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Deliverable D7.4

Report on Intelligent Transport & Parking Installations

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[1] ***Deliverable Type:***
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Executive Summary

This deliverable is an important part to reach milestone 8 in work Package 7 – "On-site Deployment and Pilot Installations".

The objective to this deliverable is to summarize the installation work of task 7.4 Pilot Area Installation. The achievements can be described related to the methodology used and defined in the three phases:

- Phase 1: Pre-Installation
- Phase 2: Installation and
- Phase 3: Post Installation.

Focus have been on implementing and installing the different infrastructure and hardware needed to realize the two main use cases; "Shared parking" and "Emergency parking". The Use Case consists of devices installed, infrastructure and Value-Added Services to be able to demonstrate VICINITY as a platform for IoT devices.

The pilot has experienced deviations due to lack of funding for proper development. A small deviation was also reported due to the parking sensors had to undergo a hardware upgrade. This has mainly affected the development of the mobile app. Some novel new ideas have been created as part of the pilot; most notably innovative ways of using smart appliances as early warning devices. All equipment has been acquired and installed at the pilot site as planned, and value-added services implemented and deployed at HITS server.

The stakeholders such as representatives from residents, carers/operators of the care service and Tromsø municipality were focused on confidentiality due to the sensitive nature of the social care centre. The pilot site has for that reason been careful about revealing too much info about privacy in the platform under development. The test has therefore been conducted in the social activity room where stakeholders are present 24/7.

Table of Contents

List of Tables

List of Figures

List of Definitions & Abbreviations

Abbreviation	Definition
EC	European Commission
EU	European Union
P2P	Peer to Peer
GDPR	General Data Protection Regulation
DoA	Description of Action

1. Introduction

The aim of this report is to present the results of the demonstration site "Intelligent Transport and Parking Installations" in Teaterkvarteret in Tromsø, Norway, as well as initial plans to capture further roll-out of the pilot.

Milestones are set 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 (VAS) that will be enabled through software and the VICINITY platform. VAS 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.

- **Phase 1: Pre-installation** Phase focused on the preparation stages for the development of the installation.
- **Phase 2: Installation** phase focused on the actual installation activities and how to manage devices and infrastructure to be installed.
- **Phase 3: The Post-Installation** phase focused on continuously upgrading and testing. Stakeholders such as representatives from the residents, carers and Tromsø municipality played a substantial 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. The pilot sites will then install and deliver their solution as described in Work Package 7 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, benefits and efficiencies. The presence of real-life stakeholders (service users and service providers) 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 Work Package 7, tasks 7.2 to 7.5.

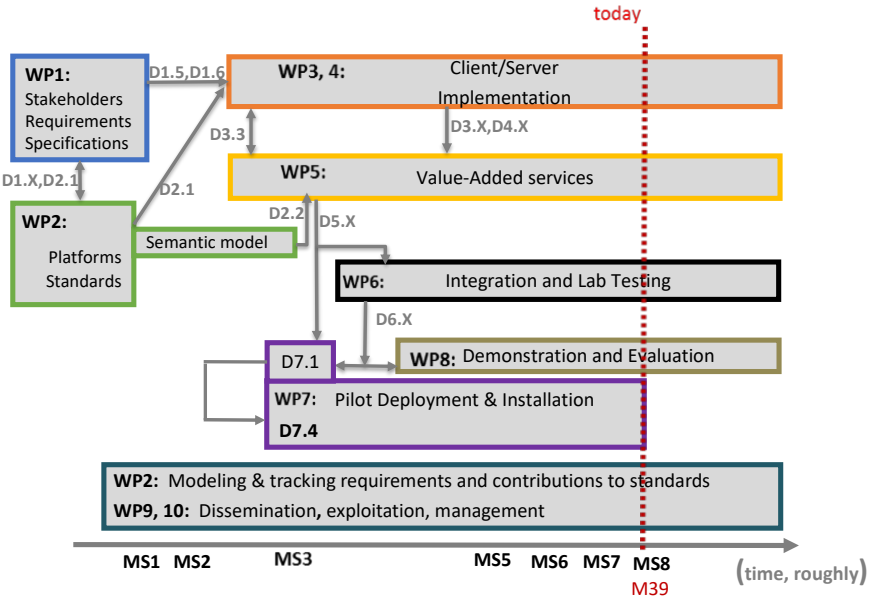


Figure 1: Overall diagram of the link between the different Work Packages

1.2. Objectives in Work Package 7 and Task 7.4

The objective of Work Package 7 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 Deliverable D7.1 “Pilot area installation methodology and planning”.

