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Deliverable D7.3

Report on Buildings for Assisted Living Neighbourhood Installations

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[1] ***Deliverable Type:***
R: Document, report (excluding the periodic and final reports)
DEM: Demonstrator, pilot, prototype, plan designs
DEC: Websites, patents filing, press & media actions, videos, etc.
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Executive Summary

This deliverable is an important part to reach milestone 8 (Pilot installations completed) in WP 7 (On-site Deployment and Pilot Installations). The deployment and installation will allow the sensors to gather real-world information relevant to the use cases defined in D5.2 (VICINITY value-added services implementation framework). In addition, it will enable us to collect feedback from the End User on how well VICINITY replaces the traditional integration of IoT devices from different vendors. Combining the results from the two, we will have gathered enough information to illustrate what value VICINITY can bring to businesses and their software/hardware ecosystems.

The achievements can be described related to the methodology used and defined in the three phases: Pre-Installation, Installation and Post Installation. The objective to this deliverable is to summarize the installation work of Task 7.3 (Pilot Area Installation of Buildings for Assisted Living Neighbourhood Use Case); devices installed, infrastructure and Value-Added Services, in order to be able to demonstrate VICINITY as a platform for IoT devices:

Use Case 1.a.1 – Predictive Operation – the IoT door sensors have been installed in offices owned by CWi, at the premises of Hoegh Eiendom[1]. The End Users of this Use Case are the cleaning personnel from the cleaning & maintenance actor, Den Lille Hjelperen.

Use Case 1.a.2 – Resource Management – the IoT power sensors have already been installed by a company called BSTeknikk[2] prior to our involvement. The water sensors could not be accessed due to restrictions enforced by the Moss municipality. Access to one power sensor has been granted to us. The parking sensors have been installed at the Hoegh Eiendom headquarters in Oslo, in collaboration with the parking maintenance staff.

The installation went according to plan. The results were two running Use cases and an ongoing stream of feedback from the stakeholders and sensor data. There have been some deviations regarding the use of water consumption measurer for Hoegh Eiendom – the data access could not be provided due legal restrictions imposed by the municipality of Moss. Further deviations include:

Added more sensors for Use Case 1.a.1 – Predictive Operation from 2 other parties; 1 from the partner CERTH-GNOMON and 1 from an IoT development company – VITIR AS[3].

Ongoing replacement of Gorenje refrigerator with the power bank for electrical cars chargers for Use Case 1.a.2 – Resource Management.

[1] Real estate company. Owners of M6: Verket in Moss: https://hoegheiendom.no/
[2] Technical maintenance company working for Hoegh Eiendom: https://www.bs-teknikk.no/
[3] Healthcare Technology and Smart Buildings company specializing in IoT sensor systems: http://www.vitir.no/

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List of Definitions & Abbreviations

Abbreviation	Definition
API	Application Programming Interface
CEO	Chief Executive Officer
CWi	Coworking International
EC	European Commission
EL-car	Electric Car
EU	European Union
HQ	Headquarters
HVAC	Heating, ventilation, and air conditioning
IoT	Internet of Things
LoRa	Long Range (data communication technology)
MTCDT	MultiConnect® Conduit®
NM	Neighbourhood Manager
P2P	Peer to Peer
SME	Small and Medium-sized (enterprises)
VAS	Value-Added Service
WP	Work Package

1. Introduction

The aim of this report is to present the results for each of the demonstration site installations, as well as initial plans for each site to capture further roll-out of the pilot.

Milestones are set for each site which differ in the detail needed to meet the overall project milestone for installation, Month 39 (March 2019).

The goals of the implementation are to install physical IoT devices (hardware) and their connection to the VICINITY platform; and Value-Added Services that will be enabled through software and the VICINITY platform. Value-Added Services enable data to be shared and analysed at a community-scale, by VICINITY partners.

The work has been divided in three phases, each with different focus and workload.

Pre-Installation phase will focus on finding companies and convincing them to become a part of the deployment and testing processes.

Installation phase will focus on the actual installation activities and how to manage devices and infrastructure to be installed.

The Post-Installation phase will focus on continuously upgrades and testing. The stakeholder will play a big part in this phase by being the responsible for benefits and feedback to the Value-Added Services installed at the Pilot Site.

