Newsletter

July-November 2017

"Interoperability as a Service" – Connecting IoT infrastructures and smart objects

Editorial

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We are proud to present the now already 4th newsletter on the VICINITY project. Why so many newsletters? Because actually, there is a lot of news. We had the successful review meeting in Brussels. We had the Demos of the VICINITY implementation in Brussels and in Athens. And: due to that we have a first running prototype. With many limitations, not really implementing every feature, but: it is there.

We now face a number of further challenges. The testing is starting in various labs. The open calls that are intended to boost the impact of VICINITY are about to start – preparation is ongoing. Last but not least, the review of the first reporting period was successful. The results of VICINITY were considered as technically excellent. The unique approach to provide interoperability while keeping privacy to the users that combines elements from peer to peer networks with other elements from edge computing. We, in consequence really earned and also received new payments from EC that is just being transferred to the partners.

Latest News and Upcoming Events

Latest news

- VICINITY project at "ITU-T Focus Group on Data Processing and Management to support IoT and Smart Cities & Communities" on 17-19 July in Geneva, Switzerland.
- HITs on behalf of VICINITY Presentation brochure at Arendalsuka on 14-18 August 2017 in Arendal, Norway.
- VICINITY was presented at EU review meeting on 1 September in Brussels, Belgium.
- VICINITY booth at the IoT-EPI Reviews and Cluster Meetings on 28 September in Athens, Greece.
- ENERC on behalf of VICINITY presented at European Utility week on 3-5 October in Amsterdam, Netherlands.

- VICINITY participated in the AIOTI WG08 Smart Cities Face-to-Face meeting hosted by CCMC in Brussels on 18 October.
- CAL on behalf of VICINITY contributed to ITU-T Focus Group on Data Processing and Management on 20 October in Geneva, Switzerland.
- CAL and UPM presented VICINITY and chaired sessions in ETSI IoT Week on 23-26 October 2017 in Sophia Antipolis, France.

IOT-EPI Projects Open Calls

The following Open Call is open for proposals:

symbIoTe Open Call 2

- Open Call launches: 31 October 2017
- Deadline: 31 January 2018
- Maximum funding per extension:Up to €50.000 (varies per topic)
- Type of applicants: Start-ups, SMEs, companies or research institutes/organizations
- Web: https://www.symbiote-h2020.eu/index.php/2nd-open-call/

Results From Participation at Conferences

Nordic Edge Expo 2017 - September 26 - 28, 2017, Stavanger, Norway

VICINITY was represented with its own stand at the Nordic Edge Expo 2017, 26. – 28. September. Nordic Edge is a spin-off of the Horizon 2020 funded project Triangulum, and is a 3 day event that consists of a conference and expo, in addition to smart city safaris and networking opportunities. The Norwegian division of VICINITY is part of a network/cluster called “Smart City Norway”, and was one of two projects that were presented at the stand. The first day it was only the exhibition was open to the public, and this gave us extra room for presenting the potential of the project. The two next days were when the actual conference took part. The media was well represented, and one of the local newspapers ran a series of articles on the exhibition. A number of visitors paid attention to the VICINITY stand. In-depth discussions were conducted with 7 municipalities with the intention of following up afterwards. Several companies were interested in learning more about the project and the open calls.
The feedback has been very positive, and represents a good platform for identifying and expand on the exploitation potential of the project.

NORDIC EDGE EXPO 2017

Interview with an SAB member

John Davies
Chief Researcher in BT's Research & Innovation Department

Please highlight here the most relevant parts of your CV.

– Prof John Davies is Chief Researcher in BT's Research & Innovation department, where he leads a team focused on Internet of Things technologies. He has a strong track record of researching and innovating and his current research interests include the application of semantic and Internet of Things technologies to smart cities, smart transport, business intelligence and information integration. He currently leads BT's contribution to the Manchester-based CityVerve IoT smart city programme and he co-wrote the Hypercat IoT standard. John has authored over 80 scientific publications and is the inventor of several patents. He is a co-author of the Hypercat IoT data catalogue specification. He is a Fellow of the British Computer Society and a Chartered Engineer. He holds a PhD in Artificial Intelligence from University of Essex, UK.

How did you develop an interest in the application of semantic technology and Internet of Things? How long have you been working with these issues?