This deliverable (D7.4) will describe the work in detail and results of the installation work at the Pilot Site in Tromsø.

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 • 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.
D7.4	T7.4 Description of the pilot "Pilot Area Installation of Intelligent Transport & Parking Use Case" deals with in-house parking with connection to apartments for assistive living. The first is Edge case testing to validate the expected prototype performance when close to the edges/limits according to the requirements detailed in WP1. The second kind of Edge testing focuses on functionality and performance, including cross-domain testing scenarios, in line with value-added services defined in WP5. The diagnosed problems during the on-site testing process are discussed and resolved by collaboration among partners to improve and enrich VICINITY prototype functionality.

Table 1: Work package descriptions

2. Methodology

The installation is divided in three phases: Pre-installation, installation and post-installation (from D7.1 “Pilot area installation methodology and planning”).

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 where details of the devices were detailed.

This also included identifying personnel that were assigned specific tasks on site.

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 VASs is addressed in Task 5.2 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 requested functionality. This activity will be a continuous phase until the project is ended if devices need replacement or upgrades.

3. Description of the Pilot Site

3.1. HITS Pilot Teaterkvarteret, Tromsø

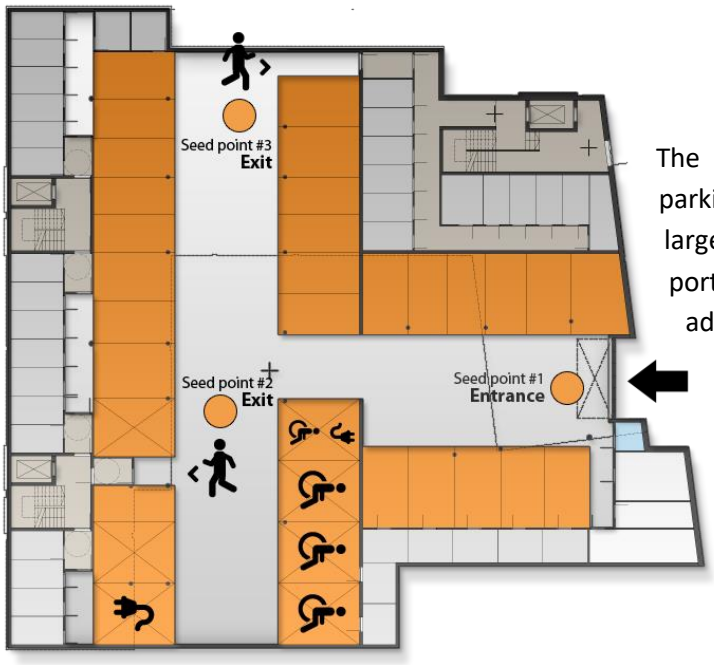
The pilot site is located at Teaterkvarteret in Tromsø, Norway.

Figure 2: Location of VICINITY pilot – Teaterkvarteret in Tromsø, Norway

Figure 3: Teaterkvarteret 1. akt (source: teaterkvarteret.no)

Teaterkvarteret is part of a complex consisting several buildings (Figure 3), each containing 10 – 24 apartments (Figure 4). Each building is owned by a cooperative and the building residents form part of the pilot stakeholders. 10 of the apartments are allocated disabled people or persons in need of care. 2 rooms are set aside for either activities/meetings and monitoring/response/administration. Every apartment has access to 1 parking space.

Figure 4: Teaterkvarteret 1.akt floorplan and apartments



The underground garage facility has 32 parking spaces, of which 7 are allocated for larger vehicles, and 2 have electric charger ports. The care centre complex is currently administrated by Tromsø municipality which operates two parking spaces on behalf of their clients.