1.1. Context within VICINITY

The results of the implementations will be described based on agreed, common methodology and common plans specified in Task 7.1 (Pilot Area Installation Planning). The pilot sites will then install and deliver their solution as described in WP 7 (On-site Deployment and Pilot Installations) and tested in environment which includes stakeholders such as operators and users.

Four pilot sites will be connected to the VICINITY platform to demonstrate benefits to users in terms of new functionality and improved development efficiency. The presence of real-life stakeholders greatly enhances the chances of further exploitation both locally and through worldwide dissemination of results.

The common methodology and plans will help the pilot sites install and deliver their technologies, which are described in WP7 (On-site Deployment and Pilot Installations), Tasks 7.2 (Pilot Area Installation of Smart Energy MicroGrid Neighbourhood Use Case) to 7.5 (Pilot Area Installation of eHealth at Home Use Case).

The overall links between the different Work Packages are shown in Figure 1.

1.2. Objectives in WP 7 and Task 7.3

The objective of WP 7 (On-site Deployment and Pilot Installations) is to plan, install and report the actions taken to have a Pilot Site running with devices and VICINITY platform. The plan and methodology used are described in detail in D7.1 (Pilot area installation methodology & planning).

D7.3 (Report on Buildings for Assisted Living Neighbourhood Installations) will describe the work in details and results of the installation work at the Oslo Pilot Site.

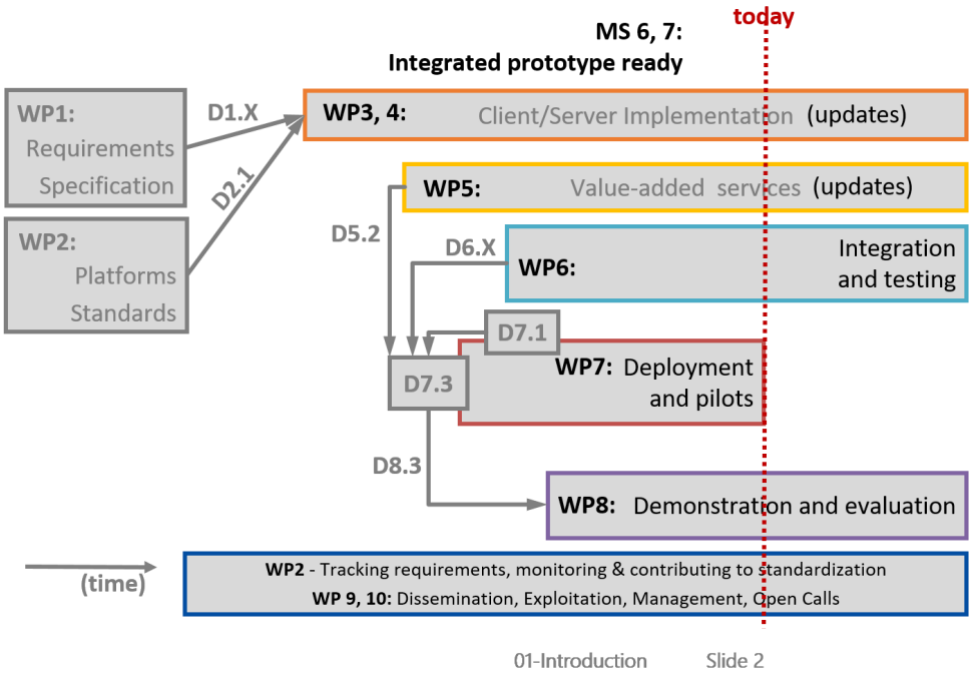

Figure 1 Overall diagram of the link between the different Work Packages

Table 1 Overall diagram of the link between the different Work Packages

Work Package/Task	Description
WP7	- To get input from WP6 (Integration & Lab testing) and provide the detailed planning for pilot installations on a larger scale at real world demonstration pilot sites, for evaluation and demonstration of the VICINITY framework - To perform the actual installation and integration of the identified IoT devices per Use Case to the VICINITY platform and to deploy the Value-Added Services, implemented in WP5. To establish the pilot test and evaluation infrastructures required for the most effective evaluation in WP8 (Pilot Demonstration and Overall Evaluation) - To integrate the VICINITY platform to operate correctly from a technical perspective for Pilot Area Installation of Intelligent Transport & Parking Use Case at the pilot sites in Tromsø, Norway.
D 7.3	Summarize the installation work of Task 7.3 (Pilot Area Installation of Buildings for Assisted Living Neighbourhood Use Case). Account for any deviations in devices installed, infrastructure and Value-Added Services

1.3. Structure of the Deliverable

Chapter 1: An introduction illustrating the aim and the scope of the deliverable.