– I began my research career at around the time the Worldwide Web was emerging in the mid-1990s. I was interested in knowledge management and information retrieval and, with a doctorate in artificial intelligence (specifically, logic-based knowledge representation), the idea of using logic (e.g. OWL) to make web-based information more amenable to machine processing was very interesting for me. This was the cetrnal idea of semantic wev technology. More recently, we have seen the emergence of the Internet of Things. Although the idea of the Internet of Things has been around for a couple of decades, more recently IoT technologies have become much more cost effective and practical due to the falling cost of components and miniaturization and the number of IoT devices is growing quickly. My particular area of interest in IoT is at the “information layer” and the provision of information platforms for the multiple heterogeneous device types that occur in Smart Cities and other IoT arenas. The challenge is to make it easier to both publish and consume data and to support an ecosystem of multiple data providers and consumers. In this way, the barrier to participation in the IoT ecosystem can be lowered, thereby fostering innovation and achieving economies of scale.

You are collaborating in Manchester-based CityVerve IoT smart city programme, Could you provide us more information about these institutions?
– CityVerve is the UK’s smart cities demonstrator, based in Manchester. CityVerve was established in July 2016 with a two-year remit to demonstrate the capability of Internet of Things (IoT) applications and address barriers to deploying smart cities, such as city governance, network security, user trust and adoption, interoperability, scalability and justifying investment. CityVerve is being delivered by a consortium of 21 organisations from the public, corporate, SME and academic worlds.
– CityVerve is delivering a ‘platform of platforms’ – a technology layer that will create a secure ‘catalogue’ of data that can unite applications. This is enabling the intelligent collection, interpretation and use of data, coupled with a flexibility to accommodate the growing and ever-changing needs of a dynamic city. As such, CityVerve is designing and implementing a Programmable City API offering uniform access to a wide range of city data. Instead of trying to create a single limited and unscalable data engine, by copying data from multiple platforms, we are deploying a simpler, unifying layer that sits above our existing hubs and platforms and provides a single means of access to an unlimited set of data sources. We refer to this as our ‘platform of platforms’, which brings together the BT’s IoT Data Hub, the Cisco Smart+Connected Digital Platform, Asset Mapping’s Building Management System and others.
– Key to this multiple platform approach is Hypercat – a specification which provides a machine readable data catalogue for the IoT data for each platform. Hypercat is in use in CityVerve and a number of other projects and initiatives in the UK and elsewhere. Hypercat promotes data interoperability between data platforms by providing a common way of interrogating platforms regarding the data they hold, the twems and conditions on which that data is available and the means of accessing the data.
– On this platform, CityVerve has selected and is creating 20 use cases over the course of the project, focused around three application areas: Travel & Transport, Health & Social care, and Energy & Environment.

What motivated you to join the VICINITY Statkeholder Advisory Board?
– It is always interesting to get a view of initiatives related to your own work and in the case of VICINITY I felt the consortium was a strong one likely to be doing interesting work!

What is your area of interest in VICINITY and how do you think to contribute to the project?
– When I heard about the VICINITY project, I was very interested in the emphasis on semantic data interoperability and the potential link to the Hypercat work I mentioned above.
– I think the VICINITY peer-to-peer approach has real potential and certainly I share the belief that lack of interoperability is an important barrier to achieve integration of IoT ecosystems between different verticals, vendors and standards.
– In fact, myself and my team at BT are now discussion with the VICINITY team at UPM regarding opportunities for collaboration.

What is, in your opinion, the ultimate goal expected to be achieved with help of VICINITY solution?
– As I touched on above, I believe one of the major challenges in IoT is to increase interoperability. A recent McKinsey report estimated that 40% of the potential value of IoT was dependent on interoperability. VICINITY is a project with the potential to deliver some very interesting research and development in this regard, by making it easier for ioT nodes to interoperate in a peer-to-peer fashion.

How much do users know about IoT and how VICINITY will change conventional approach?
– I am finding that users are increasingly aware of IoT and very interested in the business, social and environmental benefits it can deliver. VICINITY will be an important step in moving towards IoT ecosystems where a broad range of data sources can be accessed more easily. This will move away from the more silo-based approach today with its limitations and will help to maximize the value we can extract from the multiple and heterogeneous IoT data sources that are becoming ever more available.

