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Deliverable D8.4

Pilot results of Intelligent Transport & Parking Use-Case

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Task(s):	**T8.4 – Realisation and evaluation of Intelligent Transport & Parking UC**
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Executive Summary

This document focuses on the evaluation of the Tromsø Pilot Site. HITS managed to use VICINITY to develop several Value-Added Services. These VAS included integrated ecosystems for parking sensors, smart lights, business logic for emergency alerts and connect warning levels to subscription services offered by other partners. Furthermore, the VAS identifies and assigns optimal parking space. The business logic acts on real-time data gathered from sensors connected through the VICINITY Neighbourhood Manager. This information was even used for reordering parking space reservation queues in case of priority parking requests. Such requests may stem from owners of the parking space, subscribers to the parking space and emergency vehicles.

The Tromsø pilot site posed some unexpected challenges like poor reception from the parking sensors that used LoRaWAN, too few active users and short trial time to gather meaningful statistics. However, on a technical level, VICINITY delivered as promised. On a top level, the use cases deals with two main functions; one had to do with smart parking – ownership and rental, while the other deals with emergency parking and first responder functionality. Due to the similarity of the use cases, UC 1.1 Shared Parking and UC 1.2 Priority parking have therefore been combined as UC 1: Shared parking/priority parking, while UC 2.1 Emergency parking and UC 2.2 are combined as UC 2 Emergency parking/First Responder throughout this document. The first UC focuses on how the status from parking sensors can be collected through VICINITY and made available to drivers to find the most suitable parking space based on preferences and availability of access. The second UC demonstrates how data from smart homes can be collected through VICINITY and used for triggering emergency calls with automatic assignment of most suitable parking space.

The actual value-added services as described in Table 11: Value-Added Services deployed at pilot site, and content of the demonstration, remains of course the same. The evaluation comprised three types of assessments:

- Functional evaluation demonstrated that the pilot site addressed basic stakeholder needs and laid foundation for future engagement.
- The technical evaluation determined that the pilot site implementation worked as expected. There were experience gathered from sensor integration as described in section 3.2 Technical Evaluation, value-added services and compromises that had to be made – see comments from stakeholders (table 5: stakeholder feedback), 1.3.1 Infrastructure and section 5: Conclusions.
- Business evaluation established there are strong business opportunities for further development and that the solution fulfils the necessary business requirements described in VICINITY_D1_4_Business_requirements_specification_1.1

In addition, regarding the 17 EU sustainability Goals[1], the two Use cases at the Tromsø pilot site address several of UN's sustainable goals; most notably "Good health and well-being", "Sustainable cities and communities", "Responsible Consumption" and "Partnerships for the goals". Interactions with stakeholders helped to achieve the goals of the pilot site and bring useful features to the use cases. Further work will be aimed at developing and exploiting the business opportunities that have arisen.

[1] https://www.un.org/sustainabledevelopment/sustainable-development-goals/

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List of Definitions and Abbreviations

Abbreviation	Definition
$Dx_1.x_2$	Deliverable {x_1: Work package Number}.{x_2: Task Number}
EC	European Commission
EU	European Union
GDPR	General Data Protection Regulation
IaaS	Interoperability as a Service
IoT	Internet of Things
KPI	Key Performance Indicator
LoRaWAN	Low Range Wide Area Network
P2P	Peer-to-peer
SDG	Sustainable Development Goals
UC	Use Case
UN	United Nations
VAS	Value-Added Service
WP	Work Package

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1. Introduction

This deliverable contains the evaluation of Tromsø pilot site, including functional, technical and business evaluations. Additionally, Chapter 5 provides an evaluation regarding EU sustainability goals. The functional evaluation focuses on how well the pilot site manages to provide a good and useful service to the stakeholders. The Technical Evaluation subchapter focuses on the technical side of the pilot site – how well everything works and experience of developers working with VICINITY platform. Finally, the deliverable gives some points on lessons learned during the development of adapters and Value-Added Services.

The document is structured as follows:

- Chapter 1 – introduces the pilot site and its context within the VICINITY project as well as a high-level overview over the two Use cases of this pilot site.
- Chapter 2 – Describes the evaluation process used at the Tromsø pilot site
- Chapter 3 – Presents the results of both the technical and business evaluation.
- Chapter 4 – Presents an evaluation of the pilot site towards the Sustainable Development Goals
- Chapter 5 – Conclusions
- Chapter 6 – References
- ANNEX

1.1. Context within VICINITY

The Tromsø pilot site utilizes VICINITY platform to demonstrate benefits to users in terms of new functionality, benefits and efficiency. The presence of real-life stakeholders greatly enhances the chances of further exploitation both locally and through worldwide dissemination of results.

The Value-Added Services in this pilot site provide service to the end-users, utilizing data from IoT devices that function on their own platform and are integrated through a VICINITY adapter and communicate with the VAS through events. The Tromsø Pilot Site demonstrates how VICINITY can enable users to integrate IoT devices working on different platforms or devices from different vendors into a homogeneous system providing a useful service to the end-user, thereby improving their efficiency.

The KPIs for the Tromsø pilot, cited in D5.1 *"VICINITY Value-Added Services definition, requirements and architectural design"* (M24), have been adjusted to accommodate new insight gained through feedback from stakeholders. This prompted HITS to change from a questionnaire to an interview-based evaluation to better capture subtleties and experience from the participants. This was also considered relevant since there were not enough active users to provide sufficient data for statistical analysis, given the nature of the pilot site structure and the use case goals.

Work Package 8 concerns the pilot sites demonstration and overall evaluation of VICINITY Use Cases, with D8.1 *"Business scenarios & evaluation framework"* (M36) presenting the business scenarios and the evaluation framework, while D8.2-D8.5 present the evaluation results of each pilot site. The pilot sites utilize the VICINITY platform to demonstrate its benefits to the stakeholders in terms of new functionalities and interoperability.

In D1.4 *"VICINITY business requirements specification"* (M12) a set of business requirements per VICINITY domain were identified and are further evaluated in this deliverable. More details on the evaluation methodology and evaluation parameters are described in Chapter 2. The project overview is presented in the following figure.

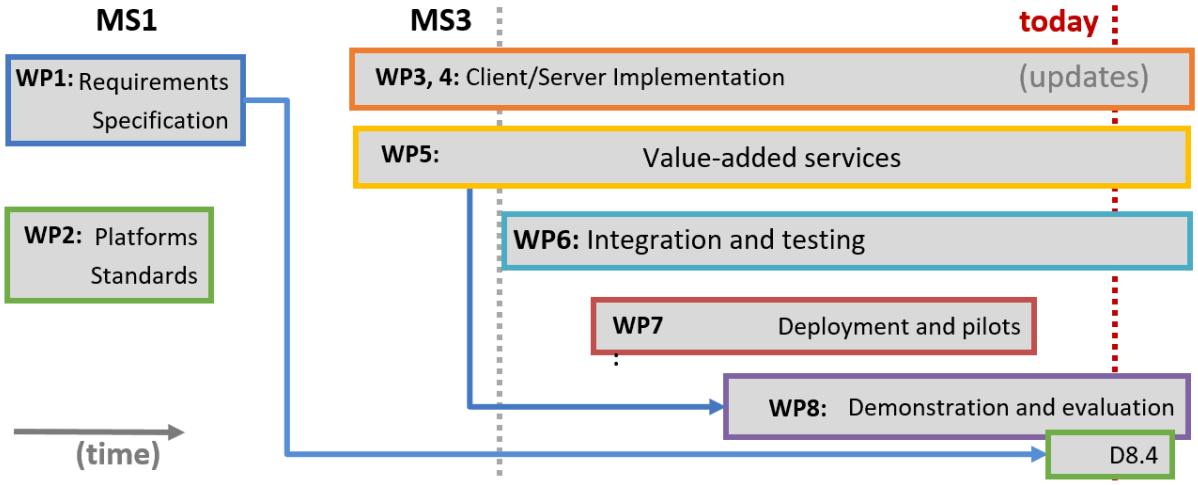


Figure 1: Project Overview

1.2. Objectives in Work Package 8 and Task 8.4

The objective of T8.4 *"Neighbourhood Smart Parking Assisted Living ecosystem"* is to evaluate results of the Tromsø pilot site Use Cases. These results include stakeholders' feedback and the evaluation of development, technology and business possibilities. The starting point for the evaluation is described in D8.1 *"Business scenarios & evaluation framework"* (M36) and elaborated in following chapters. The objective is to establish whether the Pilot Site manages to achieve its goals and provide a useful service to end users such as carers, managers and other stakeholders.

Different Pilot Sites from the domains of energy, building and transport are evaluated separately in D8.2, D8.3 and D8.5 correspondingly. GNOMON, CERTH, OTE and HITS are the responsible partners for the implementation and monitoring of the pilot site, the respective Use cases and the value-added services. User and stakeholders' experience were extracted during this period and analysed in order to adapt to any needs or requirements that arouse during the pilot realization phase. Whenever applicable and possible, especially within the business evaluation framework, the VICINITY solution is assessed against the previously available solution (baseline scenario) in order to identify the advancements achieved and offered by the VICINITY approach.

1.3. Description of the Pilot Site

The pilot site is located at Teaterkvarteret in Tromsø, Norway. This is a newly constructed cluster of buildings near the central part of Tromsø, an arctic city located far north of the Polar Circle in Norway.

Figure 2: Teaterkvarteret 1. akt (source: teaterkvarteret.no)

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

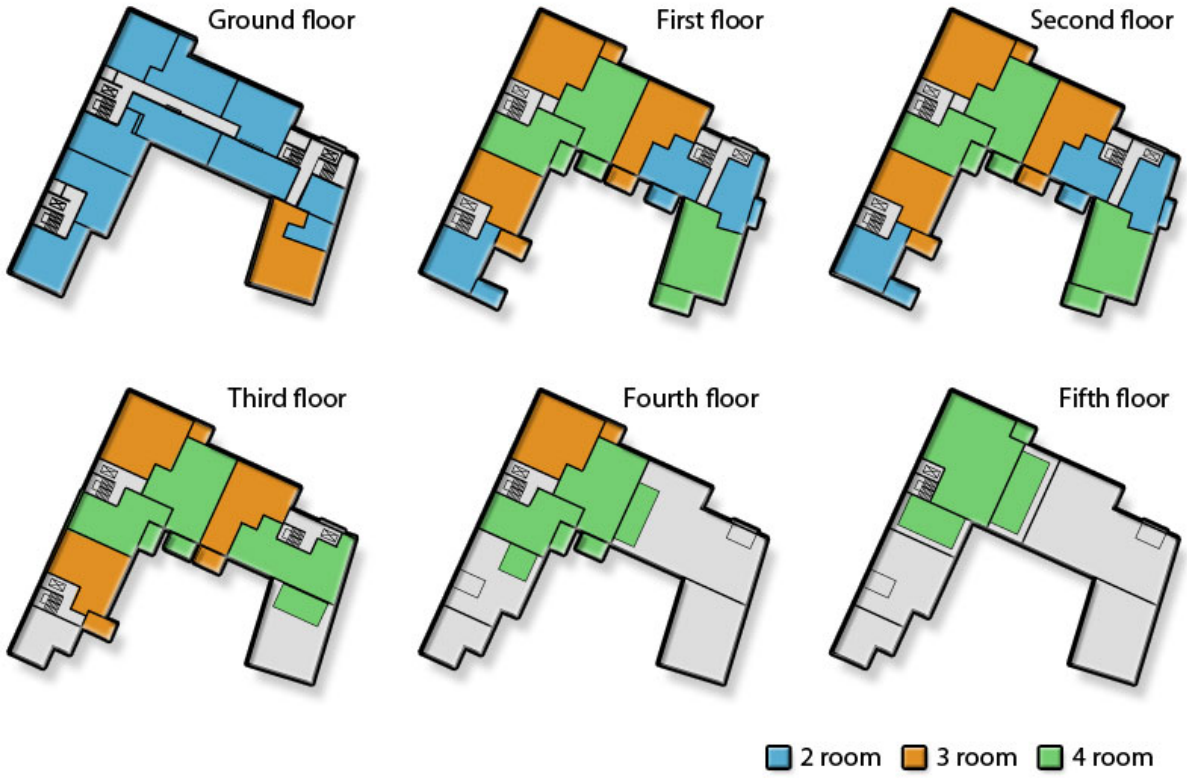
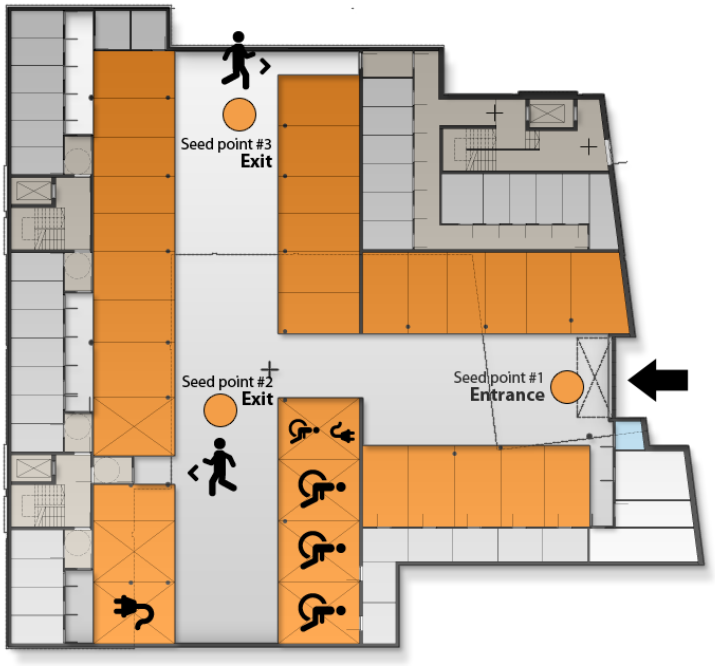


Figure 3: Teaterkvarteret 1.akt floorplan and apartments

1.3.1. Infrastructure

All parking space in the underground garage facility is owned and administrated by the building's cooperative. The available parking space is only made accessible to tenants. However, in case they have accepted being part of a rental agreement for parking space, they are free to assign or reassign use of the parking space. Restrictions will be imposed by internal policies and regulations. When accessing the garage facility, it will always be the tenants that have priority. Authorisation and access to underground garage facility is not a part of the project.



The underground garage facility has 32 parking spaces, of which seven are allocated for larger vehicles, and two 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 4: Teaterkvarteret 1. akt underground garage facility

Six parking sensors have been placed at parking spaces in underground garage facilities at Teaterkvarteret (Figure 4). 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 in communication 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. A complete list of installed devices can be found in *"Table 8: Devices required for implementation of use cases at the Tromsø pilot site"* with more information being presented in *"ANNEX: Hardware installation HITS Tromsø Pilot"*.

The underground garage facilities 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 pilot site serves to validate the VICINITY interoperability model, but the UC does not demonstrate a complete, commercial product. However, several aspects of the UC are considered relevant for extension beyond the end of the project. The pilot site therefore demonstrates basic functionality for sharing parking space and facilitates the discovery of new business models and exploitation potential in the context of mobility and assisted living.

1.3.2. UC 1 – Shared parking / priority parking

This UC operated on a total number of six parking spaces, of which three were equipped with parking sensors. The concept of the UC was to create something like an "AirBnB" for parking, offering dynamic parking space allocation in low, normal and high-demand periods. At the Tromsø pilot site this included having neighbourhood residents sharing unused parking spaces for shorter or longer periods and to be reimbursed via a separate appraisal system. The UC presented a service that allowed neighbourhood residents to share their unused parking spaces for shorter or longer periods.

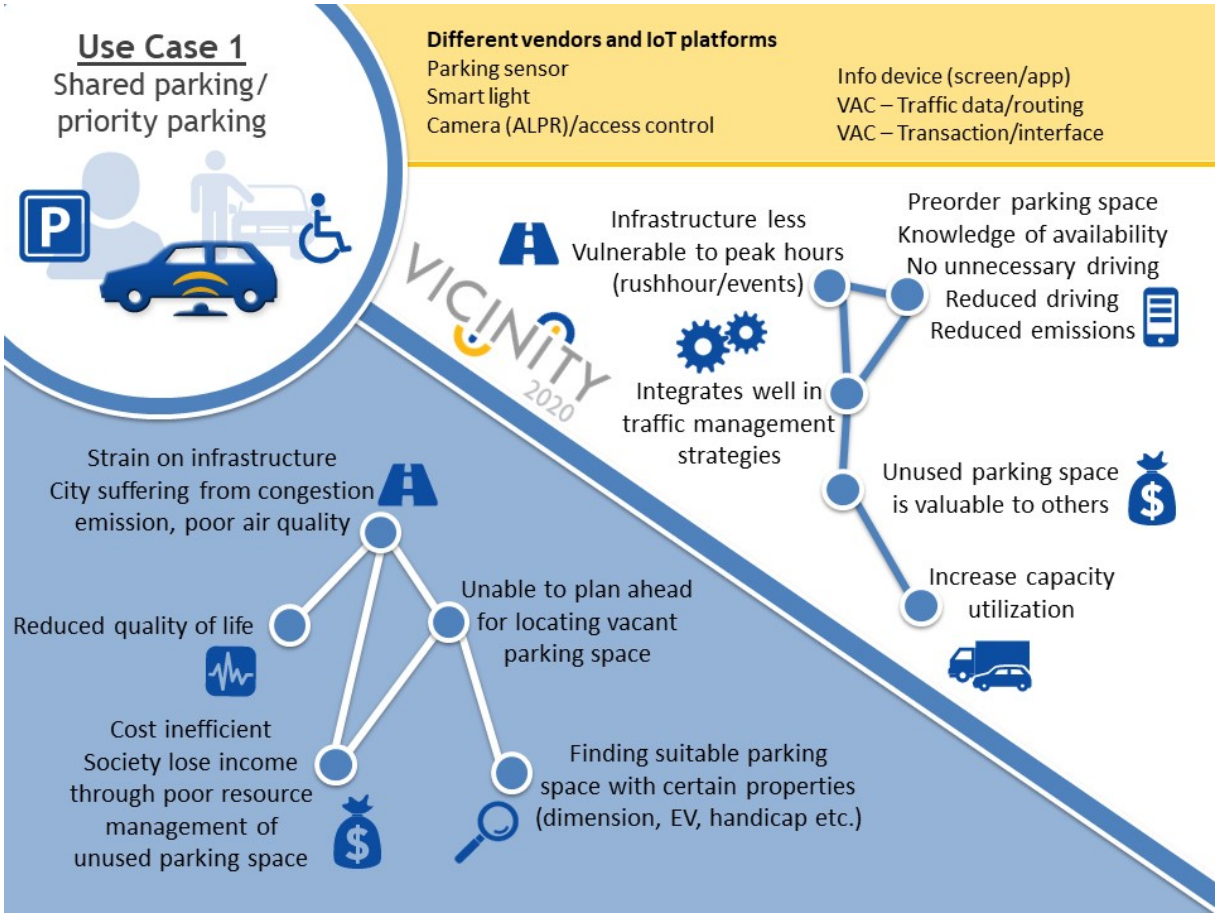


Figure 5: Narration of UC 1: Tromsø pilot shared/priority parking

Functionality is managed through a smart parking management system which supports basic operations such as; booking, ticketing, alerts and priority. The system is built to assist in day-to-day activities that are based on sensor data and some business logic rules (e.g. giving priority to health care personnel and ambulance/blue light agencies).

There are certain conditions that need to be fulfilled at the pilot site "Teaterkvarteret 1. akt". A configuration consisting of smart lights to indicate occupancy status was set up to extend the functionality even more. Usability and transparency are central to the Use Case, and special attention was directed towards mobile apps used for booking of parking space and tracking of vehicles.

As such, the statistics will later be used for building management resource planning from building managers, residents and parking space owners. They also shape the basis for improved services to vehicle owners, visitors and agencies – being private or public by nature.

1.3.3. UC 2 – Emergency parking / responder parking

Most apartments in the building cluster is privately owned held by tenants with certain demands due to age or disabilities. The municipality of Tromsø has assigned health care assistants to take care of situations that might arise. These assistants are working 24/7. Most of them are students working part time, while ¾ of the time is spent by full-time employed personnel. In order to improve the work efficiency, health care assistants need parking space in proximity of their clients.

The tenants have health care equipment from different vendors.

UC 2 is an extension of UC 1 where priority parking is assigned for medical conditions or other significant alerts received from IoT assets installed at "Teaterkvarteret 1. Akt". Since UC 2 serves as an extension, this means that KPIs and algorithmic processing also will be extended from UC 1.