Chapter 2: A short overview of how the deliverable has been carried out.

Chapter 3: A brief summary of each use case and their respective components

Chapter 4: Pre-installation: Defines the stakeholders and their involvement in use cases

Chapter 5: Installation: Describes in detail the composition of the two use cases. Explains the steps taken during the installation of their respective components.

Chapter 6: Post-installation: Evaluates the functionality and maintainability of installed and deployed use cases.

Chapter 7: Conclusive summary of the achieved results

2. Methodology

The methodology has been defined in WP7 (On-site Deployment and Pilot Installations) – D 7.1 (Pilot area installation methodology & planning). The installation is divided in three phases: Pre-installation, installation and post-installation. The originally acting waterfall model had to be replaced in favour of agile development. The main reason for this change was the everchanging nature of the project. The state of issues that VICINITY attempted to address for the stakeholders was constantly subject to change. Thus, a heavily plan-oriented model such as "the waterfall model" would only serve as an additional overhead in terms of keeping the plan up-to-date. The agile development, on the other hand, gave us a better ability to handle unexpected deviations and thus it had saved us time and resources.

Privacy

The phone number used for SMS notification can only be supplied through an admin settings control panel. The access to the admin control panel is given during the physical meeting between us and the third party, under which the third party is informed about how the phone number is used and a consent is collected. The third party is also informed about how to delete the personal information at any time.

Phase 1: Pre-installation

The Pre-installation phase was designed to let the responsible partner plan and map their actual devices to be installed. Each Pilot Site described a hardware catalogue were details of the devices were detailed.

If the installation needed special personnel was needed, that was also to be a part of the plan.

Phase 2: Installation

The Installation phase was the actual activity to install and implement all the devices according to the hardware catalogue with the necessary personnel at work.

The implementation of the Value-Added Services will be addressed in Task 5.2 (Implementation of Value-Added Services) and the different pilot sites will implement and test accordingly.

Phase 3: Post-installation

The last phase was designed to test and verify the different devices and confirm the necessary functionality requested. This activity will be a continuously phase until the project is ended if devices needed replacement or upgrades.

3. Description of the Pilot Site

VICINITY platform will be demonstrated at the M:6 co-working space in Norway. M:6 provides open plan co-working space as well as traditional office spaces. Their aim is to provide a unique environment where people from different companies can share knowledge and inspiration from each other. M:6 is operated and managed by CWI. They are eager to incorporate new technologies that can improve daily work and management of the building. The Pilot Site will also demonstrate how existing infrastructure can be integrated with VICINITY and combine information to improve quality of work or be able to use information from smart devices to gain effectivity and customers satisfaction.

To illustrate the integration of different sensors the Use Case 1a.1 will demonstrate a solution combining different sensors from different suppliers.