The VICINITY ontologies and the Thing Description vocabulary from the W3C Web of Things WG

Recently, the Web of things Working Group from the W3C has published three First Public Working Drafts. One of this documents is the "Web Of Things (WoT) Thing Description", which presents a formal model for a common representation for Thing Descriptions in the WoT context. This document includes a vocabulary definition to represent the thing description by means of classes and properties using semantic web technologies. Such vocabulary and the provided implementation have been derived from the VICINITY WoT ontology, which has been adapted and renamed to fulfill the working group needs.

The current TD (Thing Description) vocabulary included in the First Public Working Draft document is depicted in Figure 1, while the current version of the VICINITY WoT ontology is shown in Figure 2. As it can be seen, the VICINITY platform needs a broader range of definitions and relations in the vocabulary; however, there is a common core shared between models. While currently there are two implementations of the models, the future plans for the VICINITY WoT ontology are to deprecate redundant elements and fully align with the TD model once it is published as a stable version.

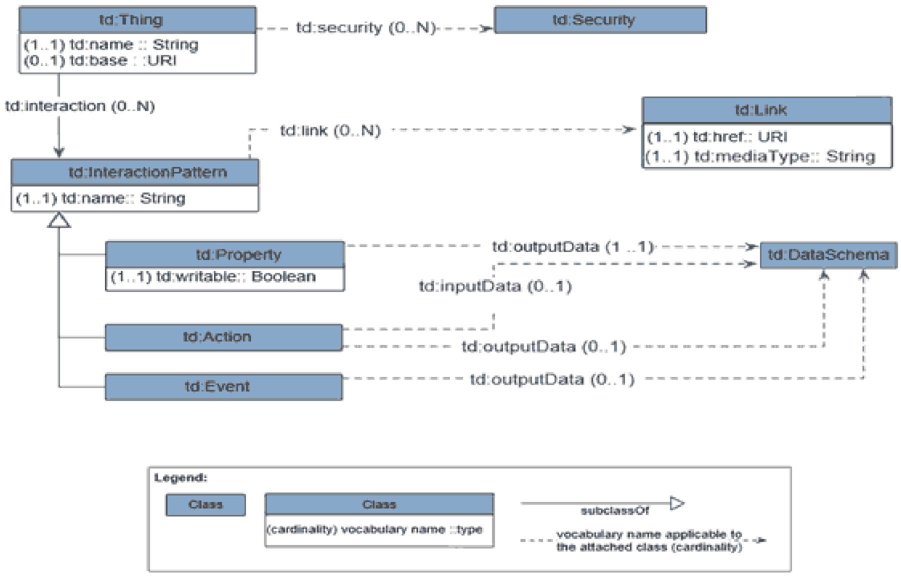


Figure 1*: TD core model. Figure taken from https://www.w3.org/TR/wot-thing-description/#vocabularyDefinitionSection.*