Figure 5: Teaterkvarteret 1. akt underground garage facility

The pilot infrastructure consists of the following Use Cases as described in detail in D5.2 Annex Tromsø:

UC1.1:	UC1.2	UC2.1	UC2.2
Shared Parking	Priority Parking	Emergency Parking	Responder Parking

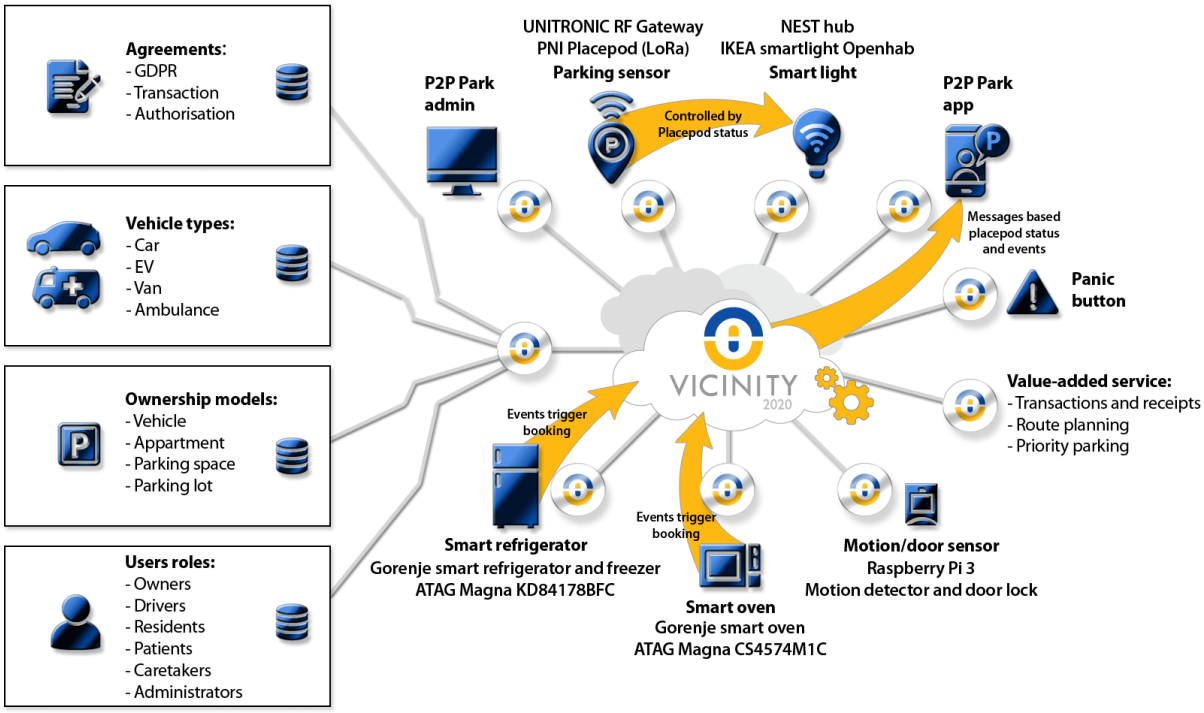


Figure 6: VICINITY pilot - configured and deployed in Tromsø, Norway

6 parking sensors (Figure 11) have been placed at parking spaces in underground garage facilities at Teaterkvarteret. Communication tests with the parking sensors were also conducted with a nearby building named "Himmel&Hav". This test was outside the scope of the pilot installation, but served as a way to measure the signal strength and identify any issues that may arise to communicate with the underground garage facility of Teaterkvarteret. HITS learned the signal strength was not good enough to communicate over that distance and thus discarded any further testing on nearby buildings.

The underground garage facilities (Figure 5) are accessed through a garage door that leads out to street level. It is also possible to gain access to the underground garage facilities from pedestrian doors at the opposite side. These doors are located at the bottom floor/cellar of the buildings where one can take either the stairs or an elevator. There is a door lock present, so it is necessary to have either keys or entry code to get access to the buildings. The apartments and rooms that are being used for test purposes are all located at the 1st floor. The configuration of the pilot is depicted in Figure 6.

The municipality, residents and board of Teaterkvarteret have been involved on different levels. Questionnaires, interviews, meetings, presentations and information have all been part of the interaction that has taken place. Currently, HITS are conducting monthly meetings with updates about the project, information about the equipment and making necessary changes based on feedback from the carers that are located on site.

4. Pre-Installation Phase

The pre-installation phase started before D7.1 was finalized, and is described below.

What we did:

- Workshops with stakeholders and technical team
- Identify need for equipment

4.1. HITS Pilot Teaterkvarteret, Tromsø

The pilot was planned to be installed and configured in a selected apartment, an activity room and the underground garage facility of Teaterkvarteret.

There were some changes in the ownership model of some of the parking spaces that were set aside for test installations, but this was quickly resolved and other parking spaces were assigned instead.