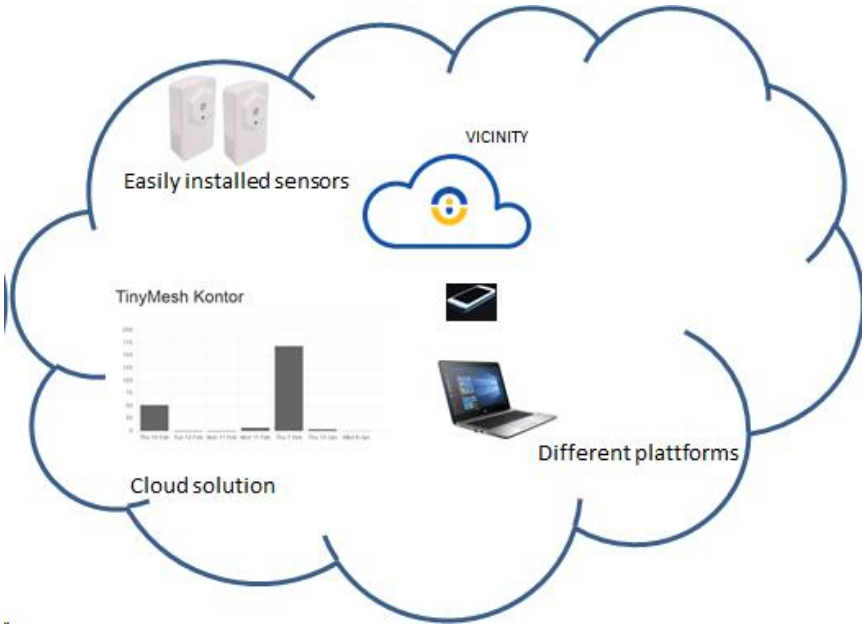

Figure 2: Use Case 1a.1 door sensors

To demonstrate integration of infrastructure, Use Case 1a.2 will integrate the existing infrastructure for Hoegh Eiendoms HVAC (*Heating, ventilation, and air conditioning*) solution and VICINITY.

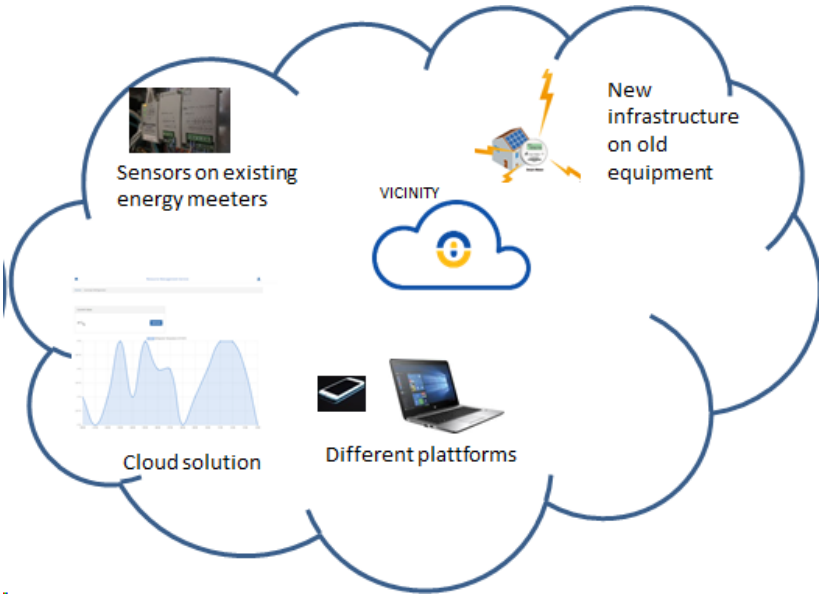

Figure 3: Use Case 1a.2 energy meters

3.1. Use Case 1a.1 – Predictive Operations

The goal of Predictive Operations is to improve efficiency and help cleaning staff to do their job easier. This is achieved by monitoring room usage using door sensors that track number of visits to each room. When number of visits reach pre-defined threshold, a notification is sent to the person responsible for the cleaning. Another feature of the Predictive Operations service is that it provides nice visual history of performed cleanings of each room and how many visits a room had before the cleaning as well as any comments from the cleaning staff. Predictive Operations use case integrates door sensors from several suppliers to demonstrate how VICINITY helps with the integration process of a device of the same type, but from a different supplier.

Use Case 1a.1 is composed of

- Value Added Service
- Adapters for various door sensors
  - Tiny-Mesh door sensors
  - CERTH door sensors
  - VITIR door sensors
- IoT Devices
  - Tiny Mesh door sensors
  - CERTH door sensors
  - VITIR door sensors
- Stakeholders
  - CWI M:6 (Office owners)
  - Lille Hjelperen (cleaning company that does cleaning in the office)

3.2. Use Case 1a.2 - Resource Management

Use Case 1a.2 is composed of

1. Value-added Services
    a. Resource Management
2. Adapters for
    a. IWMAC
    b. PNI[4] PlacePod
3. IoT Devices
    a. Gorenje Refrigerator
    b. IWMAC power sensor
    c. PNI PlacePod Parking sensor
4. Stakeholders
    a. Hoegh Eiendom AS (Building owners, Parking facility owners)
    b. M:6 – CWi (Office owners)

Water sensors from IWMAC will not be a part of Use Case 1a.2 due to legal reasons in Moss municipality.