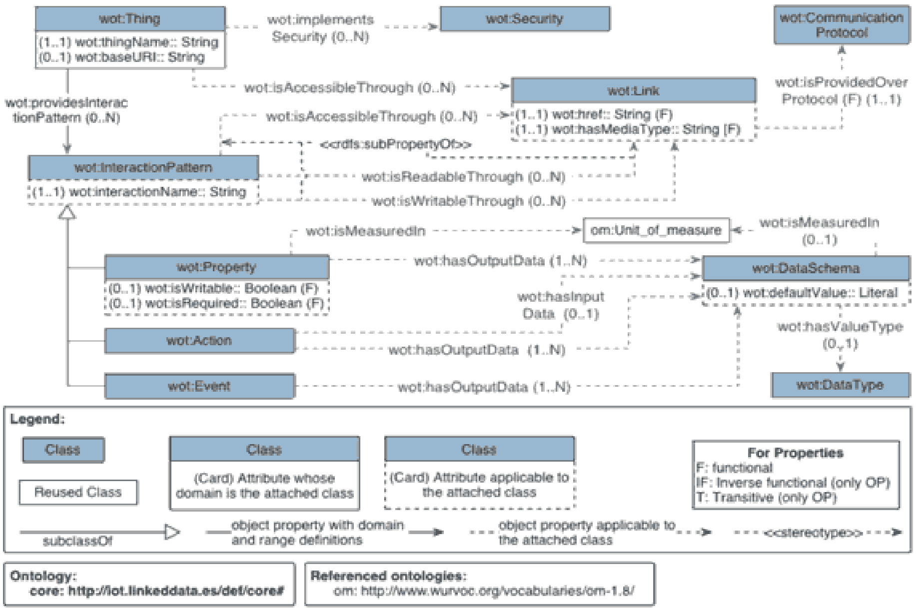


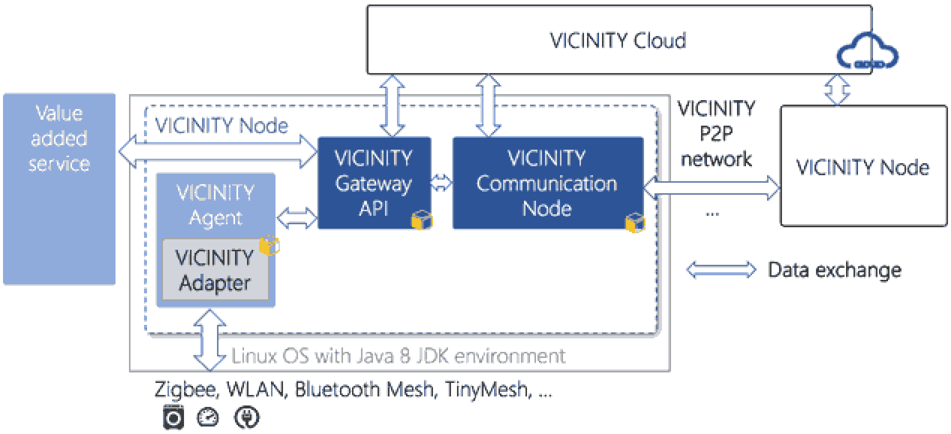
Figure 2: *VICINITY WoT ontology. Figure taken from http://iot.linkeddata.es/def/wot.*

This collaboration among VICINITY and the W3C WoT WG, not only benefits the interoperability between the WG specifications and the VICINITY outcomes but also speeds up some processes as the ontology requirement specification for the WoT ontology, since the requirements for such model have been taken from the WG current practices document.

Open Interoperability Gateway API

The VICINITY Open Interoperability Gateway API is entry point for integrated IoT infrastructures and Value-added service to access interoperability services provided by VICINITY. Moreover, the Gateway API facilitates an exchange of data between an connected IoT infrastructure and Value-aded services. These interoperabilityservice provided in VICINITY Peer-to-peer are accessible through easy-to-use REST API (extendible in future to support other technologies such as MQTT or CoAP) The exchange of information is secured by authentication and encryption services. The VICINITY Gateway API utilizes a VICINITY Communication Node (which is bundled into the same installation) with a set of technologies that makes the data transfer possible even in case when an IoT ecosystem resides behind NAT.

>From the deployment point of view, the VICINITY Gateway API is very flexible. It can run on any device that supports Java 8 runtime environment, on the same machine as the VICINITY Agent or remotely, with low overall system requirements. While the default configuration values are suitable for most installations, it can be tweaked to fit almost any environment. Wide range of logging options provides potential integrator with sufficient information about the status of the Gateway and its modus operandi, while administrators benefit from relevant security information.



Analysis of Standardisation Context and Recommendations for Standards Involvement

Standardisation is an amazing thing - without standards you can't generate a global market for any product or service and IoT is no exception. If the sensors, devices, gateways, servers and apps can't communicate effectively with each other then there will be no global market for the IoT and profitability for any individual component will be much harder to come by.

In the VICINITY project we've carried out a survey of the IoT Standards landscape including the stakeholder, business and pilot requirements and the architecture that the project intends to use. These have been consolidated these into a set of overall standards requirements. We've also identified the standards bodies that are developing standards relevant to these requirements. Then we identified the standards involvements of all VICINITY partners and compiled a standards action table identifying which partners would make contributions to the most important standards bodies over the life of the project.

An example of our proposed standards involvement includes contributing the VICINITY requirements on the Semantic Sensor Network ontology to W3C (WorldWide Web Consortium) so that these are aligned with the models developed by VICINITY to represent sensor, spatial and temporal data. Another example is that we will contribute to the development of the SAREF (Smart Appliances REFerence) ontology in ETSI to align it with the VICINITY ontology models being used for domains such as Smart Buildings, Smart Energy and e-Health. We'll let you know how successful we have been in a future newsletter.