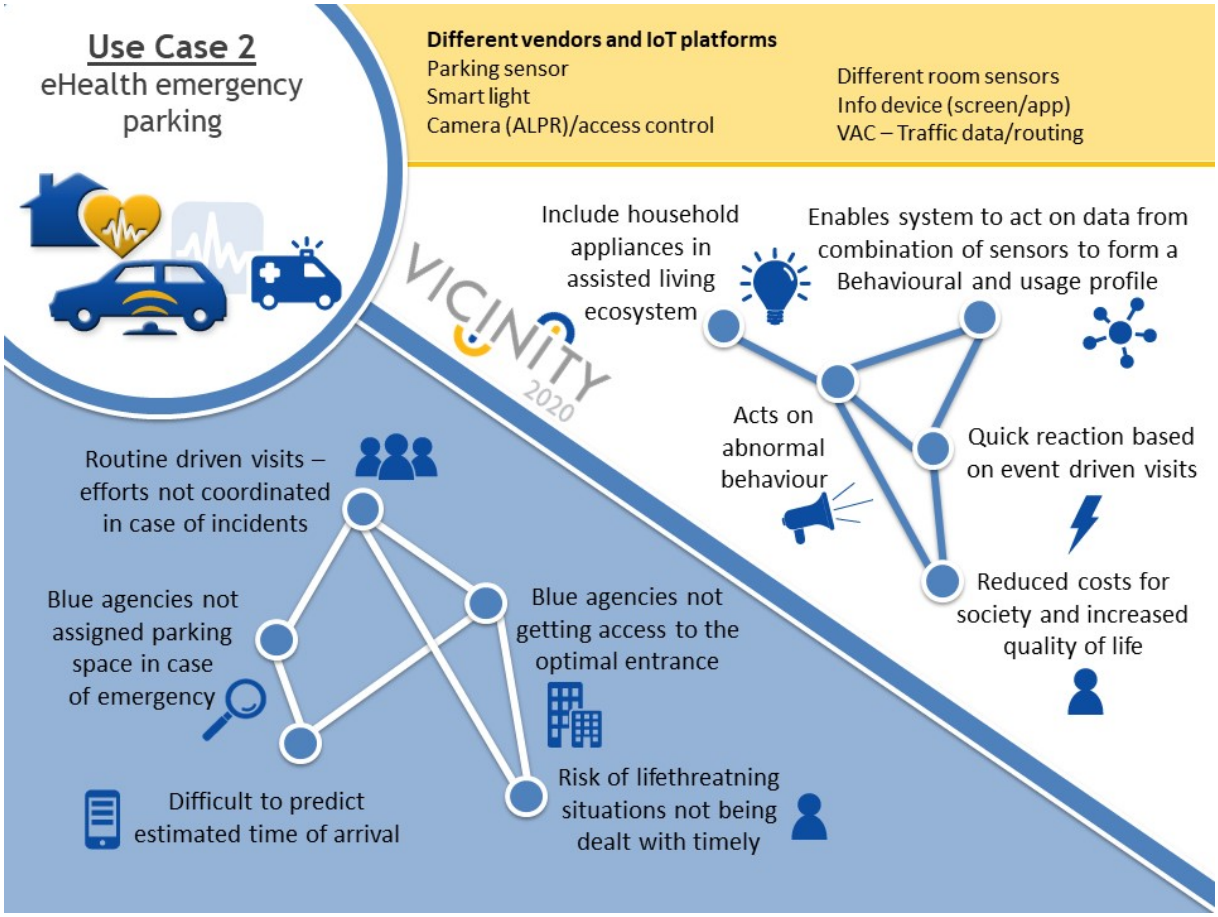


Figure 6: Narration of UC 2: Tromsø pilot eHealth Emergency parking

The system is based on three recurring main objectives; register relevant data, receive relevant information in a timely fashion, provide feedback. There will be several user groups with access to the system, but their access right will differ for privacy reasons. They will for this reason not be able to see and share the same information. Medical personnel will for instance typically have access to other information than a parking space owner, but both parties need to be able to reserve and locate parking space.

"Figure 6: Narration of UC 2: Tromsø pilot eHealth Emergency parking" presents the different sources that will provide data to the state machine that governs what actions the parking managing system shall take in case of certain (emergency) events should occur.

A key element of the eHealth emergency parking is the use of critical events; alerts that triggers certain actions.
The highest prioritized alerts are triggered by alarms.
An alarm can be triggered in three different ways;

- the tenant may push an alarm-button
- a sensor may send out a warning in case of abnormal values (e.g. fall sensor is triggered)
- Additionally, health care assistants may notice something abnormal and act based on that.

For a full list of business logic/actions to a, please refer to *"ANNEX: Report on VICINITY Tromsø Business Logic 2019"*.

In the UC scenario, the following actions were demonstrated:

- Event detection (fall sensor) triggered

- Automatic message/warning sent health care assistants, social housing administrators, next of kind
- Priority parking allocated/assigned for health care personnel
- Gorenje oven/fridge integration

Smart kitchen appliances from Gorenje are expected to introduce more potential services through monitoring for behaviour patterns and identify abnormal situations. Such situations can be that kitchen doors are being left open, the smart oven is turned on for a prolonged period or that there has not been registered any kind of use for a certain amount of time.

Table 1: sources and triggers being part of the use cases

Source	Service	Operation
Smart Parking equipment garage	Data Capture service	• Activate relevant actions (smart light) • Assign parking space based on criteria • Monitor status of space, booking
Assisted living	Event detection system	• Detect changes/requests based on IoT sensors • Analyse proper response • Inform via relevant channels (mobile, info-screen etc.)
Open data	Data Analytics services	• Provide access, monitoring and statistical analysis based on aggregated/anonymised data • Privacy/security by design of the VICINITY platform • Targeted actors: caretakers/relatives/municipality

1.3.4. Business Orientation

Providing Parking services and healthcare represents key challenges to face future cities and communities. The market is increasing, and the demand will not diminish in the foreseeable future.

Furthermore, services related to assisted living tends exists within closed ecosystems. This has made it difficult to create truly cross-platform and multi-domain Value-Added Services that can act on data from different sources. Hosting services that can offer a platform that allows for seamless, real-time data exchange within these fields therefore represents a very real business opportunity.

Smart cities and smart agencies are facing issues with lack of human capital and sustainable resources. The market potential comes from recent changes in society, and willingness to invest in relevant technologies.

There are three areas where opportunities arise;

- Assisted living as a service: smart devices integrated with available household appliances and a warning system targeted towards elderly, disabled and otherwise bedridden users.
- Smart parking as a service: where parking apps, parking devices, manual and automatic registering of parking as well as other traffic data shapes a complete picture of activities and resources relevant to short- or long-term parking.
- First Responder functionality: offering new ways of reacting to urgent situations, requests or commissions thereby creating opportunities for extending how available resources can be

distributed and assigned for different purposes such as reacting to alarms or acknowledging pickup points for products. Alerts of arrival, light signals, status update on road signs are all examples of services that can be integrated with the First Responder function when integrated through VICINITY.

1.3.5. Benefits from VICINITY

Through the auto discovery service, VICINITY also offer faster registration and configuration of smart devices. Devices that are in different parts of a building serves different purposes like detecting the presence of vehicles, communicating with digital road signs and information screen, and access controls. Thus, VICINITY is ensuring a smooth and streamlined administration process by reducing the complexity of integration while retaining privacy through encryption offered by the neighbourhood manager.

In this way integration of systems via VICINITY offers improved quality of life and ensures a higher quality of service being offered by healthcare agencies to clients. It improves on response time and promise faster access to relevant parking spaces. This also ensures that VICINITY will contribute both health benefits and reduced emissions due to reduced time looking for available parking space. Furthermore, opportunities to include more areas for parking space are increased as privately held parking space can be integrated into virtual parking lots and thus become part of public infrastructure.

Semantic data exchange using adapters with homomorphic encryption allows for trusted partners and sensor ownership. VICINITY demonstrates how privacy is maintained while devices placed in an apartment can communicate or trigger events located in the garage facility.

The results from the pilot site and the Use cases demonstrates several Unique Selling Points (USP) due to VICINITY2020 integration:

Selling point	Description
TECHNOLOGY: Ability to detect and register usage data across IoT ecosystems in order offer Value-Added Services.	This is demonstrated through the integration of parking sensors, which can span several different suppliers such as Libelium, Tinynode, Streetline, Nedap, Rosim-ITS, Placepod, Siemens, Bosch with many, many more. This has been proven by several of the Open Call winners, like Sammy for yacht parking.
RESOURCES: Subscription to events generated by external Value-Added Services	This creates opportunity to include all smart devices into an extended value chain. The IFTTT-protocol currently offer some of this functionality, but it is not a subscription service. Smart homes are an integral part of smart cities, and subscription services creates new opportunities. One of the most important USP is demonstrated through Gorenje smart appliances. This is used to trigger "First Responder" actions, thereby saving both life and property. "The increasing implementation of smart speaker, home appliances, lighting control, home healthcare, smart furniture, smart kitchen and HVAC control is driving the growth of the European smart home market".[2] This increased demand for smart solutions due to the aging population and advancing technology, and the subscription service can be integrated with all solutions that supports adapters.
PRIVACY: integrating and extending IoT ecosystems in a simple, safe and secure way	New ways of setting up services and make them available to the public are presented. In the pilot site this is demonstrated through the exchange of parking site and apartment data which should be kept anonymous, as well as offering a secure way of integration transactions on a later stage in the project.
ENVIRONMENTAL: Sustainability offered through combining data from available devices and data set combined in new Value-Added Services.	**Increased sustainability: Municipalities, city planners** Less time spend on searching for parking space, generates less traffic – and thus offers increased sustainability to smart cities. This is of great interest to municipalities and city planners. **New customer groups, citizen engagement and governance** Reduced emissions due to how privately held parking space can become part of public infrastructure will lead to health benefits. Less time spend on searching for parking space, generates less traffic – and thus offers increased sustainability to smart cities. This allows for new customer groups to arise, bringing citizen engagement and governance to a new level.
RESOURCES: Expert systems are offered a wider selection of datasets to develop learning strategies from, opening for services not yet identified.	By combining previously closed, proprietary systems - new tools can be created for datamining and expert systems. This will lead to opportunities for optimization, trading and ticketing services, building management, traffic control, monitoring and visualisation – new partnerships and envisioned services.
TECHNOLOGY: Inclusion of new platforms and potential for user interaction though VICINITY IaaS	Information about availability and recommendation can be distributed to digital signs and other visual signs such as smart lights, as well as internal administrative system. The ITS market will be one of the important driving forces when integrating smart devices. The VICINITY Interoperability as a Service approach also applies to integration of systems for authentication and access, visualisation units and EV charging station devices.

[2] Markets and Markets: REPORT CODE: SE 3326, 2019: European Smart Home Market by Product, Software & Services - Forecast to 2024

Figure 7 presents some of the services that offers extra benefits for the stakeholders.

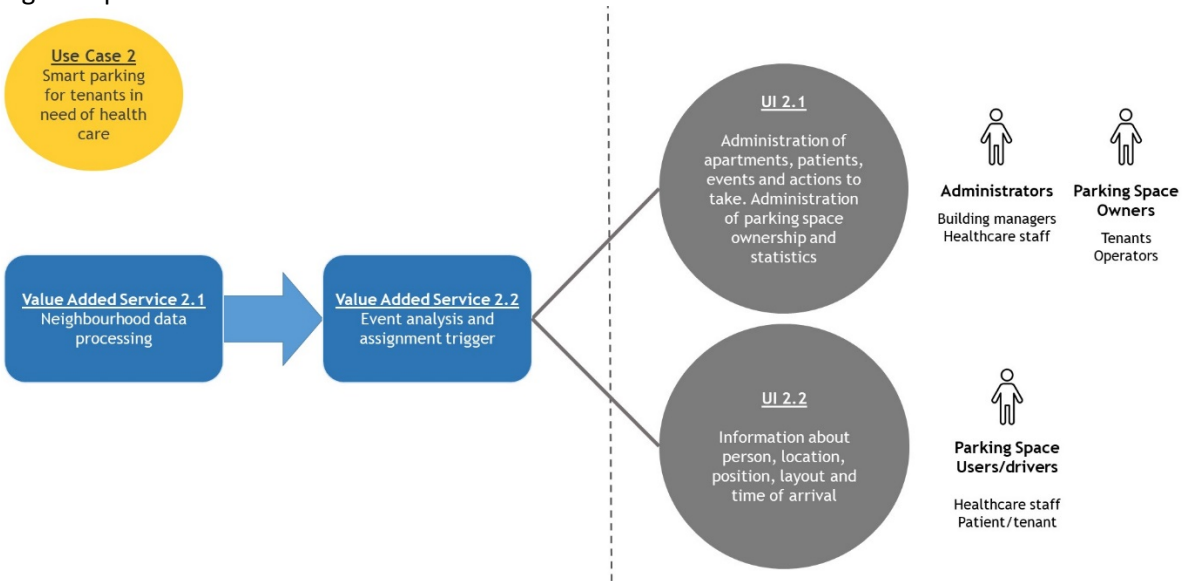


Figure 7: UC 2 associated Value-Added Services and User-Interfaces

2. Sites Evaluation Process

According to D8.1 *"Business scenarios & evaluation framework"* (M36), the pilot site evaluation framework defines two evaluation scopes, the technical and the business. For the evaluation of each of the two scopes the procedure presented in the next figure was followed.

Figure 8: Tromsø pilot site evaluation process

The scope of this deliverable is to identify the proper evaluation process for extracting meaningful performance indicators of the VICINITY Tromsø pilot. In this final stage of the project, the technical and business evaluation of the pilot site reveal the actual value of the VICINITY parking applications. This document is also targeted on the evaluation of the degree of compliance of the VICINITY overall results to the UC requirements identified in WP1 such as goals and objectives of the pilot site.

2.1. Define evaluation parameters

The evaluation has been conducted by assessing specification outlined in D1.4 *"VICINITY business requirements specification"* (M12) and identifying key points. Examples are goals that has been reached, what stakeholders have concluded and what opportunities that has been created as part of the UC implementation and lessons learned throughout the project- and development cycles.

The evaluations presented here do not differ much from those already presented in previous deliverables and do therefore primarily serve as a condensed version of some of the conclusions presented there.

It should however be states that the KPIs for UC 1 shared/priority parking has undergone several updates since the start of the project. The indicators are now more focused towards mobility results and usage profile. Due to low number of active users, the results presented as KPIs are not conclusive. They will however serve as a template for further development of the system. These indicators are shared with the other UC 2 Emergency/priority parking.

Within the mobility sector, these indicators are relevant to the Tromsø Use Case;

Table 2: Mobility indicators Tromsø pilot

Indicator	Values	Comments
Visit rate parking space	owner, driver, vehicle, reason	
Visit rate vehicle	owner, driver, reason, parking space	
Visit rate reason	owner, driver, vehicle	
Parking length	owner, driver, vehicle, reason	can also be interpreted at time spent at each patient/resident
Parking cost	owner, driver, vehicle, reason	
Parking length	owner, driver, vehicle, reason	can also be interpreted at time spent at each patient/resident
Hourly distribution per parking space	usage, income, reason	
Weekly distribution per parking space	usage, income, reason	
Monthly distribution per parking space	usage, income, reason	
Distance from apartment/visiting address	apartment, vehicle, reason	
Error rate parking space		
App satisfaction rate	driver, visitor, reason	
Efficiency rate per route	total time spent driving, total users visited	
Response time - from alert to carer response	reason, apartment, patient, carer	
Response time - from alert till vehicle has parked	reason, apartment, patient, vehicle	

Future updates will have additional indicators related to parking:

Table 3: Additional parking indicators

Indicator	Values	Comments
Occupancy:	Filled spaces ÷ Total spaces	
Availability:	Empty spaces ÷ Total spaces	
Revenue:	Revenue per citation and Revenue per space	
Average transaction value:	Transactions per hour, Transactions per permit	
Operational efficiency:	Seek time, Dwell time	
GHG Emissions		

Technical evaluation was also conducted, according to the KPIs that were initially defined in D8.1. KPIs demonstrate how effectively the VAS is achieving key business objectives and requirements that were first defined in D1.3 *"Report on Pilot sites and Operational Requirements"* and further analysed in D5.1 "*VICINITY Value-Added Services definition, requirements and architectural design"* (M24).

2.2. Evaluation methods

A basis for the evaluation method adopted was described in D8.1 for the different domains covered by the VICINITY pilot sites, defining also the evaluation parameters. Evaluation is mostly focused on VICINITY USPs trying to record the perception of VICINITY at each of the pilot cases, and more specifically the experience of the users regarding the pilot applications demonstrated on the eHealth domain.

The evaluation method from a technical perspective is based on the algorithms and the communication between the different VASs, as realised through the implemented services, in order to retrieve historical data from the IoT sensors involved in the two Use cases of the Tromsø pilot sites.

Face to face meetings and online communication with stakeholders was also a key process for the refinement of the KPIs and the pilot progress. Stakeholder engagement involved Tromsø municipality, carers and administration, tenants and end users. Representatives from each partner provided insight necessary for the evaluation the pilot applications and VICINITY USPs. During the meetings the stakeholders had the opportunity to get more in-depth knowledge about the project results, thus providing feedback on improvement. This iterative process helped the planning towards technical deployment and administrative handling of events.

A mid-term evaluation was not performed in the context of distributing questionnaires, but a continuous agile process was conducted to improve the pilot site. Continuous improvements were made based on feedback from stakeholders when meetings were held with them.

2.2.1. Evaluation Checklist

The evaluation checklist defined in D8.1 was taken into consideration throughout the evaluation process as a guide for assuring the quality of the evaluation. The checklist of D8.1 is presented in *"Table 4: Evaluation Checklist"* along comments from pilot sites. There were too few participants to provide a proper statistical result, but the stakeholders provided valuable feedback during the mid-term and completion of the test period (M41).

Table 4: Evaluation Checklist

Evaluation Step	Comments
Identify key stakeholders for surveys: users, service provider, infrastructure owners, site managers.	Key stakeholder categories have been identified, Carers, Management, Tenants, Health Agency
Review the KPIs. Are they measurable? How will the data be gathered? Are sufficient dimensions identified for the Task, as in the Project Objectives?	KPIs were reviewed through the period of the deployment and finalized after the required data were gathered as described in this document
Technical evaluation- by service provider. Are the IoT devices and gateways working correctly? How well? To what extent has 'interoperability as a service' achieved cross domain? Are the standards adequate for wide-scale deployment?	Validating the proper function of the IoT devices and gateways is a continuous process from the beginning of the pilot realization and every functionality of VICINITY is continuously validated and evaluated
Technical evaluation. Are events being logged and anomalies being logged and sent to the evaluation dashboard?	A set of common KPIs has been defined and will be monitored in the evaluation dashboard which will be presented in D8.6
Technical evaluation. Is the battery management/replacement process working?	Pilot site responsible oversees checking this process
Technical evaluation. How well are security and privacy requirements being met?	Users and stakeholders are satisfied regarding VICINITY privacy and security features as it is presented in the business evaluation
Technical evaluation. Are any fixes required resulting from the mid-trial evaluation?	Though no mid-trial evaluation was implemented, evaluation is an iterative process and through the pilot site realisation, feedback from stakeholders, responsible and users was taken into consideration for further enhancements and corrections
Technical and business evaluation. How scalable is the solution?	The solution has no technical limitations on how many devices and VAS that can be included. The software is built on a modular architecture thereby making it scalable both in terms of installations, equipment, users and data exchange. More information is presented in annex.
Business assessment. Does VICINITY add value (when comparing the 'with' and 'without' scenarios?). Did any unexpected benefits/demerits come from the trial?	More information on Chapter 2.3
Business assessment. Does the solution justify further investment?	Based on interviews from participants and presentations made during the project, the response has been positive.
Consolidate the results of the technical and business assessments, add them to the evaluation spreadsheet and prepare graphical visualisations	Chapter 3 includes the technical and business evaluation and visualization of the results
Strategic benefit. How well does the VICINITY solution match the neighbourhood, citywide, regional and/or EU requirements?	See Chapter 4, regarding Sustainable Development Goals (SDGs)
Prepare Reports to stakeholders including VICINITY Deliverables	Relevant deliverables distributed to stakeholders are D5.1, D5.2, D7.4 and D8.1 as well as the internal reports prepared for face to face meetings

2.3. Collect evaluation evidence

Evaluation process depends on processes (automated or manual) for acquiring the necessary data. This mechanism is differentiated depending on the type of the data and can be grouped, as already described, into two main categories: technical and business (both of which are stakeholder / user oriented). In this deliverable proper algorithms and questionnaires have been implemented for covering the needs of the necessary data acquisition.
The questions that needed to be answered are the following:

- *Who will collect the data?*
- *What data needs to be collected?*
- *Where will the data be found?*
- *How will the data be obtained?*

The pilot site and software such as adapters, server-side platform and mobile app has – and still do - undergoes a continuous development cycle. This agile process was and still is based on lessons learned and feedback from stakeholders. This affected both functionality and the user interface, thereby offering a more stable system better suited for the end users.