Through many different vendors and types of devices, the goal of Use Case 1a.2 is to demonstrate how VICINITY facilitates the speed of integration of IoT devices in ecosystems, and the ease of scalability. The aforementioned is achieved through input to IoT devices based on the output of other IoT devices. The temperature of the Gorenje refrigerator is automatically adjusted based on a pre-defined threshold for power consumption.

The future step is to replace the dependent variable – the Gorenje IoT fridge – with a power bank of an EL-car charger. Instead of controlling the refrigerator, based on power consumption read from the IWMAC power sensor, the power bank will limit the storage of energy if

1. The car is not present, or is not expected to arrive soon based on historical data
2. Power consumption threshold has been passed.

[4] PNI is a US-based corporation that specializes in precision location and motion tracking sensor development: https://www.pnicorp.com/

4. Pre-Installation Phase

Before the installation, we had to get in touch with firms willing to take part in the testing process. The stakeholders would have to be involved at different stages of the installation/deployment. Therefore, it was important to find the right type of firms that would have both time and motivation.

4.1. Involvements of the stakeholders.

The Oslo pilot site is at the building "M:6 Verket" owned by Hoegh Eiendom and rented and organised by Coworking International (CWi:M6) who see business benefits in participating in the VICINITY project, and an opportunity to gain considerable insight into the IoT landscape and future IoT developments.

HÖEGH EIENDOM

The building is owned and operated by Norwegian real estate owner and developer Hoegh Eiendom. Hoegh Eiendom were involved from an early start. For the privilege of getting hands-on experience with VICINITY, along with the value brought by the Value-Added Services, Hoegh Eiendom agreed to let us deploy the hardware at their facilities. Managing a real estate portfolio of 350 000 square meters, Hoegh Eiendom strive to be among the most energy efficient and environmentally concerned actors in the Norwegian real estate sector. They have taken interest in the VICINITY project as part of their involvement in Smart Cities and Smart Buildings.

cwi
coworkinginternational

Coworking International[5] (CWi) rent the premises at M:6 Verket from Hoegh Eiendom to provide a Coworking Space for SMEs and start-ups. Therefore, it was natural for them to take part as well. They provide a professional business community where creatives and entrepreneurs can meet, grow, socialize and share expertise. A modern office space that stimulates innovation and business synergies between providers of different products and services. CWi's is currently growing in Scandinavia and Europe.

[5] Office renting company in Moss: https://www.cwi.no/

IWMAC[6] is a technology group based in Trondheim (NO) and Stockholm (SE). IWMAC develops, monitors and controls technical installations, mainly within heating, ventilation, cooling and freezer facilities. The company's vision is to be innovative and ambitious; to pioneer their industry sector. The incentive behind sharing their sensor data with us was to see how VICINITY would be able to extend the value of their sensor's raw data. In other words, it is as much of a test to them as it is for us. On top of that, the success of VICINITY could potentially expand their customer reach, let alone give them the competitive edge through close partnership with us.

Den Lille Hjelperen[7] is a small cleaning company with delivering services to private institutions, private homes and company buildings. By being small they need to be as efficient as possible and deliver reports and statistics to their customers.

Our door sensors, along with VICINITY, can increase their efficiency by providing an optimal notification solution. We told them that using VICINITY, one is not bound to one particular vendor. One of the goals of the VICINITY platform is to offer flexibility in terms of choosing a vendor (Discovery in Neighbourhood Manager). They were thrilled by the concept and were more than happy to test the use case after deployment.

BS Teknikk delivers automation electronic for HVAC (*Heating, ventilation, and air conditioning) and has a close collaboration with IWMAC: They are the main supplier for all automation installation at M:6.*

[6] Computer software development company, delivers web-based sensor control systems: http://www.iwmac.no

[7] Cleaning company: http://denlillehjelperen.no/

5. Installation Phase

5.1. Use Case 1a.1

5.1.1. Tiny Mesh Door sensors

Our sensor developed for this use case was installed at CWi:M6 office space. During the development of use case 1 it was decided that it was better to utilize existing sensors on the market rather than developing our own. After developing a new mesh protocol stack to support our custom platform, it turned out that using VITIR – which actually uses TinyMesh as a backbone in their installation site – was a much more effective and sustainable resource. In our exploitation plan we see VITIR as the most suited partner for further installation and product development.

