them and see difficulties with a lack of functionalities.</p> <p>This work is our trail to measure how a network stack implementation is mature.</p> <p>In order to answer the above question, we conducted network protocol</p>

	conformance tests of various IETF standards (RFCs) across multiple userspace network stack implementations. We would like to share the preliminary results, findings of buggy implementations, and possible testing framework that we can conduct during daily development.
Title of the Journal/ Proceedings/Books	Netdev 0x13, The Technical Conference on Linux Networking
Number, date or frequency of the Journal/Proceedings/ Book	20-22 March 2019
Relevant Pages	Not available
ISBN	Not available
Publisher	The NetDev Society
Place of publication	Prague, Czech Republic
Year of publication	2019
Is this publication available in Open-Access, or will it be made available?	Yes
Is this a peer-reviewed publication?	Yes
Is this a joint public/private publication?	No

Publication information	
DOI	Not available
Type of publication	Publication in workshop (in Japanese)
Repository Link	https://onsite.gakkai-web.net/ieiceg/index.html
Link to the publication	https://onsite.gakkai-web.net/ieiceg/_pdf/d_11_013.pdf
Title	Accuracy Evaluations of Geolocation Estimation based on Camera Images Using IM2GPS

Authors	Masahiko Tahara, Kenji Kanai, and Jiro Katto
Abstract	This paper evaluates the accuracy of geolocation estimation based on camera images.
Title of the Journal/Proceedings/Books	Proceedings of the 2019 IEICE General Conference
Number, date or frequency of the Journal/Proceedings/Book	19-22 March 2019
Relevant Pages	D-11-13
ISBN	Not available
Publisher	IEICE
Place of publication	Tokyo, Japan
Year of publication	2019
Is this publication available in Open-Access, or will it be made available?	To be available
Is this a peer-reviewed publication?	No
Is this a joint public/private publication?	No

Publication information	
DOI	Not available
Type of publication	Publication in workshop (in Japanese)
Repository Link	https://onsite.gakkai-web.net/ieiceg/index.html
Link to the publication	https://onsite.gakkai-web.net/ieiceg/_pdf/b_15_016.pdf
Title	Accuracy Evaluations of Emotion Estimation Based on Biological Sensing in Music Content Viewing

Authors	Satomi Shirasaki Kenji Kanai Jiro Katto
Abstract	This paper proposes a method to estimate emotion from heartbeat variation and brain wave information while subjects are viewing music videos. The accuracy evaluation of the proposal is also presented.
Title of the Journal/Proceedings/Books	Proceedings of the 2019 IEICE General Conference
Number, date or frequency of the Journal/Proceedings/Book	19-22 March 2019
Relevant Pages	B-15-16
ISBN	Not available
Publisher	IEICE
Place of publication	Tokyo, Japan
Year of publication	2019
Is this publication available in Open-Access, or will it be made available?	To be available
Is this a peer-reviewed publication?	No
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Publication information	
DOI	Not available
Type of publication	Publication in workshop (in Japanese)
Repository Link	https://onsite.gakkai-web.net/ieiceg/index.html
Link to the publication	https://onsite.gakkai-web.net/ieiceg/_pdf/b_08_021.pdf
Title	Delay Characteristic Evaluations of IoT Communication Protocols over

	IoT Networks
Authors	Hibiki Sekine, Kenji Kanai, and Jiro Katto
Abstract	This paper presents delay performance of HTTP, CoAP, and MQTT when they are applied to IoT systems.
Title of the Journal/ Proceedings/Books	Proceedings of the 2019 IEICE General Conference
Number, date or frequency of the Journal/Proceedings/ Book	19-22 March 2019
Relevant Pages	B-8-21
ISBN	Not available
Publisher	IEICE
Place of publication	Tokyo, Japan
Year of publication	2019
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Is this a peer- reviewed publication?	No
Is this a joint public/private publication?	No

Publication information	
DOI	Not available
Type of publication	Publication in workshop (in Japanese)
Repository Link	https://onsite.gakkai-web.net/ieiceg/index.html
Link to the publication	https://onsite.gakkai-web.net/ieiceg/_pdf/b_08_014.pdf
Title	A study on an IoT system for protection from wild animal

Authors	Yuya Sasaki, Daiki Takemura, Keitarou Terada, Tetsuya Yokotani, and Hiroaki Mukai
Abstract	This paper proposes an architecture of an IoT system for wildlife control adopting MQTT. The system is intended to be used in depopulated areas.
Title of the Journal/Proceedings/Books	Proceedings of the 2019 IEICE General Conference
Number, date or frequency of the Journal/Proceedings/Book	19-22 March 2019
Relevant Pages	B-8-14
ISBN	Not available
Publisher	IEICE
Place of publication	Tokyo, Japan
Year of publication	2019
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Is this a peer-reviewed publication?	No
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Publication information	
DOI	Not available
Type of publication	Publication in workshop (in Japanese)
Repository Link	https://onsite.gakkai-web.net/ieiceg/index.html
Link to the publication	https://onsite.gakkai-web.net/ieiceg/_pdf/b_08_015.pdf
Title	A study on communication networks for wild animal life systems based

	on IoT
Authors	Daiki Takemura, Yuya Sasaki, Keitaro Terada, Tetsuya Yokotani, and Hiroaki Mukai
Abstract	This paper proposes a network architecture for wildlife control systems.
Title of the Journal/Proceedings/Books	Proceedings of the 2019 IEICE General Conference
Number, date or frequency of the Journal/Proceedings/Book	19-22 March 2019
Relevant Pages	B-8-15
ISBN	Not available
Publisher	IEICE
Place of publication	Tokyo, Japan
Year of publication	2019
Is this publication available in Open-Access, or will it be made available?	To be available
Is this a peer-reviewed publication?	No
Is this a joint public/private publication?	No