The business evaluation has there been anchored in interviews conducted throughout the duration of the project, as well as product development ideas that crystalized when working and identifying both strength and weaknesses, opportunities and threats.

HITS received feedback from representatives from the care centre, the municipality and end users came from face to face meetings conducted through the workday or at the office. Here they provided their insight such as perspectives on integration, how the pilot was used, clarifying needs and technical issues that must be addressed.

What we learned that there are certain differences between what the stakeholders focus on;

Table 5: Stakeholder feedback – carers and administration

Stakeholders	Topics
Teaterkvarteret 1. Akt: Carers and administration	
Technical	▪ It was expressed interest in the trustworthiness of VICNITY and devices connected through the neighbourhood manager. Privacy was an issue that was brought up several times, and both contracts and encryption was discussed. ▪ Quality of service was another topic. It is challenging for carers to provide the necessary assistance to everybody on their visitor list. How to measure quality was therefore of interest. The use of reordered parking space combined flexible route planning and travel log was a response to this. ▪ Receiving notifications from household appliances was considered useful. The concept of different warning levels could fit well in with internal routines and procedures but was not considered a replacement for ordinary monitoring devices and panic buttons. ▪ Local tests followed the structure, role and contact persons outlined by HITS. There were no specific targets defined, and feedback was given on a one-to-one basis.
Practical	▪ Some practical topics were discussed and requested. Importing vehicles and visiting addresses, handling different users and interrupted visits were other such topics that was later incorporated in upcoming specifications. ▪ The carers and administration were curious of what impact the test would have for parking. There were too few participants to provide any meaningful results. ▪ The same situation applied to response time. What is requested though, is to make the process of setting up smart appliances as sources for warning levels become more streamlined.
Changes in behaviour	▪ In short, the test had no impact on their daily work. It was however expressed interest in the concept, and a scaled-up version could increase the devices that report well-being of patients and in-house situation. ▪ It was not clear what the carers and administration expected when they entered the project, but it did not have any great impact or hindered them in their daily work. They are positive to the potential outcome. ▪ What both they and HITS learned was that it was necessary with more in-house personnel with technical knowledge that could assist when issues arose. This was noticeable when the WiFi- and LoRa-signals did not come through as expected.

Table 6: Stakeholder feedback – municipality / public sector

Stakeholders	Topics
Tromsø municipality / Tromsø county: Administration	
Technical	▪ The administration was interested in how to more efficiently exploit available urban space and avoid congestion. The P2P PARK and P2P Healthcare Visit apps demonstrated a different approach, and the municipality will most likely follow up on the results. ▪ Questions regarding inclusion of other data sources, such as open data and sensors were brought up, and the P2P Connectivity Platform was considered relevant for handling data exchange. ▪ Tests were not planned, but internal resources were used to give feedback and describe local needs.
Practical	▪ Opportunities offered by shared parking and how to generate the necessary incentives for having more people contribute to the parking pool were topics of interest. The P2P Connectivity Platform supports both financial transactions and gamification components, which may influence future usability studies and decision processes. ▪ As the case was for the pilot site itself, the project could not demonstrate any impact on parking. The system was however received positively, and a scaled-up version would be integrated with services from more stakeholders. ▪ The municipality was interested in how the system could contribute to providing a better service for residents/patient. The concept of roundtrips and warning levels introduced in the P2P Healthcare Visit app was thus considered of interest.
Changes in behaviour	▪ The administration found involvement in the VICINITY project interesting. It was unclear what they first expected from participating. Tromsø municipality did not express any desire to change the project engagement, but it was expressed interested in involving key-personnel familiar with Horizon2020 funded projects.

Table 7: Stakeholder feedback – other stakeholders

Stakeholders	Topics
Residents and board of management	
Technical	▪ In general, the concerns of the other stakeholders had to do with privacy and simplicity. Personal info should be kept private, and little to no training should be necessary. Transparency was considered the most important aspect. This was of a matter of importance since the project dealt with upcoming technology platforms and innovative concepts.
Practical	▪ There were several practical issues that were raised by the stakeholders; ▪ How to capitalize on shared parking space. ▪ How to handle costs and responsibility. ▪ How to handle access and contracts. ▪ What impact would it have for parking and access to the underground garage facility? ▪ What impact would it have on expected response time in case of an event – such as an accident or other kind of emergency? ▪ In the end the project did not generate a notable traffic or income for the participants, but this had to do with the limited number of test personnel that was involved and had access to the site. The Tromsø pilot site did however manage to get the attention of the media and will continue to build on this exposure.
Changes in behaviour	▪ The project did not have any impact on their daily life, again due to the low number of participants. The project was however well received, and the other stakeholders have expressed interest in following as future versions are released based on their feedback. ▪ The stakeholders had probably initially expected somewhat more of an impact. But due to the pilot site being moved and available parking space being limited, there were too many restrictions to provide any larger datasets. ▪ The stakeholders received insight in the process of how the project was developed and how their concerns were listened to and incorporated in the pilot. Simultaneously did HITS learn of how the apps would be used and challenges facing the current stakeholders.

The UC offers Value-Added Services that are adapted for different modalities, which includes transport and parking. The VAS also addresses integration with smart buildings using data from both external and local sources.

Forecast for information from traffic and parking has been prepared but has been deactivated for practical reason – mainly due to lack of developer resources and cost. Route planning for parking is offered through the integration of Google Maps, and the same applies to navigation. A simple ticketing service has been implemented to the benefit of parking space owner and vehicle user, but no real funding is transferred. How all the information is combined and distributed to the different actors is shown in Figure 9.

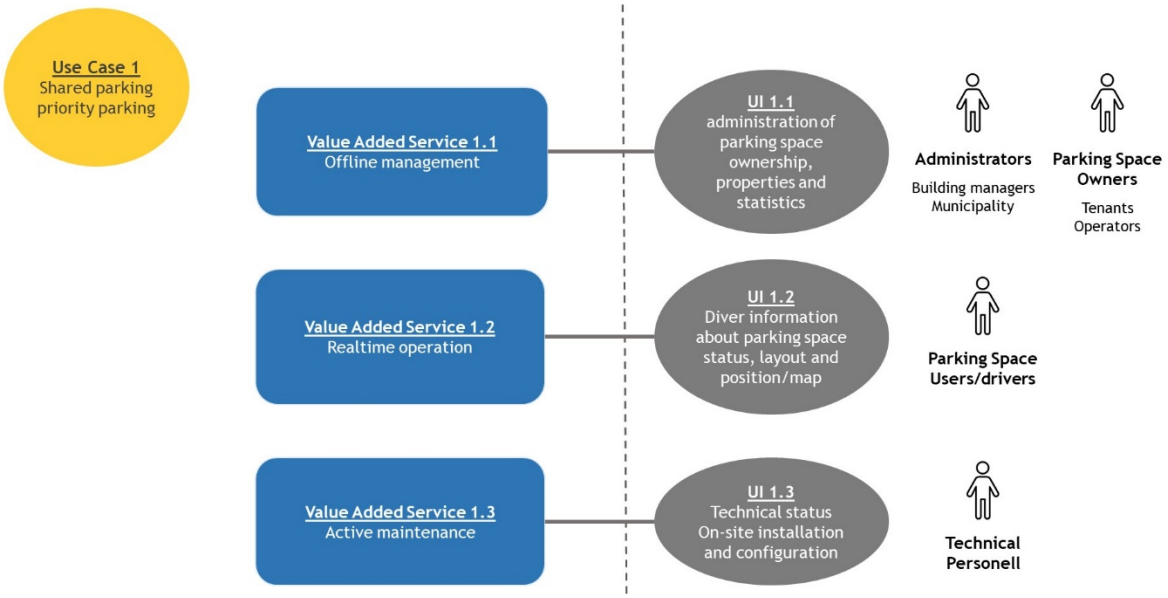


Figure 9: UC 1 associated Value-Added Services and User-Interfaces

2.4. Review collected information and take decisions

In this phase, data are processed, analysed and visualized in order to extract useful conclusions for the technical and business KPIs. The technical KPIs are presented in the form of bar charts or plain numbers. Business evaluation results are Likert scale data, which are presented in the form of stacked bar charts to compare parts across different answer categories. The evaluation results are presented in the next section.

3. Evaluation at Tromsø Pilot Site

3.1. Refinement of WP1 requirements

This section is dedicated business requirements for cross-domain applicability identified in D1.4 *"Report on VICINITY business requirements"* (M12) within WP1. It builds upon the findings presented in the domain specific requirements.
The business requirements are clustered in the following categories:

- Usability requirements;
- Implementation requirements;
- Security requirements;
- Privacy requirements;
- Legal & Ethics requirements.

The transport sector is recognised by a large amount cross-domain technologies and standards within fields such as road-side technologies, car-to-car communication, car-to-road communication, tunnel technology, smart traffic light, smart signs etc. The transport sector covers all means of logistics, being on the ground, rail, at sea or by air. This is commonly part of ITS (Intelligent Transport System). Solutions that offer a foundation for exchanging information between systems, opens for many opportunities. Transportation technology can be considered as the life blood of smart cities, as areas that suffer from pressure on the infrastructure reduce green areas, residents' quality of life and financial status of the affected areas. It is in this context that VICINITY focuses on smart parking technology for demonstration purposes.
Smart parking is based on optimising the usage of areas in and around the parking facility. Not just based on available space, but also on specifications that ranges from particular needs and demands to schedule, environmental considerations, accessibility, security/privacy issues to available services. For a more in-depth analysis and descriptions, refer to D1.4 *"Report on VICINITY business requirements"* (M12). Further descriptions of requirements for the transport domains have been moved to *"ANNEX: Transport – market and demands"*.

3.2. Technical Evaluation

To evaluate and validate the Key Performance Indicators (KPI) for the technical assessment, algorithms are developed to measure the values needed for the KPI definitions. The indicators for technical assessment are presented in D8.1 *"Business Scenarios & evaluation framework"* (M36) for the pilot site Use cases and their Value-Added Services defined in *"D5.1 VICNITY Value-Added Services definition, requirements and architectural design"* (M24) within WP5. The KPIs of the defined UC 1 and UC 2 at the Tromsø pilot site are presented in the following paragraphs.

The evaluation is conducted on both pilot site Use cases simultaneously since they are using the same technology with sensors, value-added services and using the VICINITY platform. The use cases are defined in D5.1 *"VICINITY Value-Added Services definition, requirements and architectural design"* (M24).

UC 1 demonstrates shared parking/priority parking. Topics addressed are handling of Individual residents, management of parking space and how proximity to access points are tailored to user-defined profiles. Safety, predictability, reliability, accessibility and comfort are elements that is incorporated when implementing load balancing and resource administration of parking space and available areas. This is presented in *"Figure 10: UC 1 Conceptual design"*.

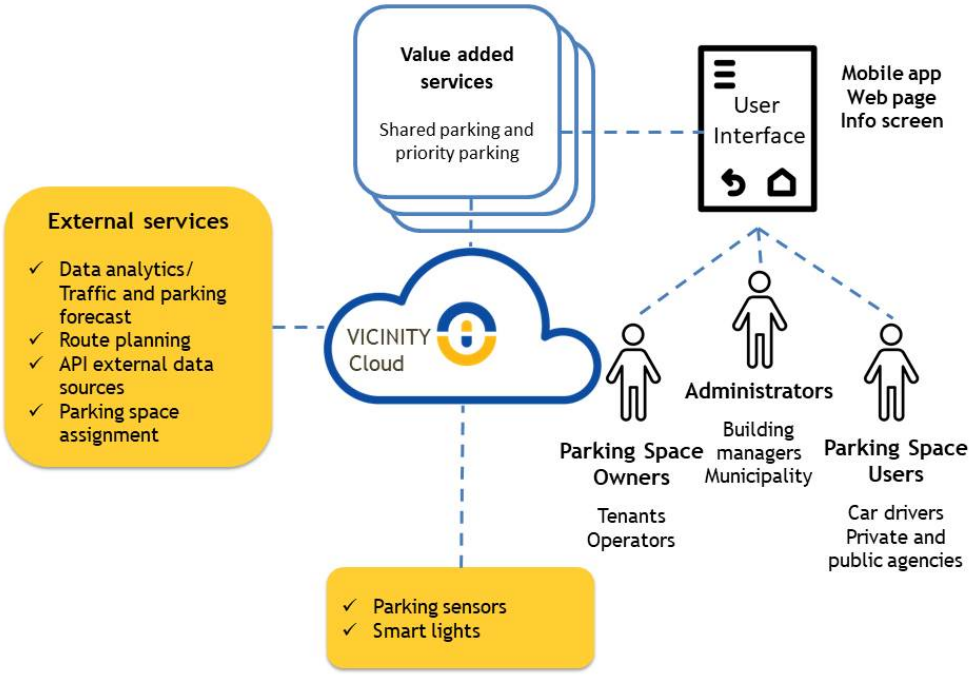


Figure 10: UC 1 Conceptual design – shared parking / priority parking

As the figure illustrates, access control and appraisal systems are functionality that needs to be supported. Access, authorisation and assignment is affected by what user type/role that is placing reservation for the parking space. Visitors need to be kept separate from residents, but the needs of the user and preferred actions will have an impact on the recommended parking space/placement. Moreover, healthcare and blue lights agencies must receive priority.

These are tied to a predefined configuration of parking sensors, indicator lights and information systems. In order to establish a sound platform for creating and offering Value-Added Services, special agreements are necessary and will be tied in with subscription contracts.

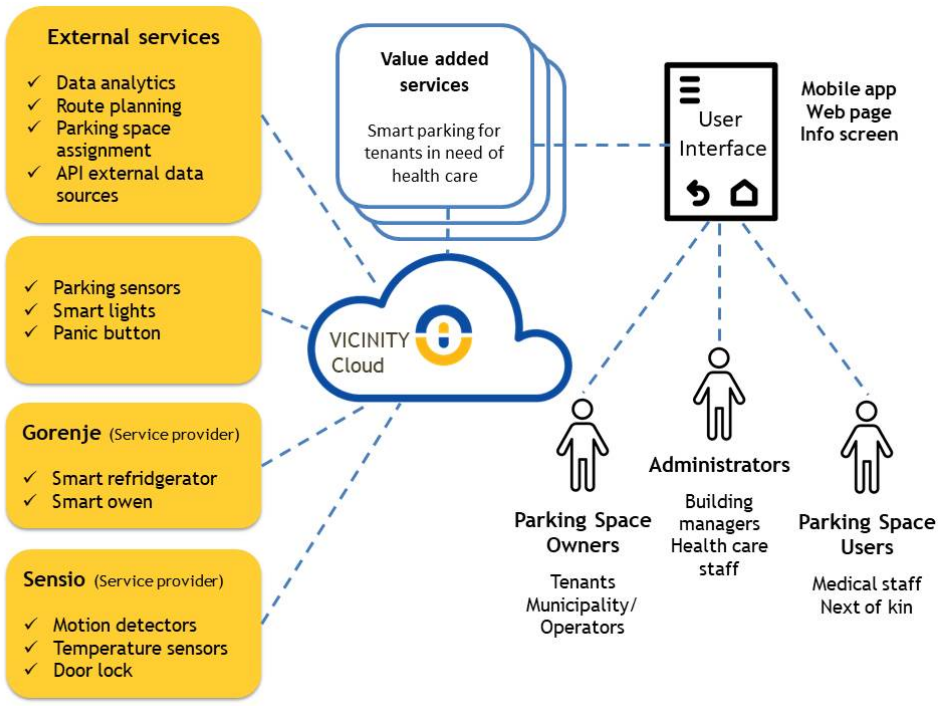


Figure 11: UC 2 Conceptual design – emergency parking / First Responder

UC 2 deals with emergency parking and is more complex, since it is combining sensors' data from several different IoT eco systems. The system generates relevant messages based on the severity of the warning and assigned recipients. Messages generated for medical assistants differ from information sent to next of kin. The core of the message is still the same; the source of the alarm, time of date, tenant id and the apartment number. This is presented in *"Figure 11: UC 2 Conceptual design"*.

The following devices are the basis of the use cases demonstrated at the Tromsø pilot site.

Table 8: Devices required for implementation of use cases at the Tromsø pilot site

Device type and vendor	*Functionality*	*Installed units*	*Use Case*	*Location*	*Deviations*
Parking Sensor PlacePod PNI	Register occupancy and temperature	3	1, 2	Parking space	Hardware upgraded
IKEA smart light TRÅDFRI LED bulb E26 980 lumen IKEA	Display occupancy status	1	1, 2	Parking space	
Smart oven ATAG Magna CS4574M1C Gorenje	Heat food and register usage	1	2	Apartment	
Smart refrigerator with freezer ATAG Magna KD84178BFC Gorenje	Cool food and register usage	1	2	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, 2	Office	
RF GATEWAY LORA ETHERNET/USB 881-1302-ND Multi-tech Systems Inc.	Wireless connection (LoRa)	1	1, 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, 2	Office	

The methodology of the installation work defined in Task 7.1 was used for the installation of Smart Parking UC 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"* (M31). The Value-Added Services for shared/priority Parking and for eHealth 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.
During the pre-and installation phase, sensors for assisted living were 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 was selected and tested including smart appliances, while key personnel were 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.

Several components of the VICINITY solution have been deployed at the pilot (*Table 9*) and are available for download at https://github.com/vicinityh2020.

Table 9: VICINITY components deployed at the pilot site as found at GITHub

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

The installation was divided in three phases: Pre-installation, installation and post-installation as described in D7.1 *"Pilot area installation methodology and planning"* (M31).

Table 10: Tromsø pilot installation phases

Phase	Name	Description
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.
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 were implemented and tested accordingly.
3	Post-installation	Deployed The last phase was designed to test and verify the different devices and confirm requested functionality. This activity is a continuous process until the project is ended, in case of devices needing replacement or upgrades.

In order to get the Value-Added Service operational, the following software components were either designed/prepared or developed:

- Delivery of a "virtualized" and "distributed" Business Intelligence framework, able to provide customized (even personalized) recommendations to the virtual network actors involved, providing actions and recommendations related to "virtual" groups preferences and needs.

- Mobile apps for end-users, presenting information on their urban area, parking space options, parking space value and income potential, allowing behavioural incentives for offering and efficiently use, rent or share private owned and public parking space
- Intelligent distribution/allocation of parking space in case of conflict situations affecting users with similar permissions, priority, authentication or access rights based on ownership or user profile.
- Configuration of smart devices from Fibaro for detecting activities and living conditions within an area. These devices are triggering requests for emergency parking if abnormal situations should arise.
- Mobile apps for end-users, presenting information on their urban area, parking space options.

Table 11: Value-Added Services deployed at pilot site

Value-Added Service Name	Use Case	Version	Deployed
Offline Management	Shared/Priority Parking	0.0.1	Yes
Real time operation (RTO)	Shared/Priority Parking	0.0.1	Yes
Active Maintenance	Shared/Priority Parking	-	Partly integrated with RTO
Neighbourhood Data Processing	Emergency parking/First Responder	0.0.1	Yes
Smart Parking Event Analysis	Emergency parking/First responder	0.0.1	Yes

The VASs were used for collecting relevant data for common KPI, although the actual worth of the data was low considering the lack of use. The VASs use resources from the P2P Connectivity Platform (business logic available to VAS can be found in ANNEX: Report on VICINITY Tromsø Business Logic 2019), which ties together the P2P PARK app, the P2P Healthcare Visit app (see examples in ANNEX: User Experience) and the devices at the pilot site with the VICINITY service.

3.3. Business Evaluation

It was decided to conduct face-to-face conversations with the stakeholders at the Tromsø pilot site which also served as users of the two use cases. These included employees of Tromsø municipality, carers stationed at the site, and tenants – of which 1 was disabled. The results of these one-to-one conversations are presented in *"Table 5: Stakeholder feedback – carers and administration"*, *"Table 6: Stakeholder feedback – municipality / public sector"* and *"Table 7: Stakeholder feedback – other stakeholders"*. The developers HITS hired for implementing the VAS were also asked for their opinion. Their comments are included in deliverable D8.6 together with the answers from the rest of the pilot sites' developers.

On the top level, the UC offers three levels of functionality;

- Offline management
- Real-time operation
- Active maintenance

Ownership and administration of the parking space is to be handled by the building manager and the owner of the physical parking space. "Teaterkvarteret 1. akt" is organised as a cooperative. The parking space owners handles the underground garage facility, while there are other parking operators that

manage the surrounding areas. Although ownership is handled by a cooperative, the parking spaces are contractually allocated tenants of the building cluster.