Workshops were conducted with representatives from Tromsø municipality, the carers at the Municipality Care Centre in Teaterkvarteret, members of the board of Teaterkvarteret, and a representative of the users in need of health care.

Inspection of the facilities provided an overview of the local configuration. Questionnaires and discussions with stakeholder served as a foundation, and a draft for IoT infrastructure and relevant VAS was prepared.

The team from HITS was made responsible for installing and configuring the current equipment. The stakeholders will be provided with adequate training and assistance to handle day-to-day situations that might arise.

The infrastructure comprised of sensor technology from Fibario, Raspberry Pi configured by Sensio, router from Telenor, RF gateway from UNITRONICS, parking sensors from PNI, smart appliances from Gorenje, and a VICINITY installation consisting of adapters, agent and gateway that served nodes and VAS (see table 2 and Figure 8: Routers/gateways placed on top of the refrigerator).

4.2. Changes to DoA (Description of Action)

The original scope for Task 7.4 Pilot Area Installation of Intelligent Transport & Parking Use Case was outlined in D3.1 “High-available VICINITY server deployment” section 10.2: “Use Case 1.2 – Norway (Tromsø) – Neighbourhood Smart Park ecosystem” and supported datasets as described in section 10.5: “IoT Use Case Data set descriptions”:

> “Pilot site installation will be implemented in close cooperation with Norwegian Helsehus and the neighbourhood district including in-house parking, street level parking and public spaces. Security and biometric protocols will be tested in order to handle security and access control policies. Assistive Living will be supported regarding dynamic space requirements from health personnel and visitors. DATEX-II communication used from HITS will be tested for IoT technology using standardized traffic protocols for Traffic and travel information defined in ISO/TS 21219 e.g. part 14 Parking information (TPEG2-PKI), Weather information, Geographic referencing, Traffic flow and prediction appliances.

The description of the deliverable in the DoA submitted with the project proposal was:

> "The deliverable will contain a report on Intelligent Transport & Parking Installation as implemented in cooperation with Norwegian Helsehus and the neighbourhood district. The report will address experiences gained from applying Security and biometric protocols to handle security and access control policies, as well as describe how Assistive Living will be supported for health personnel and visitors. Lastly it will contain information on how DATEX-II communication have been tested for IoT technology using standardized traffic protocols for Traffic and travel information."

The revised and agreed scope for D7.4 is presented in Table 1.

The following changes were proposed in VICINITY Part B Amendment and approved at Project Officer review in June 2017.

Explanation of changes made to scope of D7.4:

> "The Municipality Care Centre in Teaterkvarteret, Tromsø, Norway replaced the originally described pilot site "Tyska" as agreed in the first amendment in M13. This did not present any issues, and HITS has been in regular contact with welfare technology department and the local Home Care Health Services in the municipality."

No further deviations from the plan took place in the pre-installation phase.

5. Installation Phase

5.1. Hardware installation HITS Pilot Teaterkvarteret, Tromsø

The methodology of the installation work defined in Task 7.1 has been used for the installation of Smart Parking Use Case at the Tromsø Pilot Site. Details regarding equipment, solutions and system integration have been identified and documented in Chapter 8 of D7.1 “Pilot area installation methodology and planning”. Value-Added Services Offline management and Real-time operation for shared/priority Parking and Emergency Parking have been developed within Task 5.2. The details of the implementation are specified in the Annex to Pilot site Tromsø in D5.2 “VICINITY Value Added Services Implementation Framework”, M33.

New firmware for the parking sensors were delivered in November 2018 (M35) which resulted in physical exchange of the sensors. The upgrade has not been performed completely until M36 due to the need for an iPhone app to activate the sensors. Further installation work and testing of the Value-Added Service Real-time operation will continue until M39 and will be extended with the functionality described in D5.2 (M33).

During the pre-and installation phase, sensors for assisted living have been planned and installed in the care centre apartment. The pilot site is used for training the tenants and care centre personnel for extended care centre services. Activity sensors for inside PIR movement, door sensor, smart programmable contact, temperature have been selected and tested including smart appliances. The key personnel have been identified and trained for the use cases.

The activity sensors have been connected to a Raspberry Pi in order to identify the status and condition of the apartment via a separate user interface.

The next page includes photos of the placement of some of the smart devices.