Publication information	
DOI	Not available
Type of publication	Publication in workshop (in Japanese)
Repository Link	https://www.ieice.org/ken/program/index.php?instsoc=&tgid=&year=&region=&schkey=&sch1=1&pskey=&ps1=1&ps2=1&ps3=1&ps4=1&ps5=1&search_mode=&pnum=0&psize=2&psort=0&layout=&lang=eng
Link to the	https://www.ieice.org/ken/user/index.php?cmd=download&p=W3yl&t=

publication	IEICE- CQ&l=654da858775747c4be4dde7568e4a04ea9c22bcfe06db169861365 5b9f2746f4&lang=
Title	QoS control functions of MQTT for assured communication and their evaluation
Authors	Yuya Sasaki, Tetsuya Yokotani, and Hiroaki Mukai
Abstract	In IoT accommodating various network services, network services have been provided in wide areas. In order to improve the efficiency of IoT communication, research and development activities of communication protocols for IoT have been promoted. Communication architecture referred to as Information Centric Network (ICN) is one of promising candidates. MQ Telemetry Transport (MQTT) using publish – subscribe sequences is one of options in ICN architecture. MQTT has been expected for lightweight communication and simple implementation. In MQTT, three transfer modes, e.g., QoS 0, QoS 1 and QoS 2, are specified. One of these modes can be selected according to requirements on reliable communication. On the other hand, MQTT can be operated over TCP connections. In this report, we discuss combinations between TCP and MQTT QoS modes. Then, we evaluate communication delay in these combinations. Finally, we propose the best way with small delay and high reliability.
Title of the Journal/ Proceedings/Books	IEICE Technical Report
Number, date or frequency of the Journal/Proceedings/ Book	15-16 November 2018
Relevant Pages	vol. 118, no. 302, CQ2018-69, pp. 33-36
ISBN	Not available
Publisher	IEICE
Place of publication	Nonoichi-shi, Ishikawa, Japan
Year of publication	2018
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made available?	
Is this a peer-reviewed publication?	No
Is this a joint public/private publication?	No

Publication information	
DOI	Not available
Type of publication	Publication in workshop (in Japanese)
Repository Link	http://www.nz.comm.waseda.ac.jp/papers/KanNakKan2018Introduction0.pdf
Link to the publication	https://www.ieice.org/ken/user/index.php?cmd=download&p=zEB6&t=IEICE-NS&l=654da858775747c4be4dde7568e4a04ea9c22bcfe06db1698613655b9f2746f4&lang=
Title	Introduction of Fed4IoT Research Project for Interoperability of Cross-domain IoT Platforms
Authors	Kenji Kanai, Hidenori Nakazato, Hidehiro Kanemitsu, Hajime Tazaki, Kenichi Nakamura, Mitsuru Uesugi, Tetsuya Yokotani, Hiroaki Mukai, and Jiro Katto
Abstract	Because of recent evolutions of IoT devices and cloud computing platform, the market growth of smart city business are increasing. Toward reducing expenditure for large-scale IoT deployments and providing simple and programmable system for IoT application deployment, the authors propose the Fed4IoT research project that aims at federating IoT devices, edge/fog/cloud computing infrastructures to provide scalable and interoperable smart cities applications by applying novel IoT virtualization technologies, not only network and computing resources, but also IoT devices themselves. The Fed4IoT project is a research and innovation action jointly funded by the European Commission and Japan's MIC. In this paper, we introduce the five Work Packages of the Fed4IoT project, including the IoT device virtualization and the context information sharing system.

Title of the Journal/Proceedings/Books	IEICE Technical Report
Number, date or frequency of the Journal/Proceedings/Book	20-21 December 2018
Relevant Pages	vol. 118, no. 371, NS2018-165, pp. 41-46
ISBN	Not available
Publisher	IEICE
Place of publication	Onomichi-shi, Hiroshima, Japan
Year of publication	2018
Is this publication available in Open-Access, or will it be made available?	Yes
Is this a peer-reviewed publication?	No
Is this a joint public/private publication?	Yes

Publication information	
DOI	Not available
Type of publication	Publication in workshop (in Japanese)
Repository Link	https://www.ieice.org/ken/program/index.php?instsoc=&tgid=&year=&region=&schkey=&sch1=1&pskey=&ps1=1&ps2=1&ps3=1&ps4=1&ps5=1&search_mode=&pnum=0&psize=2&psort=0&layout=&lang=eng
Link to the publication	http://www.nz.comm.waseda.ac.jp/papers/KanNakKan2018Introduction.pdf
Title	Introduction of Fed4IoT project toward federating IoT and cloud infrastructures —Concept and future plans —
Authors	Kenji Kanai, Hidenori Nakazato, Hidehiro Kanemitsu, Hajime Tazaki,

	Kenichi Nakamura, Mitsuru Uesugi, Tetsuya Yokotani, Hiroaki Mukai, and Jiro Katto
Abstract	The Fed4IoT project aims at federating IoT devices, edge/fog/cloud computing infrastructures to provide scalable and interoperable smart cities applications by applying novel IoT virtualization technologies, not only network and computing resources, but also IoT devices themselves. In this paper, we introduce the concept and the future plans of the Fed4IoT project, including the IoT device virtualization and the context information sharing system.
Title of the Journal/Proceedings/Books	IEICE Technical Report
Number, date or frequency of the Journal/Proceedings/Book	29-30 November 2018
Relevant Pages	CS2018-81, pp. 75-80
ISBN	Not available
Publisher	IEICE
Place of publication	Tokushima-shi, Tokushima, Japan
Year of publication	2018
Is this publication available in Open-Access, or will it be made available?	Yes
Is this a peer-reviewed publication?	No
Is this a joint public/private publication?	Yes