3.3.1. Priority parking business case

Priority parking is a novel idea that has been developed for the use cases. This is request for parking that for some reason or another is considered higher ranked than normal smart parking. For the time being, the main target group that will be assigned priority parking is:

- Disabled drivers/passengers
- Healthcare assistants
- Blue light agencies (medical, fire department and police)
- Other residents
- Next of kin

Later, it will be relevant to include other user groups as well; long term contract holders like representatives from the municipality, nearby stores, representatives from the press, building owners.

3.3.2. Business models for Value-Added Services

The value-added services set out to offer solutions addressing priority parking. In this case the two first solutions have been made available, while the preferences are only halfway implemented.

- Priority parking allocation based on booking ID
- Maintenance, healthcare, blue light agencies
- Support for adaptable car sizes and position in relevance to needs (access and entry points)

Currently short time contracts are implemented. A short time contract is available within a 24 hours cycles and is applicable to both UC 1 and UC 2.

3.3.3. Future plans and opportunities

Building upon contract types, three contract types are envisioned in the next version.

- Short time contracts (ad-hoc requests), currently available
- Long term contracts, next version
- Transferral of ownership, next version – some contractually issues may arise

Additionally, different sets of subscription services might be implemented. Future conditions that will be adhered to includes;

- Reducing or avoiding the need for excessive administration and control
- Reducing the amount of physical changes or fencing
- Flexibility with respect to different user needs based on time of the day
- Reward systems for minimising the use of parking space – but avoid direct fees
- Seek to achieve a unified solution for the entire cluster
- Adhering to the different parking regulations
- Test period with different contract periods
- Estimate for setup of site and operational costs

The concept of alerting public and private agencies and automatically assign parking space in case of specific occurrences can be used to develop Value-Added Services addressing time-critical incidents. This may include fire alarms, police emergency, access to train or plane, freight of fragile goods (for instance temperature dependent), or other deliverances with very short time of opportunity.

A new VAS suggested by Smart city administration Tromsø is to make interoperable city-wide parking systems using the VICINITY platform. User-centric solutions can be made by using VICINITY Smart

Parking platforms tied with proprietary parking systems offered by international service providers Europark, EasyPark or local Tromsø Parkering. Challenge is to demonstrate how the VICINITY platform can interconnect several parking systems having their own properties. However, TPEG2 Smart Parking is the generic, high-level parking ontology being used for all kind of parking systems
On a broader perspective it can be said that the VICINITY platform is targeted IoT ecosystems, and hence do address all domains that implements IoT devices. Within the mobility domain, this can be extended to actors that deliver or process relevant data for planning and processing.
If focusing solely on parking space monitoring and Value-Added Services based on traffic data, it can be separated into areas of interest, and services. Additionally, there will be related activities that can be used to generate opportunities based on equipment and trading.

For a list of more opportunities and markets, please refer to *"ANNEX: Business opportunities"* in this document.

The continuous development of VICINITY opens for many new services. For VICINITY to provide a solid foundation for upcoming services, features for transaction (of both tokens and financial) should be implemented. However, the VICINITY architecture provides a good framework for further development and extending such services.

4. Evaluation regarding Sustainable Development Goals

Evaluation scope is defined in D8.1 *"Pilot Sites Evaluation Framework"* (M36), and environmental evaluation was also requested towards the end of the project. The Tromsø pilot built a platform that address several of the sustainability goals presented in EUs strategy documents[3]. We have identified four goals where VICINITY and the Tromsø pilot can deliver results.

[3] https://ec.europa.eu/info/strategy/international-strategies/sustainable-development-goals_en

4.1. Good health and well-being

VICINITY facilitates the ability to combine same IoT devices from different providers. This opens for new opportunities when combining real-time data from different suppliers such as Gorenje and combine it with machine learning or other available value-added services.

Both use cases of the Tromsø pilot case "Intelligent Transport & Parking", as well as results related to "eHealth & Assisted Living for elderly people at home", assist in creating a safer and more sustainable society. This is accomplished by offering more time for visit and faster response in case of emergency.

4.2. Sustainable Cities

VICINITY facilitates the ability to combine same IoT devices from different providers. Adding sensor data from parking ecosystems with shared parking and introducing incentives making it more interesting to contribute, creates more opportunities for better harvest the resources that are available in urban environments. Smart cities will thus be made smarter, carers and drivers will become smarter and waste less time at finding relevant parking space thereby reducing emissions, while owners of parking space and relevant areas becomes smarter by sharing available and unused parking space creating a positive cost-benefit.

4.3. Responsible Consumption

UC 1 and UC 2 supports functions for predictive operations and resource management. These functions promote responsible consumption of resources such as human capital, water and energy. They trigger the release of resources on demand based on a threshold mechanism. UC 1 is reducing the amount of new areas that needs to be directly allocated car parking, while carers and other participants from public agencies are using the infrastructure in a more responsible and efficient way. This is both time saving as well as ensure that help is offered when time is of essence. It may also influence the quality of the care being offered as less time may be consumed while needlessly searching for parking space. A parking space that may – or may not – already be available close to the visiting address.

4.4. Partnership to achieve the Goal

VICINITY allows users from different cities and even countries to establish partnerships through the Neighbourhood Manager (NM) web application. Through coordinated and mutually beneficial sharing of data, the NM partners may achieve better quality for their respective products. VICINITY's NM model promotes the concept of partnerships and contracts. These concepts are integrated to reach the common goal of increasing the values of the IoT devices by making the IoT devices smarter and more available. See *"ANNEX: Screenshots from VICINITY Neighbourhood manager"* for examples of shared devices and VAS between HITS Tromsø pilot site and partners Gorenje and TINYM.
Member States decided to launch a process to develop a set of Sustainable Development Goals (SDGs). These goals are a call for action by all countries to accelerate progress on sustainable development aimed at securing healthy, peaceful and prosperous life to all.

5. Conclusions

This work package started early fall 2018. Agile development was used throughout the demo phase. The Pilot Site managed to achieve its goals, although not perfect – it demonstrates well how VICINITY integrates IoT devices based on different platforms and ecosystems. The Use cases served as a proof of concept of how VICINITY could be used to extend functionality, improve on efficiency and reliability, as well as demonstrate on what opportunities exist to create new business solutions that can improve the workday by building new solutions on top of IoT ecosystems. This was demonstrated through the creation of one framework named P2P Connectivity Platform which was prepared for P2P PARK (UC 1) and P2P Healthcare Visit (UC 2)

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 city of Halden, Norway. This building project was postponed, and the pilot site was instead moved to Teaterkvarteret in city of Tromsø, Norway. The number of users were smaller and the organisation different to the originally planned pilot. More emphasis has therefore been put on 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 introduction of subscription services offered by Gorenje for the smart appliances introduced also a novel idea of how to remove complexity from a local point of view, thereby reducing the need for in-house staff to do maintenance or extend other parts of the local infrastructure.

The stakeholders were generally positive to the project and its outcome. We received a lot of attention from the press thanks to the (somewhat inaccurate) slogan “airBnB for parking” being introduced and perceived as one of the main selling points. A lesson learned is that the project probably would have benefitted from having a more mature version of the framework prepared before actively engaging the local stakeholders.

The use cases did also demonstrate that the results from VICINITY contributed to several of EUs environmental goals, thereby becoming an increasing part of research and innovation activities that supports future sustainable solutions.

The Tromsø Pilot Site has provided HITS and the stakeholders with an area for learning and a testbed for VICINITY. HITS had to face several 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.

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 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 making parts of the platform available on GitHub and offering 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 offering new solutions build on the strength of Interoperability as a Service as provided by VICINITY.

6. References

[1] D8.1 Pilot Evaluation Framework Definition, online: https://vicinity2020.eu/vicinity/content/d81-pilot-evaluation-framework-definition

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

ANNEX: Business opportunities

The following list is by no means meant as complete, but do address several customer groups and sites of interest:

- Airports
- Ports/harbours
- Train stations
- Hospitals
- Colleges & Universities
- Shopping centres/malls
- Hotels
- Residential area
- Municipalities/counties
- Business centres/enterprises
- Sports and exhibition venues

Furthermore, farms and entrepreneurs are examples of other sites that might benefit from identifying which areas that are in use at any given time, as well as historical data for statistical purposes.
The list presented in the table below is by no means complete, but provides some examples that so far has been identified and which demonstrates the potential that this technology can offer:

Table 12: Sources for developing business models

Subscription services	Sales and regulative
• Parking site • Maintenance • Integration • System – administration • System – area • System – building/parking lot	• Marketing and loyalty programs • Parking policy development • Parking patrols consulting • Sustainability and environmentally friendly initiatives • parking access and revenue control systems (PARCS) • Consultancy (other)
Apps – sale structure	**Marketing**
• Price dependent on time of day • Vouchers • Management & Operation • Lease • Rent / License • Profit Share / Joint Venture • BOOT Scheme (build, own, operate and transfer) • Value-added reseller (VAR)	• Stickers (QR code) • Retail & commercial parking services • Digital signs • Lighting • Information screens • Graphic design • Digital Marketing (customer engagement, trip planning, microsites, campaigns)
Car park management	**Optimization**
• Remote monitoring control room • Car park consulting • Equipment provision and integration • Automated 24/7 facilities • Self-service kiosk • Parking hub • Authentication solutions	• Route planning • Route optimisation • Area optimisation • Area management • peripherals • Machine learning • Forecast

• Car Park assignment on triggers • Prioritized request allocation • Assessment criteria • Licensing rights	• Identify hotspots based on time of day and available means of transport • Insight
Cooperation/partnership	**Monitoring and visualisation**
• Airport pick-up • Shuttle bus service • Special events parking • Safety & Security • Towing • EV ports/metering – smart energy • Car rental • Storage • Pick-up service • Bicycles/city bikes • Segways • City council • National Road Agency • Newspapers/media	• Data mining • Data presentation • Analytics • Visualisation • Risk analysis • Traffic management • Real-time monitoring – air quality, traffic, occupancy, temperature, weather • Aggregating traffic info • Forecast user needs based on triggers from sensors • Better parking solutions. • Workshops

ANNEX: Report on VICINITY Tromsø Business Logic 2019

6.1. Business logic

The business logic is based on addressing issues relevant to the following Use Cases/situations:

- Parking space is assigned to shared parking, parking sensors are deployed and registered in PNI ecosystem and included through VICINITY neighbourhood manager
- Mobile app displays availability of parking sensors and allows for booking of parking space
- Vacancy detected through parking sensor and triggering smart light depending on status through VICINITY adapter
- Backend solution is logging usage and allows for priority parking in case of time restraints
- Detecting alarm signals from panic button (i.e. device, app) managed through Raspberry Pi 3
- Situation is logged and source of alarm is used to trigger a relevant response.
- Appropriate message (i.e. name, apartment, condition, source of alarm) is sent to assigned roles (i.e. care takers, next of kin, medical personnel) while info screens are updated
- Priority parking procedures are put in effect and relevant parking space is set to occupied and locked

6.2. On users: User properties

During the planning stage, personas were developed, and some user journeys were defined. These were the main personas that were created, and the stories prepared for:

			
Dr. Charlotte – responsible for taking care of and following up handicapped residents at Teaterkvarteret	John – a resident suffering from severe epilepsy and cerebral parese.	Martin - property owner and manager of the parking space. Receives reimbursement for parking usage.	Julia – Johns aunt. Receives notifications when incidents that demands attention occurs at the apartment.

Based on our experience and walkthrough, we described the following business logic for users:

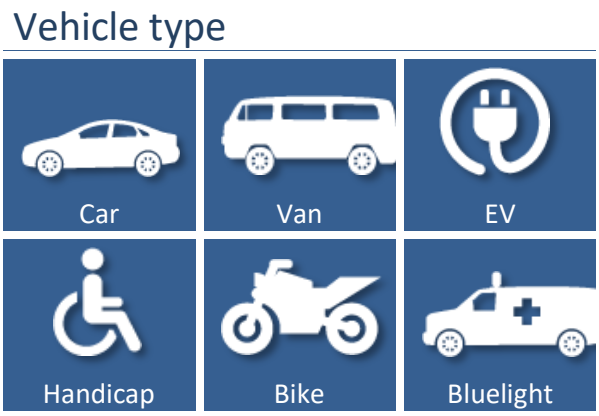
- A user can be registered as either driver, owner or health (worker).
- A user can be assigned one of three genders: male, female, other
- A user can be assigned a certain set of disabilities: none (default), wheelchair, other.
- A user can be assigned a birthday
- A user can own one or more vehicles
- A user can be assigned a vehicle owned by others (typically healthcare personnel sharing a transportation fleet)
- When registering a user both a unique username and password is mandatory. The username must be more than 5 characters, while the password must consist of both letters and numbers.
- Email and mobile number are mandatory and must be a valid format. A user confirms the registration by responding to verification received by email.
- A user can also be assigned a handicap parking permit.
- Parking on handicap designated parking spaces;
    - Only users with disabilities can book a handicap parking space.
    - A user/vehicle with parking permit can book handicap parking space.

Usertype	Driver (default)	Owner	Health
Preferences	Normal (default)	Normal (default)	Normal (default)
	Electrical	Electrical	Priority
	Handicap	Handicap	Emergency

Note: All user types can be assigned different parking preferences.

Parking permit: This permit affects what parking space can be booked. The handicap parking permit is currently assigned a user. The permit can also be assigned a vehicle. Currently the parking permit has no limitations. Later updates will introduce area-codes that can be assigned handicap parking permits.

6.3. On vehicles



- A vehicle can be either a car, van, electrical car (EV), handicap (car), bike (motorcycle) or blue light (ambulance)
- It is mandatory to assign a vehicle a description and a valid license plate number.
- Dimensions length, width, height and weight can also be applied to a vehicle.
- A vehicle can be owned by one user but be assigned to any number of other drivers. This is something that is relevant when sharing vehicles or having public owned vehicles like ambulances.

6.4. On apartments

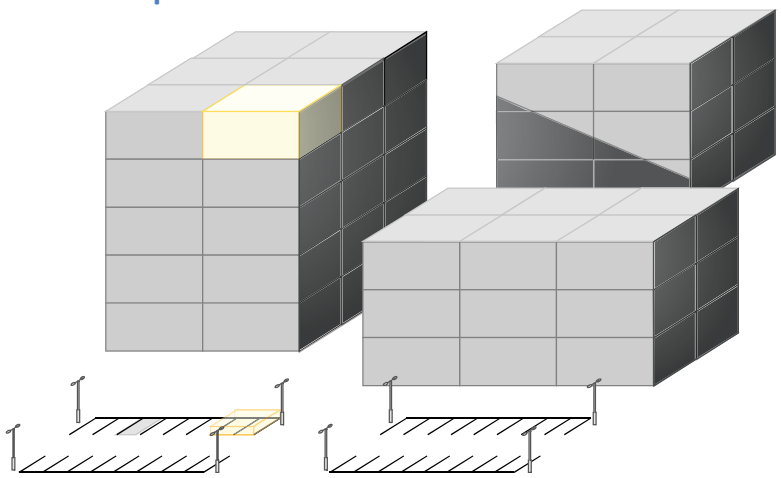


Illustration: Description of relationships between apartment, building, complex, parking space and parking lot.

Structure:

Apartment/flat (marked yellow)
Contains Rooms (1..n)

Building
Contains Apartments (2..n)

Complex
Contains Buildings (2..n)

Parking Space
Contains sensors/devices (1..n)

Parking lot
Contains parking space (1..n)

- An apartment (a flat) can be part of a building. A building can be part of a complex.
- Each apartment has an address. This address consists of street name, number, zip code and city
- There can be one or more owners of an apartment. There can also be one or more residents in an apartment.
- Each apartment can be assigned one or more parking spaces.

6.5. On parking lot

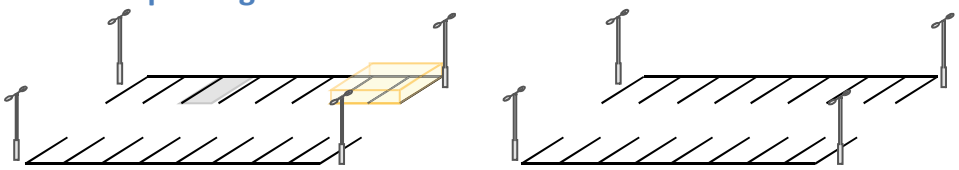


Figure: Example of one kind of parking lot.

- A parking lot is a virtual representation, and thus represents a collection of parking spaces.
- Thus, any parking space, location and type, can be assigned to a parking lot.
- A parking lot can be owned by a juridical user (person or organisation).

6.6. On parking space

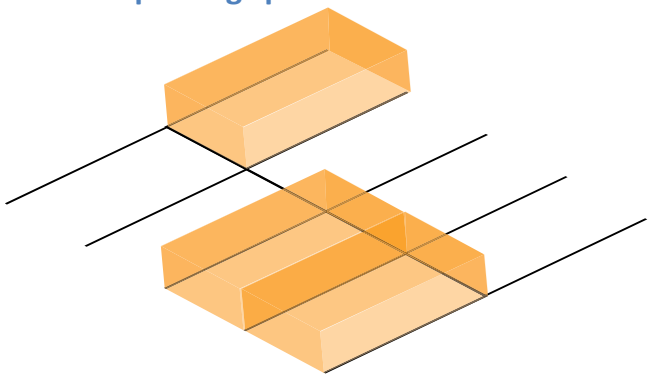


Illustration: Examples of several parking spaces with the same owner, unevenly distributed.

- A parking space can be owned by a legal user (person or organisation)
- A parking space can be assigned to a parking lot. A parking lot can be described as a collection of parking space
- A parking space can have several properties making it suitable for different vehicle types; car, van, EV, handicap, bike and blue light (ambulance).
- The properties describe spatial dimensions (width, length, height) as well as ground (hard, soft, dry, wet, weight restrictions), floor (open, closed), walls (front, back, left, right).
- A parking space can be assigned any number of devices.
- If smart parking sensor is assigned, it is possible to collect real-time information about occupancy.
- If smart light is assigned, the light can use colour to indicate the present and upcoming status of the parking space.

Not all of these properties are enabled in the alpha version.

6.7. On favourites

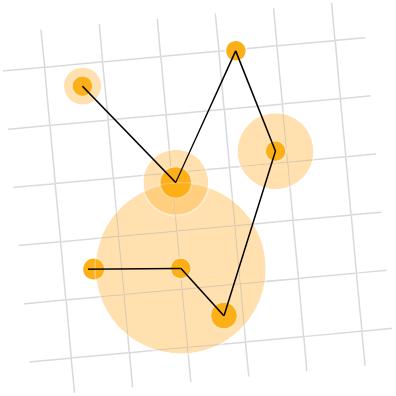


Illustration: Favourites can be represented by a list consisting of a number of points (1..n)

- Favourites represents a list of points of interests that is unique for each user. There has not been put any restrictions of the number of favourites any user can define.
- A favourite is typically either a street address or a direct location. A favourite consists of a short description as well as a location in the format of longitude/latitude.
- It is possible to share favourites with other users.
- Typical uses for sharing favourite lists comes from municipalities that has created a route with patients that shall receive visits by caretakers.
- Thus, a caretaker receives both a vehicle and a visitor list that also can serve as a journey planner.
- The history log from the visits can be used as part of the journal system.

6.8. On booking

- Booking: a request for an immediate or scheduled lockdown of parking space.
- If request is accepted due to parking space is available, the parking space is assigned the vehicle and user, and registered as locked for a given time period.
- **Emergency booking is a special case since the lockdown does not have any known end time, hence the lockdown will be active until otherwise notified.**
- The lockdown can be initiated by users and processes alike.
- Users delivering a booking request can be drivers, owners and healthcare personnel.
- There is no limit on what genders can send in booking request.
- There are restrictions on what kind of vehicles can be booked for certain parking space.
- Only vehicles specified as handicap or with handicap parking permission can book handicap parking space.
- If parking space is allocated emergency/blue light agencies, only vehicles fulfilling these criteria can book that site.
- Certain parking space may be allocated bikes due to restrictions on dimensions/weight – thus only bikes are allowed booking this kind of parking space.
- And finally – only electrical vehicles can book on parking space allocated EVs. Assumption: all EV parking space has access to a charging port.
- There are no restrictions on which vehicles can book on normal parking spaces.
- Process that can send in booking requests may take the form of scheduled booking
    - once
    - repeated booking requests from a calendar
- an event triggered by warning level 3 or higher.
- Booking activities normally receives a priority from 1-3.