VICINITY Integrated Prototype Demonstration in Brussels

On 1s of September, VICINITY present the first publically demonstration of Interoperability as a Service.
The scenario is about offering active demand-response service to AAU Micro Grid Simulation and allowing to control remote non-critical loads (such as lights, HVAC, kitchen appliances etc.) to maintain self-sustainability bases on battery State-of-Charge.

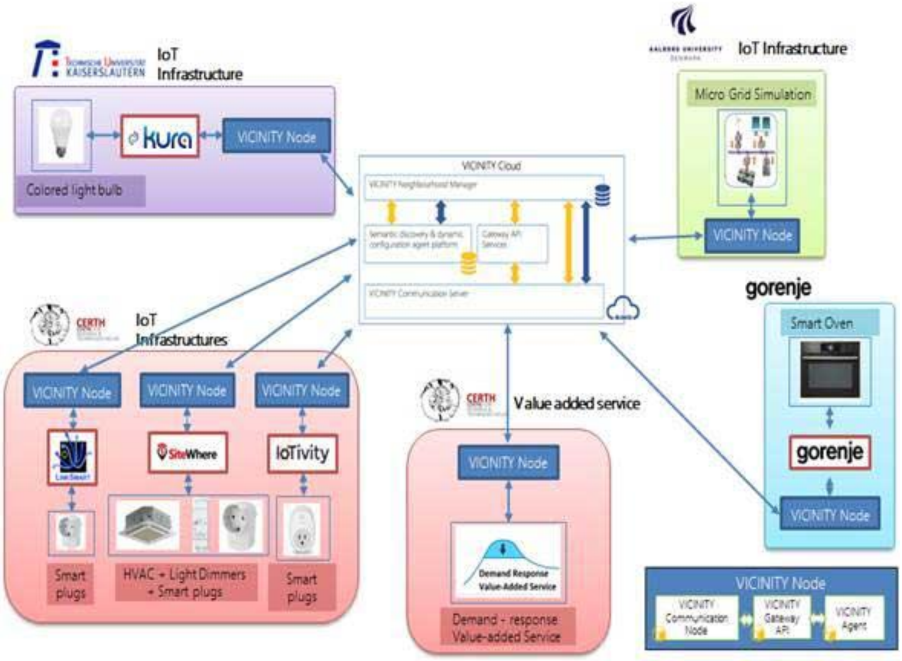


***Figure 3**: Integrated scenario of VICINITY prototype for Review M18.*

<u>**CERTH Value Added Services and Smart House Lab, Greece**</u>

CERTH's role in the first integrated VICINITY prototype demonstration was two-fold: on one hand, CERTH test lab facilities were utilized allowing the integration of 3 different IoT platforms and a number of connected sensors and actuators, while on the other hand a value-added service was created in order to allow the demonstration of a business case presenting an example of a potential commercial service on top of VICINITY.

CERTH test lab infrastructure consists of three IoT platforms: LinkSmart is deployed at CERTH/ITI main offices Building, while SiteWhere and IoTivity are deployed at CERTH Smart House lab facilities. Several integrated sensors and actuators (such as environmental sensors, HVAC, lights, smart plugs etc.) were part of the demonstration, creating a real-working environment.

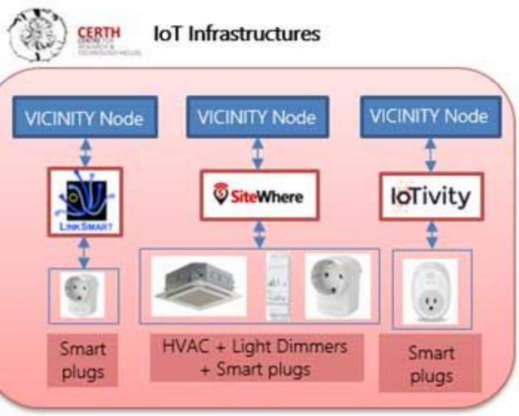


***Figure 4**: CERTH test lab infrastructure.*

The three IoT platforms were integrated through respective VICINITY Node components that were deployed on site, allowing the integration to the VICINITY cloud services and the remote demo sites. The demonstration scenario involved the decrease of consumption of some controllable loads (such as lights, air-conditioning, coffee maker, fan etc.) in an Active Demand Response scheme.

