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Deliverable D5.1

VICINITY Value-Added Services definition, requirements and architectural design

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Lead Beneficiary:	CERTH
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0.1	25/4/2017	Initial Draft	CERTH
0.2	30/5/2017	First Draft of D5.1 formatted and shared with partners	CERTH
0.3	October/ November 2017	Draft versions of the four different Pilot Cases templates, updated in collaboration with corresponding pilot representative partners	CERTH, HITS, TINYM, ENERC, GNOMON, MPH
0.4	December 2017	Finalisation of the four templates by each responsible partner	CERTH, HITS, TINYM, ENERC, GNOMON, MPH
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1.0	22/12/2017	Final for submission based on QAR results	CERTH
1.01	22/12/2017	Final review for after QAR results	HITS

Table of Contents

List of Figures

List of Definitions & Abbreviations

Abbreviation	Definition
AMAL	Intra Municipal organisation of the Algarve
BT	Bluetooth
BDVA	Big Data Value Association
CCTV	Closed Circuit Television
DNI	Direct Normal Incident
EU	European Union
GDPR	General Data Protection Regulation
IaaS	Interoperability as a Service
IoT	Internet of Things
ICS	Industrial Control System
KPI	Key Performance Indicator
L2L	Local to Local
LoRa	Long range
MPH	Municipality of Pilea-Hortiatis
NESSI	Networked European Software and Services Initiative
NRK	Norwegian Broadcasting Corporation
PC	Personal Computer
P2P	Peer-to-peer
PIR	Passive infrared sensor
PV	Photovoltaic
SaaS	Software as a Service
SLA	Service-Level Agreement
SME	Small Medium Enterprises
UC	Use case
UI	User Interface
UV	Ultra Violet
UX	User Experience
VAS	Value-Added Service
VPL	Virtual Parking Lots
WP	Work Package
Yr.no	Norwegian website for weather forecasting and other meteorological information

Executive Summary

VICINITY Value-Added Services aim to demonstrate the capabilities of the VICINITY Platform in the IoT world and to maximise the potential of adoption of the project's results. Thus, VICINITY will shape solutions regarding user preferences, real operational needs and the appropriate legal, security and privacy requirements augmenting VICINITY potential for wide adoption by user communities.

Goal of this deliverable (D5.1 - Value-Added Services definition, requirements and architectural design) is to express the definition of "Value Added Services" in the project, their role and purpose as well as their requirements, taking into account VICINITY Platform requirements, specification and architecture, as well as identified barriers (WP1). This deliverable also describes how VICINITY enables the creation of services that target the IoT domain and cover a wide range of markets.

The three Pilot Cases will cover various domains in Building, Energy, Transportation and Health sectors. Each of the foreseen Value-Added Services will be implemented in the scope of each Pilot Case and will add up to the primary use cases defined for WP6. Value-Added Services will serve as a demonstration in order to highlight how VICINITY Platform and the underlying components, enable the realization of cross-domain applications, as a proof-of-concept on the potential brought by VICINITY. Benefits and value creation of these services can evolve by exploiting the unleashed volume of semantically enhanced information stemming from the emerging IoT ecosystems connected to the VICINITY interoperability platform.

In order to extract a detailed definition of all the Value-Added Services, an iterative process has been adopted as a methodology to enable the active collaboration with the key pilot site representatives. A detailed template has been introduced, covering the different aspects needed to be specified for the defined use cases and the corresponding Value-Added Services, which has been progressively completed in order to provide a complete specification document. As a result, the selected VICINITY pilot sites manage to successfully cover four different domains (Energy, Buildings, Transport and Health) in 3 countries (Portugal, Norway and Greece), as thoroughly analysed and detailed in this report.

The table below presents the Value-Added Services that will be implemented in WP5, their reference number and name their goal in summary and their mission in VICINITY project.

Ref.	Value-Added Service Name	Goal	Goal in the Vicinity scope
VAS 1a.1.2	Cleaning and waste removal notification service and warning	Save time and efforts from the cleaning personnel, and thus offer a better or equally good service at a lower cost.	Enhance the role of VICINITY in building IoT domain and in the integration with external services.
VAS 1a.2.1	Resource consumption and alarm service	Process water and electricity consumption data streams to distinguish typical from non-typical consumption situations and trigger alarms.	Demonstrate the role of VICINITY in building and energy IoT domains and in the integration with external services.
VAS 1b.1.1	Offline management	Registration of a parking space and its associated	Enhance the role of VICINITY in building IoT domain and in the

		sensors in the parking control system.	integration with external services.
VAS 1b.1.2	Real-time operation	Booking, ticketing and forecasting of a parking space.	Enhance the role of VICINITY in building IoT domain and in the integration with external services.
VAS 1b.1.3	Active maintenance	Regular data exchange and check on installed parking sensors to detect any technical problems.	Enhance the role of VICINITY in building IoT domain and in the integration with external services.
VAS 1b.2.1	Neighbourhood data processing	Offer a suite of solutions that enhances smart cities and buildings, reduces emissions, and optimizes usage of public and private areas.	Demonstrate the role of VICINITY in building and e-health IoT domains, the way it enables cross-domain appli-cations and the integration with external services.
VAS 1b.2.2	Smart parking event analysis	Prioritize parking spaces for health personnel and relatives in cases of emergency events.	Demonstrate the role of VICINITY in building and e-health IoT domains, the way it enables cross-domain appli-cations and the integration with external services.
VAS 2.1	Municipal Services, IEQ Smart School, Dynamic Audit	Dynamic Building Audit and the IEQ services.	Enhance the role of VICINITY in building domain towards the direction of energy efficient buildings, which also provide a high quality of living.
VAS 2.2	Local to Local Services, UV for Citizens	Create awareness for elders, children and tourists, while reducing the number of persons in need of hospital care due to sunburns.	Demonstrate capability of VICINITY to leverage existing equipment for secondary use to provide local IoT enabled services.
VAS 2.3	Platform Services. Smart Clean. O&M for distributed renewable production resources.	Provide O&M (operations and maintenance) services, such as CPV trackers cleaning services taking into consideration weather predictions, human resources and equipment availability along with soiling of the surface.	Enhance the role of VICINITY in continuous operation and maintenance services and in the integration with external services.
VAS 3.1.1	Privacy-preserving Data Gathering and Storage ft. GDPR data auditing	Strengthen and unify data protection and processing of personal data in a way compliant to the recently introduced General Data	Demonstrate the integration of VICINITY with recently introduced data regulations

		Protection Regulation (GDPR).	with applications in the IoT domain.
VAS 3.1.2	Analysis and clustering of elderly's people medical data to detect unusual behavioural events	Collect medical data of elderly people living alone, allowing health care providers and relatives to know their condition.	Enhance the role of VICINITY in e-health IoT domain and assisted living.
VAS 3.1.3	Triggering abnormal detection in homes	Detect abnormal behaviour of senior citizens, based on IoT building sensors.	Enhance the role of VICINITY in e-health and building IoT domains towards assisted living services and the way it enables cross-domain applications and <something>
VAS 3.2.1	Privacy-preserving Data Gathering and Storage ft. GDPR data auditing	Strengthen and unify data protection and processing of personal data in a way compliant to the recently introduced General Data Protection Regulation (GDPR).	Demonstrate the integration of VICINITY with new European data regulations with applications in the IoT domain.
VAS 3.2.2	Individual Statistical Analysis of data from wearables, medical devices, beacons	Provide evaluation of citizens' health status, promote fitness awareness and improve their health based on activity related data.	Enhance the role of VICINITY in e-health IoT domain towards the field of preventive medicine.
VAS 3.2.3	Aggregated Statistical Analysis of data from wearables, medical devices, beacons	Provide statistical analysis of health data for the municipality's population.	Enhance the role of VICINITY in e-health IoT domain towards the field of preventive medicine.

VICINITY project will also organise a second round of Open Calls in the project, in order to invite external entities to participate in the project by implementing and demonstrating more Value-Added Services for different IoT infrastructures, keeping doors open for services with original added-value not directly related to the content, in order to cover a wider spectrum of potentials.

1. Introduction

1.1. Deliverable objectives and scope

The deliverable will analyse and define the scope and objectives of each of the foreseen Value-Added Services (VAS) to be implemented in the scope of each pilot Use Case, further defining the functionalities that they will be providing. VICINITY project shall work towards **identifying how advanced techniques** can facilitate the **creation of diverse services** across IoT **domains.** The VAS implemented by the project will demonstrate how the VICINITY Platform and underlying components and services enable the realization of cross-domain use-case applications, as a proof-of-concept of the potential brought by VICINITY.

Furthermore, the realization of the VICINITY VAS will explore the potential for the evolution of new business models and value creation that are enabled by exploiting the volume of semantically enhanced information stemming from the emerging IoT ecosystems connected to the VICINITY interoperability platform. Commercial benefits of these services for application developers and service operators should be indicated.

VAS could be defined as a piece of software that implements an algorithm (from a simple calculation/data processing to some advanced techniques such as clustering/big data analytics, data storage and auditing etc.). Moreover, there could be collaboration between the VAS including the exchange of data and outcomes from the algorithms already implemented by other VAS of the same use case. These services may also supply the User interfaces that each actor of the use case will be provided with in order to view notifications, statistical data, processed data etc. VAS collect data, in order to further process them, from the IoT infrastructure (IoT devices, sensors etc.) available in each use case.

VAS is based on the available IoT data from other IoT infrastructures and is fully integrated with the VICINITY infrastructure (and therefore participates in the VICINITY Neighbourhood taking place in "partnerships" with other VICINITY entities etc.). It should further reveal a business model potential / commercial exploitation of such a service (e.g. for application developers, service operators).

1.2. Relation to other Tasks and Deliverables

This deliverable builds on the findings and the conclusions of the following deliverables:

- D1.3: Report on Pilot sites and Operational Requirements. It should be noted that, to allow easy connection with this report, the Use Case numbering in this deliverable is trying to follow the original structure followed in D1.3.
- D1.6: Architectural design

When complete, this deliverable will provide the ground work for the following deliverables:

- D7.1: Pilot Area Installation Planning (along with D7.2-D7.5)
- D9.2, D9.3: Extending the data specification and data management plan
- D5.2: Value-added services implementation framework

The requirements for the Value-Added Services were taken into consideration in Deliverables 1.5 and 1.6 for the design of the VICINITY architecture. So, the VASs developed are compliant with the requirements of the project. The VASs will be integrated into VICINITY Platform as another VICINITY Node as was expected from the beginning of the project. This means that VICINITY platform does not need to extend in order to integrate new VASs.

1.3. Structure of the Deliverable

The report contains 9 chapters. In particular:

- **Chapter 1**: Introduction to the deliverable regarding its scope, objectives and defining the related documents.
- **Chapter 2**: Description the methodology that will be implemented in the four pilot cases.
- **Chapter 3:** Oslo Science Park (NO) – Buildings and Smart Transport Use Cases and VAS.
- **Chapter 4**: Tromsø (NO) – Neighbourhood Smart Parking Assisted Living ecosystem Use Cases and VAS.
- **Chapter 5**: Martim Longo (PO) - Neighbourhood GRID ecosystem Use Cases and VAS.
- **Chapter 6**: Pilea-Hortiatis (GR) – eHealth & Assisted Living Use Cases and VAS.
- **Chapter 7**: Open Calls purpose, requirements, schedule and benefits for VICINITY
- **Chapter 8**: Conclusions
- **Chapter 9:** ANNEX

2. Methodology

In this chapter, we present the methodology to be followed for the definition of the VAS in each of the pilot use cases which are described in detail in Deliverable D1.3.

IoT applications enable physical objects to have technology features and to sense, be programmable, and communicate with other objects and/or humans. Combining digital, cyber and virtual technology with physical objects requires collaboration and cooperation between partners from different industrial sectors and domains. The four selected demo sites in three different countries will be used to demonstrate the usage of VICINITY in real life scenarios. VICINITY identifies all the technology requirements and problems for each of the pilot cases. This includes reaching an understanding of the technology needs of a program and the assessment strategy reflecting those needs.

2.1. Survey and collaboration process

This section presents the survey that was performed in order to determine to the methodology that was followed by Task 5.1, in order to provide a common definition of the VAS requirements for each of the already defined pilot use cases. In this section we present the basis for the extraction of the respective templates for each of the pilot use cases in Norway, Portugal and Greece, which are used in Chapters 4 to 7. The adopted methodology comprises the following steps:

1. Preparation of the templates for each VICINITY pilot: After an internal survey on the definition of requirements of Services, CERTH, as the task leader designed the initial format of the templates and provided a different version for each VICINITY pilot starting from information provided in D1.3.

2. Scheduling of conference calls with each VICINITY pilot: The templates were uploaded on the project's file-sharing platform in order to be available for all partners involved in each pilot before the teleconference; each template was checked by the key partners who provided comments, remarks and feedback concerning each pilot case.

3. Handling of conferences calls: The methodology was explained to the pilot partners and any questions or proposals from the participants discussed.

4. Gathering required information in the pilot templates: The partners involved in each pilot use case progressively added their requirements to the different parts of the templates. The updated version of the templates was then discussed and refinements/additions/alternatives suggested, before going into another round of conference calls to finalize the survey.

5. Release candidate use cases templates: The result of this analysis was to verify the coherence of information that would be reported by each Pilot site regarding the definition of the VAS that each pilot will implement in the course of the project.

The result of this survey produced concrete and detailed templates which were filled with the related information by each Pilot site. The template constitutes a way to support each Pilot to understand what they want to achieve in the Pilot site exploiting the VICINITY architecture as well as the VICINITY software components. CERTH, during the teleconferences, guided the process of listing and presenting the use case scenarios in a common format and supported the work of all pilot partners.

The following paragraphs describe the main building blocks that were identified and described per VAS.

2.1.1. Use Case Conceptual Design

A high-level conceptual design will describe the Use Cases and the corresponding VAS for each pilot. This schematic representation will reveal how the services are connected to the VICINITY Cloud and to the users/actors of the VAS, as well as how the users will exploit these services for each domain. It will include a brief representation of the IoT infrastructure and instances of the use cases.

2.1.2. Use Case associated Value-Added Services and User Interfaces

A high-level architecture overview will be providing along with a schematic representation, revealing how the VAS interfaces with the use cases and the user interfaces are connected as shown in Figure 1. The pilot sites and the VAS are part of the VICINITY architecture whereas the user interface and the involved actors are not part of it. Each use case consists of VAS that can be used for any purpose necessary for the implementation of each use case.

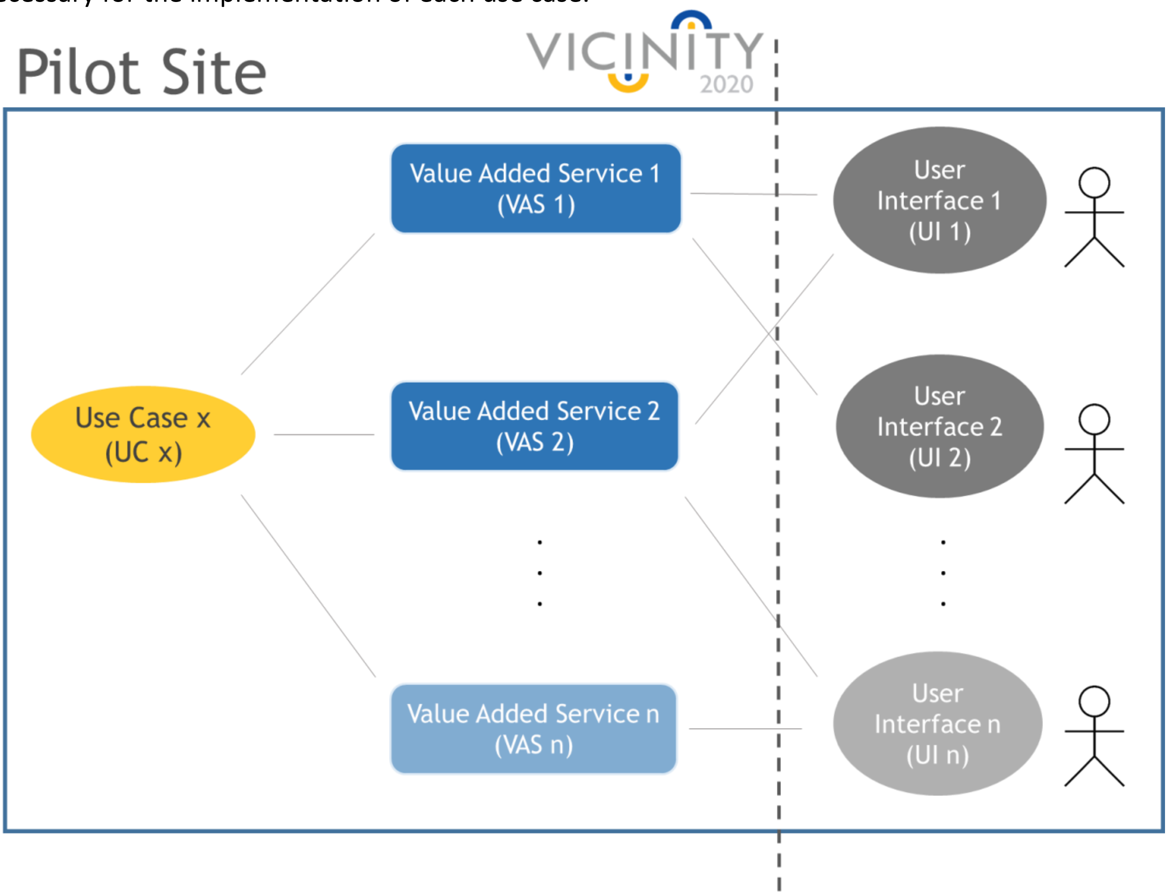


Figure 2-1 Use Case associated VAS and User Interfaces

2.1.3. VICINITY Value-Added Services

Following the initial descriptions in D1.3, the purpose of the VAS will be refined and a more clear and concrete description will be provided, targeting the VAS to be implemented within the scope of its pilot use case demonstration. A table is provided for each VAS including the following information:

- **Related Use Case**
  The Use Case related to the VAS
- **Goal – Scope**
  A short description of the goal of the VAS.
- **IoT Infrastructure involved**
  The IoT devices and sensors involved in the VAS.
- **Trigger**
  The way the VAS is triggered (e.g. event-driven, time-driven)

- **Pre-conditions / Assumptions**
  The statements that have to be true in order for the VAS to work properly.

- **Success Scenario**
  It is a use case scenario of the VAS when nothing goes wrong.

- **Key Performance Indicators (KPIs)**
  Key Performance Indicators (KPI) demonstrate how effectively the VAS is achieving key business objectives.

- **Algorithmic Data Processing**
  Description of any data processing components that will need to be implemented, in order to support the realisation of the VAS. This could refer, for example, to a back-end software component running as a service implementing real-time data processing, big data analytics, clustering algorithms etc., allowing the correlation of information and extraction of useful results based on the IoT collected data.

- **Responsible partner(s)**
  A clear allocation to consortium partner's roles.

- **Actors Involved**
  Identification of the actors that will need to be involved in each pilot site in order to guarantee the successful deployment and realisation of the specific VAS. There should also be a detailed plan on how they will be approached and commit to actively participate throughout the project lifetime and the different project phases (such as deployment, training and realisation).

- **Implementation Planning**
  A detailed planning on the efforts required for the implementation of the VAS sub-components.

A template of the table for each VAS is provided in the Annex.

2.1.4. User Interfaces

- **Related Use Case**
  The Use Case related to the UI

- **Related Value-Added Services**
  The VASs related to the UI

- **Description**
  Description of any front-end software modules that will need to be implemented to allow the interaction and presentation of information to the end-users. This could be either mobile apps and/or web/desktop applications.

- **Mock-up screens**
  Examples of the web and/or mobile interface of the UI

- **Responsible partner(s)**
  A clear allocation to consortium partner's roles.

- **Implementation Planning**
  A detailed planning on the efforts required for the implementation of the VAS sub-components.

A template of the table for each UI is provided in the Annex.

2.1.5. Value-Added Service Deployment Planning

Definition of the deployment planning for the different sub-components of the VAS in the affected pilot site locations. This will need to be aligned with the overall pilot site installation planning, to be contacted within the scope of T7.1.

2.1.6. VICINITY as an Enabler

The "added-value" brought by the VICINITY platform in the implementation and realisation of the VAS will need to be presented, revealing how VICINITY is an enabler for this. This could describe, for example, why, given the currently available IoT landscape and available solutions, such an implementation would either not be feasible or would be too complicated.

2.1.1. Use Case Business Modelling

The potential business model around each of the foreseen Use Case of the Pilot Cases will further be defined, explaining how they could be exploited from the targeted stakeholders.

3. Oslo Science Park (NO) – Buildings (TINYM)

3.1. Introduction

The first use-case for the VICINITY platform will be demonstrated at the Oslo Science Park in Norway. The Science Park houses 240 companies with more than 2400 employees in total, including offices, laboratories, lecture halls and a conference centre. The Science Park is operated and managed by OsloTech with a team of 14 people. OsloTech takes interest in new technologies, and has participated in identifying solutions and services that can add value to its organisation, tenants and improve its operational workflow.

This VICINITY use-case will be centred around using IoT technologies to improve resource management, resource consumption and predictive operations in buildings. Using wireless door sensors, as well as wireless electricity- and water meters, the two VASs will inform and alarm the management team about typical and non-typical situations. The information and alarms will enable them to target their cleaning efforts, shed electricity loads, discover water leaks and track their resource consumption in real time, thus saving time and money.

The VAS defined in the use-case can add value to other organisations operating and managing commercial buildings. Utilizing wireless technology is relevant both in the case of old and new facilities. Battery powered units are especially helpful to ensure quick and cheap installations that are independent of existing electric infrastructure. Older facilities, lacking in technological upgrades and modern information technology infrastructure, can benefit from light-weight, wireless IoT devices to provide improvements to energy efficiency, resource management and to gather inputs for daily operations. As of 2017, 35% of buildings in the EU are more than 50 years old, and their energy efficiency is significantly worse in old buildings compared to new ones.1 Moreover, they often lack modern facility management tools, such as intelligent Heating, Ventilation and Air Conditioning (HVAC) control and monitoring, as well as other industrial control system (ICS) functionality. For newer buildings, demonstrating IoT solutions will pave the way for solutions to come. A wireless, flexible infrastructure can provide valuable additions to existing systems, as well as back-up or replace cabled solutions. Cost-saving installation and operations makes it feasible to gather data on new and untraditional processes or to gather data in areas that would otherwise be too costly or impractical to monitor.

3.2. Use Case 1a.1 – Predictive operations

Keeping buildings clean and ready to use requires significant human resources. The work is based on predefined schedules, and the cleaning team spend much of their time on routine rounds to check if rooms and toilets need cleaning. The managers of Oslo Science Park recognize that IoT solutions hold potential to give input to their employees and subcontractors to make them more efficient, for example through reducing the amount of time they spend on rounds by redirecting them to where they are most needed. Since cleaning and waste management crews usually have no reliable source of information on how much a room has been used before they visit it, cleaning and waste removal

1 EUROPEAN COMMISSION. 2017. Buildings [Online]. https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings [Accessed 03.11. 2017]

services are time based, with a schedule that states how often a room should be checked and the last time it was visited by the crew.

Unfortunately, time interval is an imperfect proxy for the need for cleaning and waste removal: How dirty a room is or how much waste has been generated does not primarily depend on how much time has passed, but on how many times the facilities have been used. In the absence of usage statistics, the crew must regularly and manually check the status of all the rooms in a facility to make sure that the rooms and toilets are clean and that the waste baskets are empty. Moreover, the crew has limited input as to which parts of the facility have been used the most, and it is therefore challenging to target their efforts towards the areas that need their attention the most.

By introducing the possibility for semantic interoperability, different IoT platforms can provide data to be used for software development in an easier and real-time environment. The figure below shows the benefits that VICINITY brings with this use case.

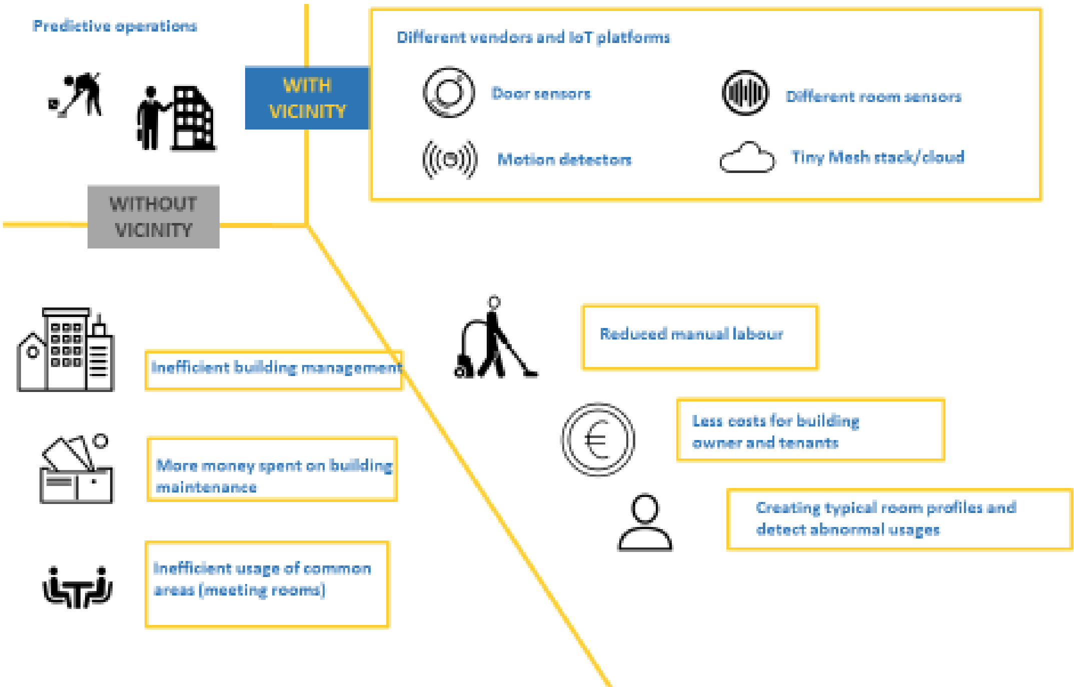


Figure 3-1 Narration of the Oslo Science Park Use Case 1a.1

VAS related to Use Case 1a.1 will correspondingly gather data room usage and provide these data to provide information, notification and alarms to the cleaning and waste collection team on how many times a toilet or meeting room has been used since it was last serviced. This will support their daily operations, give input to schedules and aid decision making on cleaning and waste removal from the common areas of a facility.

This pilot case utilises door sensors from TINYM to estimate the use frequency, and thus the need for cleaning and waste removal in meeting rooms and toilets at the Oslo Science Park. Furthermore, enabled by VICINITY, the VAS can be offered to external actors with a wide range of devices. The service only requires a signal that someone has passed the sensor, and the data could therefore come from e.g. movement sensors (PIR), turnstiles, pressure pads in the floor, beam devices or magnet switches. Moreover, data from weather forecast services could be used to control for rainy days, as rainy days will typically increase the amount of dirt that people drag in. On such days, the service can automatically adjust the threshold to trigger alarms.