- The higher priority, the higher the demand to override existing bookings that is in-transit (still not arrived at the parking space).
- Priority is assigned using these values:
  - 1 = low priority (standard)
  - 2 = medium priority (normally assigned owners of a given parking site or parking lot)
  - 3 = high priority (assigned emergency requests).
- Currently only bookings still queued, where the vehicle is still in-transit and scheduled parking can be market for reassignment due to priority requests/lockdown.
- Special case: when vehicle is parked over the time limit. This generates an extra fee, unless the vehicle is part of an emergency parking.
- In the rare case of reassignments, the affected vehicles are offer the next vacant nearby parking space in the same order as they originally appeared in the queue.
- Vehicles that were in-transit is placed first in the booking queue.
- Original scheduled parking on the reassigned parking space is taken into consideration, thus the new reassigned/offered parking cannot be for longer than what is available.
- Changes in parking costs are not taken into consideration.
- Owners of the parking site receives higher priority when booking parking at their own parking site and thus will change the queue order for bookings that have been scheduled/booked, but where the vehicle is still not in-transit
- Emergency bookings still receive higher priority than owners.

6.9. On notifications

- Notifications are sent to users of mobile app from two different sources;
  - system wide messages generated by an administrator
  - user specific notifications generated by web-based processes.
- The web-based processes are normally be triggered by events. These events are received by smart appliances or Value-Added Services. Different events trigger different notification messages.
- Currently notifications based on three warning levels are generated from Gorenje smart appliances;
- Notifications are also related to booked parking and scheduled parking:

Notification	Refrigerator	Freezer	Oven
Reminder	Door left open 5 minutes	Door left open 3 minutes	Food left after heated 10 minutes
Heads-up	Door left open 10 minutes	Door left open 6 minutes	Food left after heated 20 minutes
Emergency	Door left open 15 minutes	Door left open 12 minutes	Food left after heated 30 minutes

Notification: standard parking	Booked	In-transit	Parked
Time left to parking start	x	x	
Parking start			x
Time left to parking stop			x
Parking stop			x
Parking overdue – extra fee warning			x
Parking overdue – extra fee			x
Notification: queue handling/changes due to emergency	**Booked**	**In-transit**	**Parked**

Booking requeued – offer new parking space	x	x	
Booking changed - accepted	x	x	
Booking queue	x	x	

- There is support for other notification messages as well. These are currently not implemented.
- Such notifications come in two shapes: informative and interactive.
- It is also possible to subscribe to notifications. A user can for instance receive a message when a nearby parking space has been made available, when a visitor (next of kin or caretaker) is in-transit or have arrived or if a new care taker has been assigned to a patient.
- Furthermore, the notifications can be tied in with events from other value-added services. These can be used to inform about road conditions, air temperature, time of arrival for bus or taxi, reminders for medication etc.
- Interactive notifications request action to be made. This is typically an accept button, but it may also be to decide between several options or to navigate to a specific page.

6.10. On payment and variable fee

- A parking space supports a variable fee based on time of day. There is no support for variable fee based on weekday. The data model support for price based on popularity. There is also support for highest bidding as well as subscription price models. These are to be implemented by request as the framework is prepared.
- A fee is added when a vehicle is parked overdue. This is currently a fixed fee and do not change depending on time of day or week.
- There is currently no mechanism for alerting when a vehicle has been parked for longer than a max allocated time.
- If this is considered a big issue, an event creating notification for rescue vehicle/tow truck has already been prepared.
- Fees can also be assigned to a parking lot; in which case these values are used if no value is set at the parking space.
- The transaction income and costs can be designated:
  - a specific account per parking space
  - one common bank account that covers all or a part of parking spaces in a parking lot.
- The actual cost allocation is calculated from the registered parking logs.

6.11. On logs

- All major activities are logged. This includes start and stop time parking, end cost and end cost extra fee, user id, vehicle id and parking space id.
- Rebooking, notifications and other changes are not currently being registered.
- The architecture supports descriptions accompanies the log entry. This would typically be something like the reason for the parking (emergency, apartment id, source of event) or authorisation (event trigger, value, schedule).

6.12. On integration

- Currently Gorenje smart refrigerator, smart freezer and smart oven is supported.
- The appliances generate different events depending on how long the doors are left open or the food is left in the oven after being heated.
- The architecture supports adding all kinds of new smart appliances.

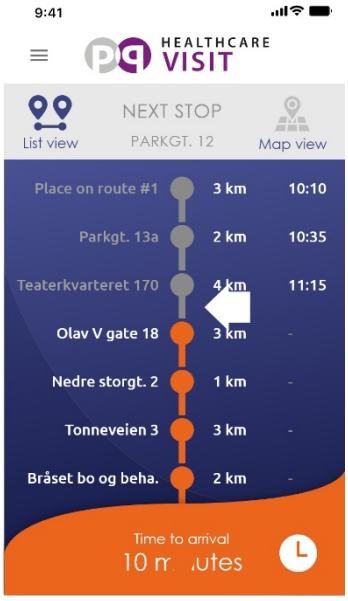
ANNEX: User Experience

Based on conversations and feedback from carers as well as municipality, some designs were prepared to accommodate daily use.

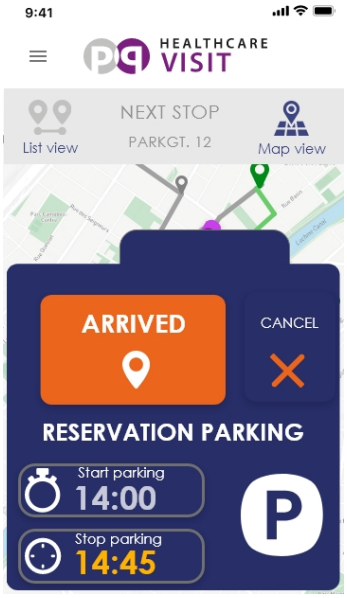
The Use cases were therefore adjusted somewhat; most notably that carers visiting residents are using a roundtrip metaphor renamed to “P2P Healthcare Visit”, while the traditional shared parking solution kept the name “P2P PARK”.

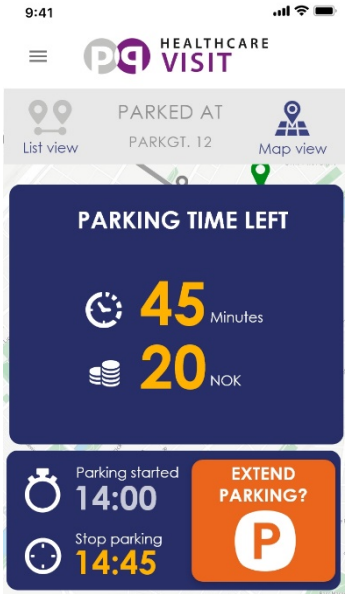
Additionally, a platform supporting the exchange of data between the different parking apps, healthcare solutions and mobility information were prepared so both first responder functionality and shared parking would work with support for transactions.

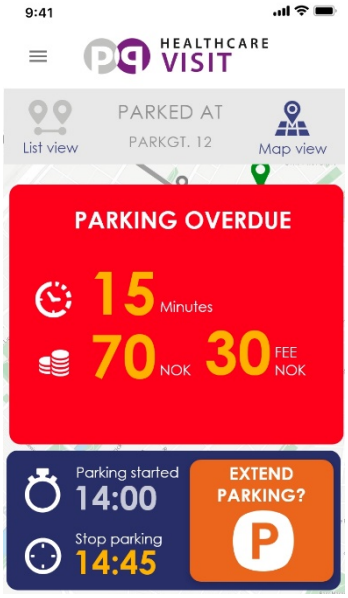

9:41
HEALTHCARE VISIT
BEGIN VISIT
PLACES
PROGRESS
SETTINGS


9:41
HEALTHCARE VISIT
List view
NEXT STOP
PARKGT. 12
Map view
Place on route #1 3 km 10:10
Parkgt. 13a 2 km 10:35
Teaterkvarteret 170 4 km 11:15
Olav V gate 18 3 km
Nedre storgt. 2 1 km
Tonneveien 3 3 km
Bråset bo og beha. 2 km
Time to arrival
10 minutes


9:41
HEALTHCARE VISIT
List view
PARKED AT
PARKGT. 12
Map view
Place on route #1 3 km 10:10
Parkgt. 13a 2 km 10:35
Teaterkvarteret 170 4 km 11:15
Olav V gate 18
Nedre storgt. 2 1 km
Tonneveien 3 3 km
Bråset bo og beha. 2 km
Remaining parking
5 minutes


9:41
HEALTHCARE VISIT
List view
NEXT STOP
PARKGT. 12
Map view
ARRIVED
CANCEL
RESERVATION PARKING
Start parking
14:00
Stop parking
14:45
P

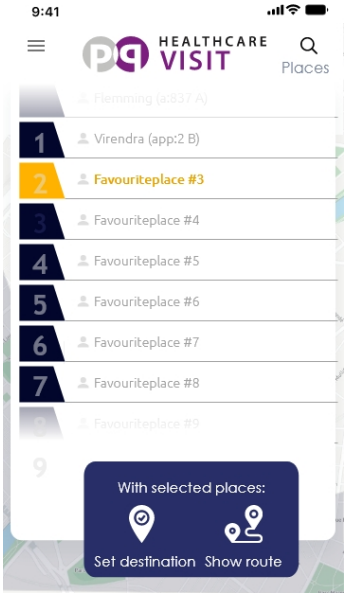

9:41
HEALTHCARE VISIT
List view
PARKED AT
PARKGT. 12
Map view
PARKING TIME LEFT
45 Minutes
20 NOK
Parking started
14:00
Stop parking
14:45
EXTEND PARKING?
P


9:41
HEALTHCARE VISIT
List view
PARKED AT
PARKGT. 12
Map view
PARKING OVERDUE
15 Minutes
70 NOK 30 FEE NOK
Parking started
14:00
Stop parking
14:45
EXTEND PARKING?
P

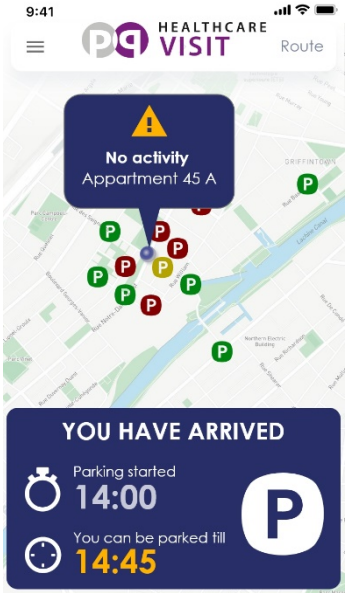

9:41
HEALTHCARE VISIT
Route
BOOK PARKING
10 11 12 13 14 15 16
05 10 15 20 25 30 35
Start parking
13:20
End parking
14:50
Cost
50 NOK
Extra fee
0 NOK

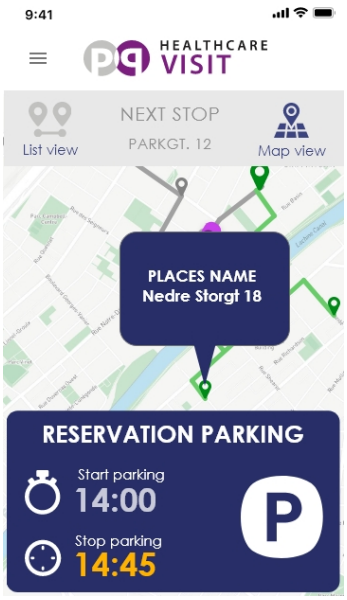

9:41
HEALTHCARE VISIT
Route
EXTEND PARKING
10 11 12 13 14 15 16
05 10 15 20 25 30 35
Start parking
13:20
End parking
14:50
Cost
50 NOK
Extra fee
0 NOK

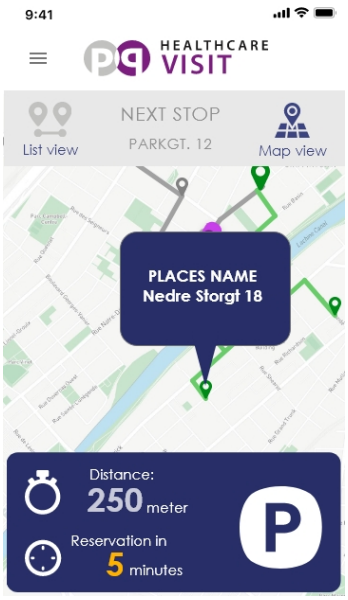

9:41
HEALTHCARE VISIT
Route
Attention required
RESPOND
Destination
Favourite #3
Parkgt. 12, 5032 Tromsø
Estimated time of arrival
13:20

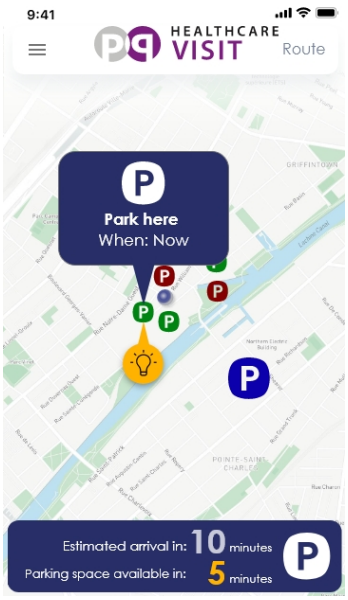

9:41
HEALTHCARE VISIT
Places
Virendra (app:2 B)
Favouriteplace #3
Favouriteplace #4
Favouriteplace #5
Favouriteplace #6
Favouriteplace #7
Favouriteplace #8
With selected places:
Set destination
Show route

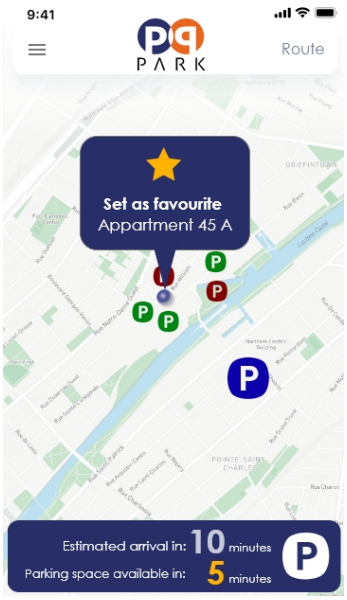

9:41
HEALTHCARE VISIT
Route
Estimated arrival in: 10 minutes
Parking space available in: 5 minutes

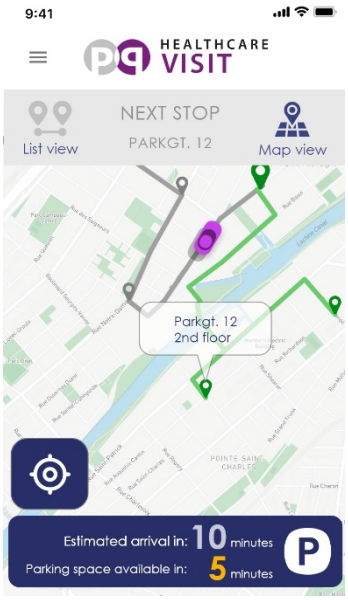

9:41
HEALTHCARE VISIT
Route
No activity
Appartment 45 A
YOU HAVE ARRIVED
Parking started
14:00
You can be parked till
14:45

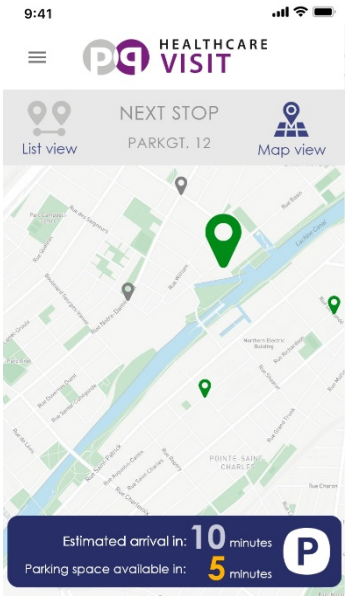

9:41
HEALTHCARE VISIT
List view
NEXT STOP
PARKGT. 12
Map view
PLACES NAME
Nedre Storgt 18
RESERVATION PARKING
Start parking
14:00
Stop parking
14:45


9:41
HEALTHCARE VISIT
List view
NEXT STOP
PARKGT. 12
Map view
PLACES NAME
Nedre Storgt 18
Distance:
250 meter
Reservation in
5 minutes

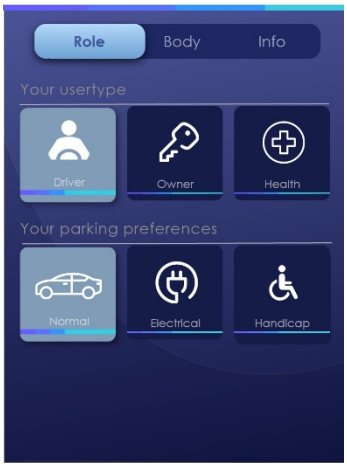

9:41
HEALTHCARE VISIT
Route
Park here
When: Now
Estimated arrival in: 10 minutes
Parking space available in: 5 minutes


9:41
PARK
Route
Set as favourite
Appartment 45 A
Estimated arrival in: 10 minutes
Parking space available in: 5 minutes


9:41
HEALTHCARE VISIT
List view
NEXT STOP
PARKGT. 12
Map view
Parkgt. 12
2nd floor
Estimated arrival in: 10 minutes
Parking space available in: 5 minutes

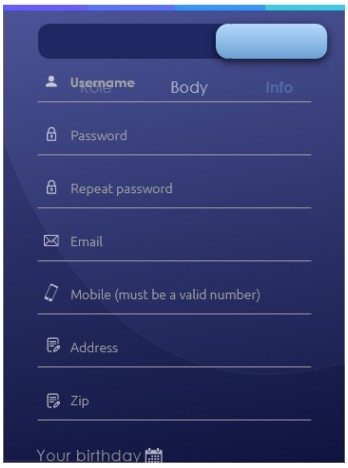

9:41
HEALTHCARE VISIT
List view
NEXT STOP
PARKGT. 12
Map view
Estimated arrival in: 10 minutes
Parking space available in: 5 minutes