Figure 5: *CERTH Smart House lab facilities.*

A **Value-Added Service** was implemented in order to demonstrate how an Active Demand Response service could be provided to a micro-grid operator (in our scenario implemented by Aalborg University micro-grid lab) to offer remote monitoring and control of building assets, integrated through participating IoT objects. The business logic behind the implemented value-added service was based on the current occupancy and environmental conditions detected in the Smart House. Based on these conditions, Aalborg micro-grid requests a reduction of the energy consumption (based on the Stage of Charge (SoC) of the micro-grid batteries) by either switching off devices, if the house was empty, or reducing energy consumption by reduce air-conditioning set temperature or dimming-down some lights, if the house was occupied.

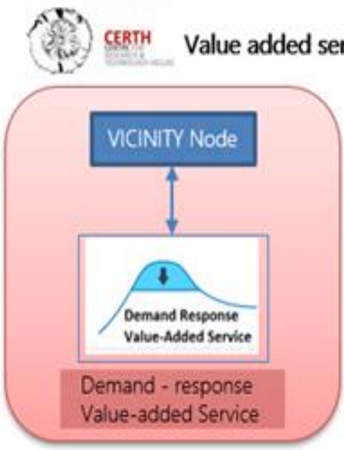


Figure 6*: CERTH Value-Added Service.*

Implementation of VICINITY adapter for Gorenje appliances, Slovenia

Gorenje approach to VICINITY is to use its own existing cloud infrastructure (CLP), which connects Gorenje's smart appliances, and connect it to the VICINITY platform. To connect both infrastructures, Gorenje introduced a dedicated server, called Gorenje VICINITY server, which is used as a bridge between both infrastructures.

Gorenje VICINITY server is a platform, which runs Open VICINITY Gateway API, together with VICINITY Agent (provided by VICINITY) on side, contains an implementation of VICINITY Adapter and implements CLP agent on the other side. In these terms, VICINITY Adapter is used to translate VICINITY requests into CLP requests and vice-versa.

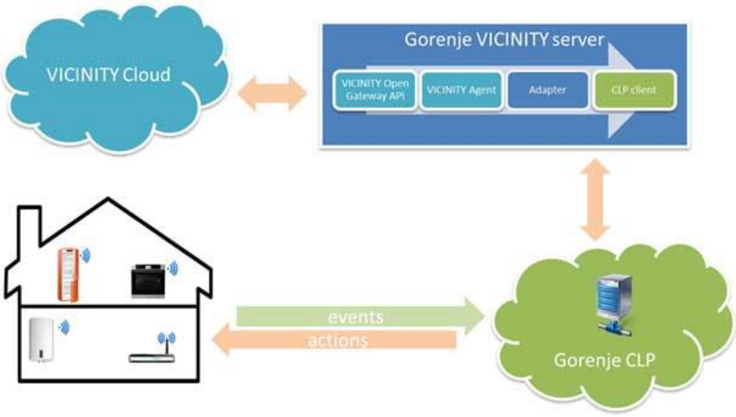


Figure 7: *VICINITY adapter implementation for connecting Gorenje smart appliances.*

Smart appliances are connected to Gorenje CLP cloud. They are receiving and executing various actions from controlling mobile application via CLP. At the same time, as some parameter is changed, this event is immediately sent to CLP, which consequently holds smart appliances latest statuses. From CLP point of view, Gorenje VICINITY server (and the corresponding VICINITY platform behind) is introduced as another controlling mobile application.

Bringing those two worlds together, one can identify two scenarios of message flow. The first one represents firing an action on the target appliance – the message comes from VICINITY platform to Gorenje VICINITY server, where it is transformed to CLP message and sent to CLP, which forwards this message to the target appliance, which consequentially executes the required action. As soon as the message is received on the target appliance, the appliance immediately responds to CLP about successfully receiving the message, although action is still not being performed. The actual result of performing an action is visible in time, by sending events to the CLP, which holds parameter values with states that witness that action actually took place.

The second scenario is when VICINITY platform queries specific parameter. The message once again comes from VICINITY platform to Gorenje VICINITY server, where again it is transformed to CLP message and sent to CLP. Since CLP holds connected appliance's latest status, it immediately responds to Gorenje VICINITY server, without event contact the target appliance. CLP response is then transformed into VICINITY response and reported back to VICINITY platform.