Moreover, VICINITY provides a flexible platform to customers, and as well opens the possibility to companies which already have sensors in the facility – such as alarm companies – to sell their data to other service providers for increased value.

3.2.1. Use Case Conceptual Design

Figure 3-2 shows the conceptual design of this use case is depicted. The IoT infrastructure and the VAS that will be connected to the VICINITY. Third party movement and weather data will also be integrated and provided through Vicinity. Third party data can be other sensors or data from different building systems. This could be using VICINITY or an API from the third-party system. The Yr.no[2] service will be used for acquiring weather data. Yr is the joint online weather service from the Norwegian Meteorological Institute (met.no) and the Norwegian Broadcasting Corporation (NRK). Yr is unique in Europe because of very detailed weather forecasts and free data policy. Finally, yet importantly, this figure shows the actors of this use case and their interaction with either the IoT infrastructure or the User Interfaces.

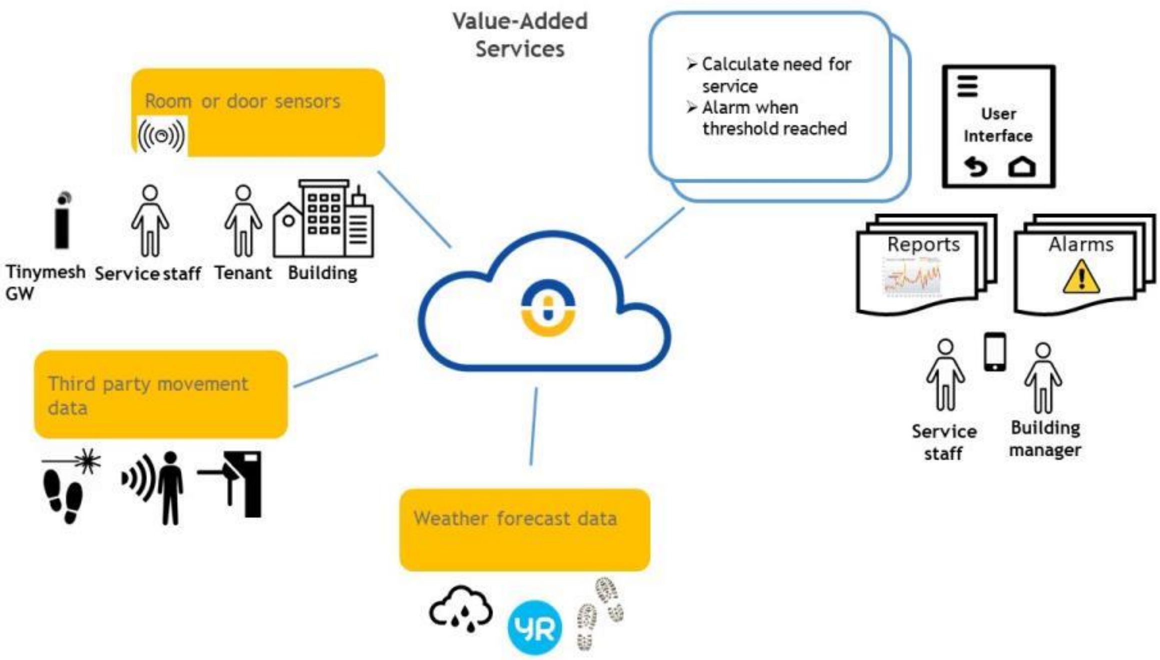


Figure 3-2 Use Case 1a.1 Conceptual design

3.2.2. Use Case associated Value-Added Services and User Interfaces

One Value-Added Service will be implemented for use case 1a.1. The Value-Added Service will provide cleaning and waste collection teams with information and alarms that can improve their efficiency and the quality of their service offerings.

The personnel will be able to access the information and their settings through an online user interface. Through the interface, they can view real time and aggregated data, as well as graphical and statistical analysis. The team can set and customise alarms with threshold values for the number of person movements. An alarm is then issued if a toilet or room has been used a certain amount of times. This way, the personnel will receive a notification that it is time to clean it and/or pick up the garbage. In summary, the service helps to reorganise cleaning and waste removal from a frequency based to an on-demand system.

[2] https://www.yr.no/?spr=eng

The figure below shows an overview of the Value-Added Service and the user interfaces that will be developed.

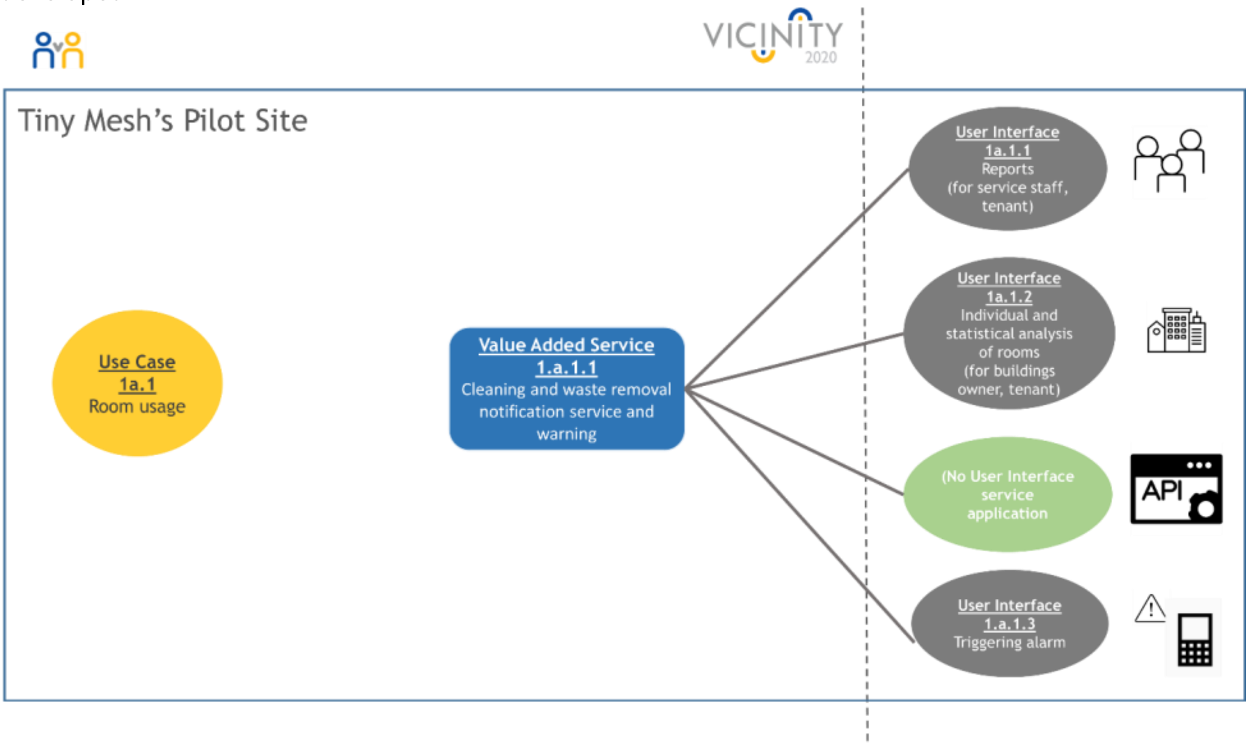


Figure 3-3 Use Case 1a.1 associated VAS and User-Interfaces

3.2.3. VICINITY Value-Added Services

3.2.3.1. *Cleaning and waste removal notification service and warning*

VAS 1a.1.1	**Cleaning and waste removal notification service and warning**
Related Use Case	UC 1a.1 – Predictive operations
Goal - Scope	The goal of this VASs to enable the cleaning and waste removal team to: - Reduce the time needed to check rooms - Sort areas hierarchically according to their projected needs - Redirect personnel to abate critical situations - Update and revise their schedules based on statistical use of the rooms. This will enable them to save time, and to target their efforts to offer a better or equally good service at a lower cost. The Value-Added Service will process data from non-intrusive sensors mounted in rooms and toilets. The data is not linked to personal information on who has entered the room. The sensors register if a person passes the door (in an anonymised way), and can thus keep track of the approximate number of people who have visited. By processing the data, the Value-Added Service will provide information to the staff about how many times meeting rooms and toilets have been used since their last visit and the amount of cleaning activities. The VAS

	will utilize an algorithm monitoring the data stemming from the sensors, triggering an event based on some dynamic thresholds define in each case, thereby warning the staff of rooms in critical need of cleaning or waste removal. Statistical usage trends combined with alarms make it possible to target cleaning according to use, and identify critical situations. Team members can be notified directly if a certain usage threshold is exceeded and take immediate action. This reduces the need for systematic checking of rooms, and allows the team to concentrate their efforts to where they are most needed, thereby saving time and helping maintain a high-quality service. Moreover, cleaning and waste removal can be limited or postponed in areas with little or no use. Through VICINITY, the VAS can be offered to external actors with a variety of devices and cloud services. Weather data can be integrated with the service to increase cleaning efforts on rainy days.
IoT Infrastructure involved	• Door sensors from TINYM • Door sensors for occupancy extraction in certain rooms such as meeting rooms • RF routers and gateways as needed to route and receive data
Trigger	• Event-driven (e.g. once a new measurement is taken and if number of uses reaches threshold value)
Pre-conditions / Assumptions	• No personal/sensitive data involved • Physically possible to install devices • Possible to keep devices powered up • No installation to be done in areas used by only one or two people to avoid accidental identification. • Devices are functional • Internet connection • Proper deployment and integration of devices • Successfully installed sensors. • Data processing algorithms/methods identified and implemented.
Success scenario	1. Measurements are forwarded to the VAS. 2. Data successfully processed. 3. The cleaning/waste collection team can access the information. 4. The cleaning/waste collection team set and get alarms based on usage thresholds. 5. The cleaning/waste collection team can use the information and alarms to improve decision making and allocation of human resources.
Key Performance Indicators	• Number of cleanings avoided (as compared to previous regime) • Number of waste removals avoided (as compared to previous regime) • Number of unnecessary inspections avoided (compared to previous regime) • Number of critical situations handled based on alarms • Tenant satisfaction (toilet/meeting room cleanliness – survey) • Cleaning/waste removal team satisfaction (survey)
Algorithmic Data Processing	Statistical capacity to identify trends in cleaning and waste removal needs based on usage history.

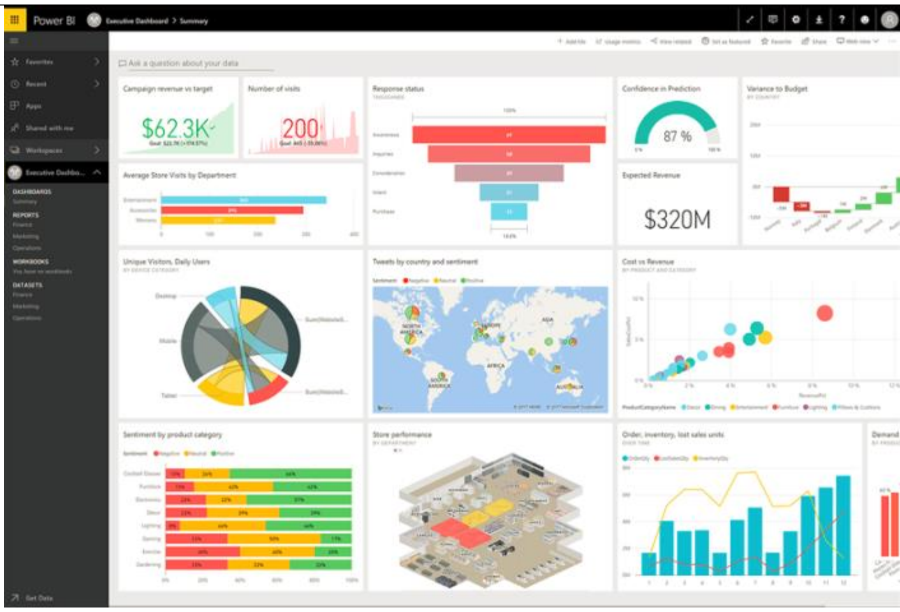
	Capacity to tabulate data with a sorting functionality according to number of visits, room category and location within the facility. Capacity to trigger warning and issue e-mail alarm if certain number of visits is reached. Capacity to change threshold if there is rain.
Responsible Partner(s)	• TINYM: Will use background knowledge in radio technology, mesh networks and cloud processing to gather and process data to present information and alarms to the involved actors.
Actors Involved	• Building managers • Tenants • Cleaning and waste removal team
Implementation planning	M23-M25: Get sample data, analyze V-A requirements (TINYM) M26-M28: Develop first version of user interface (TINYM) M27-M32: Get feedback from partners, iterate (TINYM) M33-M33 Finalize implementation (TINYM)

3.2.4. User Interfaces

3.2.4.1. *Reports*

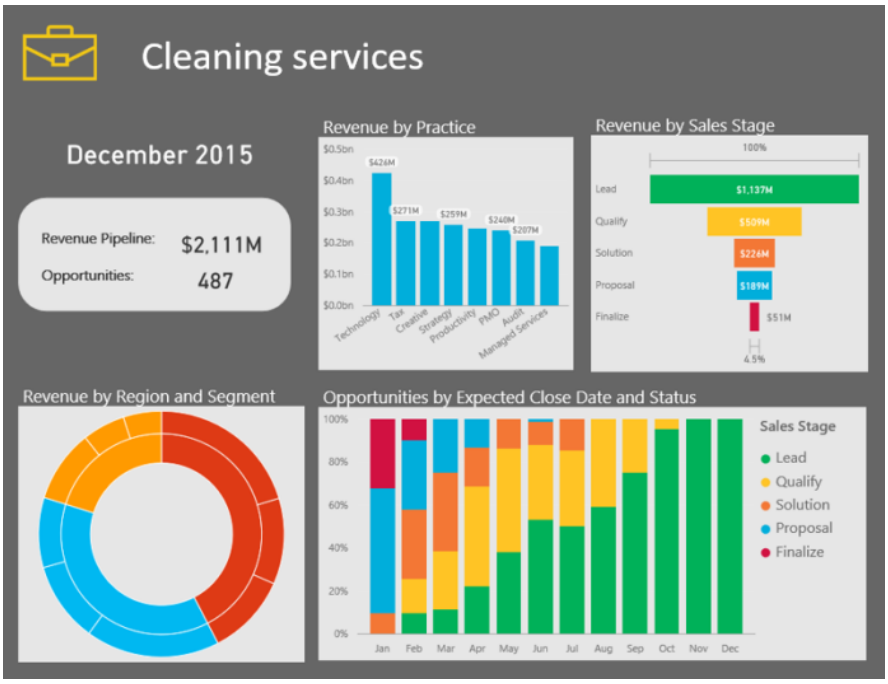
UI 1a.1.1	**Reports**
Related Use Case	UC 1.a.1 – Predictive operations
Related Value-Added Services	VAS 1a.1.1 - Cleaning and waste removal notification service and warning
Description	The user interface will be provided as an online display, using Microsoft Power BI on top of Microsoft Azure[3]. Available on desktop Power BI has a range of visualization options available, including numbers, gauge charts, line charts, maps, tables and bar charts that can be combined to functional and customizable dashboards and reports for the end user. Power BI is available for desktop, web and mobile devices. The user interface will give the user extracted data and real-time information of the rooms usage. The service staff can use the same interface to report cleaning services to the rooms.
Mock-up screens	Interface on desktop

[3] https://azure.microsoft.com/en-us/



Responsible Partner(s)	• TINYM will be responsible for the development of the UI
Implementation planning	M26-28: Test data, first version M29-31: Revision M32-33: Finalize implementation

3.2.4.2. *Individual and statistical analysis of rooms*

UI 1a.1.2	**Individual and statistical analysis of rooms**
Related Use Case	UC 1.a.1 – Predictive operations
Related Value-Added Services	VAS 1a.1.1 - Cleaning and waste removal notification service and warning
Description	The user interface will be provided as an online display, using Microsoft Power BI[4] on top of Microsoft Azure. Available on desktop This interface will provide statistical information on the number of rooms that are used, for how long, which are the most visited rooms, and how often there is need for cleaning. These statistics help to analyse the need of numbers of e.g. toilets, meeting rooms etc.
Mock-up screens	Statistics information 
Responsible Partner(s)	• TINYM will be responsible for the development of the UI
Implementation planning	M26-28: Test data, first version M29-31: Revision M32-33: Finalize implementation

[4] Power BI has a range of visualization options available, including numbers, gauge charts, line charts, maps, tables and bar charts that can be combined to functional and customizable dashboards and reports for the end user. Power BI is available for desktop, web and mobile.

3.2.4.3. *Room usage and warnings*

UI 1a.1.3	**Room usage and warnings**
Related Use Case	UC 1a.1. – Predictive operations
Related Value-Added Services	VAS 1a.1.1 - Cleaning and waste removal notification service and warning
Description	The warning interface will be provided on a mobile device The mobile device can be one of many UIs for a service regarding alarms. By using an application on a mobile device, the service manager, can be anywhere in the building receiving the necessary information before taking action.
Mock-up screens	Mobile Interface 
Responsible Partner(s)	• TINYM will be responsible for the development of the UI
Implementation planning	M26-28: Test data, first version M29-31: Revision M32-33: Finalize implementation

3.2.5. Value-Added Services Deployment Planning

The VAS will be implemented on Microsoft Azure, utilising their Power BI for visualisations. Azure is a secure and flexible cloud platform trusted both by Fortune 500 companies and US government institutions.

3.2.6. VICINITY as an Enabler

VICINITY provides significant value to the service by replacing laborious and costly point-to-point integrations. Moreover, by providing a broad semantic engine, VICINITY enables device and cloud agnosticism to the clients. As long as data streams can be successfully interpreted, translated and forwarded via VICINITY, the value-added service will be able to process the stream and to provide calculations, alarms, graphs and statistics independent of the equipment and protocols used at the clients' facility.

This enables the clients to choose whichever hardware, communication protocol and software solution that is available in their region and suits their needs.

VICINITY makes it possible to use the same data in a range of different contexts: With VICINITY, the alarm company could make their data available to other services, such as the TINYM cleaning and waste alerts. The personal movement data could also be used in a health-house context for example to monitor the movements of elderly's people.

From a service supplier standpoint, VICINITY makes it easier to provide services without hardware ownership or hardware knowledge. The suppliers can offer a wide range of services given access to the data stream and data processing knowledge.

If the data is on the correct format and correctly defined through VICINITY, the services can increase the flexibility of their offerings. For example, the VAS for personal movements could be used for other applications that would benefit from counting the frequency of some parameter and act on certain thresholds, for example the number of a medicine cabinet.

Moreover, VICINITY makes the service available and broadcasted to a wide audience. This makes it easy for new clients to discover the service, and for other service providers to identify unfilled niches.

VICINITY also opens possibilities for new multi- and cross-domain services. One service provider could base new VAS on the output of other services. As an example, VAS from the Oslo Pilot Site and CERTH Pilot Site could be combined in a common user interface for managers of a health house needing information on both human activity and building parameters.

In the absence of VICINITY, it would require significant customization and human resources to handle multiple data streams, data types and devices running on various protocols. A data agnostic system would be infeasible without a broad semantic engine, and significant sources would need to be spent on point-to-point integrations and customer specific customisations.

3.2.7. Use Case Business Modelling

TINYM can now reach a broader market for its proprietary technology, by using VICINITY as an enabler to other domains.

TINYM delivers an IoT "middleware" platform, from the firmware stack on a Mesh RF module to an Internet based API where the costumer can connect and program the IoT device directly, stream data and send control signals to the device.

Our new door sensor with TINYM technology, developed for the Demo site in Oslo Science Park, will be commercialized depending on the feedback and result from the Pilot Site.

Our Value-added service, can be bundled together with our hardware.

One of our use cases will provide information and alarms to the cleaning and waste collection team on how many times a toilet or meeting room has been used since it was last serviced. This will support their daily operations, give input to schedules and aid decision making on cleaning and waste removal from the common areas of a facility.
Statistical usage trends combined with alarms make it possible to target cleaning according to use, and identify critical situations. Team members can be notified directly if a certain usage threshold is exceeded and take immediate action. This reduces the need for systematic checking of rooms, and allows the team to concentrate their efforts to where they are most needed, thereby saving time and helping maintain a high-quality service. Moreover, cleaning and waste removal can be limited or postponed in areas with little or no use.

TINYM sees possibilities in selling and partnering with other actors as Building managers, Building owners, Utilities, Building tenants and an income from Software as a Service (SaaS, licences, SLA, Upgrades and Transaction cost. In building management and in old buildings, one of the assets of Tiny Mesh Technology is that the equipment/sensors are a battery-powered and therefor independent of an electricity supply, which means it can be installed everywhere. At this time TINYM sees no need for the platform to extend in anyway – and can be used as is – to make new business for TINYM

3.3. Use Case 1a.2 – Resource management

In addition to human resources, the management and operation of a building requires significant amounts of consumable inputs, such as energy and water. IoT solutions hold potential to conserve and redistribute these resources, while accommodating tenants' needs and expectation. The VAS related to use case 1a.2 will provide continuous information to the management team on electricity and water consumption. This will make data collection easier for the management team, and help them exploit considerable cost saving potential in their electricity consumption. Moreover, they will be able to accurately bill their tenants and discover water leaks or other abnormal consumption patterns early. The service will support their daily operations and decision making on energy management, load optimisation and Heating, Ventilation and Air Conditioning (HVAC) control by distinguishing typical from non-typical situations. Combined with weather forecast data, the service can predict upcoming electricity peak loads based on estimated needs for additional heating or cooling of the premises.

The service can provide considerable value to managers by helping them harmonise electricity loads to save on load factor tariffs, as well as to discover statistical trends on how consumption changes throughout seasons, weekdays and times of day for improved operations planning. If an upcoming peak load is identified, the managers may shift or shed loads immediately, e.g. by temporarily turning off or down heating, cooling or ventilation systems. Moreover, automatic consumption data collection gives value to managers by replacing time consuming and sporadic manual meter readings, and enables them to bill tenants precisely and transparently.

As such, the service provides value to building managers in three key ways:

1. Consumption data collection for billing and statistical overview, as well as input to operational scheduling of resource consuming systems. Provides value through time-savings, tenant billing and improved future operations.
2. Alarms about non-typical situations, so that periods with e.g. unusually high electricity load or abnormal water consumption can be discovered and abated. Provides value by enabling electricity load harmonisation for reduced load factor tariffs and early warnings about potential water leaks or tenant negligence.
3. Automatic control signals based on non-typical situations. Such as alarms, automatic control signals enable harmonisation of electricity loads. In the Oslo Science Park, this will be demonstrated by controlling the Gorenje Smart Refrigerator.

In the following figure the benefits that VICINITY brings with this use case are depicted.

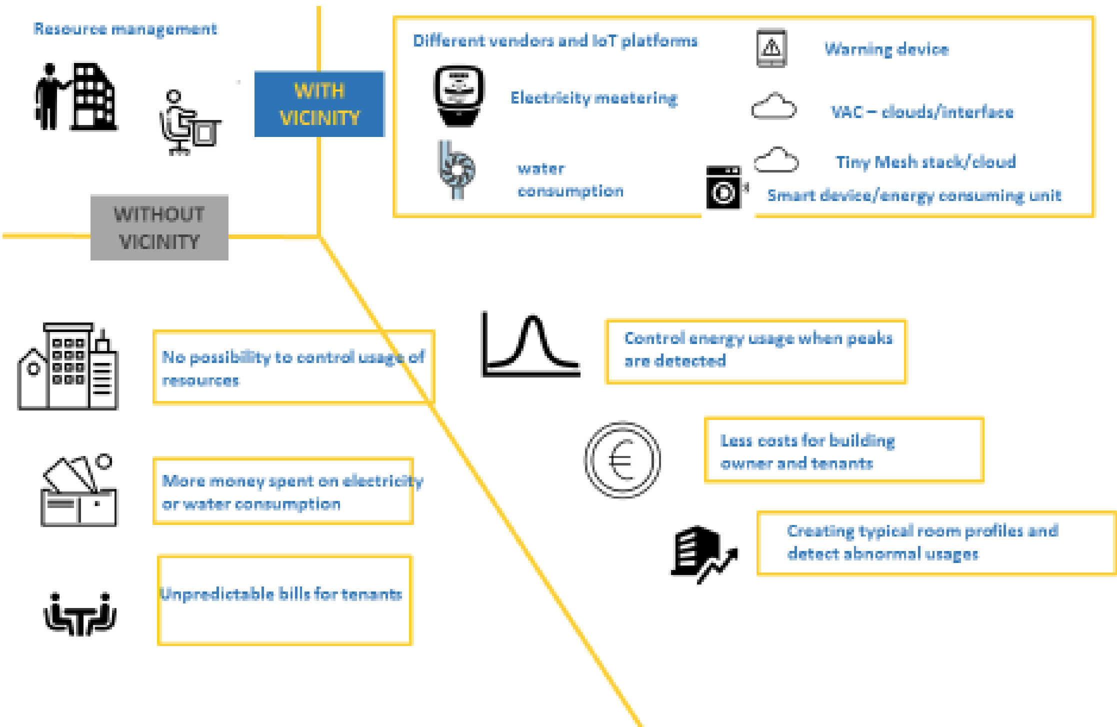


Figure 3-4 Narration of the Oslo Science Park Use Case 1a.2

Although the VAS will only consume data from water meters and electricity meters in the demonstration case, the range of data sources could be expanded in a commercial version. Data from other meters and sensors that measure the rate of consumption or usage of some resource could be processed by the service. Examples could be fuel for generators or heaters, or the airflow through ventilation ducts.

3.3.1. Use Case Conceptual Design

The figure below shows the conceptual design of this use case. The IoT infrastructure and the VAS that will be connected to the VICINITY Cloud are presented. This figure also shows the actors of this use case and their interaction with either the IoT infrastructure or the User Interfaces.