USER ROLE

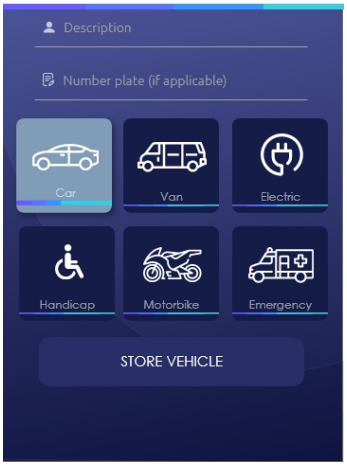


USER TYPE

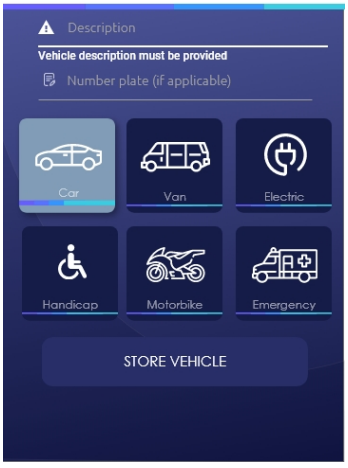
USER INFORMATION



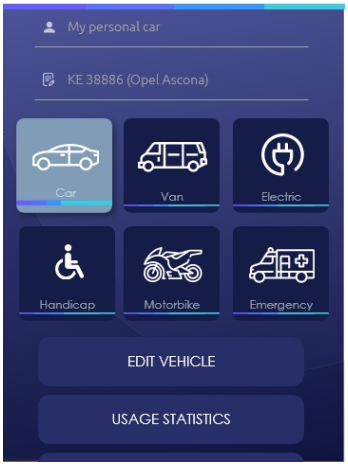
REGISTER INFORMATION



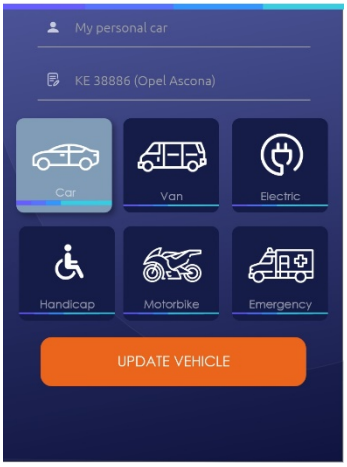
REGISTER VEHICLE



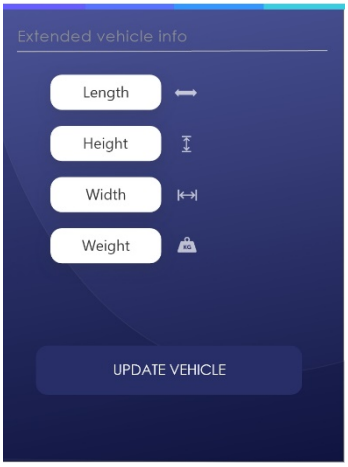
VEHICLE INFORMATION



EDIT VEHICLE



VEHICLE PROPERTIES



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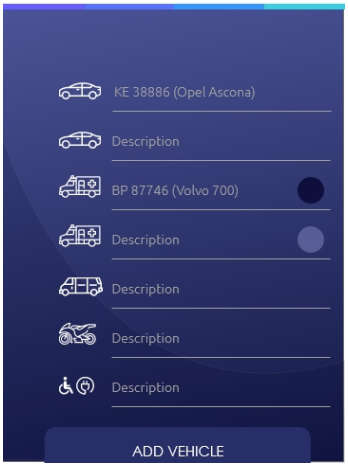
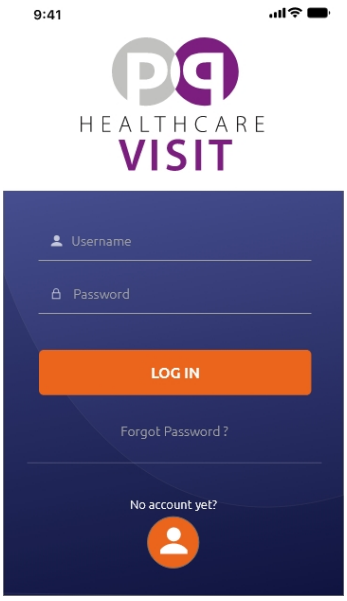
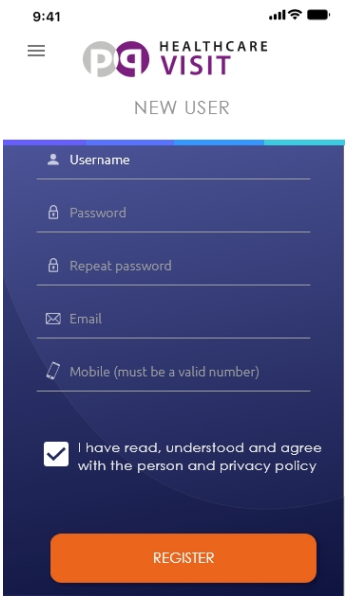
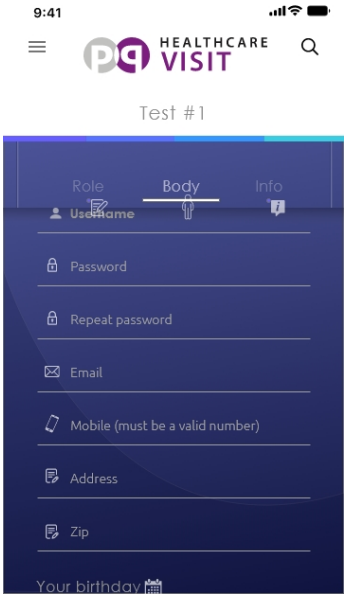
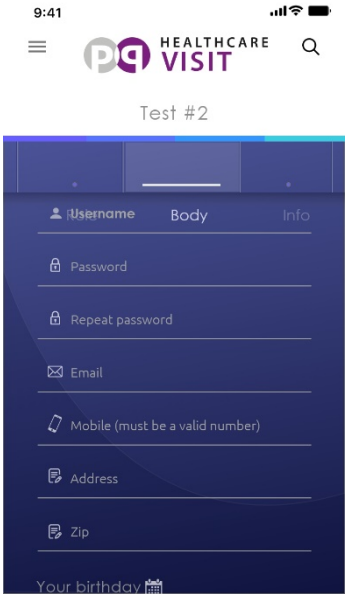
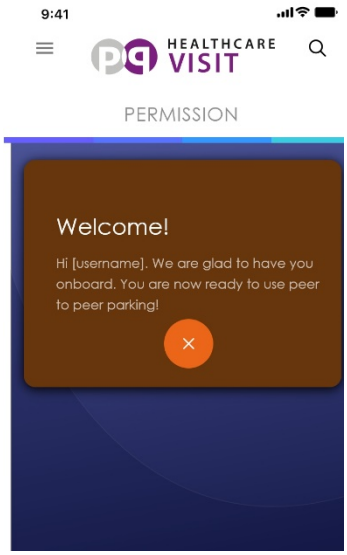


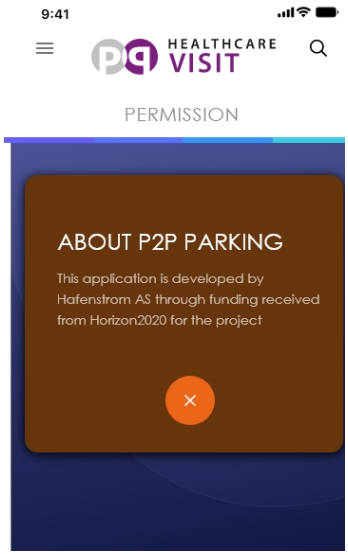

9:41
HEALTHCARE
VISIT
Username
Password
LOG IN
Forgot Password ?
No account yet?

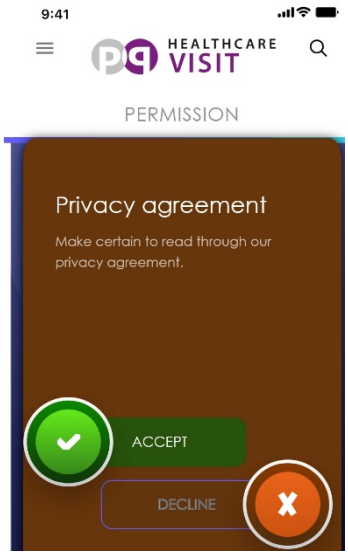

9:41
HEALTHCARE
VISIT
NEW USER
Username
Password
Repeat password
Email
Mobile (must be a valid number)
I have read, understood and agree with the person and privacy policy
REGISTER

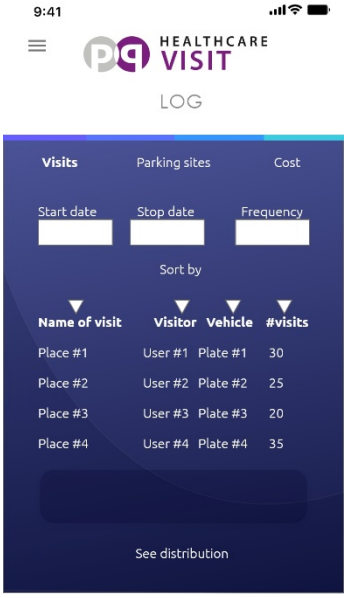

9:41
HEALTHCARE
VISIT
Test #1
Role
Body
Info
Username
Password
Repeat password
Email
Mobile (must be a valid number)
Address
Zip
Your birthday

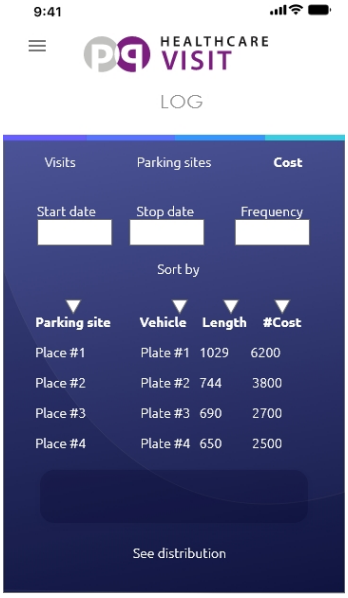

9:41
HEALTHCARE
VISIT
Test #2
Username
Body
Info
Password
Repeat password
Email
Mobile (must be a valid number)
Address
Zip
Your birthday

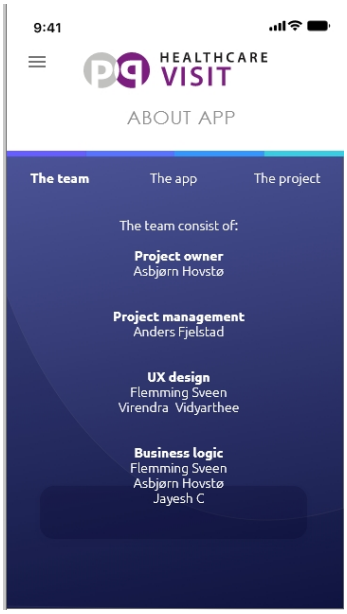

9:41
HEALTHCARE
VISIT
PERMISSION
Welcome!
Hi [username]. We are glad to have you onboard. You are now ready to use peer to peer parking!

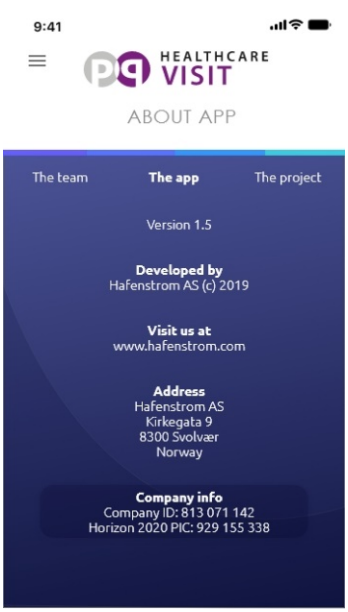

9:41
HEALTHCARE
VISIT
PERMISSION
ABOUT P2P PARKING
This application is developed by Hafenstrom AS through funding received from Horizon2020 for the project

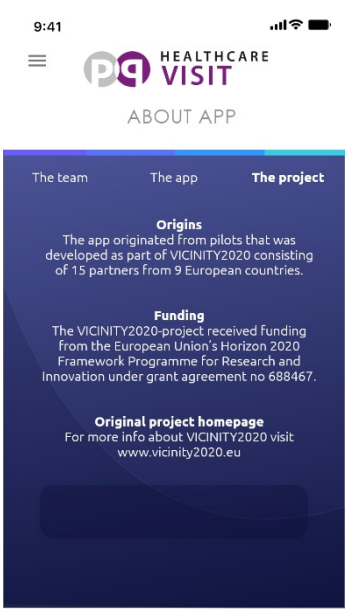

9:41
HEALTHCARE
VISIT
PERMISSION
Privacy agreement
Make certain to read through our privacy agreement.
ACCEPT
DECLINE


9:41
HEALTHCARE VISIT
LOG
Visits
Parking sites
Cost
Start date
Stop date
Frequency
Sort by
Name of visit
Visitor
Vehicle
#visits
Place #1 User #1 Plate #1 30
Place #2 User #2 Plate #2 25
Place #3 User #3 Plate #3 20
Place #4 User #4 Plate #4 35
See distribution


9:41
HEALTHCARE VISIT
LOG
Visits
Parking sites
Cost
Start date
Stop date
Frequency
Sort by
Parking site
Vehicle
Length
#Cost
Place #1 Plate #1 1029 6200
Place #2 Plate #2 744 3800
Place #3 Plate #3 690 2700
Place #4 Plate #4 650 2500
See distribution


9:41
HEALTHCARE VISIT
ABOUT APP
The team
The app
The project
The team consist of:
Project owner
Asbjørn Hovstø
Project management
Anders Fjelstad
UX design
Flemming Sveen
Virendra Vidyarthee
Business logic
Flemming Sveen
Asbjørn Hovstø
Jayesh C


9:41
HEALTHCARE VISIT
ABOUT APP
The team
The app
The project
Version 1.5
Developed by
Hafenstrom AS (c) 2019
Visit us at
www.hafenstrom.com
Address
Hafenstrom AS
Kirkegata 9
8300 Svolvær
Norway
Company info
Company ID: 813 071 142
Horizon 2020 PIC: 929 155 338


9:41
HEALTHCARE VISIT
ABOUT APP
The team
The app
The project
Origins
The app originated from pilots that was developed as part of VICINITY2020 consisting of 15 partners from 9 European countries.
Funding
The VICINITY2020-project received funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation under grant agreement no 688467.
Original project homepage
For more info about VICINITY2020 visit www.vicinity2020.eu

ANNEX: Transport – market and demands

The business requirements conclude the VICINITY Objective 1.2 "IoT interoperability requirements and barriers are elicited, captured and analysed as principal drivers of the VICINITY research activities" and presented in D1.4 *"Business Requirements Specification"* (M12). The document presents among other things a set of common business requirements (such as usability, implementation, security, privacy, legal requirements).

VICINITY-BR-TRA010	Abide to legislation
Parking sites abides to legislation for ownership models, income from rental, privacy[4] and security[5] agreements regarding access and authorisation to indoor parking sites[6].	

VICINITY-BR-TRA020	New kind of contracts need to be prepared
Contracts that define responsibilities for ownership of parking space, access and personal data has been defined, but is currently not mandatory.	

VICINITY-BR-TRA030	New rental models need to be prepared
Transaction and rental models have been introduced for long term, short time, subscription based and contract-based usage.	

VICINITY-BR-TRA040	Standards for traffic data need to be adhered
Agreements should adhere to standards [7]used for exchanging (semantic) data with ITS equipment, traffic control centrals, nearby vehicles, and digital signs.	

VICINITY-BR-TRA041	Supporting European standards and communication protocols
Support for standardised communication protocols used for smart parking and relevant equipment needs to be anchored on a contractual level. The European standard DATEX II has been the preferred choice. The common rules in the field of data provision and publication are based on this standard, and it is the basics for public procurement and apply for all smart parking detection technologies, payment terminal and other transactions, traffic information and control centres data work.	

VICINITY-BR-TRA042	Privacy and security settings must be implemented
The encryption and storage of data adheres to EU's Data Protection Directive 95/46/EC2 as well as the Norwegian legislation. This includes anonymising person data and other information that can identify an individual.	

VICINITY-BR-TRA043	Integration with other transport related sectors
Integration with other transport related sectors – most notably car sharing and public transport has been supported in order to establish the foundation for a healthy ecosystem, and also alleviate some of the pressure on the infrastructure, thereby reducing the climate footprint.	

[4] EC Regulation 2016/679, EU's Data Protection Directive 95/46/EC, Regulation 45/2001/EC, EU Council Decision 2008/615/JHA
[5] ITU-T Recommendation E.408
[6] Directive 2010/40/EU
[7] CEN TC278, ISO/TC204 and all related standards, with special attention to C-ITS, including ETSI TC ITS.

VICINITY-BR-TRA044	Support datasets with information about EV charging stations

Support and access to updated information on available EV charging stations with technical information, current status and availability is supported through the underlaying platform.

VICINITY-BR-TRA050	Access control need to be integrated in specifications

Different ways of getting access – to underground garage facilities – has been defined. This includes authorisation equipment and systems like camera systems for reading licence plates, car-based sensor, card reader, RFID, Bluetooth, geo fencing and biometric systems. Other reader/detection units will be integrated when deemed necessary.

VICINITY-BR-TRA060	User experience should be adapted to a variety of users with different backgrounds and capabilities

Demands on user experience design was an integral part of the solution. This addressed both devices and accessibility, with an emphasis on supporting unified design. Certain disabilities and lack of previous experience might affect the usability aspect. Users on that handles the parking experience on small devices, as these tend to put extra strain on the end users' cognitive capabilities. There is little or no time for training, and the system will be based on an On-Demand approach. This is even more significant when the mobile devices offer interaction with the 3rd party services that will be built on top of the parking experience. User experience should be continuously measured and evaluated by UX designers through anonymous tracking of user navigation on the panel.

VICINITY-BR-TRA070	Structural plans for garage facility

Structural plans/layout for garage facilities has been prepared for the administrative system. This includes information of the building complex/landscape with information about access points, charging stations, fire extinguishers, escape exists, alarm signals as this is necessary in order to provide a proper service that can be implemented and expanded on a longer term.

VICINITY-BR-TRA080	Logistics perspective needs to be included

The transport domain contains challenges within areas such as logistics (e.g. assignment, allocation, optimising routes, history). Transportation does also include such topics as authorisation/ authentication/access, integration of other services and visualisation of complex information. This means that proper knowledge of priorities, special requirements for vehicles and users, historical data and ownership of transport related equipment and services will be one of many parameters that will influence logistics and other outcomes from the transport related issues.

Therefore, Interoperability on these areas including other value-added services is supported.

VICINITY-BR-TRA090	Different data sources to provide input

Interoperability on rulesets that support actions based on changing values and their relevance to the transport domain is supported. This includes data from manual booking, trigger mechanisms based on rulesets integrated with other domains (i.e. eHealth and building), request from technical or health care personnel, ground based sensors and visual data from other sources.

VICINITY-BR-TRA100	Unified descriptors create opportunities for replicating and scaling up the installations

The Technical Specification standard CEN 16157-6:2013, Annex D (Data Dictionary), describes DATEX II data exchange specifications for traffic management and information, of which part 6 deals with Parking publication. Standardisation of DATEX II establish a basis for common exchange between the traffic and the travel information sector, thus opening for cross-domain value-added services.
This standard serves for setting out the rules for parking management and should be part of the common framework for handling smart parking related activities.

VICINITY-BR-TRA110	Camera and Light sensor for number plate recognition

Camera with Automatic Licence Plate (ALR) detection and reading capabilities affect authentication and authorisation processes and is part of the entrance security system. This operation also provides the facility owners and managers with information about how many and what registered vehicles that are present at any time.

VICINITY-BR-TRA120	Parking Sensor for occupancy detection

Detection of parking space occupancy has been applied to optimisation of both short-term and long-term parking space usage. These data can also be when correlated with data from ALR-detection and hence improve parking services processes.

In WP1 health domain requirements were defined for the Tromsø UC paying attention to the challenges of this domain, including the right handling of medical data. In the following table the requirements defined in D1.4 are presented.

VICINITY-BR-HLT020	Cost-benefit, effective devices need to be selected

The devices involved to the two Use cases are low cost, effective and easy to use for the users (disabled and tenants).

VICINITY-BR-HLT030	Audit management must be adopted and adhered

An effective audit management mechanism is implemented in the GDPR compliant database developed for the needs of this pilot case. Users are fully aware, giving consent of who has access to their personal health data.

VICINITY-BR-HLT040	Contracts need to be prepared for authorised third parties

Users' personal health data are handled through contracts defining ownership of data, usage of data and privacy.

VICINITY-BR-HLT060	A standard process for emergency cases need to be adopted and adhered

A standard process is followed in cases that alerts/warnings are triggered (see VICINITY-BR-HLT110). Warning level 1 sends a reminder to the owner of the device (refrigerator, oven) that generate the warning. Level 2 sends a message to next of kin to be aware. Level 3 triggers message to assigned caretaker as well as a first responder call if no acceptance is received within one minute.

VICINITY-BR-HLT070	Health and Home Monitoring devices

Access to health status and in-house conditions are provided to caretakers for identifying abnormal behaviour with the supervised person.

VICINITY-BR-HLT110	Oven and Fridge usage monitoring

Household appliances usage data deployed to a citizen's house in order to identify abnormal behaviour.

ANNEX: Hardware installation HITS Tromsø Pilot

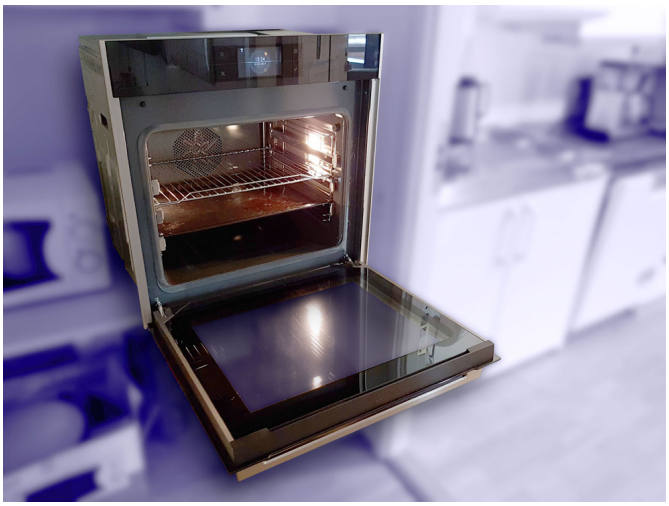


Figure 12: Placement of the Gorene smart oven

Figure 13: Routers/gateways placed on top of the refrigerator

Figure 14: 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

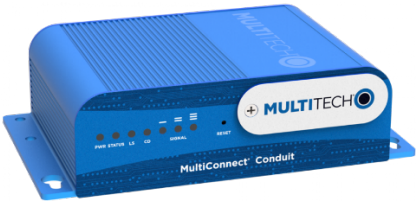
Figure 15: Locked steel closet for equipment

Figure 16: 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 are 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 presented in Table 8 and Table 13.
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 D9.3 *"Data Management Plan, second version"*. This applies to both physical accessibility as well as storage and exchange of personal data.