5.1.2. CERTH Door sensor

CERTH has provided two door sensors for this use case. Only one is currently deployed. This was because of the way the doors are constructed in the office space of the CWi:M6. The plan was to use these sensors for meeting rooms in the office, but because of glass walls and very thin door frame the sensors proved to be unsuitable due to low aesthetic. However, one sensor was successfully deployed in the Tiny Mesh's office. The sensor was carefully mounted in such a way that it was less noticeable.

5.1.3. VITIR Sensors

Third type of door sensors used are from a company called VITIR. They provide a third-party door sensor and cloud-based API for getting information from the sensors. We have developed a VICINITY adapter to their cloud API so that devices they provide can be used through VICINITY. In Use Case 1a.1 we utilize 5 of the door sensors VITIR provides. They were installed on the toilet doors at the office so that the Value-Added Service can monitor usage and send notifications when toilets need to be cleaned.

Figure 4: VITIR Door Sensor

5.2. Use Case 1a.2

5.2.1. IWMAC Sensors

The installation of the power sensors and the water sensors had already taken place prior to TinyMesh's involvement with CWi:M6. The installation was done by the vendor in collaboration with BSTeknikk, and CWi. In December 2018, TinyMesh received access to one power consumption sensors.

Deviation

The water sensors are owned by the municipality of Moss and could therefore not be accessed due to legal reasons.

5.2.2. Gorenje Refrigerator

Gorenje refrigerator was initially installed by TinyMesh at its old office location. TinyMesh received the pre-configured IoT fridge from Gorenje in April 2018 and was quickly able to connect it to the office network. The IoT fridge was able to register its presence in the VICINITY cloud and appeared visible in the VICINITY Neighbourhood Manager shortly after. In August 2018, the refrigerator has been relocated to CWi:M6.

Figure 5: Gorenje refrigerator

5.2.3. PNI PlacePod Parking Sensor & MultiTech MTCDT Gateway

Unlike the Gorenje refrigerator, the MTCDT Gateway and the PNI parking sensors were not shipped pre-configured. The bundle was installed in February 2019 at the Hoegh Eiendom HQ in Oslo after a successful verbal agreement between TinyMesh and the CEO of Hoegh Eiendom AS. The parking sensor was configured in TinyMesh offices at CWi:M6 February 20, 2019 and mounted in the parking facilities of Hoegh Eiendom February 25, 2019 by Tinymesh and Hoegh Eiendom's certified technician.

Figure 6: Mounted PNI PlacePod parking sensor at Hoegh Eiendom

5.3. Hardware Installation

Table 2: IoT Hardware Installed

Device type and vendor	*Functionality*	*Number of installed units*	*Use Case*	*Location*
Power sensor IWMAC	Measures power consumption	1	2	CWi:M6 Moss
Gorenje refrigerator Gorenje	Refrigeration	1	2	CWi:M6 Moss
Parking sensor PNI	Tracks car Presence in a Parking spot	1	2	Hoegh Eiendom HQ Oslo
MultiConnect® Conduit® (MTCDT) **Gateway MultiTech**	LoRa communication with the parking sensors	1	2	Hoegh Eiendom HQ Oslo
Tiny Mesh Door Sensor	Sends events when door is opened and closed	1	1	CWi:M6
CERTH Door sensor	Sends events when someone enters or exits the room	1	1	CWi:M6
VITIR Door Sensor	Sends events with number of door openings each time a door is opened	5	1	CWi:M6

5.4. Value added services Deployment

Table 3: VASes, respective to each use case

Ref.	Value-Added Service Name	Version	Deployment
VAS 1a.1	Predictive operations	0.0.1	Deployed on TinyM server
VAS 1a.2	Resource Management VAS	0.0.1	Deployed on TinyM server

5.5. VICINITY Components Deployment

Table 4: Core VICINITY Node Components

VICINITY Component Name	Version	Deployment
VICINITY Gateway	0.6.3.1	Deployed on the server
VICINITY Agent	0.6.3.1	Deployed on the server

6. Post-Installation Phase

6.1. Use Case 1a.1

Deviation

When the Value-Added Service – Predictive Operations were designed, there was a prerequisite that there would be waste bins in each office, that the cleaners should empty.