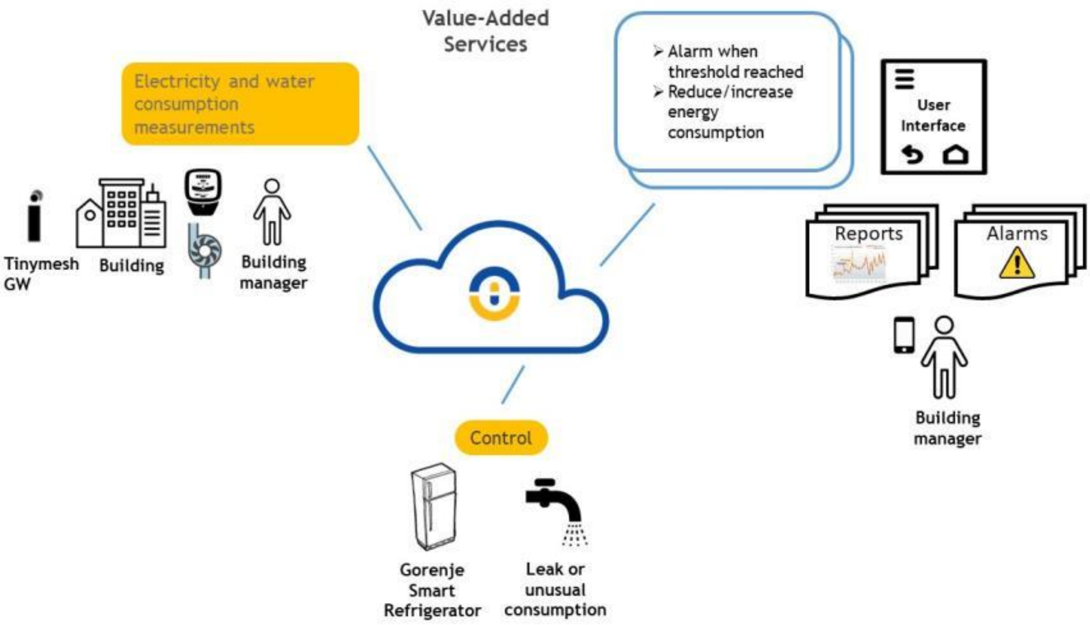


Figure 3-5 Use Case 1a.2 Conceptual design

3.3.2. Use Case associated Value-Added Services and User Interfaces

In addition to human resources, a building requires significant amounts of consumable inputs, such as energy and water. IoT solutions have potential to help conserve and redistribute these resources, while accommodating tenants' needs and expectations. The value-added service will provide continuous information on electricity and water consumption. This will help exploit cost saving potential in the electricity consumption, to accurately bill tenants, and to discover water leaks or other abnormal consumption patterns early.

The service will support daily operations and decision making on energy management, load optimisation and Heating, Ventilation and Air Conditioning (HVAC) control. Combined with weather forecast data from YR[5] the service can predict upcoming electricity peak loads based on estimated needs for additional heating or cooling of the premises. The service generates value through electricity load harmonization to save on tariffs, as well as to discover consumption trends for improved operations planning.

The figure below shows the VAS and the different user interfaces that interact with the service.

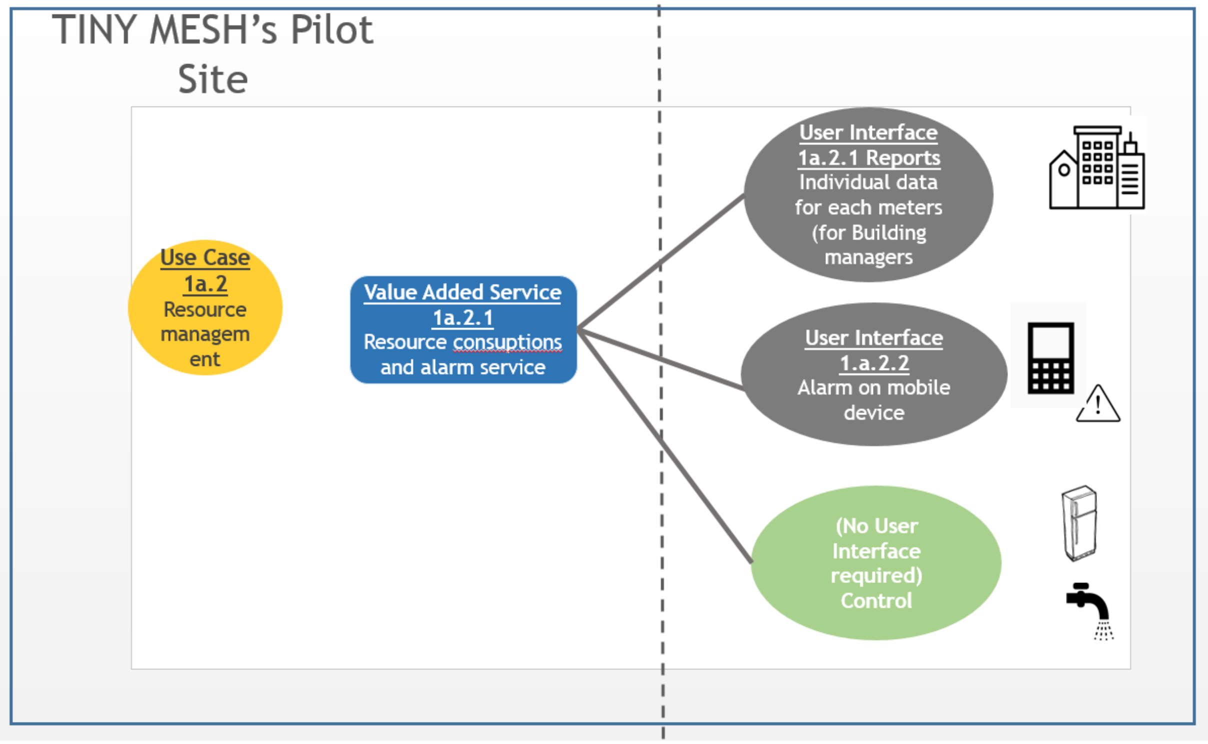


Figure 3-6 Use Case 1a.2 associated VAS and User-Interfaces

[5] https://yrkundesenter.zendesk.com/hc/en-us

3.3.3. VICINITY Value-Added Services

3.3.3.1. *Resource consumption and alarm service*

VAS 1a.2.1	Resource consumption and alarm service
Related Use Case	UC 1a.2 – Resource management
Goal - Scope	The VAS consumes client data on resources consumption through VICINITY, processes the data, and issues alarms or control signals to the client as appropriate. Moreover, the service can consume data from weather forecast APIs to predict upcoming load spikes due to increased need for heating or cooling. In the pilot case, the goal of the VAS is to consume and process water and electricity consumption data streams to distinguish typical from non-typical consumption situations. A non-typical situation (high electricity load, apparent water leak) triggers an alarm that initiate actions – manual or automatic – to save or redistribute resources.
IoT Infrastructure involved	• Electricity meters with wireless capabilities • Wireless reader unit for existing meters • Water meters with wireless capabilities
Trigger	• Time-driven (update meter readings every minute) • Event-driven (trigger alarm if non-typical situation arises)
Pre-conditions / Assumptions	1. Successfully installed sensors. 2. Successful integration with external weather forecast provider (www.YR.no) 3. Data processing algorithms/methods identified and implemented. 4. Devices are functional 5. Internet connection 6. Proper deployment and integration of devices 7. Successfully installed sensors.
Success scenario	1. Measurements are forwarded to the VAS 2. Data successfully processed. 3. The management team can access the information. 4. The management team set and get alarms based on load thresholds. 5. The management team can use the information and alarms to improve decision making, load harmonisation and allocation of resources. 6. The Gorenje refrigerator receives and reacts to automatic control signals from the VAS.
Key Performance Indicators	• Money saved on reduced load factor tariffs • Reduction in kW of highest monthly electricity peak load • Number of water leaks discovered • Money saved on accurate tenant billing • Time saved by avoiding manual meter readings • Number of peak loads identified and alarmed by service • Manager satisfaction (survey)

Algorithmic Data Processing	Statistical capacity to identify trends in resource consumption trends Capacity to predict upcoming peaks based on weather forecast Capacity to tabulate data with sorting functionality. Capacity to trigger alarm and issue e-mail alarm if certain thresholds are reached (i.e. non-typical situation identified). Capacity to issue control signal to Gorenje refrigerator.
Responsible Partner(s)	• TINYM: Will use background knowledge in radio technology, mesh networks and cloud processing to gather and process data to present information and alarms to the involved actors.
Actors Involved	• Building managers • Tenant
Implementation planning	M23-M25: Get sample data, analyze V-A requirements (TINYM) M26-M28: Develop first version of user interface (TINYM) M27-M32: Get feedback from partners, iterate (TINYM) M33-M33: Finalize implementation (TINYM)

3.3.4. User Interfaces

3.3.4.1. Individual data for each meters

UI 1.a.2.1	Individual data for each meter
Related Use Case	UC 1a.2 – Resource management
Related Value-Added Services	VAS 1a.2.1 - Resource consumption and alarm service
Description	The user interface will be provided as an online display, using Microsoft Power BI[6] on top of Microsoft Azure. The user interface will show the usage of water or electricity consumption, statistics on the consumptions and will allow the user to monitor real time usage. Tre will be reports on statistic and simple analyses of data. When a e.g. consumption peak is reached, the user can monitor or take actions directly from this interface - turn of the Gorenje fridge manually or let the system do it when stipulated in the program. Alarm UI will also be shown on a UI on a mobile device.
Mock-up screens	Web Interface and reports 
Responsible Partner(s)	• TINYM will be responsible for the development of the UI
Implementation planning	M26-28: Test data, first version M29-31: Revision M32-33: Finalize implementation

[6] Power BI has a range of visualization options available, including numbers, gauge charts, line charts, maps, tables and bar charts that can be combined to functional and customizable dashboards and reports for the end user. Power BI is available for desktop, web and mobile device.

3.3.4.2. *Triggering alarm*

UI 1.a.2.2	**Alarm on Mobile Device**
Related Use Case	UC 1a.2 – Resource management
Related Value-Added Services	VAS 1a.2.1 - Resource consumption and alarm service
Description	The warning interface will be provided on a mobile device. The mobile device can be one of the many UIs for a service regarding alarms. By using an application on a mobile device, the service manager, can be anywhere in the building receiving the necessary information before taking action.
Mock-up screens	Mobile Interface 
Responsible Partner(s)	• TINYM will be responsible for the development of the UI
Implementation planning	M26-28: Test data, first version M29-31: Revision M32-33: Finalize implementation

3.3.5. Value-Added Services Deployment Planning

The VAS will be implemented on Microsoft Azure, utilising their Power BI for visualisations. Azure is a secure and flexible cloud platform trusted both by Fortune 500 companies and US government institutions.

3.3.6. VICINITY as an Enabler

Just as for the cleaning and waste collection service, VICINITY will make the resource management service agnostic as to what equipment is installed at a customer location. Moreover, integrations are made seamless, and data from already existing data sources may be integrated through the platform – utilities and grid owners, for example, can give access to their data to external services via VICINITY.

The hardware agnostic, easy-to-use platform paves the way for easier and cheaper load harmonisation in the future, providing benefits to managers through cost savings, while allowing grid owners to postpone investments in electricity infrastructure.

As for VAS 1a.2.1, the service can be flexible as to what types of data it handles. For example, the VAS for resource consumption could be used for other applications that would benefit from measuring the flow of some resource and act on certain thresholds, for example the air flow through ventilation ducts or the diesel used for a backup generator. Since VICINITY handles the semantics, both the client and the VAS would know what kind of data is being processed through the meta-data, and could change units, headers and alarm settings accordingly (automatic process).

New multi- and cross-domain services could be provided on top of VAS 1.a.2.1 as well. Electricity consumption data could be combined with electricity price data to calculate and predict upcoming costs. Moreover, weather forecast data could help predict upcoming peaks driven by increased need for heating or cooling.

3.3.7. Use Case Business Modelling

The VAS that is implemented for this use case will make data collection easier for the building management team, and help them exploit considerable cost saving potential in their electricity consumption. Moreover, they will be able to accurately bill their tenants and discover water leaks or other abnormal consumption patterns early. Although the VAS service will only consume data from water meters, electricity meters and electricity meter readers in the demonstration case, the range of data sources could be expanded in a commercial version.

The VAS consumes client data of resources consumption, through VICINITY, processes the data, and issues alarms or control signals to the client as appropriate.

In the pilot case, the goal of the VAS is to consume and process water and electricity consumption data streams to distinguish typical from non-typical consumption situations. A non-typical situation (high electricity load, apparent water leak) triggers an alarm that initiate actions – manual or automatic – to save or redistribute resources.

This allows managers to harmonise electricity loads to save on load factor tariffs, as well as to discover statistical trends on how consumption changes throughout seasons, weekdays and times of day for improved operations planning. If an upcoming peak load is identified, the managers may shift or shed loads immediately, e.g. by temporarily turning off or down heating, cooling or ventilation systems. Also in summertime there will be a need for air conditioning, especially around noon. At that time the refrigerators could be turned down to avoid warm air adding to the air-conditions load at peak times.

Moreover, automatic consumption data collection gives value to managers by replacing time consuming and sporadic manual meter readings, and enables them to bill tenants accurately and transparently.

Our sensor with Tiny Mesh Technology, developed for the Demo site in Oslo Science Park, will be commercialized depending on the feedback and result from the Pilot Site.

The VAS for energy resource management will be commercialized depending on the feedback and result from the Pilot Site.

This VAS can be bundled together with equipment for measuring energy and water consuming.

Possible customers for this solution could be Building managers, Building owners, Utilities and Building tenants. The product to be delivered to market would be a Software-as-a-Service (SaaS) with licences, SLA, Upgrades and Transaction cost.

4. Tromsø (NO) – Neighbourhood Smart Parking Assisted Living ecosystem (HITS)

4.1. Introduction

This pilot will take place at the "Teaterkvarteret 1. akt". 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. The site includes three 6-store buildings with a total of 38 owner sections[7], of which all are apartments. The 8 apartments are either owned or assigned for residents that are either elderly or disabled. The underground garage facility has 32 parking spaces, of which, 7 are allocated for larger vehicles, and 2 have electrical charger ports.

Figure 4-1 Teaterkvarteret 1.akt consists of 38 apartments (image source: teaterkvarteret.no)

The use-case will have specific focus on managed healthcare apartments, and demonstrate how transport information and building data can be integrated with assisted living through agreements with car space owners and other stakeholders.

In the demonstrated solution, prioritized parking space, booking, traffic analysis, customized and messaging services based on authorization and access data will be managed according to conditional rulesets. The smart parking sensors will report proximity and temperature. These will included with datasets from stemming from external traffic sensors and open data. The datasets will be used for big data analysis to identify usage profiles and generate traffic forecasts that will be available to building managers, traffic controls and virtual neighborhoods. Booking, configuration and status of parking space will be handled through different devices and user platforms such as mobile apps.

All parking space elements will be stored and presented in a format that adheres to the ISO/PDTS 21219-14 draft: *"Intelligent transport systems — Traffic and travel information via transport protocol experts group, generation 2 (TPEG2) — Part 14: Parking information (TPEG2-PKI)"*

Cross domain	Smart Parking equipment garage	Assisted living	Open data
Data sources	• Parking sensor • Smart light • Mobile log • Info screen	• Smart appliances • Health care • Panic button • Motion sensor • Door lock	• History log • Weather data • Traffic data • Emission profile • Preferences

7 http://teaterkvarteret.no/1.akt/vedtekter/

Table 1: Both use cases will demonstrate cross domain integration using data from a variety of sources.

The pilot site will serve as a way to validate the VICINITY interoperability model, and the use case will not demonstrate a complete, commercial product. There are however aspects of the use case that is considered relevant to extend beyond the scope of the project. Desired functionality are authorisation and authentication control. This functionality will demand more time and resources than there is room for in the projects.

The integration will be an incremental process. As such, the second use case (UC1b.2) will serve as an extension of the first use case (UC 1b.1).

The pilot site will therefore demonstrate how basic functionality for sharing parking space can offer new business models and exploitation potential when using interoperable ecosystems and Value-Added Services from mobility and assisted living.

Value-Added Services implemented for the Pilot Site are for demonstration activities of the project. Further extension of them is required in order to convert them into commercial product.

Figure 4-2 Pilot site test location - underground garage facility

4.2. Pilot Use Case 1b.1: Shared parking / priority parking

HITS aims to create an "AirBnB" for parking, meaning a new service that is offering dynamic parking space allocation in low, normal and high-demand periods.

The use case presents a service that allows neighbourhood residents to share their unused parking spaces for shorter or longer periods.

All parking space in the underground garage facility is owned and administrated by the buildings 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 the use of the parking space as they like as long as it does not go against the regulations. When accessing the garage facility, it will always be the tenants that have priority.

Functionality is handled through a smart parking management system that will calculate forecasts based on current and historic data. Furthermore, the management system will handle all booking, ticketing and access calls. The system will assist in day-to-day operations 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 and digital signs will extend the functionality even more. Usability and transparency is central to the use case, and special attention will be directed towards mobile apps used for booking of parking space and tracking of vehicles.

As such, the statistics will later on 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.

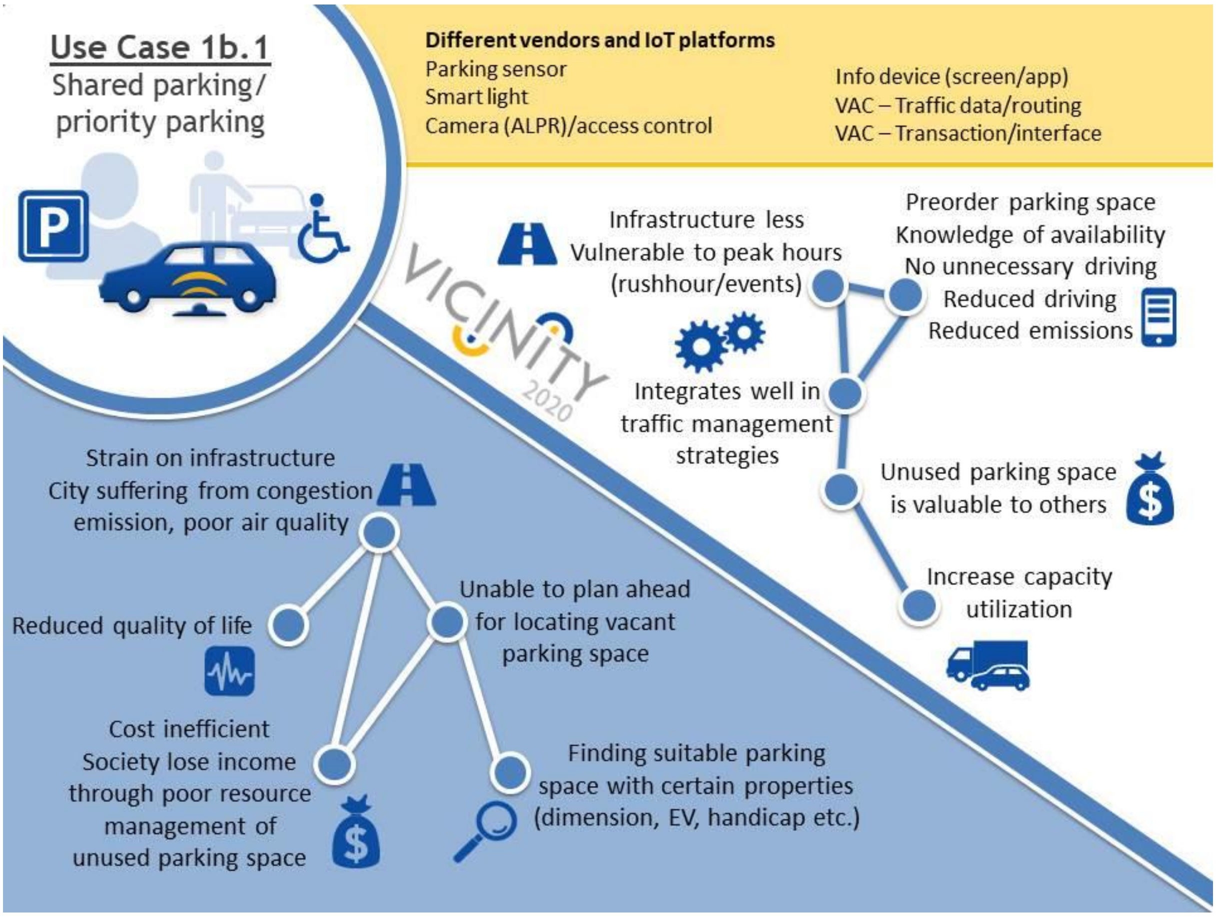


Figure 4-3 Narration of the Tromso pilot shared/priority parking

4.2.1. Use Case Conceptual Design

In the following figure, the conceptual design of this use case is presented. The IoT infrastructure and the Value-Added Services that will be connected to the VICINITY Cloud are also depicted in the figure. External services will also be integrated and provided through Vicinity. Moreover, the User Interfaces that will be developed in order to communicate the information that is provided by the VASs, to the actors, are presented.

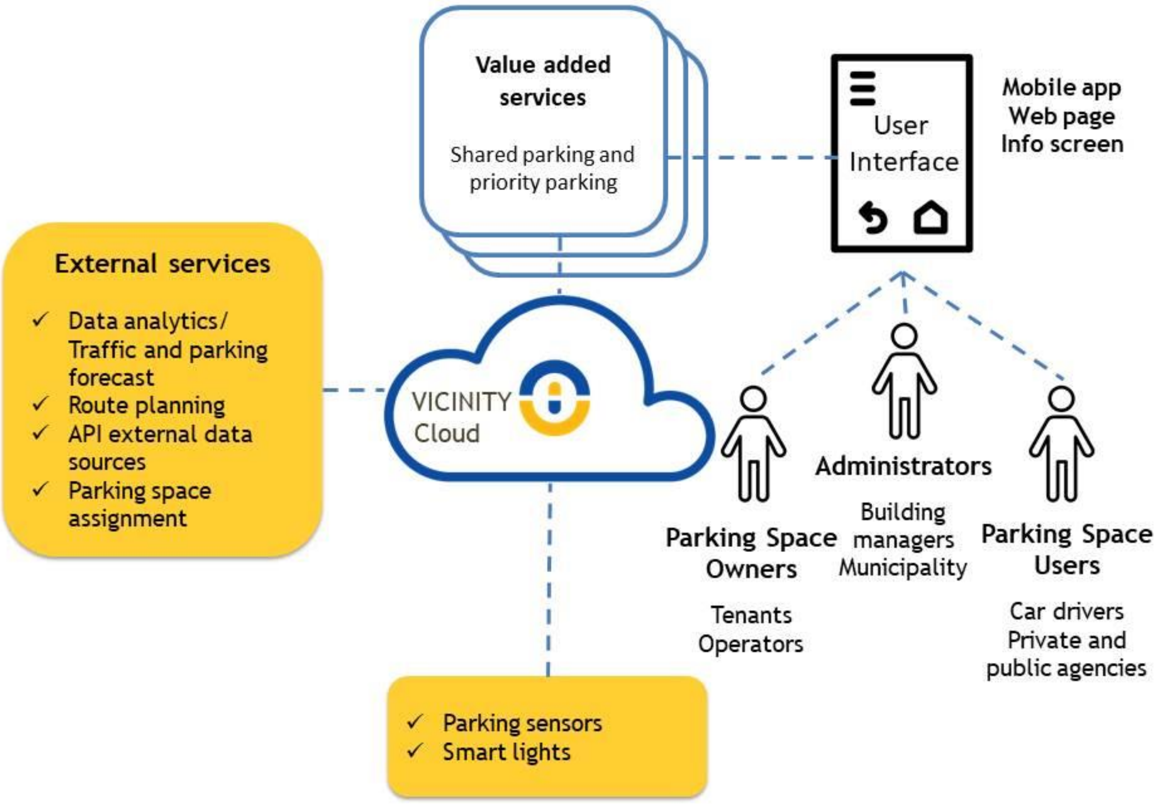


Figure 4-4 Use Case 1b.1 Conceptual design

In order to address the needs of the individual residents, management of parking space and proximity to access points will be tailored to user-defined profiles. Safety, predictability, reliability, accessibility and comfort are elements that will be incorporated when implementing load balancing and resource administration of parking space and available areas. Access control and appraisal systems are functionality that needs to be supported, which will be affected by what kind of users optioning for the use 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 particular priority.

4.2.2. Use Case associated Value-Added Services and User Interfaces

This Use Case will offer 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.

This Use case will use the information from traffic and parking forecasts, and offer route planning for parking and simple ticketing service to the benefit of parking space owner and vehicle user. How all the information is combined and distributed to the different actors is shown in Figure 4-5.

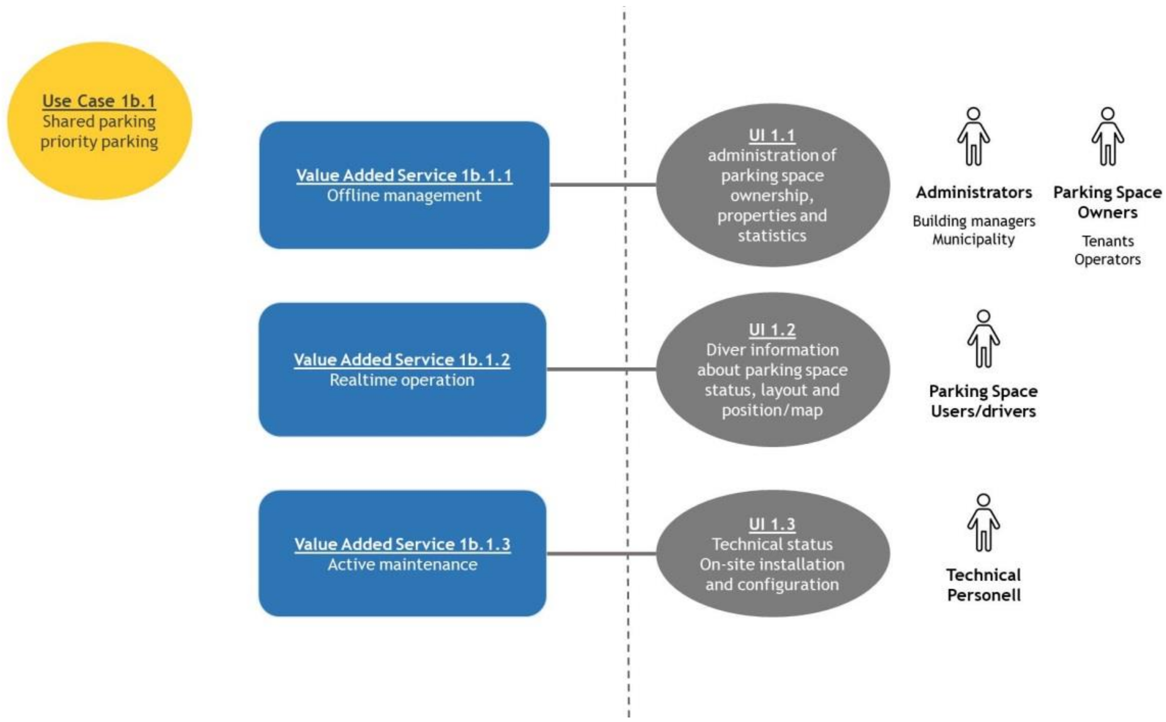


Figure 4-5 Use Case 1b.1 associated Value-Added Services and User-Interfaces

On the top level, this use case offers three levels of functionality;

- Offline management
- Real-time operation
- Active maintenance

Ownership and administration of the parking space will be handled by the building manager and the owner of the physical parking space. "Teaterkvarteret 1. akt" is community organised and it are parking space owners that handle the underground garage facility, while there are other parking operators that manage the surrounding areas. The ownership of parking space is handled by a cooperative, but are contractually allocated tenants of the building cluster.

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 on, it may 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 etc.