Table 13: Equipment installed at pilot site

<table>
<tr>
<td rowspan="3">Smart refrigerator with freezer
ATAG Magna KD84178BFC
Gorenje
 
Figure 17: Gorenje smart refrigerator</td>
<td>Smart oven
ATAG Magna CS4574M1C
Gorenje
 
Figure 18: Gorenje omart oven</td>
<td></td>
</tr>
<tr>
<td>IKEA smart light
TRÅDFRI LED bulb E26 980 lumen
IKEA
 
Figure 19: IKEA smart light</td>
<td>Trådfri Gateway
IKEA
 
Figure 20: IKEA Trådfri gateway</td>
</tr>
<tr>
<td>Door Sensors
FGDW-002
Fibaro
 
Figure 21: Fibaro door sensor</td>
<td>Motion sensors
FGMS-001
Fibaro
 
Figure 22: Fibaro motion sensor</td>
</tr>
</table>

	Parking Sensor PlacePod PNI  **Figure 23: PlacePod parking sensor**	**RF GATEWAY LORA ETHERNET/USB** 881-1302-ND Multi-tech Systems Inc.  **Figure 24: RF Gateway LoRa Ethernet/USB**

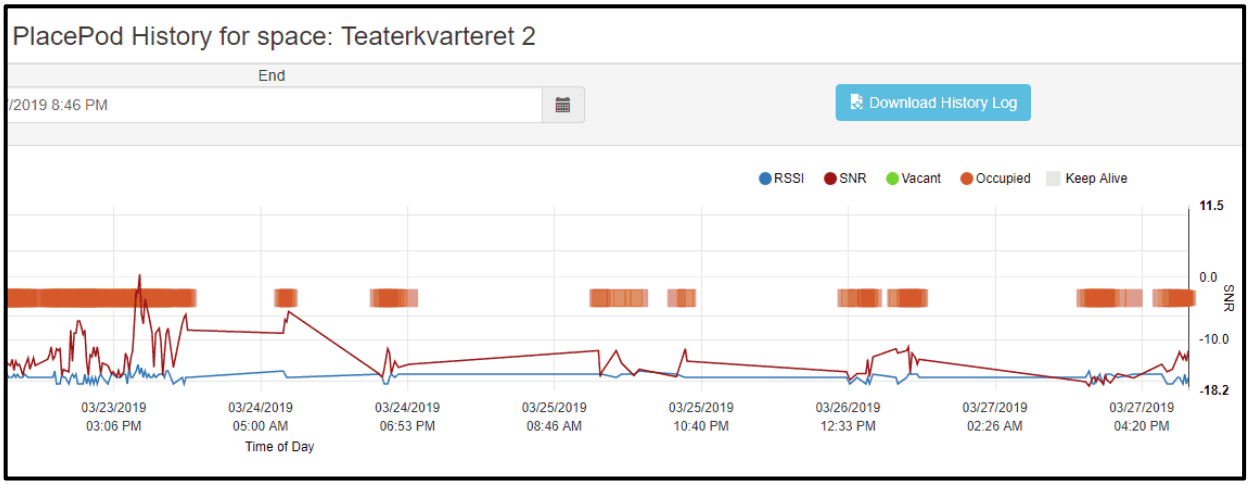


Figure 25: Excerpt from parking sensor history log

ANNEX: Screenshots from VICINITY Neighbourhood manager

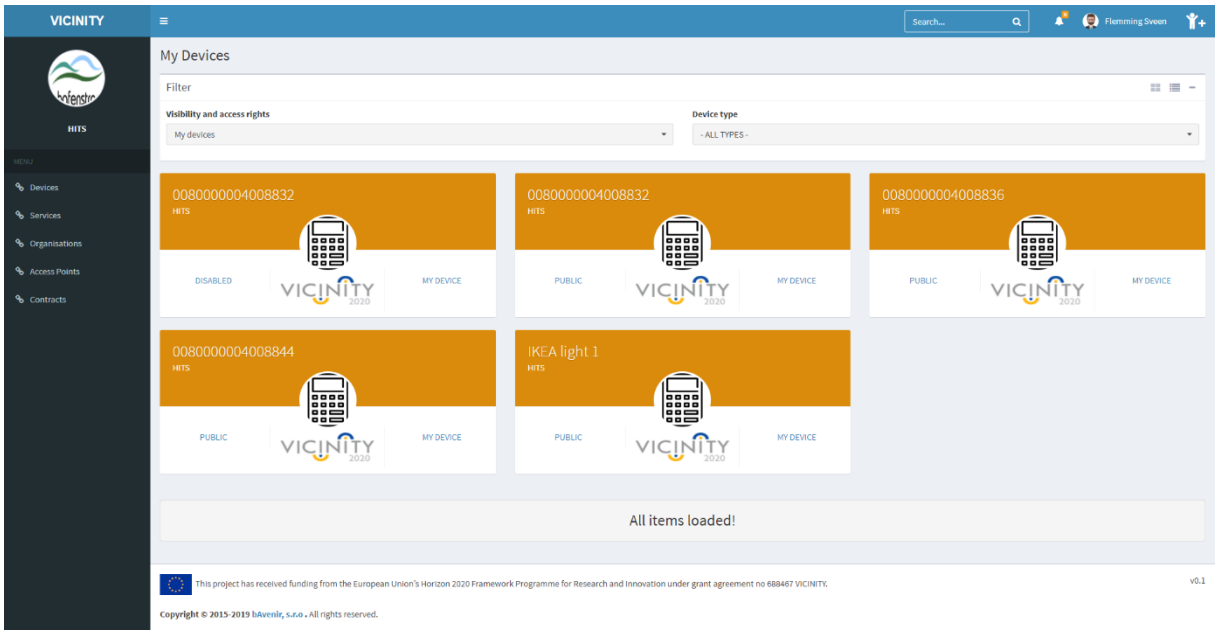


Figure 26: Overview of all local devices available to the Tromsø pilot site

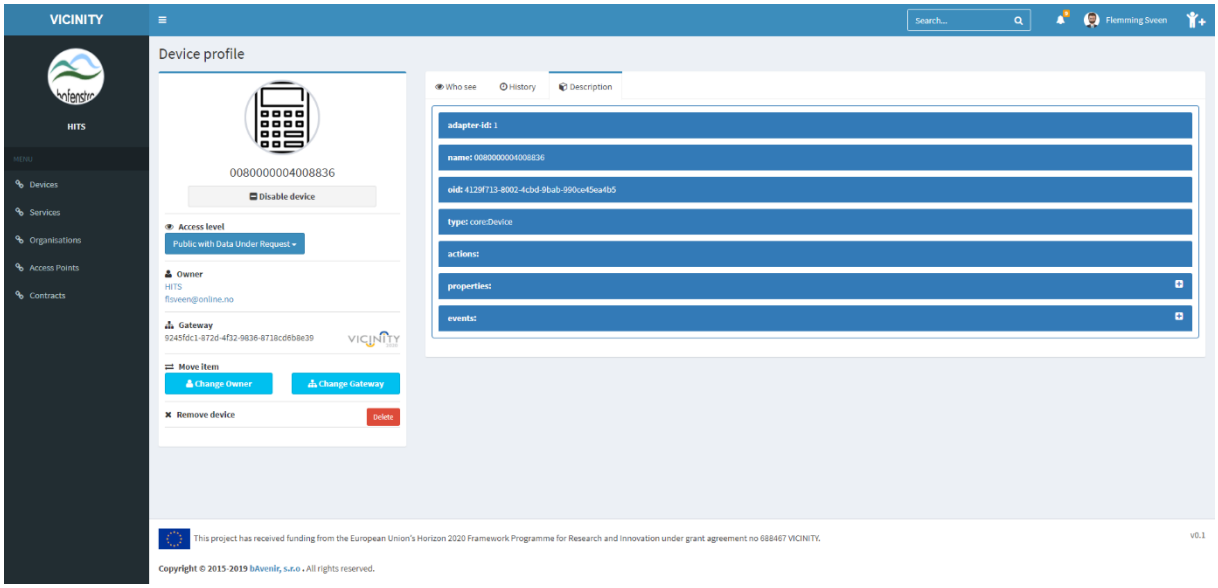


Figure 27: Overview of availability of one of the parking sensors

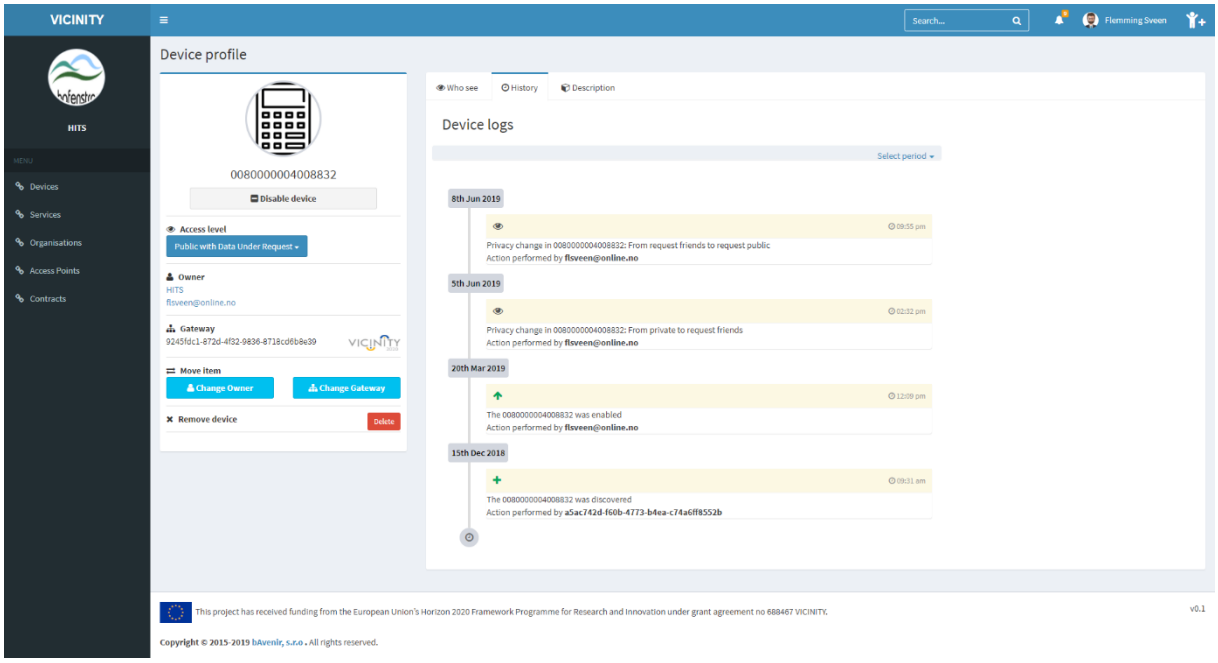


Figure 28: Overview of updates made at one of the parking sensor devices.

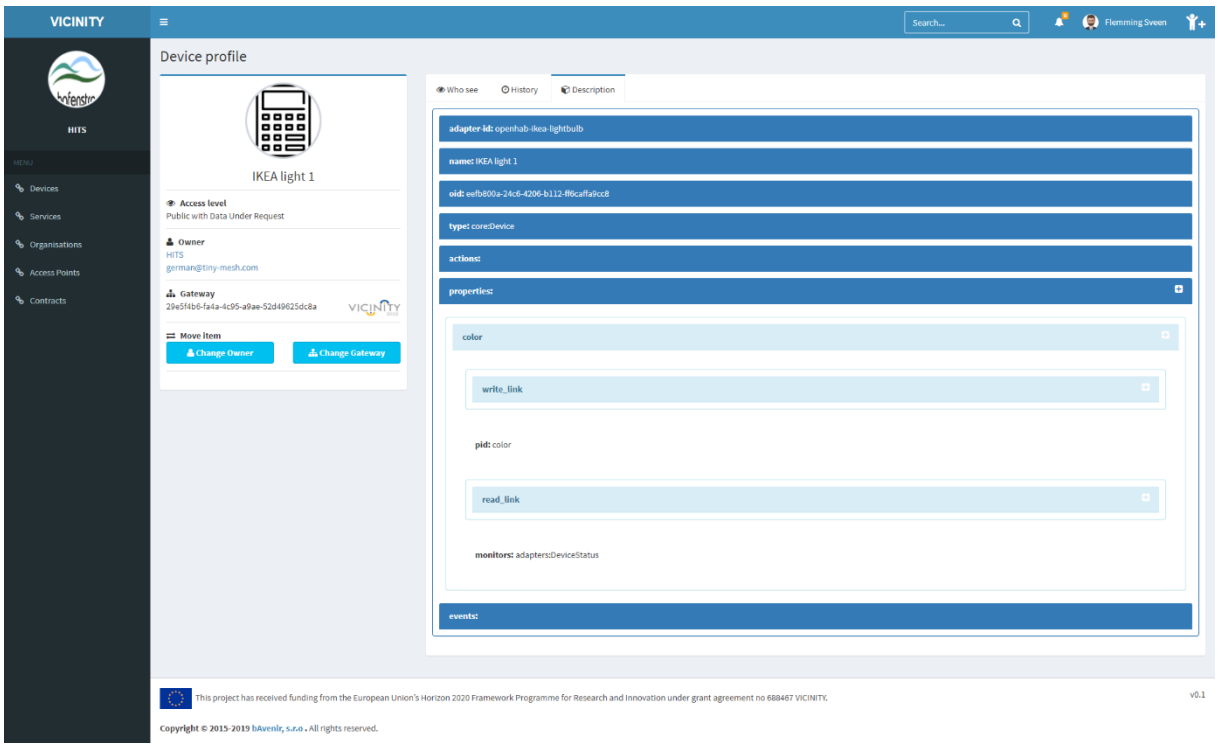


Figure 29: Overview of some of the device properties available for the IKEA smart light placed at the Tromsø pilot site

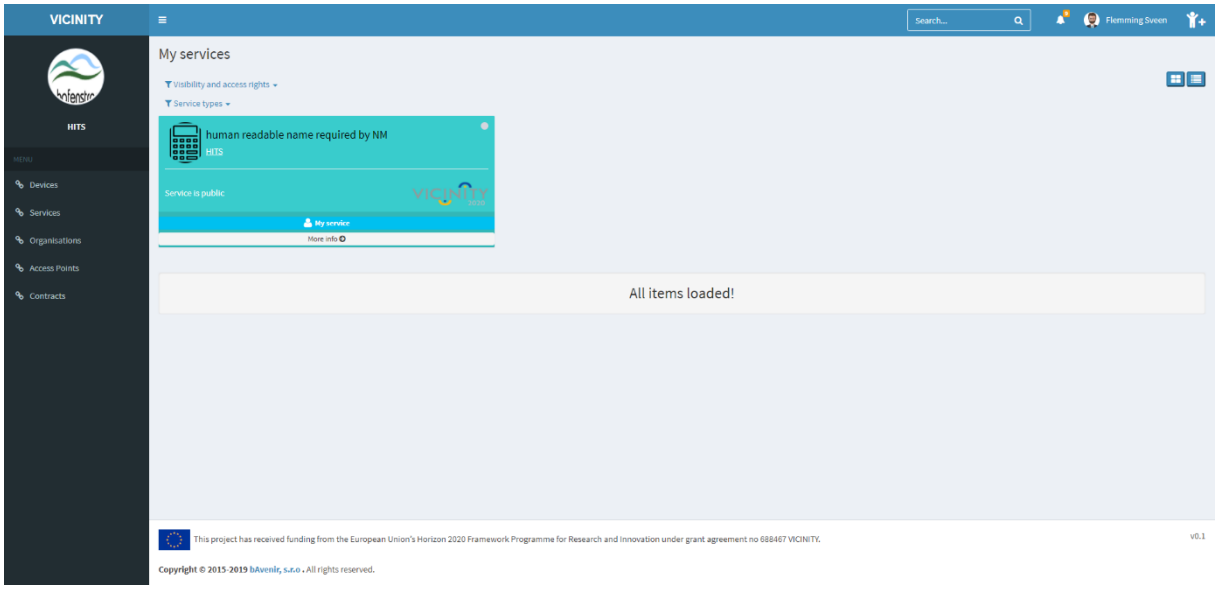


Figure 30: Example of one of the services available at the Tromsø pilot site

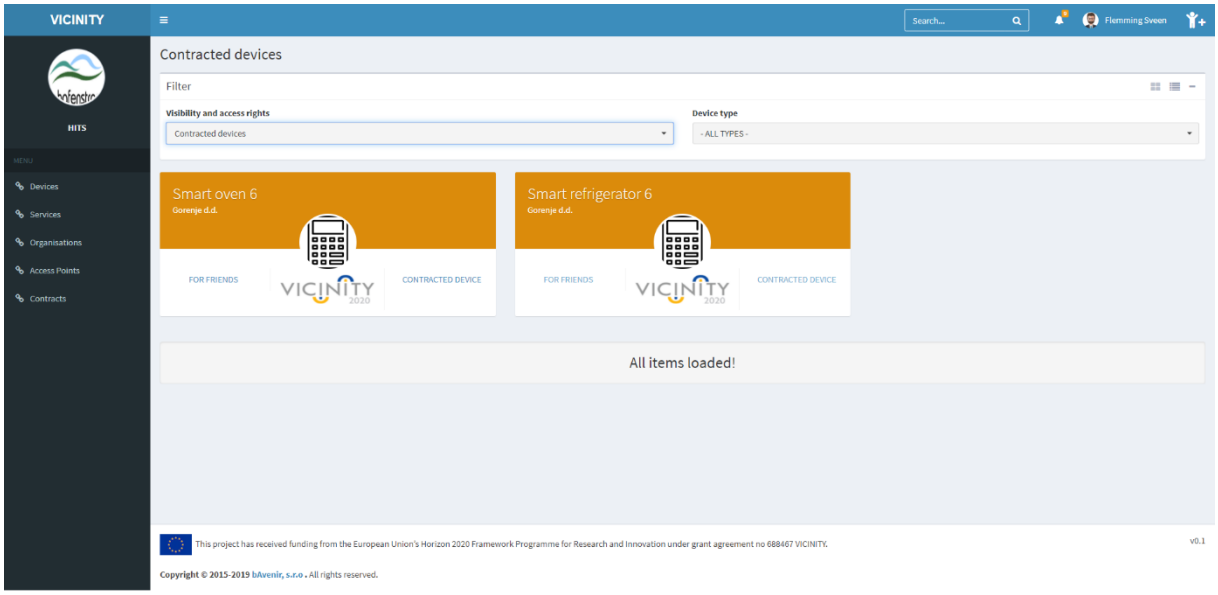


Figure 31: Contracted devices - subscribing to events from Gorenje smart refrigerator and smart oven

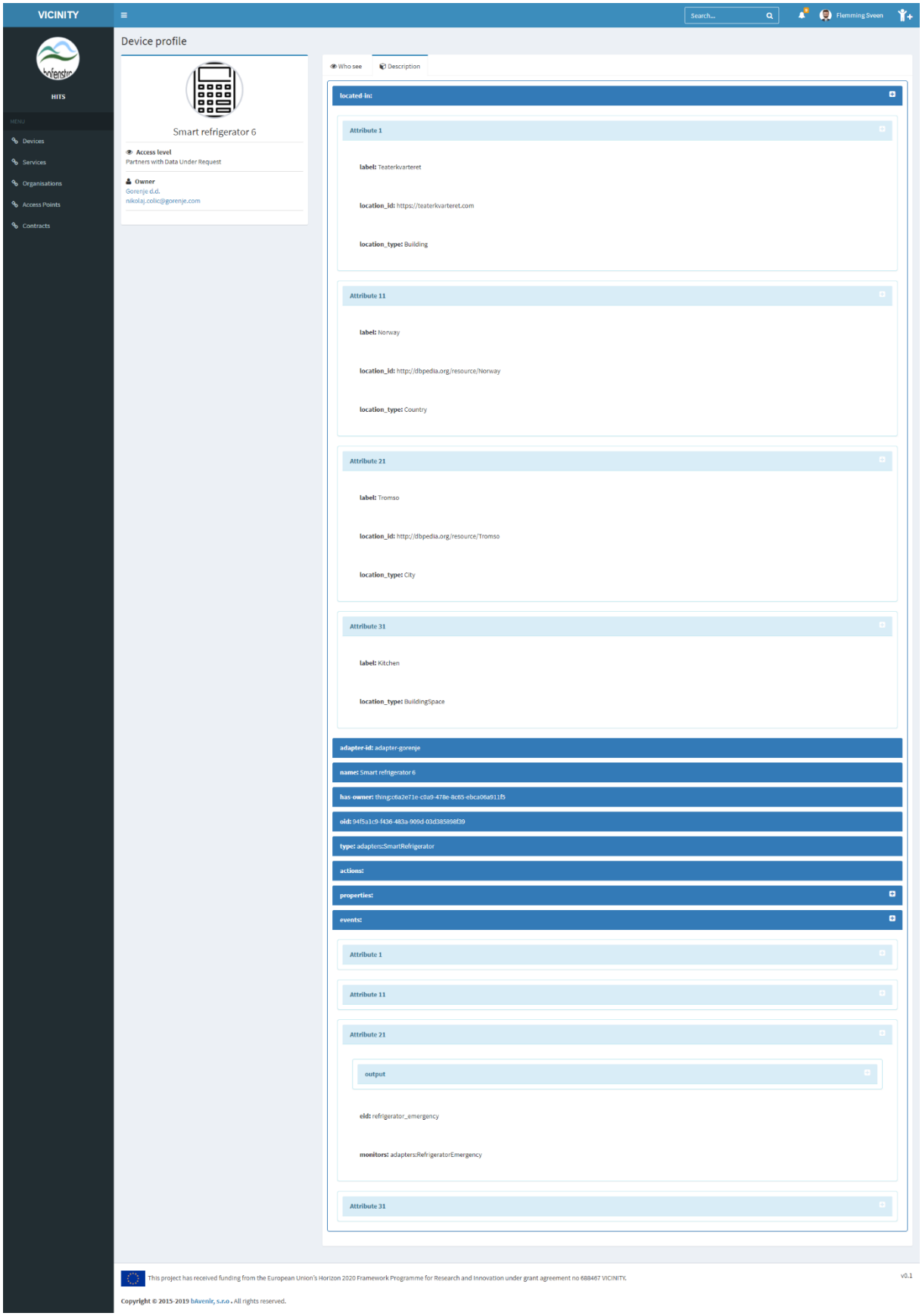


Figure 32: Device profile of Gorenje smart refrigerator generating warning levels based on how long door is left open