<u>bAvenir - VICINITY prototype and Open Gateway API, Slovakia</u>

bAvenir provided prototype to demonstrate building process of a social network in virtual neighbourhood thorough partnership and sharing of devices in VICINITY Neighbourhood Manager. Second objective was to demonstrate its integration of social network into VICINITY P2P network through VICINITY Communication Server and facilitate data streams between integrated partners based on social relationships in virtual neighbourhood using VICINITY Open Gateway API. Third demonstration objective was to show simplicity to connect IoT infrastructure into VICINITY through generating simple pair of credentials in VICINITY Neighbourhood Manager and updating the configuration of VICINITY Adapter secure connection to VICINITY P2P network. The prototype consists of the VICNITY Neighbourhood Manager, VICINITY Communication Server VICINITY Communication Node and VICINITY Open Gateway API.

UNIKL Testing Lab, Germany

For the demonstration, UNIKL has provided a Rasperry PI based Gateway running KURA (OSGI based IoT middleware) that provides interoperability at lower levels of communication. The KURA software was modified by UNIKL to connect via an adapter to the VICINITY interoperability gateway. In the demonstration, it was connected via ZigBee with two Hue light bulbs that could then be controlled by the VICINITY interoperability gateway.

Aalborg University IoT Microgrid Lab, Denmark

AAU infrastructure is a real time experimental platform-based PV/wind/battery hybrid islanded microgrid. The hybrid islanded microgrid infrastructure consisted of two Danfoss 2.2 kW inverters, a grid simulator, a real-time dSPACE1006 platform, a resistive load, adapter, agent services, and VICINITY gateway. A microgrid energy management system (EMS) is developed for substation monitoring, operation optimization, power generation and load consumption forecasts.

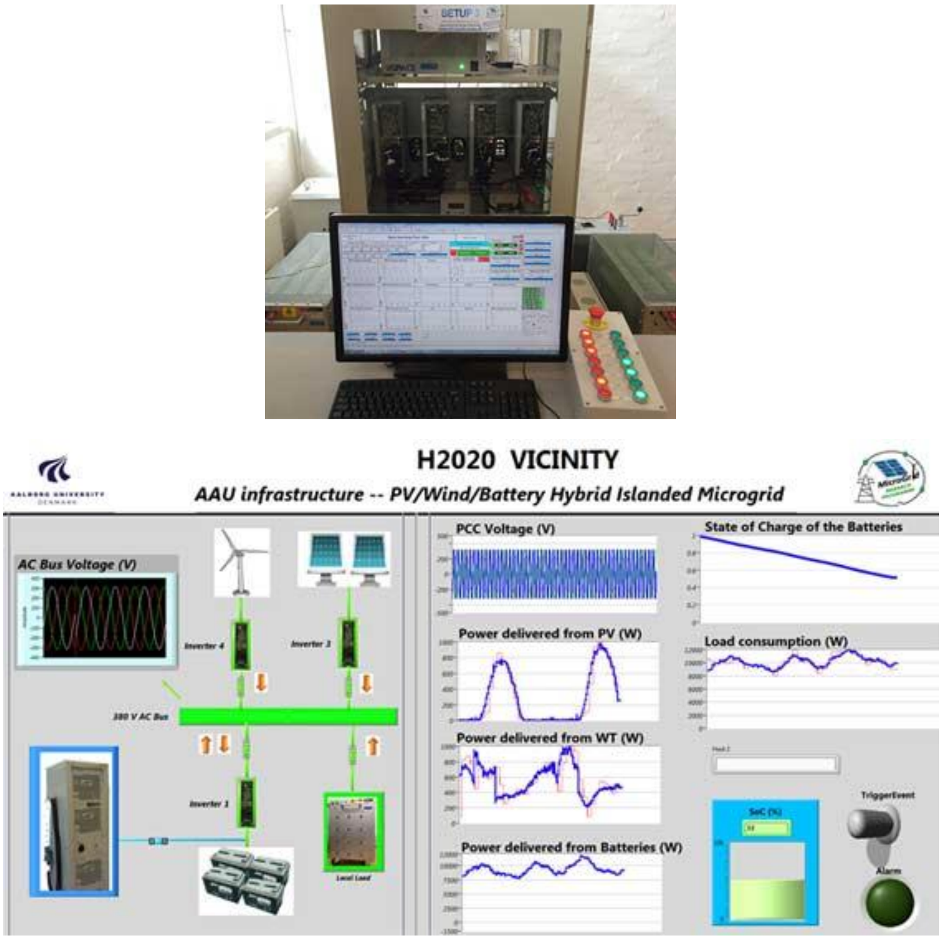


Figure 8: AAU microgrid experimental setup and GUI of energy management system.