The value-added services set out to offer solutions addressing:

- 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)

The priority parking will be contract based. Three kinds of contracts are envisioned:

- Short time contracts (ad-hoc requests)

- Long term contracts
- Transferral of ownership

Additionally, different sets of subscription services might be implemented.

There are several conditions that need to be adhered to;

- 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

4.2.3. VICINITY Value-Added Services

In order to get the Value-Added Service operational, the following software components needs to be 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 will trigger requests for emergency parking if abnormal situations should arise.
- Mobile apps for end-users, presenting information on their urban area, parking space options.

The following tables describes these value-added services in more detail.

4.2.3.1. *Offline management*

VAS 1b.1.1	**Offline management**
Related Use Case	UC 1b.1
Goal - Scope	This VAS offers manual administration, analysis and statistics. The VAS operates on Virtual Parking Lots (VPL). A VPL is a logical construct that represents a cluster of parking space. These parking spaces may be physically located close to each other, but may also include sites that are placed in other locations.

	Important functionality of the VAS is assigning parking space to a VPL. In order for a parking space to offer real time data, a parking sensor must be installed at the site and registered. A parking space without any sensors installed, can be registered but will not be able to provide any feedback. A parking space will contain information about physical properties and proximity data. Furthermore, parking space can contain extended user generated information, such as contract type, price and intermediator fee to parking space. This VAS is tying together shared resource management of urban areas and support of multi-domain integration within adjacent ecosystems (transport/mobility, assisted living, smart grid, smart building) The goal is to offer a suite of solutions that enhances smart cities and smart buildings, reduces emissions, optimizes usage of public and private areas, creates new revenue models, introduces flexibility and versatility in urban areas and focuses on smart building management.
IoT Infrastructure involved	• Parking sensor network installed at the parking space • Smart light network placed near the parking space • External sensor information from traffic load monitoring equipment containing weather conditions and air particles.
Trigger	Triggering mechanisms may include: • Event-driven e.g. new ID appears in list of sensors that can be assigned to a virtual parking lot • User-driven e.g. manual registration of parking space sensor by an owner or manager.

Pre-conditions / Assumptions	• Relevant software should be developed/installed in PC and mobile devices.
	• The system is considered secure and adheres to directives presented in GDPR
	• Software has been installed, and users have received training or are otherwise knowledgeable about how to use the apps and equipment.
	• Agreements must be in place with affected parties such as building owners/the board, tenants and city officials.
	• Agreements must address
	  o Availability of parking space
	  o entrance to location
	  o income models for building/residents
	• The following hardware must be installed, configured and operational:
	  o VICINITY server/adapter installed and operational
	  o Battery powered: Ground mounted, parking sensor(LoRa)
	  o Electrical wired: roof mounted/wall mounted smart light (Z-wave)
	  o Electrical wired: wall mounted, info screen/monitor 45” (Wifi/Chromecast ultra)

Success scenario	• A parking site is created and assigned to the virtual parking lot. • A parking sensor is registered and gets assigned to a parking site. • An access rule is created and assigned an entrance id. • Heartbeat (alive) signal is received within 1 minute after registration

Key Performance Indicators	Key performance indicators define sets of values against which data to measure. • How many virtual parking lots are defined • How many parking spaces are registered per parking lot • How many parking spaces are registered as operational • How many users have access to the parking space • How many vehicles are able use the parking space • How many vehicles are using the parking space a week/month • What is the success rate of registering a parking space (yield) • What is the success rate of ordering and freeing up a parking space in a timely fashion KPI – before and after values after installing system: • What is the area has been saved by sharing parking space instead of occupying more land-use • Reduction of person-hours used for surveillance • Effect on traffic when parking space being out of order • What is the cost benefit of (investment vs. income/savings) – what is the cost of installing the sensors, what financial gain is registered, and how do these values measure up towards each other • How much is spent on searching for vacant parking space • How many tonnes CO2 (emission) are generated yearly when searching for vacant parking space • How many person hours spent yearly searching for parking space
Algorithmic Data Processing	• Assign suggested layout to virtual parking lot based on available information • Suggested physical properties of registered parking space • Sort parking space relevance within virtual parking lot based on physical properties (location and dimension) • Identify smart parking sensor ID within parking lot sensor- pool • Generate smart light signal based on order/event status • Generate notification based on registered parking space • Generate statistics based on nearby/similar parking space log • Calculate suggested usage cost based on available contract types See also recommendations in ETSI TS 103 463 A.1 People A1.1. Health
Responsible Partner(s)	HITS in cooperation with Troms County and Tromsø Municipality aims to integrate affordable, state of the art parking sensors and smart lightning. Future options include integrating authentication, authorization and access to restricted areas as well as to gates. HITS will provide: • App development • User experience (graphic design, interaction design, information architecture) • Backend solution (configuration and database design).
Actors Involved	• Vehicle owners and managers: Depend on user role and operational aspects - could be drivers, passengers, owners of parking space (public/private), commercial transport carriers, public officials,

	special interest groups (disabled/electric) etc. Interested for information related to their working/living space and transportation needs.
Implementation planning	Implementation plan: • M25: Planning, make sample dataset, analyse requirements (HITS) • M26 – M28: Implement first version of virtual parking lot (HITS) • M29 – M31: Implementation parking space assignment (HITS) • M31 – M32: Routing and guiding (HITS) • M33: Make final implementation based on feedback from stakeholders (HITS)

4.2.3.2. *Real-time operation*

VAS 1b.1.2	**Real-time operation**
Related Use Case	UC 1b.1
Goal - Scope	Typically, this VAS will address issues related to parking space assignment, but also to other time-critical or context-sensitive value-added services. Examples of such services are booking, ticketing and forecasting.
IoT Infrastructure involved	See IoT infrastructure at VAS 1b.1.1
Trigger	• Time-driven e.g. Temperature value is sent once every 5 minutes. • Event-driven e.g. status from parking sensor. The signal contains the strength of the magnetic field that indicates if something is placed above the sensor. The threshold value can be adjusted. If the status contains an abnormal message, a reset signal is sent. The signal is also used for smart light indications about vacancy status. • User-driven e.g. a trigger can be activated manually through placing a booking request. This will be software based and result in the following actions: o Request for assigning a parking site based on different criteria, such as vehicle properties and booking priority. o ID used for authorisation criteria is assigned for limited time o Short time parking contracts are defined and assigned
Pre-conditions / Assumptions	See pre-conditions under VAS 1b.1.1
Success scenario	• A parking site is assigned based on a number of parameters (like width, size, height, weight, priority, entrance, special needs of drivers, EV outlet) • Vehicle arrives at gate • Entrance is provided and gate opens • Smart light signal indicates status of parking space: o green: available o red: occupied o blinking green: about to be released

	○ blinking red: occupied, but about to be released (due to inactivity) ○ yellow, slowly blinking: maintenance/error • Parking site is freed up after agreed time (1 minute – 1 hour) • Info screen updates location of assigned parking space and alarms
Key Performance Indicators	See KPI under VAS 1b.1.1
Algorithmic Data Processing	• Develop decision tree that takes into account various parameters (priority, entrance, vehicle dimension etc.) • Signalling software to communicate with smart light • State machines to interconnect values from different sources (access, presentation, notification)
Responsible Partner(s)	See responsible partners under VAS 1b.1.1
Actors Involved	See actors under 1b.1.1 for further description
Implementation planning	See implementation planning under VAS 1b.1.1

4.2.3.3. *Active maintenance*

VAS 1b.1.3	**Active maintenance**
Related Use Case	UC 1b.1
Goal - Scope	The system depends on all components being in working order. It is therefore essential with regular data exchange and health check on installed parking sensors, as well as other related equipment and Value-Added Services. If something is amiss, reports needs to made on technical issues.
IoT Infrastructure involved	See IoT infrastructure at VAS 1b.1.1
Trigger	• Time-driven e.g. Heartbeat sent every 30 minutes. Information about the health of the parking sensor. If no signal is detected within expected time-interval, notification about maintenance is sent. • Event-driven e.g. status from parking sensor. The signal contains the strength of the magnetic field that indicates if something is placed above the sensor. The threshold value can be adjusted. If the status contains an abnormal message, a reset signal is sent.
Pre-conditions / Assumptions	See pre-conditions under VAS1b.1.1
Success scenario	• Lack of heartbeat signal(s) within expected timeframe is detected • Reason for missing heartbeat from parking sensor is discerned • Issues with smart light is identified • Problems with info screen/digital sign is located

	• Maintenance is ordered, performed and completed • Sensors are functional
Key Performance Indicators	See KPI under VAS 1b.1.1 • The number of reporting errors/out of order • The number of false reports (alarms/occupancy) KPI – effect when out of order • what is the cost of smart parking sensor being out of order • what is the reduction of vehicles when smart parking sensor is out of order • what impact will an error have on related traffic/increase in time looking for available parking space: • how many tonnes CO2 (emission) will increase when parking space is non-functional • how many extra person hours will be spent per smart parking sensor being out of order
Algorithmic Data Processing	• Identify updated smart parking sensor ID within parking lot sensor-pool • Signalling software to communicate with smart light based on status • State machines to interconnect values from different sources (access, presentation, notification) • Generate statistics based on error log and usage • Generate relevant notification message to registered users and owners of parking space/virtual parking lot
Responsible Partner(s)	See responsible partners under VAS 1b.1.1
Actors Involved	• Technical personnel: sensor and gateway installations, system configuration, technical integrators of 3rd party products, app developers, area and structural manager that decides how and what to install and integrate of control systems and parking spaces.
Implementation planning	Implementation plan: • M25: Planning, make sample dataset, analyse requirements (HITS) • M29 – M32: Implementation of detection and event handling • M33: Make final implementation based on feedback from stakeholders (HITS)

4.2.4. User Interfaces

There will be designed a separate user interface for each main user group;

- Administrators; assigning, maintenance
- The residents, visitors and others; status of availability and cost
- Owners of the parking space; status, statistics
- Owners of the parking lot; usage status, statistics and history

There will also be prepared two main platforms for communication;

- PC/website
- Mobile app

Other platforms like smart TV and smart mirror will be supported later on in the life cycle.

Below are some examples of a user interface for private car owners allocating and assigning parking space:

4.2.4.1. *Administration of parking space*

UI 1b.1.1	**Administration of parking space**
Related Use Case	UC 1b.1
Related Value-Added Services	VAS 1b.1.1 VAS 1b.1.2
Description	The user interface will be designed for both PC and mobile. It will be based on a web interface and target the following user groups: • building manager/parking lot owners • tenant/parking space owner • driver/vehicle owner The interface will serve four primary functions; 1. registering new devices and parking space – including virtual parking sites and graphical overview 2. managing personal information and history/logs 3. creating access codes, entrance data and other security related information 4. give access to statistics/analytics
Mock-up screens	The mock-up screens will cover these user groups and information content: Administration for building managers • Overview garage facility • Overview installed parking sensors • Overview smart light indicators • Parking space history/logs • Parking space statistics • Parking space ownership • Contact person maintenance Administration for tenants • Parking space history/logs • Parking space statistics • Parking space ownership • Smart parking vacancy Mobile application:

	• Building manager administration of parking space ownership and statistics
Responsible Partner(s)	• HITS will be responsible for all development and UX design. This includes creating the backend of the administrative system. Communication will be handled through a frontend communicating via a REST interface.
Implementation planning	• M25: UX design (mobile and PC) • M26 – M27: Prototyping/user engagement • M31: Make final implementation based on feedback from stakeholders (HITS)

4.2.4.2. *Real time Information about parking space*

UI 1b.1.2	**Real time Information about parking space**
Related Use Case	UC 1b.1
Related Value-Added Services	VAS 1b.1.1 VAS 1b.1.2
Description	The GUI is targeted towards users that is navigating to or already has arrived at the location. The navigation module is displays a map and the recommended route to the site. On arrival an entrance code will be made available, and information about the assigned parking space will be presented. The user interface will be designed for both PC and mobile. It will be based on a web interface and target the following user groups: • building manager/parking lot owners • tenant/parking space owner • driver/vehicle owner • technical personnel The interface will primarily serve two functions; • give access to statistics/analytics • display position, route/guidance and map/layout of facility Some of the information will be passive. A monitor inside the parking facility will display a map consisting of the layout of the parking site, where the location of the assigned parking spot is being highlighted.
Mock-up screens	The mock-up screens will cover these user groups and information content: Owner administrating parking space availability (time/date) and statistics Information for building managers • Overview of garage facility • Occupancy • Status of smart lights Information for tenants • Time to arrival • Contact persons

	• People alerted Mobile application (additional information – context sensitive) • Route – priority parking • apartment
Responsible Partner(s)	See responsible partners under UI 1b.1.1
Implementation planning	See implementation planning under UI 1b.1.1

4.2.4.3. *Maintenance of parking sensors*

UI 1b.1.3	**Maintenance of parking sensors**
Related Use Case	UC 1b.1
Related Value-Added Services	VAS 1b.1.1 VAS 1b.2.2
Description	The user interface will be designed mobile. It will be based on a web interface and only target technical personnel and building managers. It will be used for on-site adjustment and feedback on installed devices-typically parking sensors and smart lighting.
Mock-up screens	The mock-up screens will cover these user groups and information content: Information overview of garage facility • Entrance In garage facility • Mobile overview
Responsible Partner(s)	See responsible partners under UI 1b.1.1
Implementation planning	See implementation planning under UI 1b.1.1

4.2.5. Value-Added Services deployment planning

In order to get the Value-Added Service operational, the following software components needs to be 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 and parking space options
- 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.

4.2.6. VICINITY as an enabler

Most smart parking solutions offers solutions within a closed ecosystem (Libelium, Tinynode, Streetline, Nedap, Rosim-ITS, Placepod, Siemens, Bosch with many, many more). 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.

VICINITY opens for complex rulesets that are based on events taking place within a large number of IoT systems. By combining previously closed, proprietary new tools can be created for datamining and expert systems. This will lead to opportunities for optimisation, trading and ticketing services, building management, traffic control, monitoring and visualisation – new partnerships and envisioned services.

Information about availability and recommendation can be distributed to digital signs and internal administrative system thanks to VICINITY Interoperability as a Service approach.

Thus, VICINITY contribute with both health benefits and reduced emissions due to how private held parking space can become part of public infrastructure. 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.

The priority parking case allows for integration of smart light systems, authentication, visualisation units and EV charging station devices. Thus, a foundation for versatile, scalable solutions which can be extended with new functionality is being created.

4.2.7. Use Case Business Modelling

New Value-Added Service (VAS) suggested by Smart city administration Tromsø is to make interoperable city-wide parking systems using 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 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.

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:

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 • Car Park assignment on triggers • Prioritized request allocation • Assessment criteria • Licensing rights	• Route planning • Route optimisation • Area optimisation • Area management • peripherals • Machine learning • Forecast • 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	• Data mining • Data presentation • Analytics • Visualisation • Risk analysis

• EV ports/metering – smart energy • Car rental • Storage • Pick-up service • Bicycles/city bikes • Segways • City council • National Road Agency • Newspapers/media	• 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

Table 1: sources for developing business models

The continuous development of VICINITY will open for many new services. In order 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 will developing and extending such services.

4.3. Pilot Use Case 1b.2: eHealth Emergency 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 some 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 make their work most efficiently, the health care assistants need parking space close to their clients.

The tenants have health care equipment from different vendors. The ones VICINITY will integrate with have been developed by Fibaro and supplied by company Sensio. Sensio offers a complete ecosystem for logging and reporting situations that may arise.

UC1b.2 is an extension of UC1b.1 where priority parking is assigned medical conditions or other significant alerts received from IoT assets installed at “Teaterkvarteret 1. Akt”. Since UC1b.2 serves as an extension, this means that KPIs and algorithmic processing also will be extended from UC1b.1.

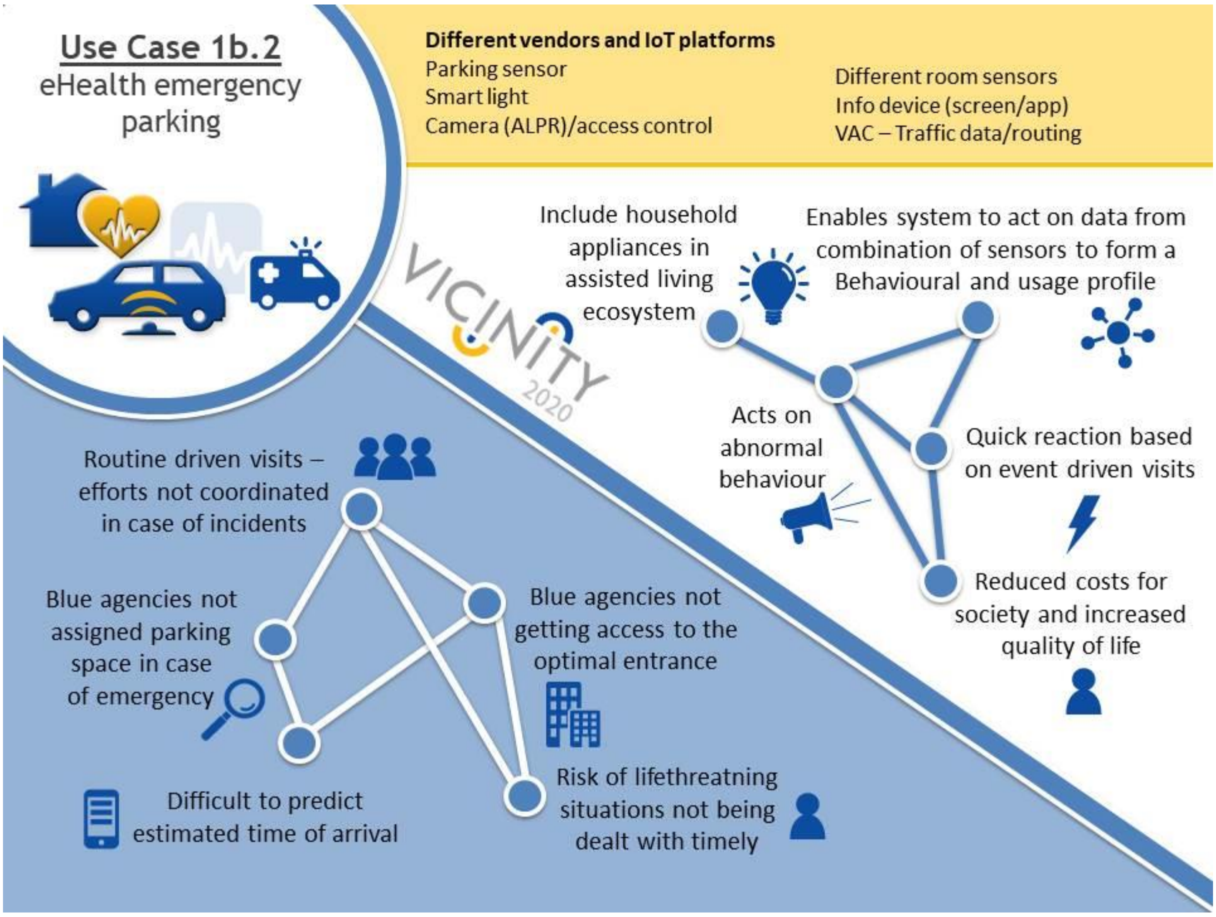


Figure 6: Narration of Tromsø pilot eHealth Emergency parking

4.3.1. Use Case Conceptual Design

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.

The figure demonstrates 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.

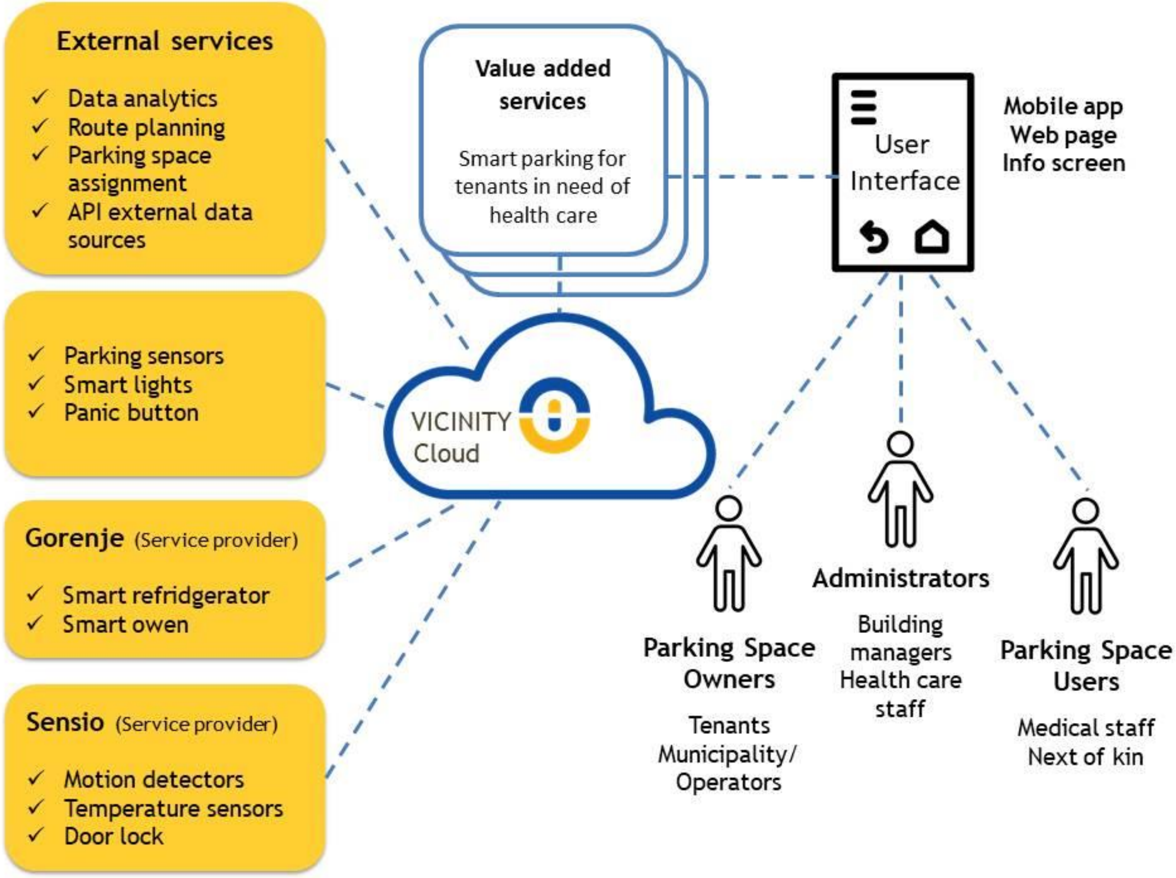


Figure 4-7 Use Case 1b.2 Conceptual design

This use case is more complex, since it is combining sensors' data from several different IoT eco systems.

The system will generate relevant messages based on the severity of the warning and assigned recipients. Messages generated for medical assistants will therefore differ from information sent to next of kin.

The core of the message will still be the same; the source of the alarm, time of date, tenant id and the apartment number.

4.3.2. Use Case associated Value-Added Services and User Interfaces

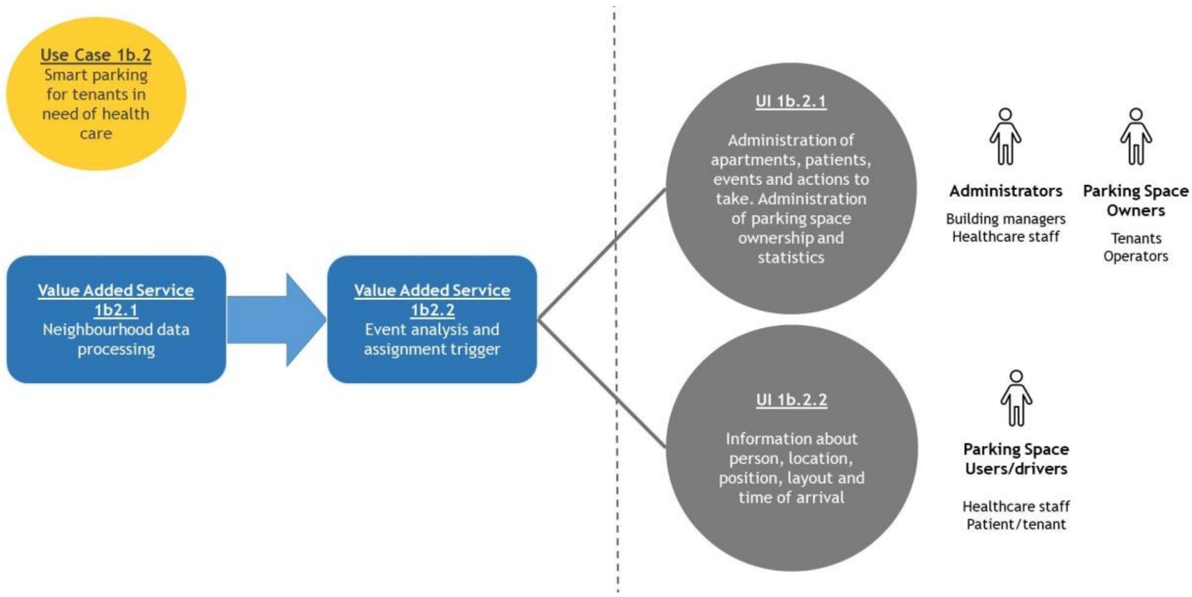


Figure 4-8 Use Case 1b.2 associated Value-Added Services and User-Interfaces

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 (eg. fall sensor is triggered)
- Additionally, health care assistants may notice something abnormal and take action based on that.

In the use case scenario, the following actions will be 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 of time or that there has not been registered any kind of use for a certain amount of time.