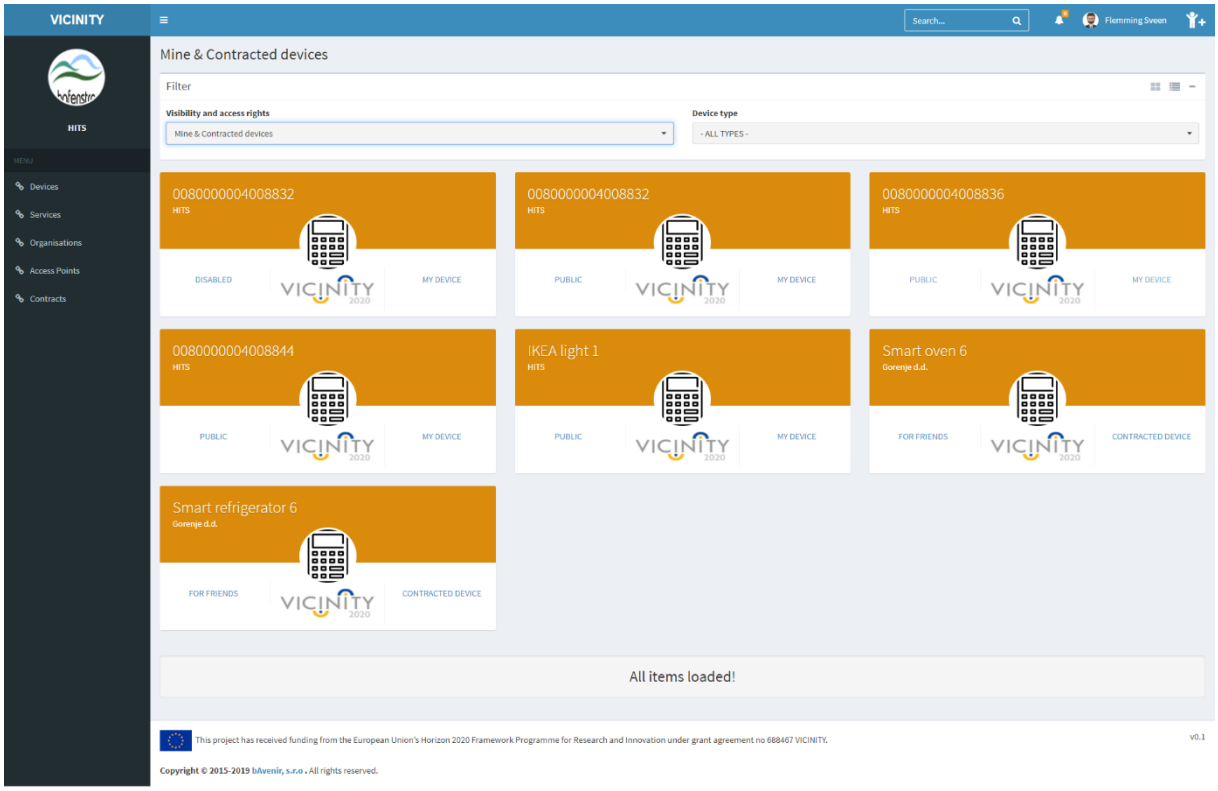


Figure 33: All assigned devices to the Tromsø pilot site

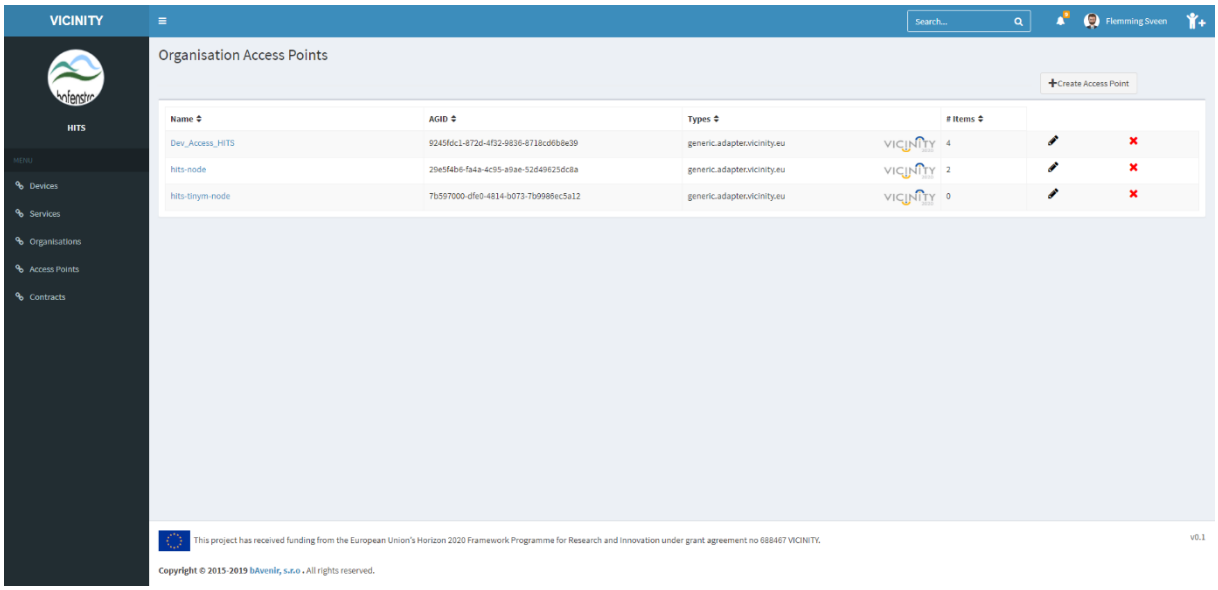


Figure 34: All agents assigned to the Tromsø pilot site

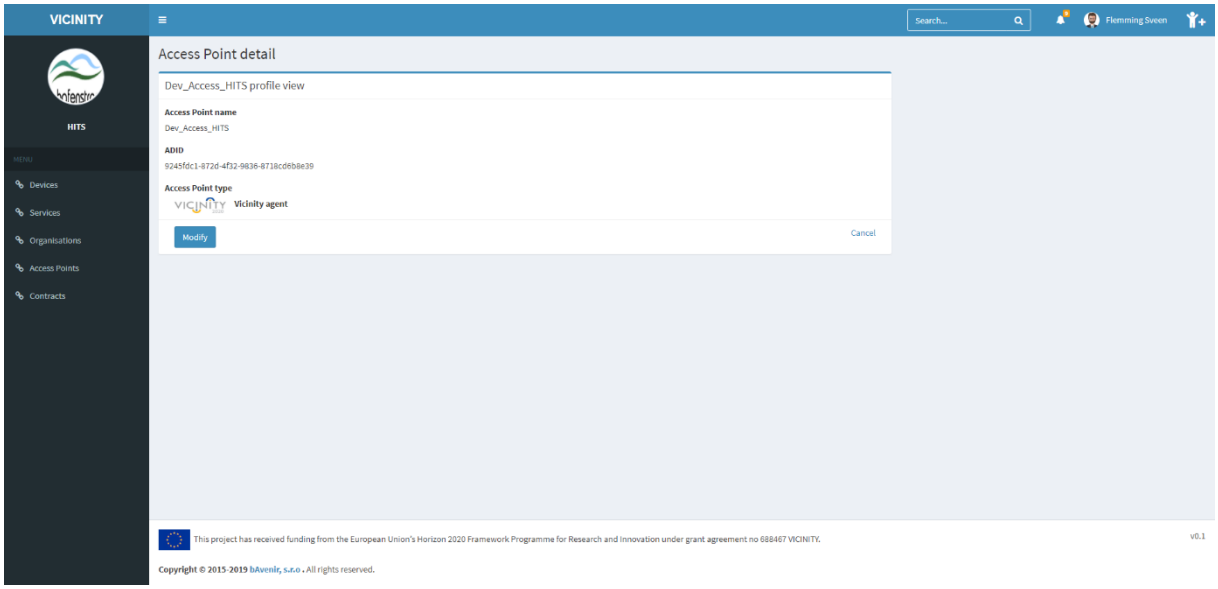


Figure 35: Detailed view of one of the agents assigned to the Tromsø pilot site

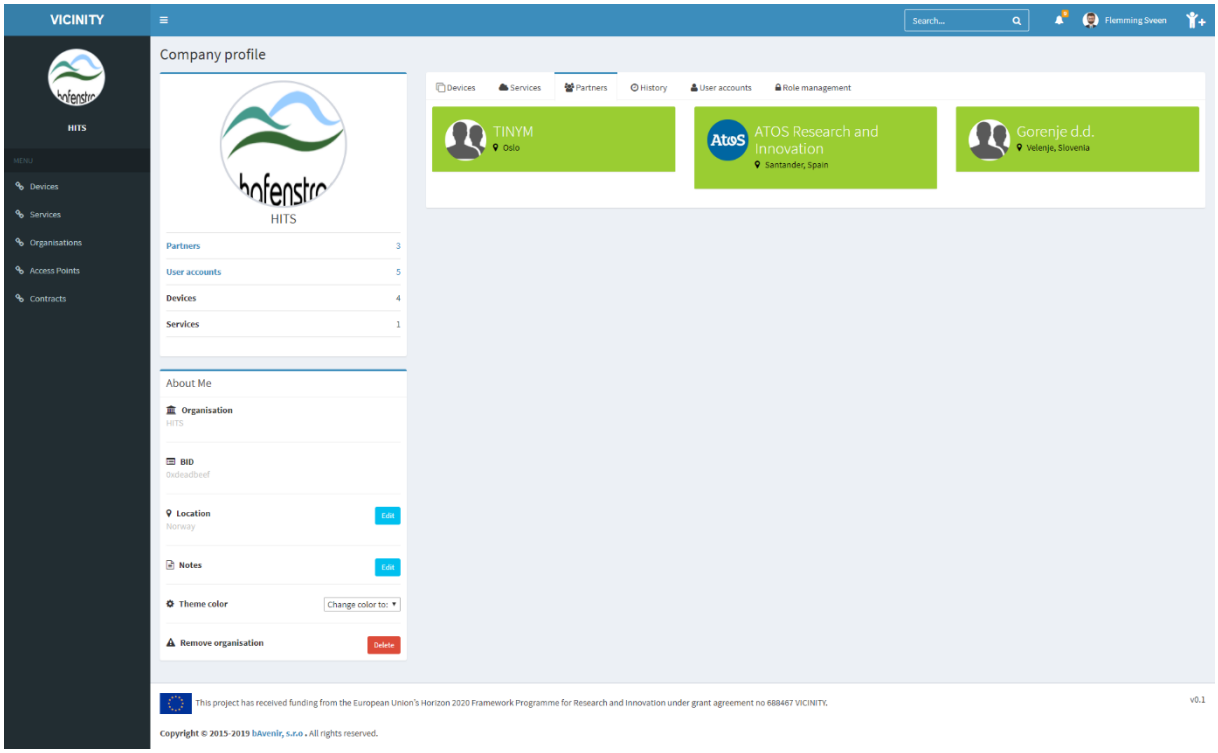


Figure 36: All partners having access to Tromsø pilot site assets

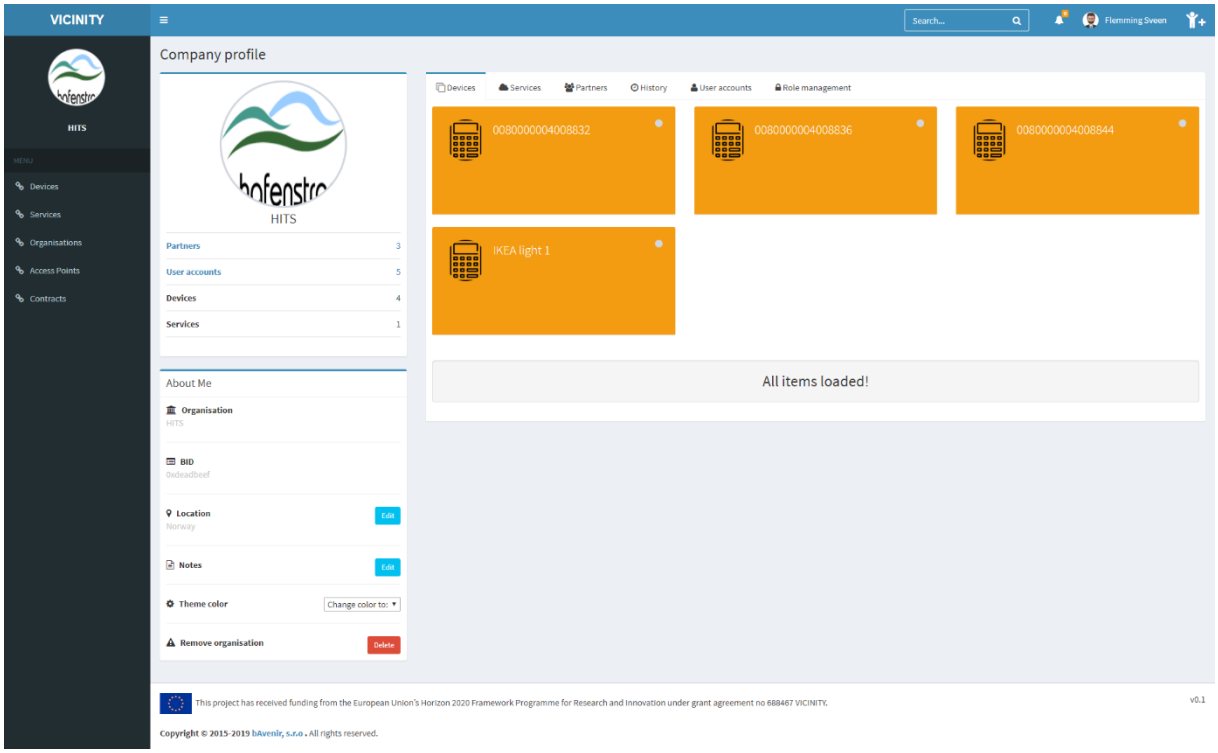


Figure 37: Local devices available at the Tromsø pilot site

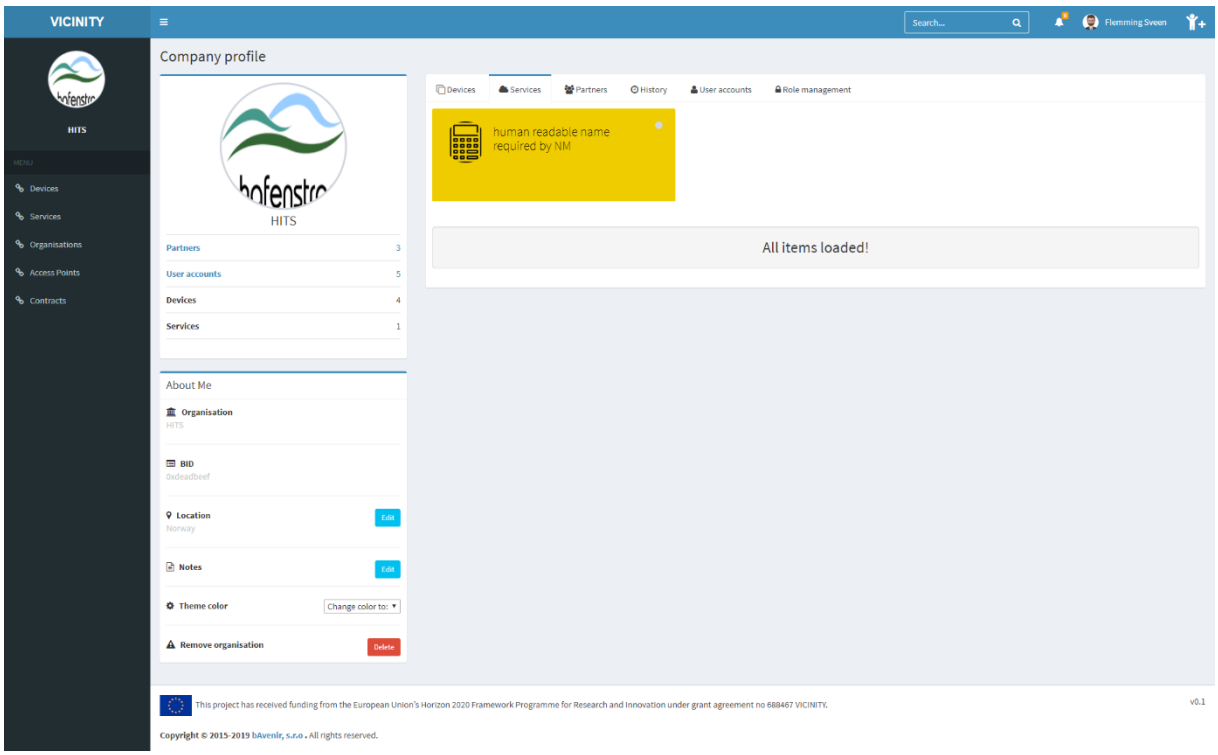


Figure 38: Service prepared for Tromsø pilot site

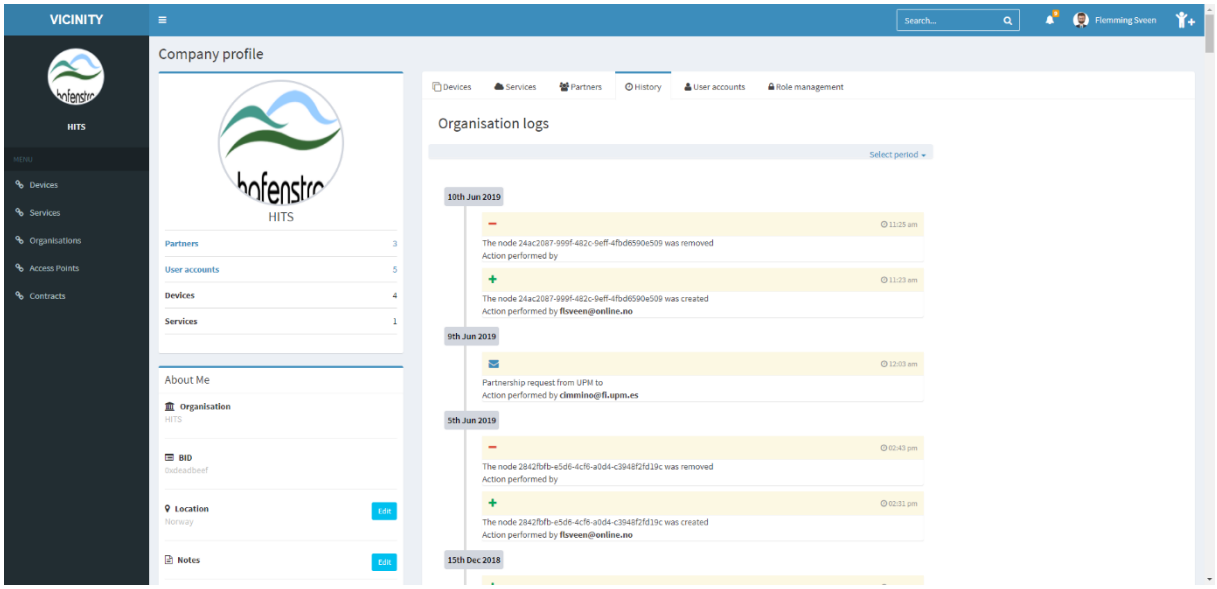


Figure 39: Outtake from a log listing updates made to the HITS nodes