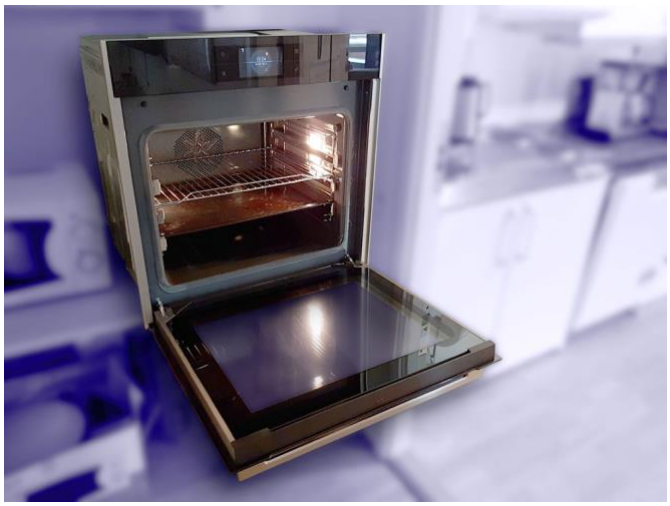


Figure 7: Placement of the Gorene smart oven

Figure 8: Routers/gateways placed on top of the refrigerator

Figure 9: Placement of the Gorenje smart refrigerator. Please notice the arrow pointing to the routers/gateways.

Explanation to numbers on figure:

1. Router Telenor – used for net access
2. Raspberry Pi 3 – used for Fibaro devices
3. RF Gateway – used for Placepod Parking Sensors

Figure 10: Locked steel closet for equipment

Figure 11: One of the parking sensors placed in the garage facility

The smart appliances Gorenje fridge and oven have been connected via the secured protocol WPS / wireless router to connect to the Gorenje Cloud. Support for alarm and emergency aspects will be provided by the smart appliances. The PlacePod smart parking sensors have been connected through Multitech gateway and the VICINITY Cloud to the PlacePod Cloud, where the actual measurements are stored. These measurements will be forwarded as "events" to the VICINITY platform so that VICINITY Client Nodes of the VASs will be notified.

All the installed equipment, and their specifications, are identified in Tables 2 and 3.

A non-disclosure agreement with the Tromsø municipality has been signed, and HITS has ensured to follow up on the guidelines and methods outlined in the D9.3 "Data Management Plan, second version". This applies to both physical accessibility as well as storage and exchange of personal data.

Smart refrigerator with freezer
ATAG Magna KD84178BFC
Gorenje

Figure 12: Gorenje smart refrigerator

Smart oven
ATAG Magna CS4574M1C
Gorenje

Figure 13: Gorenje omart oven

IKEA smart light
TRÅDFRI LED bulb E26 980 lumen
IKEA

Figure 14: IKEA smart light

Trådfri Gateway
IKEA

Figure 15: IKEA Trådfri gateway

	Door Sensors FGDW-002 Fibaro  Figure 16: Fibaro door sensor	**Motion sensors** FGMS-001 Fibaro  Figure 17: Fibaro motion sensor
	Parking Sensor PlacePod PNI  Figure 18: PlacePod parking sensor	**RF GATEWAY LORA ETHERNET/USB** 881-1302-ND Multi-tech Systems Inc.  Figure 19: RF Gateway LoRa Ethernet/USB