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

Table 2: sources and triggers being part of the use case

4.3.3. VICINITY Value-Added Services

4.3.3.1. *Neighbourhood data processing*

VAS 1b.2.1	**Neighbourhood data processing**
Related Use Case	UC 1b.2
Goal – Scope	Tying together shared resource management of urban areas supporting multi-domain integration within adjacent ecosystems (transport/mobility, assisted living and smart building) The goal is to offer a suite of solutions that enhance smart cities and -buildings, reduce emissions, optimize usage of public and private areas, create new revenue modules, introduce flexibility and versatility in urban area and smart building management.
IoT Infrastructure involved	• Gorenje cloud service for Gorenje appliances • Sensio cloud service monitoring Fibario sensors • Parking sensor network installed at the parking space • Smart light network placed near the parking space • External sensor information from traffic load monitoring equipment containing weather conditions, air particles
Trigger	Trigger mechanisms may include: • Time-driven (e.g. Heartbeat is sent from Gorenje appliances every 15 minutes. If no signal is received, continue checking for 2 hours. If still no signal is detected, prepare message for maintenance.) • Event-driven (e.g. Operational status containing information sent when door has been opened or closed.) • User driven (e.g. booking request is received from an actor (vehicle))

Pre-conditions / Assumptions	See pre-conditions under VAS 1b.1.1
	
	Software has been installed, and users have received training or are otherwise knowledgeable about how to use the apps and equipment.
	Agreements must be in place with affected parties such as building owners/the board, tenants/caretakers and city officials.
	• Agreements must address
	  o Availability of parking space
	  o entrance to location
	  o Sharing of personal data
	• The following hardware must be installed, configured and operational:
	  o VICINITY server/adapter installed and operational
	  o Battery powered: Ground mounted, parking sensor(LoRa)

	○ Electrical wired: roof mounted/wall mounted smart light (Z-wave) ○ Electrical wired: wall mounted, info screen/monitor 45" (Wifi/Chromecast ultra) ○ Battery powered: various sensors from Fibario in apartment (Z-wave) ○ Electrical wired: Household appliances from Gorenje (Wifi)
Success scenario	• A parking site is assigned based on a number of parameters (like width, size, height, weight, priority, entrance, special needs of drivers, EV outlet) • Entrance is provided and smart light signal is triggered. • Parking site is set to free after agreed time • Info screen updates location of assigned parking space and alarms
Key Performance Indicators	See KPIs under VAS1b.1 Also: • how much area are allocated shared parking services (per building) • How many parking spaces are registered as suitable for emergency vehicles per parking lot • how many (emergency) vehicles are able use the parking space • how many (emergency) vehicles are using the parking space a week/month • How many parking spaces are registered as operational and available to emergency vehicles • how many long-term contracts have been made with municipalities • what is the share of population that has access to basic health care services within 500 meters • number of shared vehicle parking space per vehicles per km^2? • number of traditional parking space available per km^2? • how many people have access to vehicle sharing services per km^2? KPI – before and after installing system: • effect on emergency when parking space being out of order • how many person surveillance hours has been reduced • how many lives can be saved because emergency vehicles may park and arrive in time
Algorithmic Data Processing	See algorithm data processing under VAS1b.1
Responsible Partner(s)	See responsible partners under VAS 1b.1.1 Also: Partners will provide support for integration between eHealth, assisted living and mobility. • Sensio will provide medical sensors and configure service • Gorenje will provide household appliances and configure service
Actors Involved	See actors involved under VAS1b.1.1 Also:

	• Blue light and health agencies, healthcare personnel, neighbours, relatives, other residents and visitors that may be affected by availability of suitable parking space.
Implementation planning	See implementation planning under VAS1b1.1

4.3.3.2. *Smart parking event analysis*

VAS 1b.2.2	**Smart parking event analysis**
Related Use Case	UC 1b.2
Goal - Scope	See Goal under VAS1b.2.1
IoT Infrastructure involved	See IoT infrastructure under VAS 1b.2.1
Trigger	Trigger mechanisms may include: • Time-driven e.g. Heartbeat is sent from parking sensor every 30 minutes. Information about the health of the parking sensor. If no signal is detected within expected • Event-driven e.g. status from parking sensor, alerts triggered by fall-sensors or panic-alarm.
Pre-conditions / Assumptions	See pre-conditions under VAS 1b.2.1 Also: • Guidelines for how to react in case of emergency or alarm being triggered must be in place

Success scenario	This is a typical sequence that will be triggered when an alarm or event is registered;
	• The source of the alarm is identified
	• The severity of the alarm is calculated based on the source
	• A signal is sent to the health care assistant currently on duty
	• The health care assistant will have to respond within a certain set of time Based on the severity, a message will be sent to either Personal health care assistant, next of kin or neighbour
	• The recipients need to confirm they have received the message
	• When confirmation is received, certain actions are triggered automatically;
	  o Parking space is allocated based on severity, location and availability
	  o Dimensions and other properties of vehicle
	  o Special demands (vehicle/patient transport)
	  o The smart lights/LED strips of the assigned parking space change colours to indicate they have been reserved
	• Info screen updates location of assigned parking space and alarms

Key Performance Indicators	See KPI under VAS 1b.2.1
Algorithmic Data Processing	See algorithmic data processing under VAS 1b.2.1

Responsible Partner(s)	See responsible partners under VAS 1b.2.1
Actors Involved	See actors under VAS 1b.2.1 Also: Technical personnel: sensor and gateway installations, system configuration, technical integrators of 3rd party products, app developers, area and structural manager that decides how and what to install and integrate of control systems and parking spaces.
Implementation planning	See implementation planning under VAS 1b.1.2

4.3.4. User Interfaces

There will be designed a separate user interface for each main user group;

- Administrators; assigning, maintenance
- Health care assistants; information about apartment and recommended course of action
- Medical personnel; patient history, medicines
- The residents, visitors and others; status of availability
- Owners of the parking space; status and statistics
- Owners of the parking lot; usage status, statistics and history

There will also be prepared two main platforms for communication;

- PC/website
- Mobile app

Other platforms like smart TV and smart mirror will be supported later on in the life cycle.

Below are some examples of a user interface for private car owners allocating and assigning parking space:

4.3.4.1. *Administration of priority parking*

UI 1b.2.1	**Administration of priority parking**
Related Use Case	UC 1b.2, UC 1b.1
Related Value-Added Services	VAS 1b.2.2, VAS1b.1.2
Description	The GUI will provide a toolbox for preparations of emergency parking. In case of certain events should occur, the appropriate parking space should be assigned, and users should be directed towards the source of the event. The user interface will be designed for both PC and mobile. It will be based on a web interface and target the following user groups: • building manager/parking lot owners • tenant/parking space owner • driver/vehicle owner • medical personnel/caretakers

	The interface extend the admin UI presented at UI1b.1.1. The priority parking serves four primary functions: 1. registering new devices and parking space – including household appliances and other relevant smart devices 2. managing personal information and history/logs. This includes special considerations. Contacts like next of kin and neighbours are also data that will be assigned. 3. creating access codes, entrance data and other security related information 4. give access to statistics/analytics
Mock-up screens	The mock-up screens will cover these user groups and information content: Administration for building managers • Overview garage facility • Overview installed parking sensors • Overview smart light indicators • Parking space history/logs • Parking space statistics • Parking space ownership • Contact person maintenance Administration for healthcare assistants • Apartments – address, number, position • Tenants/patient name • Status • Trigger warnings – events and actions to take • Contact person - who to contact Administration for tenants • Parking space history/logs • Parking space statistics • Parking space ownership • Smart parking vacancy Mobile application
Responsible Partner(s)	HITS will be responsible for all development and UX design. This includes creating the backend of the administrative system. Communication will be handled through a frontend communicating via a REST interface. • Sensio will provide API to access data from medical sensors • Gorenje will provide API to access data from household appliances
Implementation planning	• M25: UX design (mobile and PC) • M26 – M27: Prototyping/user engagement • M28 - M30: Implementation and testing • M32 – M33: Make final implementation based on feedback from stakeholders (HITS)

4.3.4.2. Real time Information about priority parking in progress

UI 1b.2.2	**Real time Information about priority parking in progress**
Related Use Case	UC 1b.2 UC 1b.1
Related Value-Added Services	VAS 1b.2.2
Description	The GUI is targeted towards users that is navigating or close to the destination. The user interface will be designed for both PC and mobile. It will be based on a web interface and target the following user groups: • driver/vehicle owner • medical personnel/caretakers • building manager/parking lot owners • tenant/parking space owner • driver/vehicle owner The information display consists of two modules; • The navigation module is targeted towards users that is navigating to or already has arrived at the location. The module displays a map and the recommended route to the site when outside the facility. When inside, the module presents a layout of the parking lot when inside the building and information about the assigned parking space. An information screen inside the garage facility will always use mode 2 (layout and status of parking space). • A separate module will provide information about the apartment and source of alert.
Mock-up screens	The mock-up screens will cover these user groups and information content: Information for building managers • Overview of garage facility • Occupancy • Status of smart lights Information for healthcare assistants • Apartments (address, position, apartment number) • Tenants/patient – name, age etc. • Contact person • Status • Trigger warnings – colour code, actions to take Information for tenants • Time to arrival • Contact persons • People alerted Mobile application (additional information – context sensitive) • Route – priority parking • Apartment

	The mock-up screens will cover these user groups and information content: • Information overview of garage facility • Entrance In garage facility • Mobile overview
Responsible Partner(s)	See responsible partners under UI1b.2.1
Implementation planning	See implementation planning under UI1b.2.1

4.3.5. Value-Added Services deployment planning

The services will be installed at "Teaterkvarteret 1. akt" which is located in Tromsø, Norway. The hardware will be located in and around the buildings that constitutes the pilot site.

A local server will handle all requests and as most time-critical events will trigger a local response.

Information will be encrypted and stored in two separate databases where identifying data is removed.

A log will contain information about events, but only members of the medical staff will gain access to sensitive data related to emergency situations.

Logs regarding parking will be kept in definitively, but no identifying information about the vehicles be stored.

The deployment plan:

- M25 - M28: Installation of parking sensors and smart light (Gorenje and Fibario equipment is already installed)
- M25: Planning, make sample dataset, analyse requirements
- M26 – M30: Implementation of smart parking analysis and assignment
- M29 - M30: Installation and Integration of camera system
- M30: Training and information about the emergency parking system.
- M31: Implementation of routing and guiding system
- M32: Test run of emergency parking system
- M33: Make final implementation based on feedback from stakeholders

4.3.6. VICINITY as an enabler

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.

The same situation applies to smart parking solutions (see further descriptions in chapter 4.2.6: VICINITY as an enabler) as well as services to gain access.

Through the auto discovery service, VICINITY also opens for faster registering and configuration of smart devices. Within an environment that contains devices that are located in different parts of a building and serves different purposes like detecting the presence of vehicles, communicates with digital signs and information screen, access controls – it is pertinent for the administration process being as smooth as possible.

What VICINITY also offer is to maintain privacy while allowing devices placed in an apartment to communicate or trigger events located in the garage facility.

In this way VICINITY opens for integration of systems that offer 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 space.
In this way will VICINITY contribute with 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 private held parking space can be integrated in virtual parking lots and thus become part of public infrastructure.

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.

The eHealth Emergency Parking use case are relevant to a large number of situations that demands action being taken within a short time frame. It therefore represents a foundation for versatile, scalable solutions directed towards blue light agencies, public officials and other parties with time critical tasks and special permissions.

4.3.7. Use Case Business Modelling

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.

5. Martim Longo (PO) - Neighbourhood GRID ecosystem (ENERC)

5.1. Introduction

Use Cases

Neighbourhood GRID ecosystem, generation, consumption and beyond

The Use Cases in the ENERC pilot include several buildings: the Solar Lab located on the Solar DEMO Platform, a cluster of the Municipality managed buildings - a secondary School, a Retirement home and a Sports Centre including a Swimming Pool, and a private home. This cluster of Municipal buildings and the private home form a neighbourhood both digitally and geographically. The cluster in combination with the Solar Lab would form a setting for use cases, which were first identified in D1.3 and further developed during 2017. The use cases also underwent stakeholder prioritisation and subsequent analysis and further development.

As a result, three distinct categories of services/solutions that will form the base of Value Added Services enabled by VICINITY are being designed and developed by ENERC. Each outlined category of services addresses a separate stakeholder segment within the public or private sector. The public sector services are specifically focused on Municipal asset management (building use and resource consumption) and IoT related Services delivery for Municipalities that will be subsequently rolled out towards the wider public audiences they serve. The O&M IoT enabled services will be demonstrated at the Solar Platform DER RES site. Decarbonisation of the energy sector and the drive towards reducing operation and maintenance cost of distributed assets is at the core of this VAS.

The concept of IoT enabled equipment leveraging (use of resource for secondary use) within the neighbourhood at municipal level is being explored. The Solar Lab facility is a model building facility with a DER RES system (self-consumption) which will serve as a data input and source. It will demonstrate consumption flexibility and serve as a model for a community grid towards the Municipal Buildings Cluster

The growing capacities and decreasing cost of sensor devices holds promise for the rollout of many services that will be facilitated through the VICINITY platform VAS. IEQ (Interior Environmental quality) is one of these services that is being designed by ENERC for the municipal setting and will be tested as a solution for Municipal schools in the region based on the DEMO facility in Martin Longo. ENERC previously supported educational activities in the region and hosted school visits and educational events.

Public informational services and public engagement combine to make up the third category of use cases and related VAS for the pilot. The activities are structured around the most relevant and impactful topics within the region, such as Ultra Violet (UV) exposure due to very strong solar irradiation in the region, with the goal to replicate the informational services to areas of high risk such as beaches and the public events. These VAS and the associated use cases are fully aligned with regional smart energy specialisation by the Algarve region and focused on the strategic sectors of the regional economy.

Infrastructures participating in the pilot´s use cases are located at Solar Lab facility of Solar Demonstration Platform of Martim Longo, Municipal Buildings Cluster (Sports Centre - Swimming Pool, Retirement home, and School) and in the private home within the Municipality.

The three categories of VAS are expected to give rise to further developments in innovation and additional solutions rollouts through so-called Labs approach beyond the project duration. The image below outlines Municipal Services VAS, IoT enabled Local to Local services and IoT enabled Operations and Maintenance for distributed renewable energy assets management (DER O&M), Platform Services.

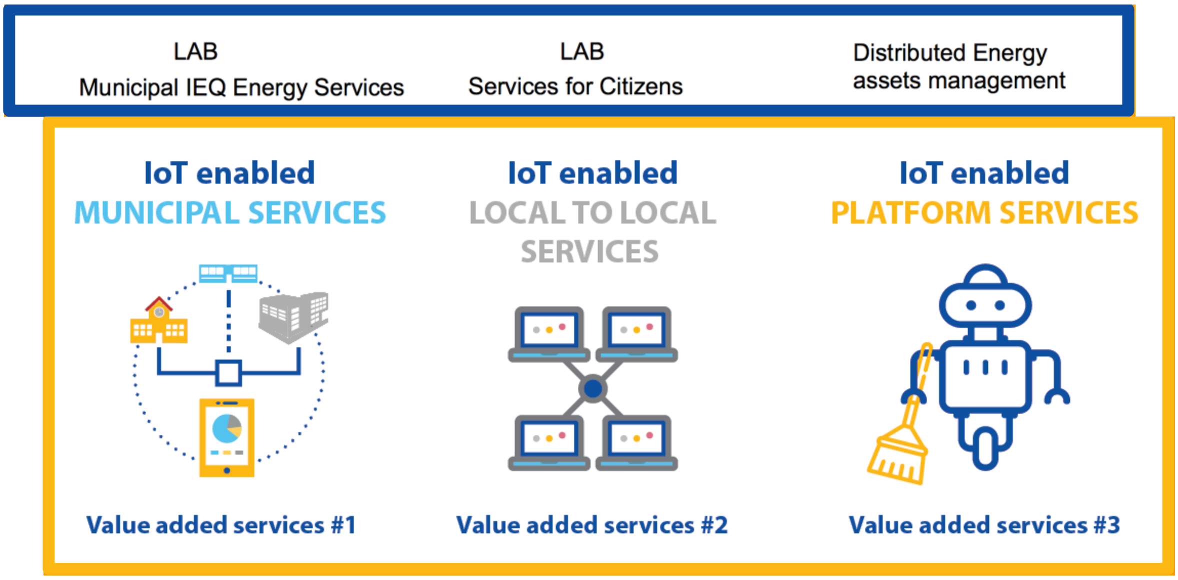


Figure 5-1 Value Added Services 2.1, 2.2, 2.3

Figure 5-2 Municipal Buildings, Martim Longo

List of the use cases after prioritisation:

1. Municipal Services

UC 2.1 SOLAR LAB Resources Management
UC 2.2 Management and resources (Dynamic audit)
UC 2.3 Building Energy Consumption, Building Energy Profile
UC 2.4 Building Energy Potential Flexibility
UC 2.5 Smart School IEQ
UC 2.10 Municipal Buildings IEQ Smart School
UC 2.11 Smart Refrigerator and Smart Oven

2. Local to Local

UC 2.9 UV (Ultraviolet) info service for citizens and tourtists
UC 2.1 SOLAR LAB Resources Management

3. Platform Services

UC 2.6 DNI Verification
UC 2.7 RES DER Operating Model OPEX

5.2. Use Cases 2.1, 2.2, 2.3, 2.4, 2.5, 2.10, 2.11 – Energy Efficiency and IEQ Management in Municipal Cluster of buildings – Municipal Services

Buildings in general and Municipal Buildings in particular are used within the originally designed and designated parameters without any consideration of space optimization that can be achieved by taking into account the measurement of the consumption of resources by each space and other parameters, such as Interior Environmental Quality (IEQ) which is based on parameters such as light, CO2 accumulation, or space use optimization by users. This link between the space use, IEQ quality measurement and resources consumed by buildings optimisation is at the core of the set of use cases that form VAS 2.1, Municipal Services at buildings level.

In this set of Use Cases (Solarlab at the Solar Demo platform, Municipal School, Sports Centre - Swimming Pool and Retirement home) multiple types of sensors and equipment are used to collect information from the buildings in real-time. Parameters such as temperature, CO2, humidity, noise, motion and energy consumption are considered for further processes modification and analysis, some processes automation maybe considered and analysed for viability. These parameters are also combined with data from a weather station, which is located at the SolarLab facility and currently gathers multiple streams of local data.

The primary goal is to facilitate dynamic data collection from various sources, including sensors and other cloud services with the goal of creating a new service offering through VICINITY Value added Services, preliminary named Dynamic Building Audit. The collection of data becomes useful for various decision-making processes, such as equipment substitution and upgrades of municipal assets/equipment, optimal space utilization and functional use, energy and other resource management, daily consumption optimisation, including peak shaving and subsequent integration into energy flexibility systems. Well-functioning Demand Response models and eventually fully integrated smart grids would depend on well-integrated building blocks, which start at the building level, scaling up to the buildings cluster level and further on onto neighbourhood, city and region. VAS #1 aims at the Municipal cluster buildings level with the goal of scaling up.

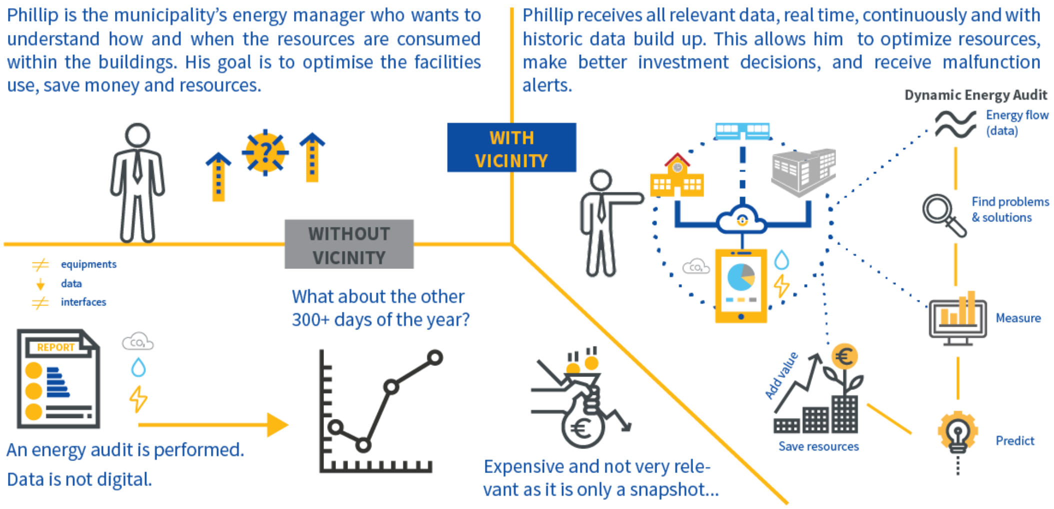


Figure 5-3 Narration of the Martim Longo Use Cases - Dynamic Building Audit

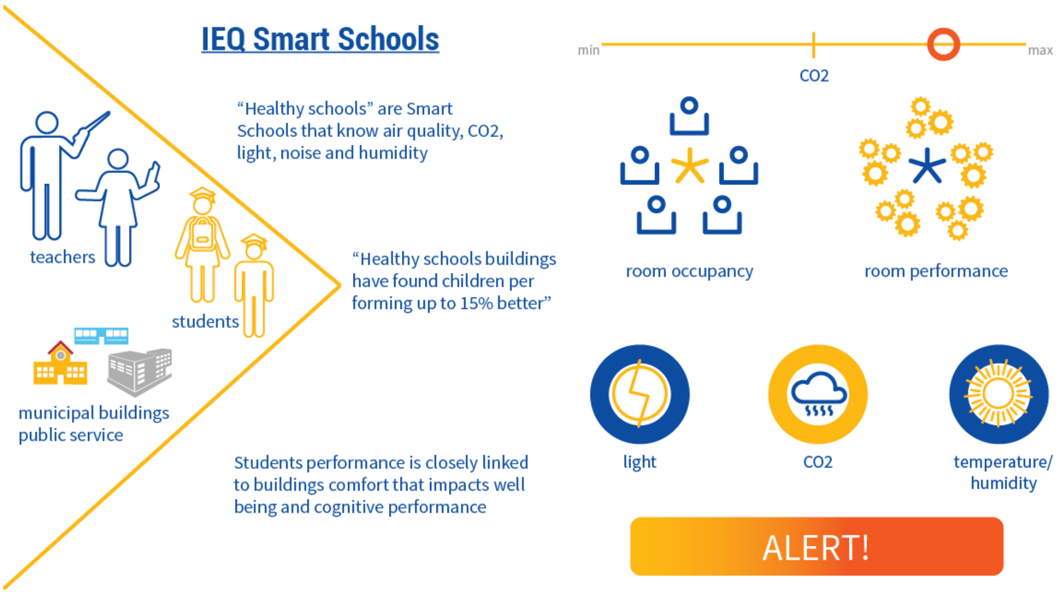


Figure 5-4 Narration of the Martim Longo Use Cases - IEQ services for Smart Schools

5.2.1. Use Cases Conceptual Design

The three categories of VAS at ENERC are designed in such a way that further rollout of services could be enabled based on the described approach; hence two categories of VAS could be a platform for future extensions and rollouts – Local to Local VAS and Municipal Services. The Solar Demo Platform´s model already serves as a platform for additional services roll out.

The image below outlines the main flows of information and the set parameters visualised in order to achieve optimised use of facilities, get greater insights as to systems performance and build a building block for future neighbourhood level comparisons and optimisations within the smart grid paradigm. The actors and the process of the Dynamic Building Audit are depicted in the figure below.

The diagram below outlines the location and the facilities involved:

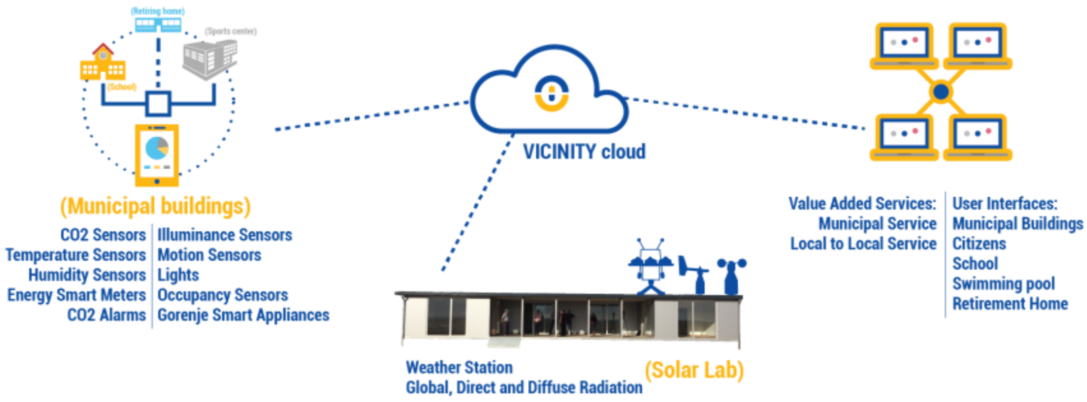


Figure 5-5 Use Cases Conceptual design

5.2.2. Use Case associated Value-Added Services and User Interfaces

For the Use Cases related to VAS 1, outlined above there is one VAS which will be integrated and enabled to deliver services for Municipal Buildings and facilitate rollouts of IoT enabled Local to Local Services.

Enercoutim aims at creating a new service offering after deployment of the use cases and Value-Added Service: ***Dynamic Building Audit for Municipal resources management and the IEQ services for public schools.***

This VAS will use the information from the sensors and communication equipment installed within the Municipal Buildings and also information obtained from the weather station located at the Solar Lab, which is about one kilometre away from the Municipal Buildings cluster. Information combined through the VICINITY Cloud would be used as shown in Figure 5-6 from each different actor in the process.

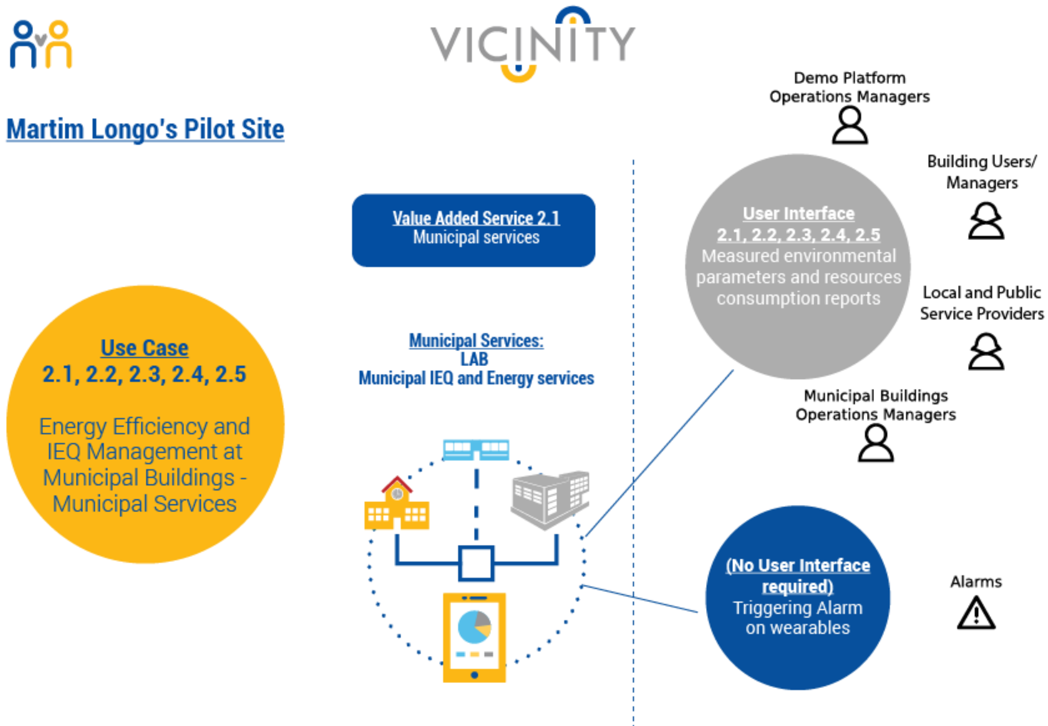


Figure 5-6 Use Cases associated VAS and User-Interfaces

This figure describes the different expected outcomes from the VICINITY Cloud towards the different actors in the process.