CWi has introduced a common area for disposal of waste and each co-worker will sort their waste in to the right 'bucket' where recycle is possible. CWi strives to reduce its environmental footprint and therefore constantly looks for ways to be more environmentally friendly. This means that the need for a solution for predict waste removal is no longer needed.

Figure 7: Waste bins relocated to the common area at CWi

6.1.1. CERTH Door sensors

Only one sensor has been installed of the two sensors that CERTH have provided for this use case. The way doors are constructed in the meeting rooms prevented us from successfully deploying both sensors.

6.1.2. VITIR Sensors

All sensors were successfully deployed and are operational. These sensors do not require any physical maintenance. If any technical issues with API arise, they are handled by VITIR, and if there are any issues with VICINITY adapter for their devices then it's handled by TINYM.

6.1.3. TINYM Sensors

TINYM handles all maintenance of its own sensors both physically and digitally – if there are any issues with hardware, they are handled by TINYM and all issues are related to API and adapter are handled by TINYM.

6.2. Use Case 1a.2

6.2.1. IWMAC sensors

IWMAC sensors are currently being operated through a joint effort of CWi:M6 and BSTeknikk. The sensors are up and running, tracking their respective measurements on a 24/7 schedule, with an interval of minutes. The sensors have been reporting data as they should to TinyMesh's VICINITY IWMAC adapter since the first access time.

At the time of writing, there are currently 2 sensors that are shared with TinyMesh for the purpose of VICINITY. The sensor's data will be available through the VICINITY NM to the Hackathon hosted by bAvenir to promote creativity and demonstrate practical use of VICINITY.

6.2.2. Gorenje refrigerator

The IoT fridge is up and running at the CWi:M6 facilities. It is being physically managed by the office owners and maintained by its cleaning staff. The technical maintenance is done by TinyMesh on a weekly basis, along with remote assistance from the vendor – Gorenje – if necessary.

Testing has been done to ensure that Gorenje fridge correctly communicates with the NM and that they exposed endpoints actually allow the fridge to be controlled (temperature degrees).

6.2.3. PNI Parking sensor & MTCDT Gateway

The parking sensors are running on a 24/7 schedule and provide immediate reports when a car enters/leaves the parking place. The sensors are physically maintained by Hoegh Eiendom, while technical maintenance is done by TinyMesh remotely through the sensor's cloud control panel.

The sensors have undergone unit testing to ensure that the data transfer is integrous and reliable.

Conclusions

The installation at Oslo Pilot Site has been a continuous process to make sure that all stakeholders have been involved and that their ability to deliver business remained unaffected while the installations took place. The identified milestones and activities ensured a clear path towards achieving the necessary goals, while avoiding resource mismanagement. The building at Oslo Pilot Site was under development and was not ready for installation before August – which slightly, yet insignificantly, delayed the deployment. In the process of rehabilitation of the building, Hoegh Eiendom has been forced to make changes to their energy and HVAC solution to fulfil their obligations to the tenants and their owners. Despite all the delays, the demonstration of VICINITY has been fulfilled and the stakeholders have been able to manage their daily work and own project deliverables.

The stakeholders were committed to see the project come to life and some were very eager to contribute in any way they could. Hoegh Eiendom took full care of mounting the parking sensors. Hoegh Eiendom, CWi and Den Lille Hjelperen have been actively involved in giving feedback along the way with an outstanding level of detail, including suggested changes to optimize solutions, thus giving us the necessary input to improve the project.

Due to the everchanging nature of the project, the originally acting waterfall model had to be replaced by agile development. The new agile model provided less overhead in terms of premature planning, while yielding a clear benefit in manoeuvrability to tackle the unexpected. This resulted in a spawn of several deviations from the projects, however, the benefits of change were deemed necessary to retain the qualitative value that VICINITY. Ultimately, this decision was made to either keep the stakeholders interested (1a.2), or to account for an unforeseen change of events (1a.1).

7. References

[1] http://www.vicinity-h2020.eu

[2] ICT 30 – 2015: Internet of Things and Platforms for Connected Smart Objects - http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/914-ict-30-2015.html