Table 2: Equipment installed at pilot site

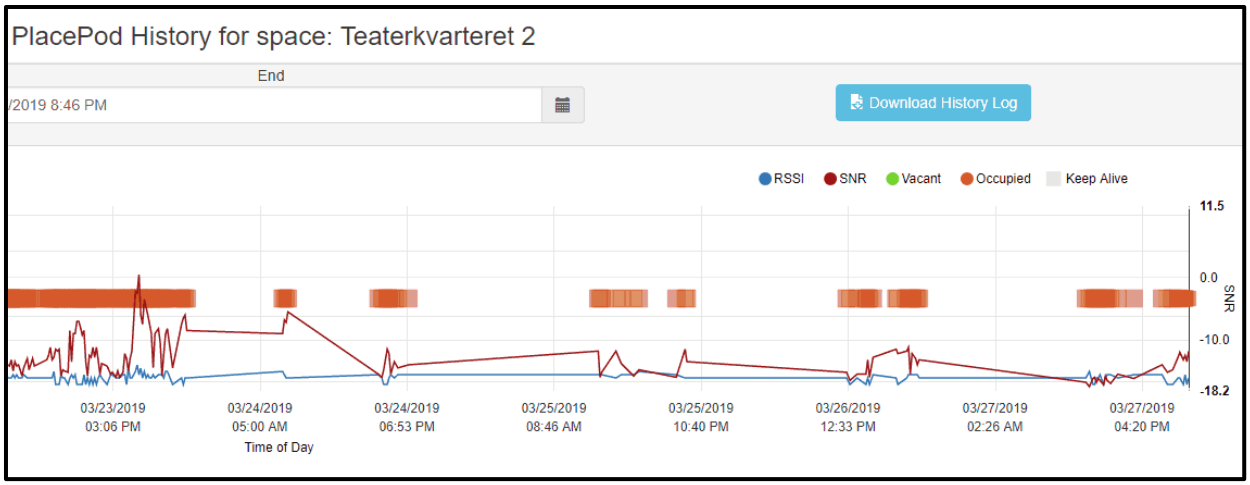


Figure 20: Excerpt from parking sensor history log

Device type and vendor	*Functionality*	*Installed units*	*Use Case*	*Location*	*Deviations*
Parking Sensor PlacePod PNI	Register occupancy and temperature	3	1.1,1.2,2.1, 2.2	Parking space	Hardware upgraded
IKEA smart light TRÅDFRI LED bulb E26 980 lumen IKEA	Display occupancy status	1	1.1,1.2,2.1, 2.2	Parking space	
Smart oven ATAG Magna CS4574M1C Gorenje	Heat food and register usage	1	2.1	Apartment	
Smart refrigerator with freezer ATAG Magna KD84178BFC Gorenje	Cool food and register usage	1	2.1	Apartment	
Motion sensors FGMS-001 Fibaro	Triggered when a motion is detected in the room	1	-	Apartment	
Door Sensors FGDW-002 Fibaro	Triggered when a door is opened or closed	1	-	Apartment	
Trådfri Gateway IKEA	Wireless connection (NEST)	1	1.1,1.2,2.1, 2.2	Office	
RF GATEWAY LORA ETHERNET/USB 881-1302-ND Multi-tech Systems Inc.	Wireless connection (LoRa)	1	1.1,1.2,2.1, 2.2	Office	
Raspberry Pi Model B+ V1.2 Raspberry Pi Foundation	Gateway for devices and sensors	1	-	Office	
Routers D-Link DWR-921 Wireless N 4G LTE Router, Huawei OTE	Wireless Internet connection	1	1.1,1.2,2.1, 2.2	Office	

Table 3: Specification of equipment installed at pilot site

5.2. Value added services Deployment

Ref.	Value-Added Service Name	Version	Deployment	Deviations
VAS 4.1.1, 4.2.1	Shared/Priority Parking	0.0.1	Deployed on HITS server	-
VAS 4.1.2	Smart light Adapter	0.0.1	Deployed on HITS server	
VAS 4.1.2	PNI adapter	0.0.1	Deployed on HITS server	

Table 4: Value-added services deployed at pilot site

5.3. VICINITY Components Deployment

Several components of the VICINITY solution have been deployed at the pilot (Table 5).

VICINITY Component Name	Version	Deployment
VICINITY Gateway API	0.6.3.1	Deployed on HITS server
VICINITY Agent	0.6.3.1	Deployed on HITS server
Adapter PNI PlacePod	0.0.1	Deployed on HITS server
Adapter IKEA smartlight	0.0.1	Deployed on HITS server
GRN VICINITY adapter	1.0.0	Deployed on HITS server

Table 5: VICINITY components deployed at pilot site

5.4. Challenges faced during the Installation Phase

One of obstacles HITS had to solve, was issues with coverage/signal strength.

The equipment was originally placed inside a steel closet (Figure 10) where the network, routers and gateways were located. Wireless communication did however prove to be an issue. The steel closet did not receive signals from the wireless router on 4G and neither with the sensors on WiFi. Problems with LoRa communications were also significant. Thus, the equipment has been moved into the living room on top of the refrigerator (Figure 8).

The RF Gateway (Figure 19) used for the parking sensors was one of the devices that was affected by the poor signal strength. Another building ("Himmel&Hav") with a care centre located 500 meters away was temporarily included, although outside the scope of the pilot. This served as a test case for measuring max distance between gateway and sensor.

Other devices that were affected was the Fibaro door and motion sensors. HITS had to re-evaluate the effective distance to the sensors without having to add repeaters. This challenge was somewhat alleviated when parking sensors with new hardware were received late in the test phase. The thickness of the concrete surrounding the walls and floor underground garage facility still presents a challenge though.