5.2.3. VICINITY Value-Added Services

Municipal Services Category of VAS would demonstrate test an offering of - ***Dynamic Building Audit and the IEQ services***

5.2.3.1. *Municipal Services, IEQ Smart School, Dynamic Audit*

VAS 2.1	Municipal Services, IEQ Smart School, Dynamic Audit
Related Use Cases	UC 2.1, 2.2, 2.3, 2.4, 2.5, 2.10,2.11
Goal - Scope	To facilitate dynamic data collection from various sources, to create a new service offering through VICINITY Value added Services Dynamic Building Audit for various decision-making processes. Equipment substitution and upgrades, optimal space allocation and IEQ parameters assessment, energy and other resources management, daily energy consumption optimisation are among. The service aims at creating a new dynamic platform approach of monitoring and analysis of building performance, resources and use and systems performance evaluation. Smart School service aims at delivering IEQ services where CO2 level in the classrooms could be managed by teachers and hence directly improving study conditions. Municipal cluster of building is treated as a neighbourhood and its flexibility potential can be assessed based on the outcomes of Dynamic Audit. Third party services or components could be integrated.
IoT Infrastructure involved	• Smart Electricity Meters • Serinus IEQ Sensors (Temperature, Humidity, Motion, CO2, Noise, Luminance) • Smart water and gas meters or alternative ways of reading data • Weather station • Smart appliances, such as oven and refrigerator
Trigger	-Time-driven (e.g. send collected data every 10 minutes) -Event-driven (e.g. once a new event occurs, such as when a peak shaving boundary optimisation is detected)
Pre-conditions / Assumptions	• Correct handling and sharing of sensitive personal and building data • Getting collaboration from building managers to install IoT devices/sensors • Battery-based devices should be charged/powered on • Third party services collaboration and integration

Success scenario	1. Sensors collect data every 10 minutes; 2. VICINITY-based service Municipal Audit service receives data; 3. VICINITY-based service Municipal Audit shows collected data in real time in a dashboard; data is processed; 4. User can select a time period and service generates report on resources consumption and building usage; 5. A set of alarms and advisory actions is generated for school caretakers; 6. Information is displayed on a screen within premises.
Key Performance Indicators	• Facilities and Energy Management tool to achieve dynamic awareness regarding the consumption of resources in the building through numerical reports; (The results and the use of the resources would be provided in a dynamic format vs. once a year energy bill;) • Space usability management tool: creation of awareness regarding the use of space within the cluster of the municipal buildings; • Creation of service for provision of alternative was to currently performed audits, including building performance in terms of energy efficiency, including equipment performance; • a tool to assess performance of the systems vs. stated efficiency and resources consumption by systems with visualisation; • Control through measurements of the interior environment quality of the buildings; • Comparison of various buildings in the cluster on resources consumptions at Neighbourhood level; • Notifications of unusual resources consumption; • Develop Methods to build historical data of buildings; • Prediction of use of each room in the public building to optimise the energy efficiency; • Integration of Gorenje Smart appliances and design of flexibility of resources use within public buildings. • Development of the tool for schools IEQ, while increasing awareness, students' engagement and active management of interior environment to stay within health advisable parameters.
Algorithmic Data Processing	• Data hub aimed at creation of historical profile of the building and its "behaviour" under various weather conditions will be set. Historical correlation of data for identification of unusual situations or based on set criteria. As an example, if a building has an electricity usage of X kWh per day for a certain time of the year and the current consumption is Y% above the normal consumption the algorithm can trigger a notification stating that something is consuming too much energy;

	• Clustering algorithms must be developed in order to create building categories based on the functional use. Municipal buildings constructed X years ago, that have Y rooms and are used by Z persons should have a similar energy consumption profile. This can be used to estimate possible cost savings for as yet non-audited or certified buildings. • Clustering of facilities, peer performance and creation of a comparative index of Municipal buildings category such as Municipal school performance, Swimming pools, Retirement homes would allow for dynamic comparison of performance and resources and systems optimisation. It could link to carbon performance and facilitate shift toward dynamic certification vs. static.
Responsible Partner(s)	• ENERCOUTIM will be responsible for coordinating the deployment of the sensors with the Municipality of Alcoutim, Solar Lab and the Demo Platform in collaboration with sensor manufactures. • Municipality is responsible for assisting in the deployment of sensors. Enercoutim is also responsible for the development of the visualization dashboards and services development.
Actors Involved	• Equipment owners • Local services providers • Public Services providers • Municipal operations managers of buildings and other services • Demo Platform operations managers and users.
Implementation planning	Sensors, gateways, routers and smart meters in series will need to be deployed at the mentioned buildings. Weather station and the related sensors, smart meter are already implemented at the Solar Lab. A successful installation would need to be a joint effort between the Municipal Services and Enercoutim with support of additional equipment providers, such as sensors from Serinus and Energomonitor. Deployment of Serinus sensors and the communication network should begin in mid-December 2017. Development of clustering and correlation algorithms can start in February but using only dummy data since there will be the need to gather real data for some time to have a baseline for real audits. M23-M25: Finalize sensor deployment, get sample data, analyse VAS requirements (ENERC) M26-M28: Develop first version of user interface (ENERC) M27-M32: Get feedback from partners, iterate (ENERC) M33: Finalize implementation (ENERC)

5.2.4. User Interfaces

5.2.4.1. *Municipal Services, IEQ Smart School, Dynamic Audit*

UI 2.1-2.5	Municipal Services, IEQ Smart School, Dynamic Audit
Related Use Case	UC 2.1, 2.2, 2.3, 2.4, 2.5 , 2.10, 2.11
Related Value-Added Services	VAS 2.1
Description	An app / web-app containing dashboards for visualization of the measured and processed data with the possibility to create reports on energy consumption, equipment performance and building usage patterns related to the resources consumption. Display within the facilities for public consultation and for management use are envisioned. Municipal cluster model and regional cluster model is being envisioned as a way to scale up this VAS. IEQ Smart school displays and interior placed alerts for teachers within classrooms.
Mock up screens	*Interface of VAS will be mobile based Mock-up screen set up.* 
Responsible Partner(s)	ENERCOUTIM will be responsible for the development of the respective UIs, and VICINITY partners BVR will be responsible for the programming architecture, Atos for modelling of services in the ATOS lab along with the Aalborg Lab for modelling Smart grid neighbourhood. Sensors and the related equipment providers will provide data sources and partners responsible for integration would provide technical integration. Univ. of Kaiserslautern is planning to create municipal model and regional models for Virtual Municipal cluster and Virtual Algarve based on the current use cases and VAS.
Implementation planning	During the months of January (M25) until March 2018 (M27) ENERCOUTIM is planning to install the necessary equipment's in addition to the installed base to start collecting data within the Municipal Building and subsequently integrate it with the

	VICINITY Platform. The rationale for cloud services creation is being assessed for each VAS. M23-M25: Finalize sensor deployment, get sample data, analyse V-A requirements (ENERC) M26-M28: Develop first version of user interface (ENERC) M27-M32: Get feedback from partners, iterate (ENERC) M33: Finalize implementation (ENERC).

5.2.5. Value-Added Services Deployment Planning

The deployment phase will begin with the installation of IEQ sensors and smart metering devices, during December 2017 with subsequent additional installations. After the successful deployment and local connectivity tests the second phase can start, which consists of the integration of the mentioned devices with the VICINITY platform, allowing collected data to flow to the VICINITY Cloud. The development of the interfaces will be done in parallel (dummy interfaces) and phase three will consist on the testing of the interfaces with data coming from the VICINITY Cloud. Tutorials and documentation on how to register devices and send/receive data to/from VICINITY will be necessary from the end of phase one. Deployment of devices and services is expected to be finished by August 2018.

5.2.6. VICINITY as an Enabler

IaaS will be demonstrated by the VICINITY platform during the realisation of the VAS. For the Municipal Dynamic Audit VAS, VICINITY is expected to be an enabler in terms of interoperability, allowing the service-providers to be abstracted from the low-level device protocols, which in many cases are not compatible, and integrate third party cloud services solutions. Service-providers can then focus only on the standardised data flows that can be used by software applications as a service.

Implementations of such metering and analysis systems are possible today but everything has to be custom designed which does not result in scalable solutions since there is no incentive to make devices interoperable. A company that wants to create such services can do it but there is no incentive for other companies to reach a common communication protocol for interoperability of devices. The VICINITY IaaS will allow a shorter time-to-market as service providers will not depend on data from a single manufacturer since any standardised data flow can be replaced by another of the same nature, even if the equipment is made by a different manufacturer and communicates in a different native protocol.

An analogy between VICINITY and current solutions can be made by comparing Sigfox and LoRa. Sigfox has all the communication infrastructure ready and one can just set up a device and use the network, paying for data but getting a much shorter time to market. On the other hand, with LoRa you can invest in implementing your own network infrastructure and not pay anything for data, although the time-to-market is much longer.

5.2.7. Use Case Business Modelling

Based on the results that would be achieved, coupled with business model tests and economic impact taking into the account the total cost of ownership - the model and the solution will be presented and demonstrated to the Intra Municipal organisation of the Algarve uniting 16 municipalities (AMAL) to be suggested for assessment, replication and regional rollout as a first step. The outcomes of the solution are expected to be presented to the regional government in an attempt to be considered for further replication and further development.

Total cost of ownership of the system would depend on the cost of systems set up, components, cost of connecting to VICINITY and running costs. These numbers could only be partially estimated at this time and fine tuning of each model will be expected.

5.3. Use Case 2.9– UV (Ultraviolet radiation) info services for Citizens and Tourists – Local to Local Services

Hyper local services designed and developed to meet the need for information services provided by Municipalities within Smart cities or towns context for health benefits and local conditions awareness towards citizens and tourists. The goal is to create a way of leveraging the existing equipment within the region, town, city that can provide data for creation of local IoT enabled VAS. These VAS that are built on the unleashed data could be processed and made available to tourists and citizens geographically located in the area. By creating these services, it would be possible to improve current indicators and augment simple weather conditions with advisory and more L2L (local to local) relevant services. In addition to the services described below additional cases can be proposed for open calls, such as leveraging existing CCTV security cameras for wild fire identification using computer vision and machine learning techniques. The premise of leveraging the existing equipment (through integration into VICINITY platform) for secondary use is at the core of the L2L concept.

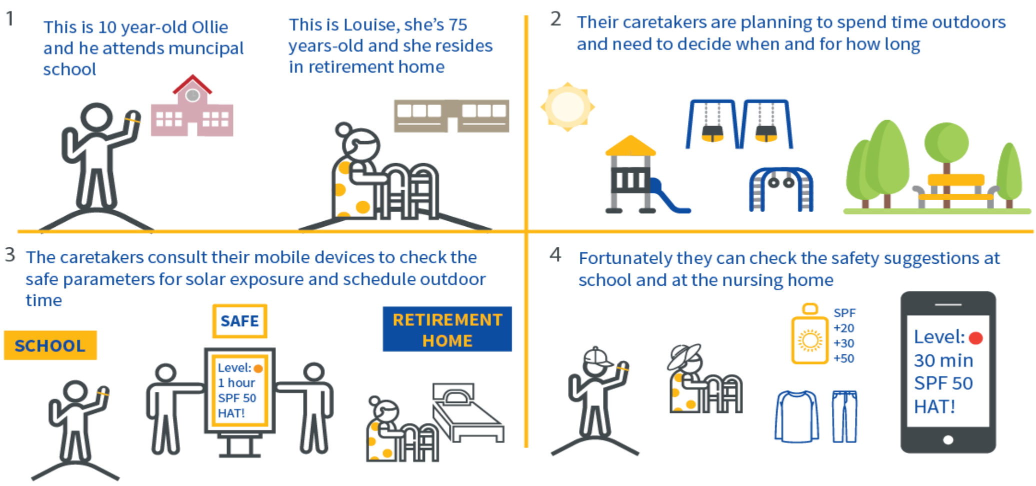


Figure 5-7 Narration of the Martim Longo Use Case 2.9 – L2L Services

5.3.1. Use Case Conceptual Design

A high-level architecture overview is shown below with a schematic representation, revealing how the VAS interfaces with the different parts of the overall VICINITY architecture and components. Specialised UV sensor that is part of the electronic equipment of the Weather station deployed at the Solar Lab will be used

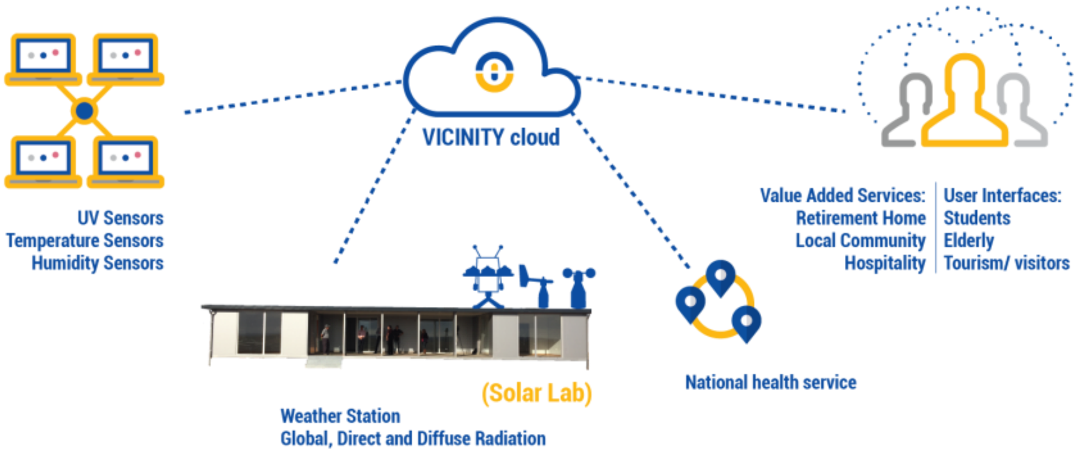


Figure 5-8 Use Case 2.9 Conceptual design

5.3.2. Use Case associated Value-Added services and User Interfaces

This VAS has corresponding UC 2.9, which will be implemented for different approaches to deliver Services for Citizens.

Enercoutim aims at creating a new service offering after deployment of the use cases and Value-Added Service: ***UV for Citizens – <u>Local to Local Services</u>.***

This VAS will use information from the UV solar radiation, external temperature and relative external humidity sensors from the weather station located in the Solar Lab, which is about one kilometre away from the Municipal Buildings and Martim Longo town. Information combined through the VICINITY cloud would be used as per figure 6 below from each different actor in the process.

A Value-added service will then combine the collected data with medical data to provide UV exposure information to users in their devices and in information screens located in some city buildings.

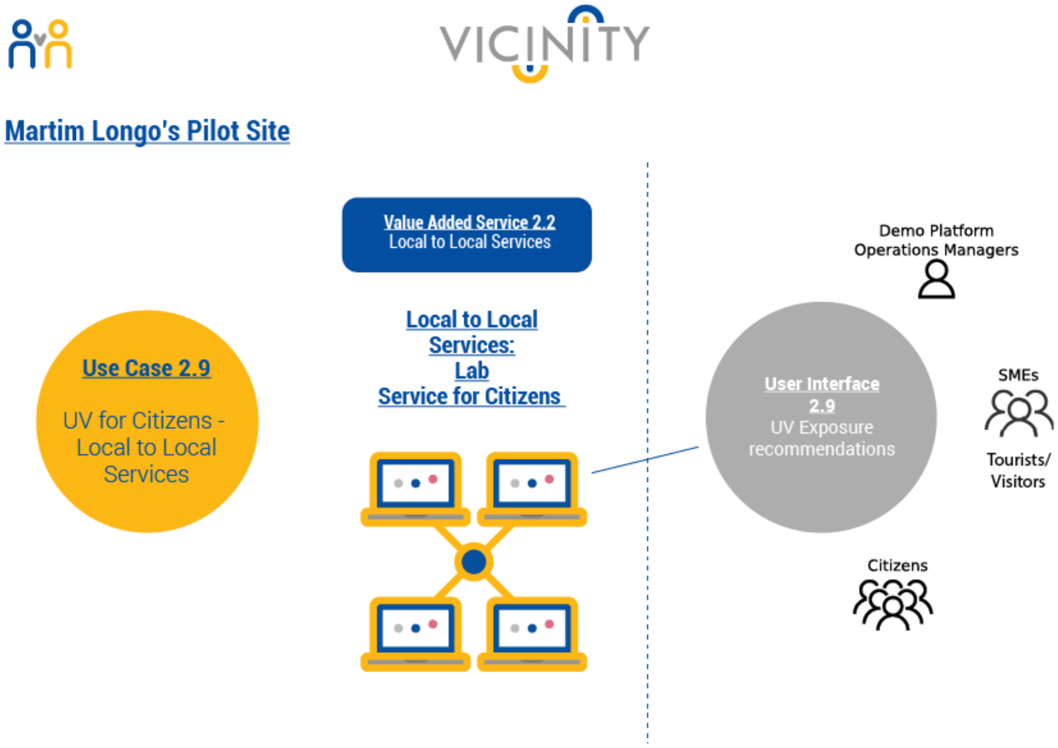


Figure 5-9 Use Case 2.9 associated VAS and User-Interfaces

5.3.3. VICINITY Value-Added Services

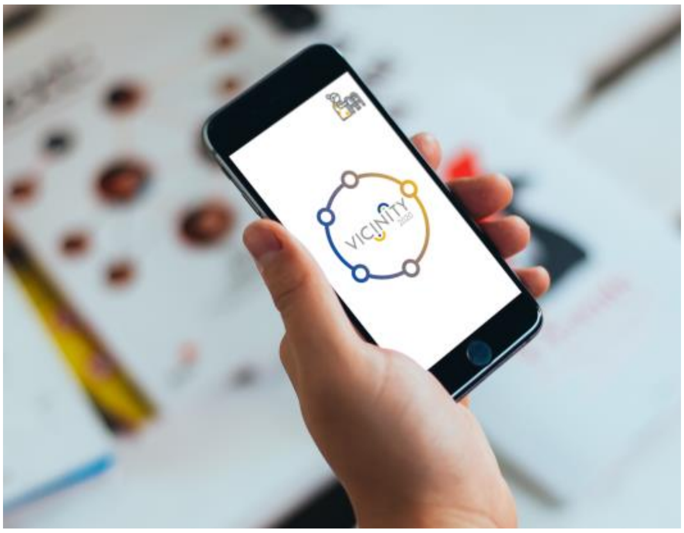
5.3.3.1. *Local to Local Services, UV for Citizens*

VAS 2.2	**Local to Local Services, UV for Citizens**
Related Use Case	UC 2.9
Goal - Scope	Design, test and demonstrate capability of VICINITY to leverage existing equipment for secondary use to provide local IoT enabled services by Public entities and specifically to the citizens through activating equipment and devices producing data for secondary use within L2L environments, such as town, municipal or regional level. As an example of the usefulness of this kind of services, Algarve is a very sunny region attracting tourists from Europe and beyond. It is increasingly common to find tourists with (severe) sunburns. By using this kind of informational service throughout the region it can create awareness and make the vacation experience much safer and more comfortable for all tourists while reducing the number of persons in need of hospital care due to sunburns. The service will be also tested in retirement homes to decrease exposure of vulnerable citizens and in public schools.
IoT Infrastructure involved	• UV radiation meter; • Weather station at the Solar Lab (ambient temperature, precipitation, wind speed and direction, solar radiation, - direct, global and diffuse, atmospheric pressure).
Trigger	-Multi decision criteria driven service

Pre-conditions / Assumptions	• Sensors must be working and sending data to VICINITY. • Making users familiar with interfaces • Introduction to caretakers • Selecting preferred methods of display
Success scenario	1. Sensor measures UV radiation and sends it to VICINITY; 2. UV service takes the UV radiation values, determines the level of exposure danger and provides safety advice to users; 3. Users receive safety information in their mobile devices or municipal information screens.
Key Performance Indicators	• Increased level of understanding and awareness of UV exposure in relation to time periods within the region; • Greater exposure of the services to tourists visiting the region; • Communication channel for alerts to the general public and tourists related to the heat waves or adverse weather conditions at a second stage; • Service could reduce a number of people going to hospital due to exposure to heat or dehydration; • There is an overall impact on the healthcare system long term; • Creation of a channel to ensure greater awareness of protective methods available, responsible behaviour stimulation and optimal sun exposure guidelines, • The experience and the application could be used/expanded for heat wave awareness and other climate change related awareness programs by public sector, becoming a regional platform.
Algorithmic Data Processing	A look-up table with safety information for several UV radiation ranges will need to be built. Integration of Information needs to be obtained from National health service.
Responsible Partner(s)	ENERCOUTIM is responsible for the integration of the sensors and the development of software application; ENERCOUTIM is responsible for the medical safety advice to be obtained and integrated.
Actors Involved	• Demo Platform operations managers • School managers • Citizens • Hospitality sector • SMEs.
Implementation planning	A UV sensor device will need to be installed at the Solar Lab, including communication capability. The software applications will need to be developed so as to demonstrate the use case. M23-M25: Finalize sensor deployment, get sample data, analyse V-A requirements (ENERC) M26-M28: Develop first version of user interface (ENERC) M27-M32: Get feedback from partners, iterate (ENERC) M33: Finalize implementation (ENERC)

5.3.4. User Interfaces

5.3.4.1. *Local to Local Services, UV for Citizens*

UI 2.9	**Local to Local Services, UV for Citizens**
Related Use Case	UC 2.9
Related Value-Added Services	VAS 2.2
Description	An app / web-app containing dashboards for visualization of the measured data with the possibility to create reports on personalized UV radiation exposure recommendations based on citizen data information.
Mock-up screens:	 This screen (in the Smartphone or in a specific screen in the School, Retirement home, will display the UV index, ambient temperature, humidity and some alerts according to the information received.
Responsible Partner(s)	ENERC will be responsible for the development of the respected UIs and service design.
Implementation planning	M26-M28: Develop first version of user interface (ENERC) M27-M32: Get feedback from partners, iterate (ENERC) M33: Finalize implementation (ENERC).

5.3.5. Value-Added Services Deployment Planning

The deployment of the UV for Citizens VAS is planned to begin in Spring 2018. ENERC is collaborating with the Kipp&Zonnen equipment manufacture and sensor provider for the hardware and further support for this VAS. The next step is to proceed with connecting the radiation meter to the VICINITY platform in other to get radiation data integrated into VICINITY. After establishment of the data flow the UV for Citizens as a service could be fully developed facilitated by VICINITY. Since the connectivity of the device to VICINITY can only be made when documentation on how to establish the connection and read/send data to VICINITY is available, meanwhile ENERC would work on a dummy interface app for further integration with the VICINITY service. Conversion of the dummy interface application into a real working VICINITY service can only be done when documentation and/or tutorials on creating VICINITY services are available.

The information also should be directly obtainable from IPMA - Portuguese Institute for Sea and Atmosphere. IPMA has responsibilities at national territory level in the areas of the sea and atmosphere.

5.3.6. VICINITY as an Enabler

In this VAS 2, VICINITY is an enabler also in terms of interoperability but also in terms of scalability, allowing the same type of information from different data sources to be enabled.

The implementation of this kind of service is possible nowadays but it wouldn't be easy and everything would have to be custom designed and not expected to be scalable since there would be no incentives to make devices from different manufacturers interoperable due to high costs. On the other hand, manufactures also do not have immediate economic drivers to make APIs and enable interoperability if clear economic returns are not identified. These insights are obtained from stakeholders' discussions and attempts to engage equipment providers. A company aiming to create such service would be tied with a single UV radiation sensor manufacturer or would have to invest a considerable amount of time to make sensors from other manufacturers interoperable. Without VICINITY there would be no incentives for other companies to reach a common communication form for interoperability of devices, hence linking territories and expanding geographical reach while achieving scalability and service relevance. VICINITY is expected to ensure a shorter time-to-market.

5.3.7. Use Case Business Modelling

Based on the results that will be achieved, coupled with business model test and total cost of ownership - the model and the solution will be presented to other municipalities, organisation.

The public service would need to be assessed for scaling up and could serve as a platform for additional complimentary services provision.

The model for creation of public services provision based on locally available IoT enabled equipment that could be integrated to VICINITY would be tested.

SaaS and regional Lab for public services roll out would be proposed for consideration.

5.4. Use Cases 2.6, 2.7– Distributed Energy assets management – Platform Services

Operations and maintenance of distributed energy assets could be optimised through deployment of IoT enabled automated services. This constitutes a large portion of O&M of systems expense. Further penetration of DER RES provides further opportunities of scale and optimisation.

When the owner or operator of a PV plant has access to information such as weather conditions, solar radiation and PV production they can more easily identify problems with the PV plant, and improve optimization including better scheduling of systems maintenance.

This use case intends to optimise resource deployment and the resulting scheduling of cleaning of the panels by indicating the best possible dates for panel cleaning taking into account several different parameters such as high concentration of soiling on the PV modules, predictability of rain, solar resources, human resources availability and the related equipment readiness.