We assume that the hybrid microgrid not only supplies power to the local critical load, but also delivers electricity to virtual neighborhood. According to the power generation and load consumption forecasts, a non-critical load scheduling event will be trigged from AAU infrastructure to CERTH Value-Added Service through VICINITY Cloud when the state of charge of batteries is less than 50 % in order to avoid deep-discharge of the batteries and to maintain sustainable power supply to local critical loads.

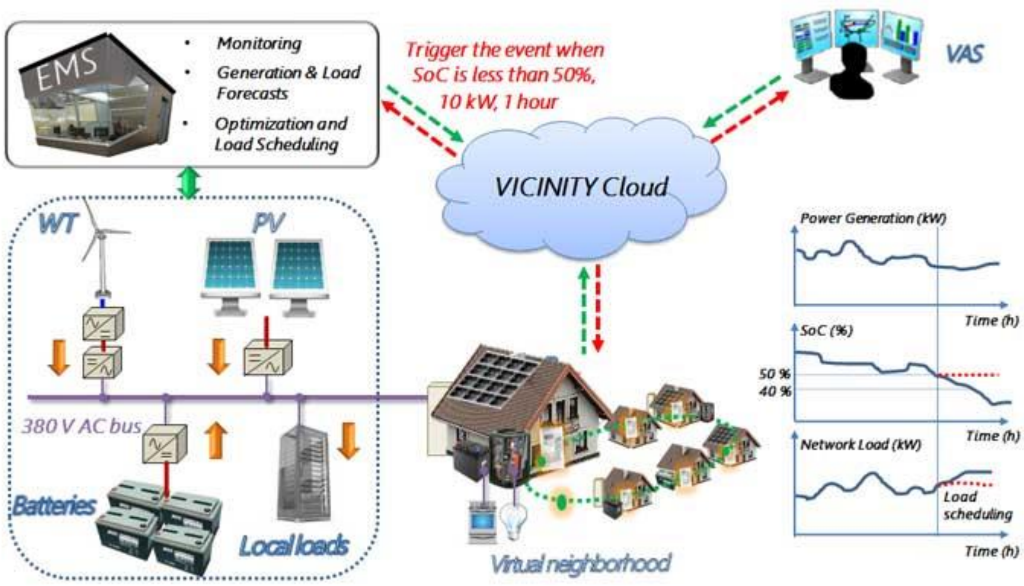


Figure 9: *AAU Infrastructure – PV/Wind/Battery Hybrid Islanded Microgrid.*

Reviewer comments

Overall assessment: Project has fully achieved its objectives and milestones for the period.

General comments: Since the last interim review held at month 9, the project has made a good progress, especially impressive in technical terms. This progress is not yet fully reflected in the deliverables due by month 18, but was well evidenced during the review meeting. During this reporting period, the project has completed WP1 on stakeholders, requirements and specifications. WP2 on platform, standards and semantic modelling is still running, but major work on specifying platform and standardisation is completed, Modelling and requirements work is still ongoing so that requirements can be updated if needed. Several other WP 3, 4, 5, 9 and 10 have started and are running. WP6, 7 and 8 have not yet started.

Scientific and Technical Publications

- “Conditional Random Fields - based approach for real-time building occupancy estimation with multi-sensory networks”, Stylianos Zikos, Apostolos Tsolakis, Dimitrios Meskos, Athanasios Tryferidis, Dimitrios Tzovaras, *Automation in Construction*, 25 May 2016.

Milestones

- VICINITY Review Meeting in EU, Sept. 1, 2017, Brussels, Belgium.
- VICINITY first publically demonstrate was presented in IoT-EPI Reviews and Cluster Meetings, Sept. 28, 2017, Athens, Greece.

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