The placement and configuration of the parking sensors also had another very practical challenge; the app used for configuring the sensors was only available for iPhone, while the project had standardized on Android phones. This made us unable to activate, measure real time data about signal strength and adjusting keep-alive time when being on the site.

The development cycle went through more phases than originally intended, as the business logic created for the VAS turned much more complex than originally anticipated. Combined with 5 changes in key personnel for development adapters, backend server and mobile app made it difficult to keep the know-how and flow consistent.

The mobile app still needs more attention, but delivers on the use cases. The backend server now also serves as a proper platform for building new VICNITY related solutions on, making it suitable for new VAS and Open Call activities.

The inclusion of a subscription model to the Gorenje smart appliances was unexpected. It represented however an innovative addition of an early warning system which generated interest with the stakeholders and Gorenje alike. This is a concept that all partners can continue to build upon, and which make a good addition to the municipality to offer other apartments in need of care takers.

Another unexpected situation occurred when the PlacePod parking sensors were installed and should be activated. HITS learned that the control software for configuring status updates, measuring signal strength and other necessary maintenance was based on iOS. VICINITY had standardized on the Android platform, and hence HITS had to borrow an iPhone from the stakeholders to install the parking sensors. Later an alpha version of an Android app was sent from Unitronic (the European representatives), but the problem remains to this day.

6. Post-Installation Phase

The Tromsø Pilot Site has undergone three installation phases during testing. They have all been related to examining the effects of updates made to the VICINITY agent and the adapters.

Since new versions of adapters and events has been introduced throughout the project, changes have been made to the setup and configuration of the equipment at the pilot site.

Currently all devices – with the exception of the parking sensors - are located in or near an activity room at the pilot site. This provides HITS with more relevant test data since more stakeholders are actively using the room 24/7. The different units will be moved into apartments by the social care service.

Training of key personnel among the stakeholders has been undertaken, and more information material is planned to be released towards the end of the project.

Tromsø municipality and the social care service will be the stakeholders that actively maintain the operation of the equipment, while HITS will provide updates to app and installation/configuration of equipment such as parking sensors and smart appliances. New business models are also expected to be part of future installations.

Depending on their user roles and access rights, stakeholders will be allowed to manage different parts of the system – including historical statistics about usage – time and location, notifications and sharing cost. The same applies to care takers and the use of mobile app.

Usage meta-data is now being collected and uploaded to the system monitoring dashboard maintained by the University of Kaiserslautern.

We consider the pilot site trials to be a continuous ongoing development process, with need for more equipment and updates to the mobile app. Continuous improvements are being made in the post-installation phase, but these are not considered to be deviations from the scope or plan.

7. Conclusions

The Tromsø Pilot installation is now complete and fully operational.

The pilot was originally intended to be conducted at Tyska, a building complex that was planned to be built in Moss, Norway. This project was postponed, and the pilot site was instead moved to Teaterkvarteret in Tromsø, Norway. The nature of the value-added services has also been updated with more focus on user experience and less focus on validating specific standards used in the pilot.

The Tromsø Pilot Site has provided HITS and the stakeholders with an area for learning and a testbed for VICINITY. HITS had to face a number of challenges throughout the project – most notably the lack of developer resources. At the site itself the stakeholders were actively involved with input and were solution oriented. Some detailed implementation challenges have been described in section 5.4. Experimental results are collected in order to facilitate ease of use and future maintenance and exploitation.

The Tromsø Pilot has offered HITS and VICINITY a great opportunity for being part of a living ecosystem where the service providers and service users would provide input and be interested in continuous use, also after the completion of the project. This is something HITS will continue to build upon in further endeavours and exploitation activities.

The exploitation phase will include expanding the number of areas the system can be applied to and present the system as a platform. In order to gain traction, HITS plan on make parts of the platform available on GitHub and offer development rights to software companies. HITS plan on presenting different subscription models for end users when integrating sharing, renting and transaction services. On a long-term perspective, HITS intend to migrate parts of the platform onto new markets that have yet to be identified.

8. 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

[3] D5.1 Value-added services definition requirements and architectural design

[4] D5.2 VICINITY Value Added Services Implementation Framework

[5] D7.1 Pilot area installation methodology and planning

[6] D9.3 Data Management Plan, second version