The service has potential to be rolled out inter-regionally for distributed renewable energy production facilities: **Automated cleaning service "Smart Clean" for distributed renewable assets in operation.**

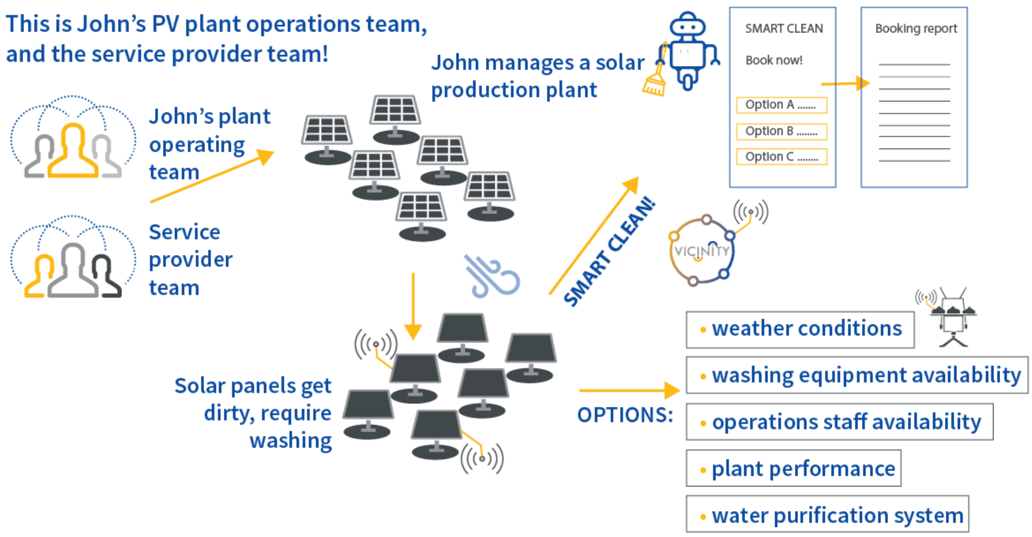


Figure 5-10 Narration of the Martim Longo Use Cases 2.6, 2.7 - Platform Services – Smart Clean

5.4.1. Use Case Conceptual Design

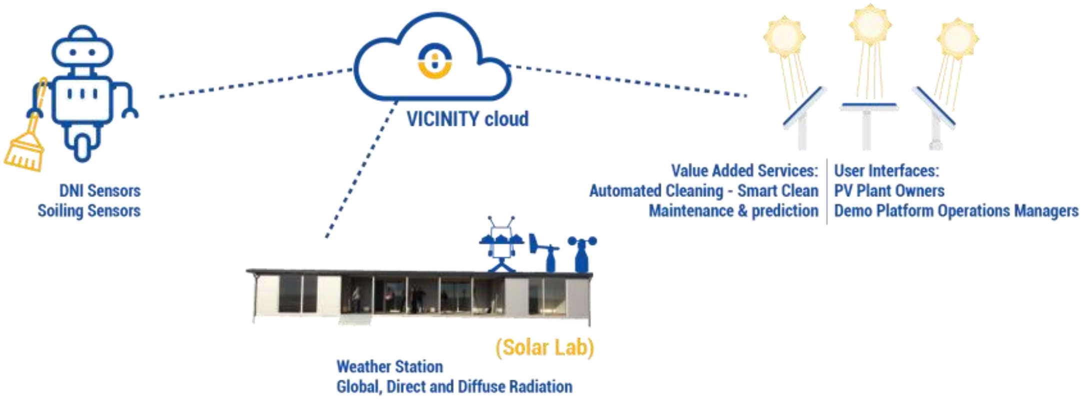


Figure 5-11 Use Cases 2.6, 2.7 Conceptual design

5.4.2. Use Case associated Value-Added Services and User Interfaces

Enercoutim aims at creating a new VAS offering: **Automated cleaning service "Smart Clean".**

This VAS will use the information from the Direct Normal Incident (DNI) solar radiation from the weather station located at the Solar Lab as well as from the CPV modules soiling sensor. A VICINITY enabled service will take this data, weather forecast data and information on availability of equipment and staff from the services provider and, upon request, will provide plant managers with the suitable options to book the cleaning of the panels based on offered parameters. Plant managers will be able to choose the options that best suit their goals, i.e. options that minimize generation (revenue) losses as well as cleaning cost. With such service each booking process will be an effortless and mostly automated task to replace current practices of email based scheduling.

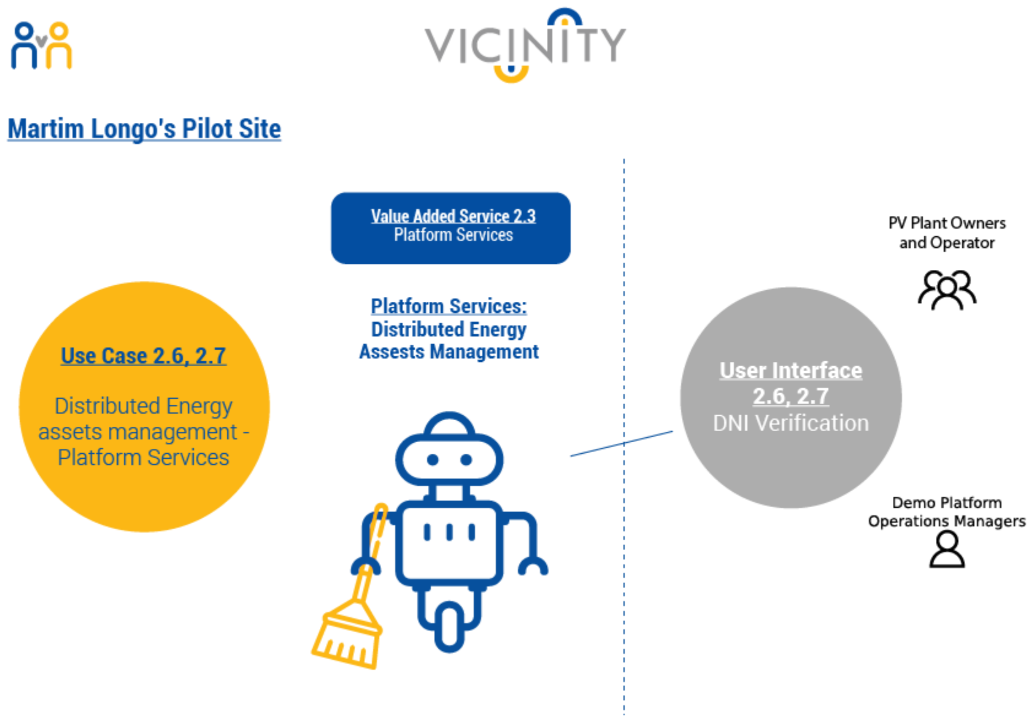


Figure 5-12 Use Cases 2.6, 2.7 associated VAS and User-Interfaces

5.4.3. VICINITY Value-Added Services

5.4.3.1. *Platform Services. Smart Clean. O&M for distributed renewable production resources.*

VAS 2.3	**Platform Services. Smart Clean. O&M for distributed renewable production resources.**
Related Use Case	UC 2.6, 2.7
Goal - Scope	Demonstrate VICINITY capability to provide automated service for the Solar demonstration platform services O&M (operations and maintenance), such as CPV trackers cleaning services taking into consideration weather predictions, human resources and equipment availability along with soiling of the surface.
IoT Infrastructure involved	Water purification system; Soiling Sensor; DNI sensor; Weather station data
Trigger	Event-driven (e.g. calculate cleaning options when user requests them or notify plant managers when level of soiling increases and optimal weather conditions for cleaning are anticipated)
Pre-conditions / Assumptions	Water purification system must be connected to VICINITY Cloud and give a signal one day before start the cleaning to guarantee that there

	is sufficient water sufficiently treated available to start the cleaning process; Soiling sensor is placed on the panel independent from the systems only available to the system operator, and needs to be connected to VICINITY. This sensor sends information of the concentration of soiling which after reaching determined boundary parameter and the related algorithm output would send an alert signal to the Platform operation staff; DNI sensor must be connected to VICINITY, this sensor sends information of the DNI measurements (located at the Solar Lab) and will be used to analyse the energy production of the CPV modules; Weather prediction data must be flowing into VICINITY, to send information for various periods (10 days forecasting weather) to see if rain is anticipated and what production is anticipated.
Success scenario	1. User accesses app and requests suggested cleaning dates 2. Service takes information from the weather forecasts, DNI sensors and staff/equipment availability timetables 3. Service creates list of suggested dates to schedule the cleaning 4. Once a date is selected and the cleaning service is booked the service sends scheduling information to staff and programs the water purification system to prepare a certain amount of treated water in advance of the booked date in order to have it available when necessary.
Key Performance Indicators	Optimisation of O&M services; minimization of production losses due to shut down of systems during the cleaning cycle; Monitoring of production losses during the cleaning and comparison with previous cleaning services. Lower O&M costs; Avoid periodic cleaning inspections; Optimization of the power production, controlling the degration of energy production; Evaluation quality of service. Regional relevance rollout of services for smaller DER RES producers and smaller self-consumption operators.
Algorithmic Data Processing	An algorithm to estimate the production losses during the cleaning according to weather forecast, soiling sensor and DNI information will have to be developed.
Responsible Partner(s)	ENERC is responsible for the installation of soiling sensor and development of the service, algorithm and application interface
Actors Involved	Renewable energy site operator, Demo Platform operations managers, SMEs
Implementation planning	A soiling sensor device will need to be installed at the SolarLab, including communication capability. The software application will need to be developed so as to demonstrate the use case. M23-M25: Get sample data, analyse V-A requirements (ENERC) M26-M28: Develop first version of user interface (ENERC)

	M27-M32: Testing phase and getting feedback from partners, iterate (ENERC) M33-M34: Finalize implementation (ENERC)

5.4.4. User Interfaces

5.4.4.1. *Platform Services. Smart Clean. O&M for distributed renewable production resources.*

UI 2.6, 2.7	**Platform Services. Smart Clean. O&M for distributed renewable production resources.**
Related Use Case	UC 2.6, 2.7
Related Value-Added Services	VAS 2.3
Description	An app / web-app will show customers the available dates for cleaning of the panels outlining potential production losses/savings for each of the options.
Mock-up screens	 The screen (on Smartphone), will display in real time the information about the soiling level of the modules, the DNI, the optimized dates for cleaning and staff availability. Other complimentary type of information could be made available depending of the user access credentials.
Responsible Partner(s)	ENERC will be responsible for the application for booking cleaning services as services operator.
Implementation planning	During the month April 2018 M23-M25: Finalize sensor deployment, get sample data, analyse V-A requirements (ENERC) M26-M28: Develop first version of user interface (ENERC) M27-M32: Get feedback from partners, iterate (ENERC)

M33: Finalize implementation (ENERC)

5.4.5. Value Added Services Deployment Planning

The deployment of the Smart Clean VAS has already begun. The DNI sensor is already deployed and the water purification system is currently being installed. Soiling sensor will be acquired in collaboration with Kipp&Zonnen in the next three months and installed. The next step will be to proceed with connecting the several devices to the VICINITY platform in order to get data flowing into VICINITY. Since the connectivity of the devices to VICINITY can only be made when documentation on how to establish the connection and read/send data to VICINITY is available, meanwhile ENERC would work on a dummy interface app for further integration with the VICINITY service. Conversion of the dummy interface application into a real working service can only be done when documentation and/or tutorials on creating VICINITY services are available.

5.4.6. VICINITY as an Enabler

VICINITY is an enabler in terms of interoperability, allowing to abstract low-level device protocols and work only with standardised data flows of multiple different natures (meteorology, measurement equipment, staff availability) that can then be used by software applications as a service.
Today such implementations are possible but it would not be easy as everything would have to be custom designed and not scalable since there would be no incentive to make devices interoperable. A company who would want to create such services could do so but there would be no incentive for other companies to reach a common communication form for interoperability of devices. VICINITY approach would facilitate a shorter time-to-market.

As an example, we could look at VICINITY VAS existing solutions as the comparison between IoT communication infrastructures Sigfox and LoRa. While Sigfox has all the communication infrastructure ready and one can just setup a device and use the network, paying for data, with LoRa you can invest in implementing your own network infrastructure and not pay for data. In the Sigfox business model you receive revenue from selling communications while in the LoRa business model you receive revenue from selling hardware.

5.4.7. Use Case Business Modelling

This VAS will demonstrate the advantage of the smart cleaning in PV plants which would provide a better and more precise timing to clean the PV modules, while increasing system performance and overall output. It would help the operator organization as well as services provider organisation to optimize operations and staff management. O&M in distributed energy resources management could reach high levels and hence lowering this operating cost component of DER RES is an important driver towards higher penetration of renewable resources within the solar sector. In general, this service is expected to improve efficiency in the production of PV systems.

The gateways commercialisation for the Energy vertical solutions, the costs and business case need to be determined. The solution could be licensed to O&M services providers.

The assessment of the DEMO total cost of ownership of the system would depend on the cost of systems set up, components, cost of connecting to VICINITY and running costs. These numbers could only be partially estimated at this time and fine tuning of each model will be expected.

6. Pilea-Hortiatis (GR) – eHealth & Assisted Living (CERTH – GNOMON - MPH)

6.1. Introduction

The fourth pilot case will be demonstrated in the municipality of Pilea-Hortiatis of Northern Greece, with the participation of a number of targeted people, who will be identified by the municipality health care services. The municipality has 70.110 inhabitants (2011 census [3]) in an area of 167.800 km^2 and is a pioneer in e-health services in Greece. It is a member of the "National Inter-municipal Network Healthy City - Health Promotion (NINHC-HP)", which is certificated by the World Health Organization (WHO) as a National Range Cities Network and it is also offering a program for elderly and middle-aged people called "e-Help at Home", in order to allow Pilea-Hortiatis citizens to live an independent and healthy life. The program offers monitoring of the weight and blood pressure of citizens registered to the program, as well as two notification services in case of emergency (panic/fall button, positioning of an Alzheimer patient).

In order to further improve the municipality's existing activities towards assisted living and preventive medicine and motivate more citizens to participate, VICINITY pilot case will take advantage of the existing facilities and extend them with more monitoring devices and *six new VAS*. Eligible users are patients with chronic diseases such as respiratory, heart diseases, hypertension, diabetes, third aged people or any citizen on the grounds of prevention, as people with high cholesterol or high blood pressure.

This pilot case is important not only for the citizens of Pilea-Hortiatis but for all Greek and European citizens, as it will set an example for other municipalities, hospitals, institutional homes to follow. It is vital for government to promote disease prevention, better and effective management and rehabilitation of older people. In 2014, Europe had a 31,4% and Greece a 24,2% share of elderly people who live alone, according to [4]. VICINITY use case regarding health domain can facilitate with expenditures of hospitals, health institutes and health care providers and VAS of Pilea-Hortiatis, could be integrated in other municipalities in order to protect and improve EU elderly people's lives. Moreover, both Europe and Greece have a high proportion of overweight people, 51,6% and 56,7% respectively [5], thus the VAS for "Health improvement for the middle-aged persons" adds up to EU actions for promoting better nutrition and physical activity in the EU [6][7].

6.2. Use Case 3.1 - eHealth and Assisted Living for elderly people at home

The health of the Citizens of Pilea-Hortiatis is a top priority for the municipality, therefore among other activities, the municipality will deploy homes of elderly people living alone to remotely monitor their routine tasks, everyday activities and medical data in order to implement assisted living for them and feel safe at home. The VAS related to Use Case 3.1 will create applications for health care providers/municipality to track, monitor and cluster data of people participating in assisted living programs while privately preserving them. These data are collected from IoT devices and sensors integrated into houses.

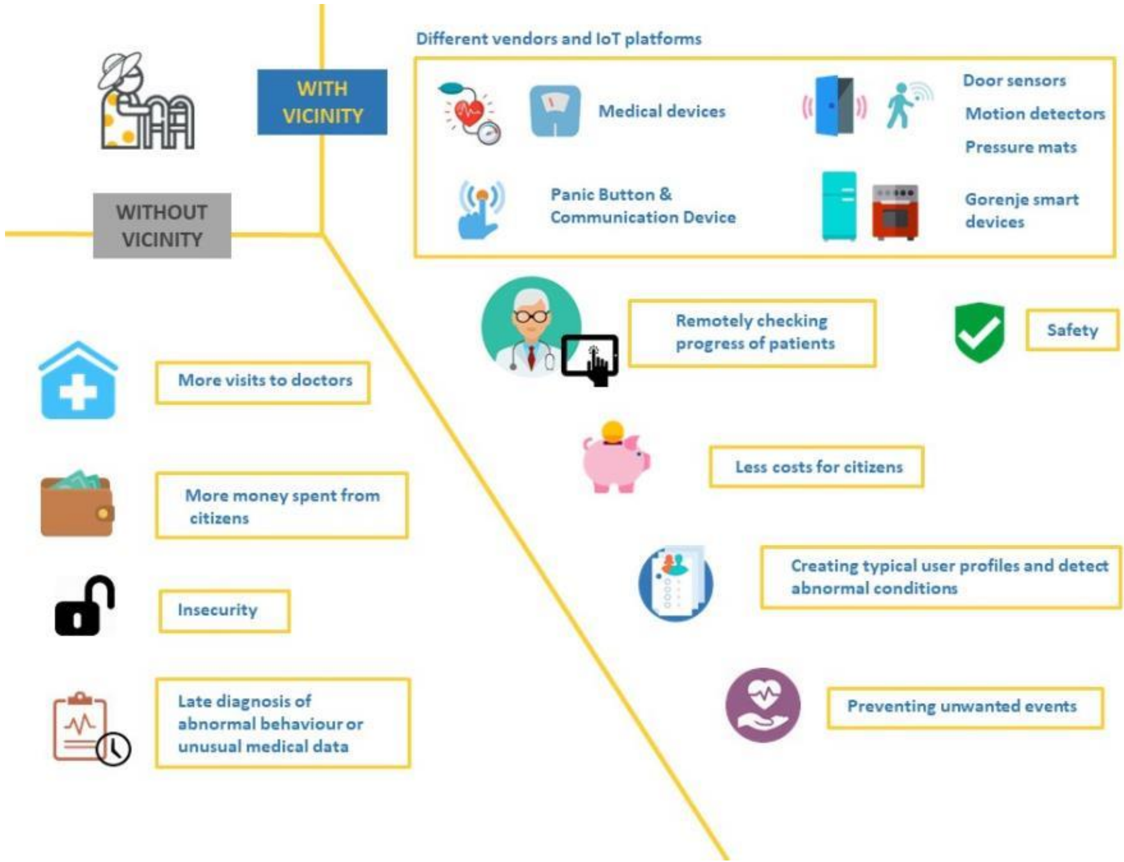


Figure 6-1 Narration of the Pilea-Hortiatis Use Case 3.1

Furthermore, a VAS that will be implemented for this use case is to detect abnormal detection at elderly's people home. Therefore, in this Pilot Case we combine building sensors to leverage assisted living and eHealth at home with real-time analysis of information collected from Building IoT sensors at home (motion detectors, smart appliances etc.) which leads to a cross-domain use case.

6.2.1. Use Case Conceptual Design

The following high-level architecture overview provides a schematic representation of the use case, revealing how the VAS interfaces with the different parts of the overall VICINITY architecture and components are integrated. There will be deployed two types of houses. The first house type will be the basic one, deployed with a raspberry Pi gateway connected to three medical devices (blood pressure monitor, weight monitoring devices and panic button). The second house type will be deployed with the devices of the basic type plus building sensors, leading to a cross-domain use case. The additional devices/sensors, that will be integrated into this house type, are the Gorenje smart appliances, occupancy sensors, motion detectors and pressure mats.

The houses are considered as VICINITY Nodes connected to VICINITY Cloud. The VAS are VICINITY Nodes connected to VICINITY Cloud as well. The actors of this use case are the Relatives and the health care providers of the elder person, and each one will have a user interface for monitoring the health data.

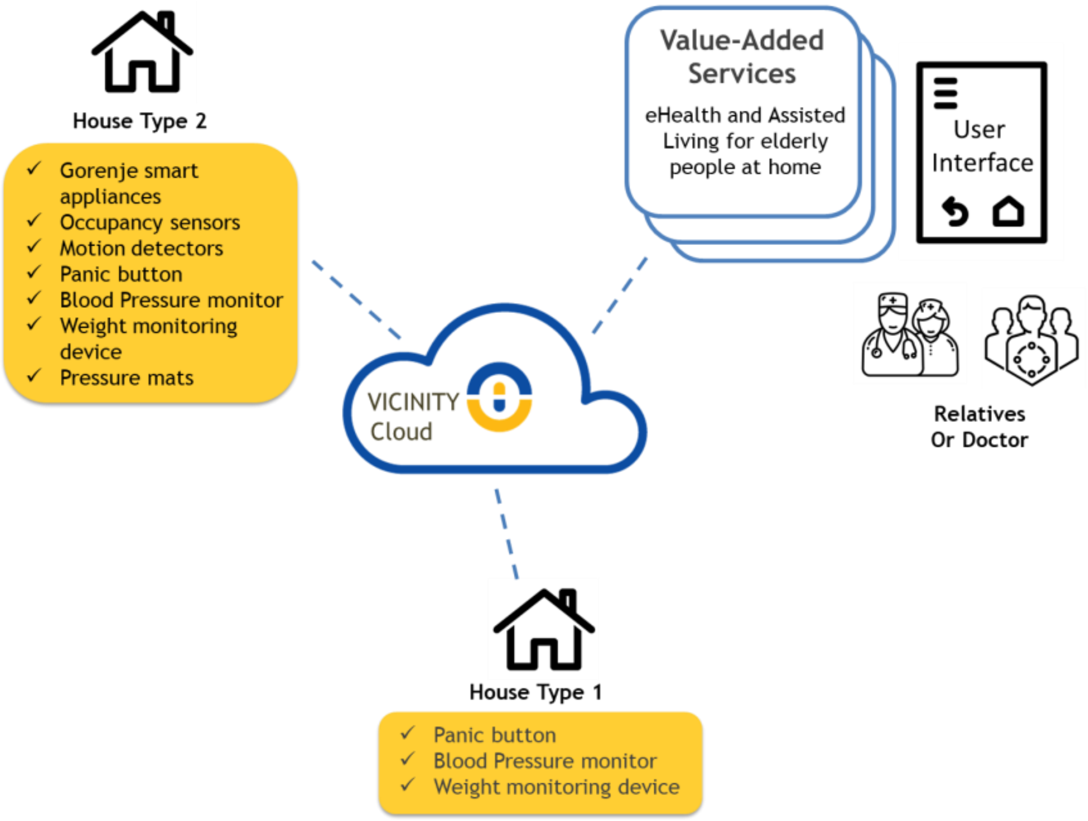


Figure 6-2 Use Case 3.1 Conceptual design

6.2.2. Use Case associated Value-Added services and User Interfaces

Specifically for the use case in the health domain in Greece, three VAS will be implemented in order for the various actors to have access to the data or services they are concerned.

VAS 3.1.1 gathers the data coming from the two-house types, meaning the data from building and health devices deployed in-house in both cases, and privately stores them in order to be available for further processing by other VAS. A further scope of this VAS is to strengthen and unify data protection and processing of personal data for all individuals within the Use Case complying to the GDPR. Auditing of the data transaction, which is implemented, is essential for privacy issues. In addition to the latter, data access mechanisms will be developed introducing the concept of consent, meaning that a user shall be able to control and manage who has access to his/her data. The GDPR “right to be forgotten” is of essential importance for the user and so relevant functionality will be developed that will delete all audit logs and data related to a user that desires to abandon the project and delete his/her account.

Health care providers have the potential to process their patients’ data through a user interface, exploiting the VAS 3.1.2, which will provide clustering of the available medical data and individual medical data. This VAS is also an asset for relatives of the elderly to access their historical and real-time data and be aware of their condition. Finally, VAS 3.1.3 triggers an alarm to a 24h call centre immediately when an abnormal behaviour is detected through building sensors.

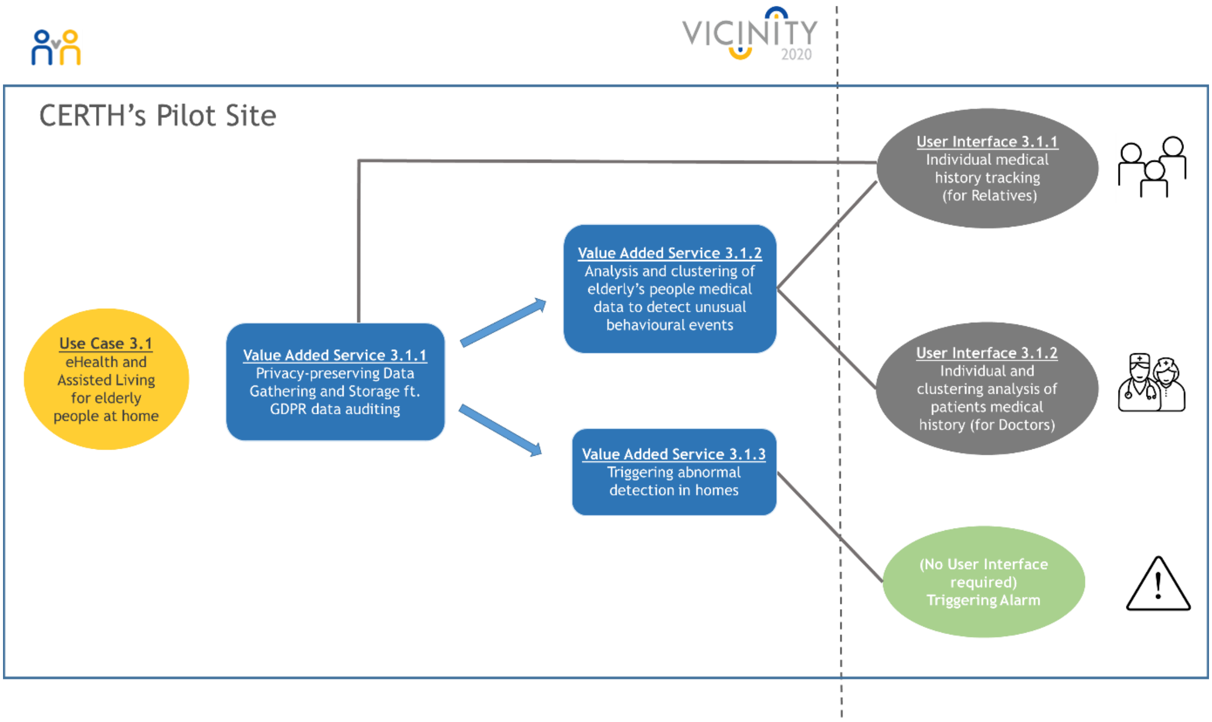


Figure 6-3 Use Case 3.1 associated VAS and User-Interfaces

6.2.3. VICINITY Value-Added Services

6.2.3.1. *Privacy-preserving Data Gathering and Storage ft. GDPR data auditing*

VAS 3.1.1	**Privacy-preserving Data Gathering and Storage ft. GDPR data auditing**
Related Use Case	UC 3.1 - eHealth and Assisted Living for elderly people at home
Goal - Scope	VAS 1 gathers the data coming from building and health devices, deployed in-house in both cases, and is responsible for storing them in a secure repository/database system so that they become accessible for further processing by other VAS. The main scope of this VAS is to strengthen and unify data protection and processing of personal data for all individuals within the Use Case in a way compliant to the GDPR. Therefore, access to raw data will be given over a secured protocol, meaning GDPR, and not via a non-secure server-cloud. Taking advantage of the VICINITY architecture, the communication between the VICINITY nodes using the VAS and the VAS itself will be accomplished via VICINITY P2P (Peer to peer) network. Relevant functionalities that result from the use of GDPR will be implemented. Specifically, the service will include auditing of the data transaction and access control mechanisms for the user (e.g. relative of the elderly citizens) to have absolute control of who can access the data (concept of consent). In addition, the service will guarantee the compliance to the "right to be forgotten", meaning that in case a user desires to delete his/her account, all relevant data and audit logs will be deleted as well.

IoT Infrastructure involved	• Weight monitoring device • Blood pressure monitoring device • Panic Button with Fall detector • Communication Device (automatically dialling to call centre) • Occupancy sensors (e.g. door sensors, motion detectors, Pressure mats) • Smart appliances (fridge, oven) – monitoring of appliances usage e.g. how many times and when the user opens the fridge within the day
Trigger	- Event-driven (e.g. once a new measurement is taken or panic button pressed) or Time-driven (e.g. send devices in batch every night)
Pre-conditions / Assumptions	• Right handling and sharing of sensitive personal data. • Data available whenever needed • Private storage of data • Right auditing of data transaction • Conformance to the GDPR • Preserving data as long as they are needed
Success scenario	1. The elder person takes measurements from the medical devices. 2. Measurements are forwarded to the Value-added service. 3. The data are being gathered. 4. A health care provider, appointed by MPH partner for the case and with full data access rights provided by the relative of the elder, accesses the data related to blood measurements. 5. An audit log is automatically generated for the previous step. 6. The elder's relative checks the audit logs related to his/her account and finds full access details for his/her measurements, including the audit log generated in step 5.
Key Performance Indicators	• Percentage of right auditing of data transaction • Number of data exposed
Algorithmic Data Processing	Access control mechanism will be developed to offer the relevant functionality to the user (e.g. relative of the elderly citizens) of controlling who will have access to the data, mainly regarding the scenario where health care professionals are involved. For example, a participant might prefer for his measurements to not be accessible by all the health care professionals involved but only by a specific one. Auditing algorithms that will offer the option to the user to be able to view and control all the access details of his/her account (i.e. who accessed it, when, etc.) will also be developed to guarantee the compliance with relevant requirements coming from the GDPR. In addition to the latter, a functionality related to the "right to be forgotten" will be offered to user, meaning the option to delete all data and logs related to the him/her after he/she decides to delete his/her account.
Responsible Partner(s)	• GNOMON will provide its expertise gained by relevant assisted living programs, managed by MPH and supported by GNOMON, but also in the field of privacy due to the latest specifications introduced by the GDPR. Based on that, GNOMON will be responsible for the development of the service. • CERTH will provide its background knowledge in the field of assisted living and will assist GNOMON.
Actors Involved	• N/A

Implementation planning	M23-M26: Analyse and extract VAS's requirements (GNOMON) M27-M30: Develop first version of the service and register it to the VICINITY platform (GNOMON) M31-M33: Continuous evaluation of the developed service and relevant improvements if necessary (CERTH, GNOMON)

6.2.3.2. *Analysis and clustering of elderly's people medical data to detect unusual behavioural events*

VAS 3.1.2	**Analysis and clustering of elderly's people medical data to detect unusual behavioural events**
Related Use Case	UC 3.1 - eHealth and Assisted Living for elderly people at home
Goal - Scope	The goal of this VAS is twofold. The service will collect medical data of elderly people living alone allowing health care providers and relatives to know their current condition in order to provide advices if needed and check whether there is aberration. The service will also handle historical data of medical devices and sensors deployed in-house in order to create behaviour profiles and help in clustering elderly people to different medical groups.
IoT Infrastructure involved	This VAS receives data from VAS 3.1.1 concerning the following IoT equipment: • Weight monitoring device • Blood pressure monitoring device • Panic Button with Fall detector • Communication Device (automatically dialling to call centre)
Trigger	- User-driven, triggered by the UI of the health care provider/relative to analyse collected data or time driven (e.g. every night)
Pre-conditions / Assumptions	All *Pre-conditions/Assumptions* described for VAS 3.1.1 should be fulfilled, moreover • VAS 3.1.1 should operate correctly
Success scenario	1. The VAS fetches stored measurement data of elderly persons. 2. The data are being processed (e.g. grouping/clustering of similar data, cleansing of data). 3. The health care providers (and/or relatives) can be informed about the elder's person medical condition. 4. The medical data of elderly people are used by the VAS that clusters them into groups in order to help health care providers make decisions. (e.g. a group of patients with high blood pressure) 5. In case that an unusual sequence of events, related to the usage of medical equipment, is detected (e.g. increased use of the panic button in a non-usual manner or no blood-pressure measurements during one week etc.), a notification will be sent to the health care providers/relatives application.
Key Performance Indicators	• Number of created groups (clusters) in relevance to the number of patients. • Number of patients actively participating with regular measurements/number of initial participants • Number of visits at the health care provider avoided (thanks to the remote monitoring of the elderly people medical conditions) per year • Number of early problem detection per year • Patient / Health care provider satisfaction (through questionnaire) • Number of false measurements automatically detected and rejected.

Algorithmic Data Processing	Clustering algorithms will be developed in order to process the medical data and identify different groups/clusters of people, further creating patterns of usual expected behaviour of each individual. Based on the analysis of the collected data and the comparison with the typical patterns, the service will be able to detect non-usual sequence of events, raising events in order to properly notify the related people (health care providers, relatives).
Responsible Partner(s)	• CERTH will provide its background knowledge in the field of assisted living and will work together with GNOMON for the development of data processing and clustering algorithms (providing several outputs such as graphs, processed data), unusual condition detection and triggering of respective notifications based on data collected. • GNOMON will provide its background knowledge in the field of assisted living and tele care in the context of social workers as well as work together with CERTH for the development of the aforementioned algorithms. In addition, GNOMON will actively contribute in the use case pilot setup, assessment and benchmarking. • MPH will provide its background knowledge on assisted living programs in order to find the elderly people and the health care providers that are needed for this scenario.
Actors Involved	• Health care providers (pathologist) • Elderly people • Relatives of the elderly people.
Implementation planning	M23-M26: Get sample data and analyse VAS's requirements (CERTH, GNOMON). Find actors that will be involved in this scenario (MPH) M27-M30: Develop first version of algorithm for patients' data processing clustering (CERTH, GNOMON) M31-M33: Continuous evaluation of the developed service and relevant improvements if necessary (CERTH, GNOMON)

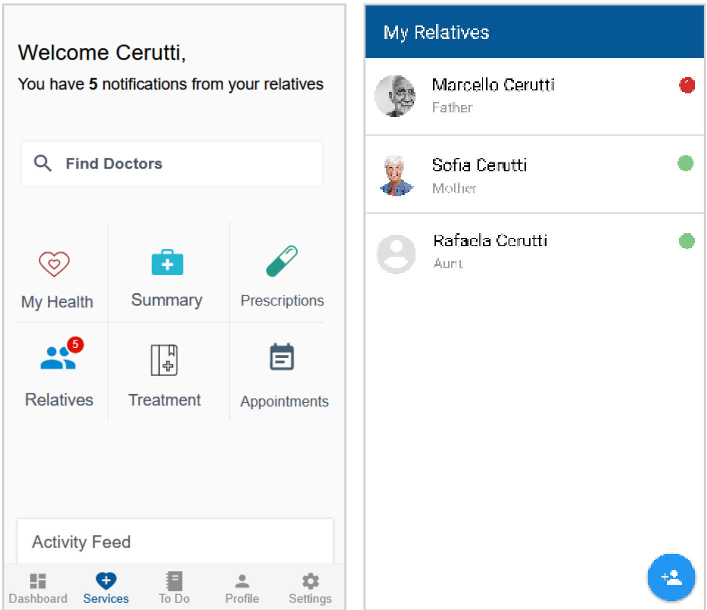
6.2.3.3. Triggering abnormal detection in homes

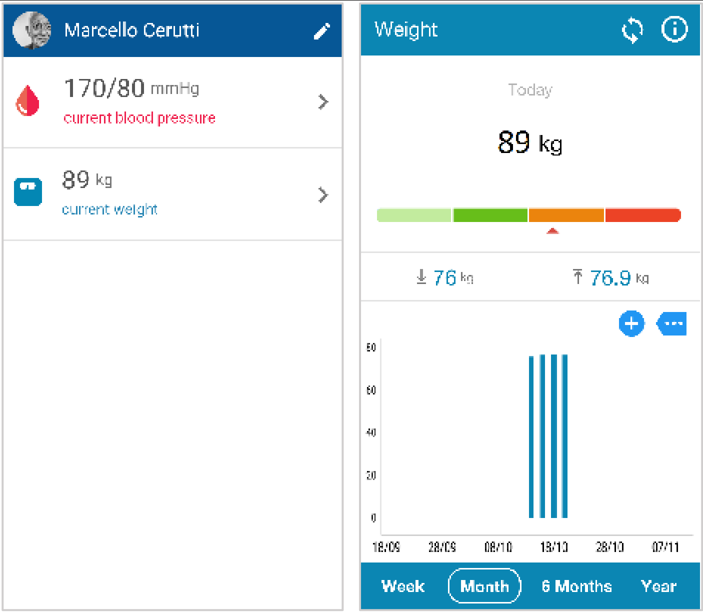
VAS 3.1.3	**Triggering abnormal detection in homes**
Related Use Case	UC 3.1 - eHealth and Assisted Living for elderly people at home
Goal - Scope	The goal of this VAS is to detect abnormal behaviour of senior citizens with long-term needs and/or chronic illness, based on IoT building sensors deployed in-house in order to obtain a better quality and independent life. It will rely on data coming from integrated building IoT sensors, creating people behaviour profiles and dispatch alarms (e.g. to a call centre or hospital) when an incident is detected. Information collected in real time will allow tracking of end-user's activity at home in order to create "typical" user profiles and, therefore, be able to detect abnormal conditions, in order to raise events (e.g. alerts/messages) when deviating from normal conditions. The normal conditions will be determined per person, according to his/her usual habits, which will be extracted from the monitored building sensor data.
IoT Infrastructure involved	This VAS receives data from VAS 3.1.1 concerning the following IoT equipment:

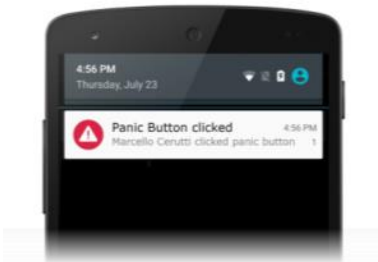
	• Occupancy sensors (e.g. door sensors, motion detectors, Pressure mats) • Smart appliances (fridge, oven) – monitoring of appliances usage e.g. how many times and when the user opens the fridge within the day
Trigger	– Time-driven (send collected building data such as occupancy every 15min)
Pre-conditions/ Assumptions	All *Pre-conditions/Assumptions* described for VAS 3.1.1 should be fulfilled, moreover • Creation of the model of normal living conditions, occupancy patterns, usage of appliances, for each elderly person. • VAS 3.1.1 continuous operation
Success scenario	1. An abnormal sequence of events or lack of typical events is detected (e.g. end-user has not interacted with any device for a prolonged period). 2. A signal to the call-centre is sent.
Key Performance Indicators	• Number of successful abnormal detections per year • Number of false alarms per year • Elderly person's satisfaction.
Algorithmic Data Processing	Creation of user models and profiles in order to be used in pattern recognition algorithms.
Responsible Partner(s)	• CERTH will provide its background knowledge in the field of assisted living and will be responsible for the development of algorithms for abnormal detection in homes. • GNOMON will provide its background knowledge in the field of assisted living and telecare in the context of social workers and support CERTH in the development process. In addition, GNOMON will actively contribute to the use case pilot setup, assessment and benchmarking. • MPH will provide its background knowledge on assisted living programs in order to find the elderly people and the health care providers that are needed for this scenario.
Actors Involved	• 24h Call Centres: Automatically reception of signals from home devices, including identification parameters, sensor values etc. • Elderly people with long term needs (such as people with hypertensive, dementia, obesity)
Implementation planning	M23-M26: Get sample data and analyse Value-Added requirements (CERTH, GNOMON). Find actors that will be involved in this scenario (MPH) M27-M30: Development of first version of algorithm for abnormal detection (CERTH). Supporting and contributing to the development of the algorithms (GNOMON) M31-M33: Continuous evaluation of the developed service and relevant improvements if necessary (CERTH, GNOMON)

6.2.4. User Interfaces

6.2.4.1. *Individual medical history tracking (for Relatives)*

UI 3.1.1	**Individual medical history tracking (for Relatives)**
Related Use Case	UC 3.1 - eHealth and Assisted Living for elderly people at home
Related Value-Added Services	VAS 3.1.2 - Analysis and clustering of elderly's people medical data to detect unusual behavioural events
Description	The User Interface (UI) will comprise of a mobile application (Android), based on an already developed solution by GNOMON under the name eHealthPass. This application will further be extended for the needs of VICINITY case, adding more options and functionalities. In particular, in order to inform relatives about unusual behavioural events and abnormal detections, a notification area will be added to the main screen of the UI, displaying any issues identified based on the analysis of the collected data (e.g. increased use of the panic button, call-centre triggered, very few movements tracked within the day etc.). In addition to the notification functionality, the elder's relatives will be able to remotely receive information (both current and historical) on the related medical data based on measurements made by the participants themselves and give access to medical data to corresponding health care professionals.
Mock-up screens	

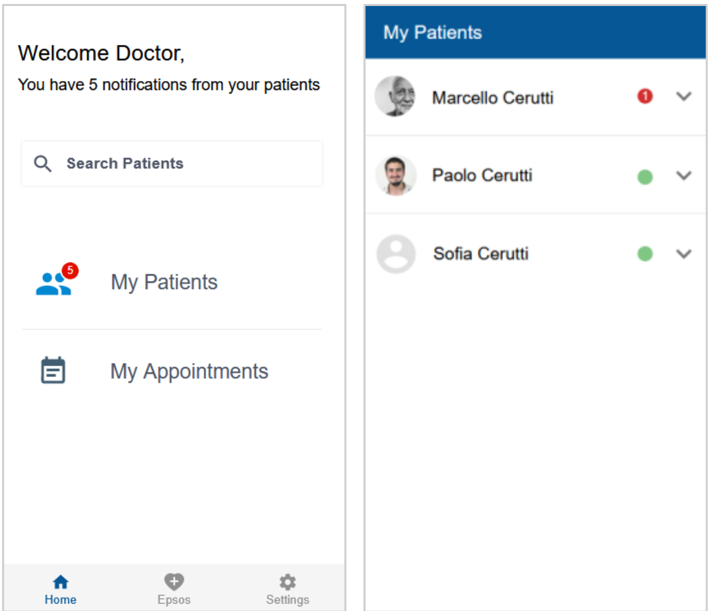


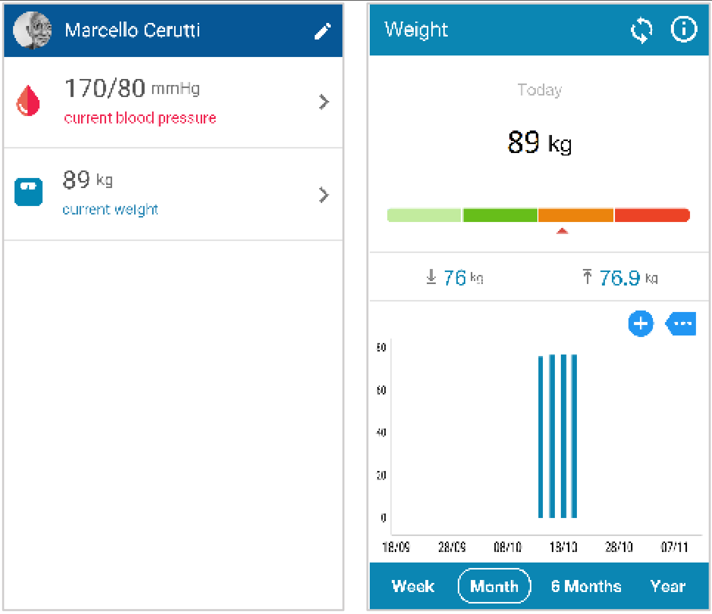


Responsible Partner(s)	• GNOMON will be responsible for the design and development of the respected UIs • CERTH will support the design of the respected UIs
Implementation planning	M23-M26: Prepare and agree on the design of the respected UIs (CERTH, GNOMON) M27-M30: Develop first extension of eHealthPass that will include the respected UIs as well as the relevant functionalities for VICINITY case (GNOMON) M31-M33: Continuous evaluation of the developed solution and relevant improvements if necessary (CERTH, GNOMON)

6.2.4.2. *Individual and clustering analysis of patients' medical history (for Health Care Professionals)*

UI 3.1.2	**Individual and clustering analysis of patients medical history (for Health Care Professionals)**
Related Use Case	UC 3.1 - eHealth and Assisted Living for elderly people at home
Related Value-Added Services	VAS 3.1.2 - Analysis and clustering of elderly's people medical data to detect unusual behavioural events
Description	The User Interface (UI) will comprise of a mobile application (Android), based on an already developed solution by GNOMON under the name

	eHealthPass. This application will further be extended for the needs of VICINITY case, adding more options and functionalities. In particular, in order to provide to health care professionals information about unusual behavioural events and abnormal detections, a notification area will be added to the main screen of the UI, displaying any issues identified based on the analysis of the collected data (e.g. increased use of the panic button, call-centre triggered, very few movements tracked within the day etc.). The application will also provide options to health care professionals to view the historical, real time medical data and clustering analysis of their patients' data. The UI will keep track of the historical individual medical data of the elderly people presenting them in a sorted way according to their condition. Regarding the patient clustering result coming from VAS 3.1.2, it is expected to be presented in a way that will be customized for the metric of each case, e.g. a multi-coloured bar for the weight in mock-up screen below.
Mock-up screens	



Responsible Partner(s)	• GNOMON will be responsible for the design and development of the respected UIs • CERTH will support the design of the respected UIs
Implementation planning	M23-M26: Prepare and agree on the design of the respected UIs (CERTH, GNOMON) M27-M30: Develop first extension of eHealthPass that will include the respected UIs as well as the relevant functionality (GNOMON) M31-M33: Continuous evaluation of the developed solution and relevant improvements if necessary (CERTH, GNOMON)

6.2.5. Value-Added Services Deployment Planning

The VAS will be first tested at the CERTH Smart House lab at CERTH facilities (in coordination with WP6 activities) and will then be ported on the MPH server. The full dataset of occupancy sensors deployed in CERTH / ITI's smart house, that are not sensitive, will be accessible through a local experimental repository.

All VAS will be deployed and will be running on a secure server hosting medical services of the municipality, located in the MPH premises. To strengthen the case, the latter approach is expected to have - due to relevant assisted living programs managed by MPH and supported by GNOMON - full approval by the Hellenic Data Protection Authority [9]. The full dataset of sensors deployed in houses of elderly people are sensitive therefore will be confidential and only the authorized MPH personnel and related end-users will have access as defined. The latter authorized groups of users will access data in a tamper-proof way with an audit mechanism triggered simultaneously to guarantee alignment with relevant requirements from the GDPR. Specific consortium members involved in technical development and pilot deployment will further have access under a detailed confidentiality framework.

6.2.6. VICINITY as an Enabler

By performing data analysis of health-related data, AI-based services will provide users with similar data streams and user profiles recommendations about prevention and health condition improvements. In each pilot site, we deal with a need that arouses by the deployment of VAS.

Nowadays, various IoT networks are being deployed for sensing, measuring, controlling and business process optimization purposes while various IoT platforms are emerging on the market to manage these networks. VICINITY's goal is to bridge the lack of semantic IoT protocol interoperability between different platforms. Specifically for this use case, the interoperability that VICINITY offers, enables health care providers or relatives of the elderly people living alone to be notified about elder's person health profile handling only one mobile or web/desktop application for every sensor or device inside the house regardless of the device brand, communication protocol or IoT platform that is implemented.

VICINITY enables different levels of admittance regarding the user (health care providers, relative or municipality) considering **privacy** and **user rights**. The user can decide whether he allows authorized parties to have access on his data in case of emergency ("break glass" mode) and should have the option to stop sharing his data during a specific period of time. For example, health care providers can have access to specific data of the elderly people through their application and evaluate their health condition whereas relatives can have total access of the elderly people data. Moreover, the administrator should not be able to tamper with user's data. He/she should not have the right to modify or erase them whereas the user can ask for his recorded data to be erased.

The cost of residential care can vary considerably by location and country and depends on whether someone requires also nursing or dementia care. The solution of a nursing home is necessary in some cases due to everyday conditions and obligations or serious illnesses. When relatives of the elderly work long hours, their obligations often keep them away from home and is very difficult to be able to properly care of an elderly parent. It is also a necessary solution in cases of health issues that need continuous medical care, such as when suffering from Alzheimer's disease or a severe disability. However, it is preferable to keep the elderly parent at home and assisted by medical personnel at home.

Thanks to VICINITY elderly people could feel safe at home even if living alone. Health care providers, call centre, relatives will be immediately notified in case of an emergency. This notification could be triggered by a relevant alarm if the elderly person wants to or automatically if the person's data are of concern. This way the elderly citizen would be more content, independent and not feel alienate from their family and society. The solution promotes cost savings by reducing unnecessary hospital costs and pressure. Thanks to IoT devices, sensors and actuators, routine tasks and everyday activities of the elderly could be monitored remotely and encourage them to take medications or follow specific exercises. EHealth technologies allow health care professionals to monitor medical data of people remotely reducing the need for personal visits.

VICINITY in this use case, helps on staying focused on the algorithmic development of the respective VAS, without taking care of the hardware or IoT framework that will or is already used. This means that this solution could be offered to municipalities with existing installed infrastructures and to new ones without putting burdens on the hardware or software selection for deployment.

6.2.7.Use Case Business Modelling

Use cases proposed from VICINITY project could assist on elderly's people life in Greece and generally in Europe. It is critical to find solutions regarding health domain because according to [8] elderly citizens in Greece have bad quality of life compared with other citizens in Europe. Due to low quality of seniors' people in Greece, Greek Ministry of Health have policies for e-health to improve healthy life expectancy while dealing with diseases and tight budgets. It is vital for government to promote disease prevention, better and effective management and rehabilitation of older people. VICINITY use case regarding eHealth and assisted living can assist to this problem and facilitate with expenditures of hospitals, health institutes and health care providers. Public care centres for seniors in Greece is generally limited to either day care centres or help-at-home programs. There are no state-funded long-term care facilities for the elderly in the county and many of the private facilities providing these services face economic issues.

Value propositions of use case eHealth & Assisted Living is that participants in assisted living programs have the ability to remotely monitor their health by specialized staff and stay at home instead of caring institutions reducing primary costs for citizens and municipalities that have implemented the use case. Municipalities, call centres and private health institutes will be offered with services regarding abnormal behavioural detection services in order to prevent unpleasant situations for elderly people.

The VAS derived from the use case could be distributed as a SaaS distribution model and offer data analytics service on top of collected data to municipality.

The outcomes of the solution are expected to be presented to the regional government with the objective to be considered for further replication and further development in other municipalities.

6.3. Use Case 3.2 - Health improvement for the middle-aged persons

This use case focuses on the promotion of a healthy lifestyle to the middle-aged citizens of the Municipality of Pilea-Hortiatis (MPH). Its goal is to help the citizens to adopt new healthy habits and thus preventing, as much as possible, future health problems, meaning less visits to health care providers or dieticians and less primary institutional costs for health services. The above, require that middle-aged citizens of MPH will change their everyday habits, take part in athletic activities and measure their participation on these activities.

Specialized staff (pathologist, dietician) will monitor the middle-aged citizens' blood pressure and weight measurements as well as their exercise data on daily basis and examine their improvement. For this purpose, equipment such as wearable activity trackers (fitness trackers) and weight and pressure monitoring devices will be delivered to the citizens that participate in this use case, and beacons will be placed at the municipality's athletic facilities in order to monitor data concerning the participants' visits.

Moreover, citizens will take part in a municipal-scale competition ("urban marathon") and compete with other citizens on health improvement achievements (e.g. citizen A ranks at the top 10% of citizens, according to the miles he/she has walked this week). These means will be used in order to motivate citizens to participate even more to this health improvement use case. Citizens will be informed for the status of their activities by using a mobile application which will be also used in order to sign up for this urban marathon.

Finally, yet importantly, the municipality will have access to anonymised statistical data concerning its middle-aged citizens health status and improvement over the period of this use case. The benefits that VICINITY VAS introduce in this use case are depicted in the figure below.

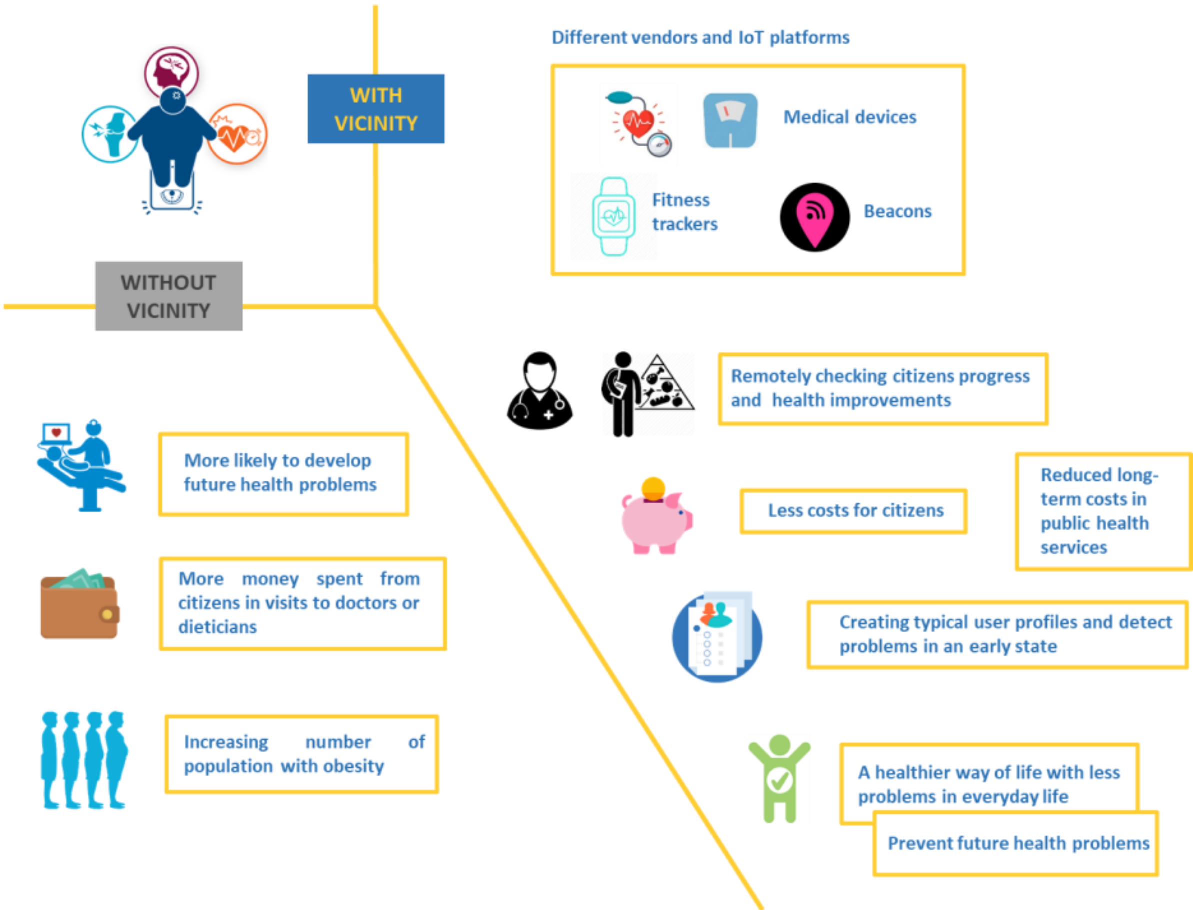


Figure 6-4 Narration of the Pilea-Hortiatis Use Case 3.2

6.3.1. Use Case Conceptual Design

In the following figure, the conceptual design of use case 3.2 is depicted. We can see the IoT devices/sensors and VAS that will be registered to the VICINITY Cloud as well as the devices/sensors' location (e.g. sport centre) and their mean of interaction with VICINITY (e.g. mobile device). Furthermore, the figure shows the actors of this use case and their interaction either with the IoT devices or with the User Interfaces.

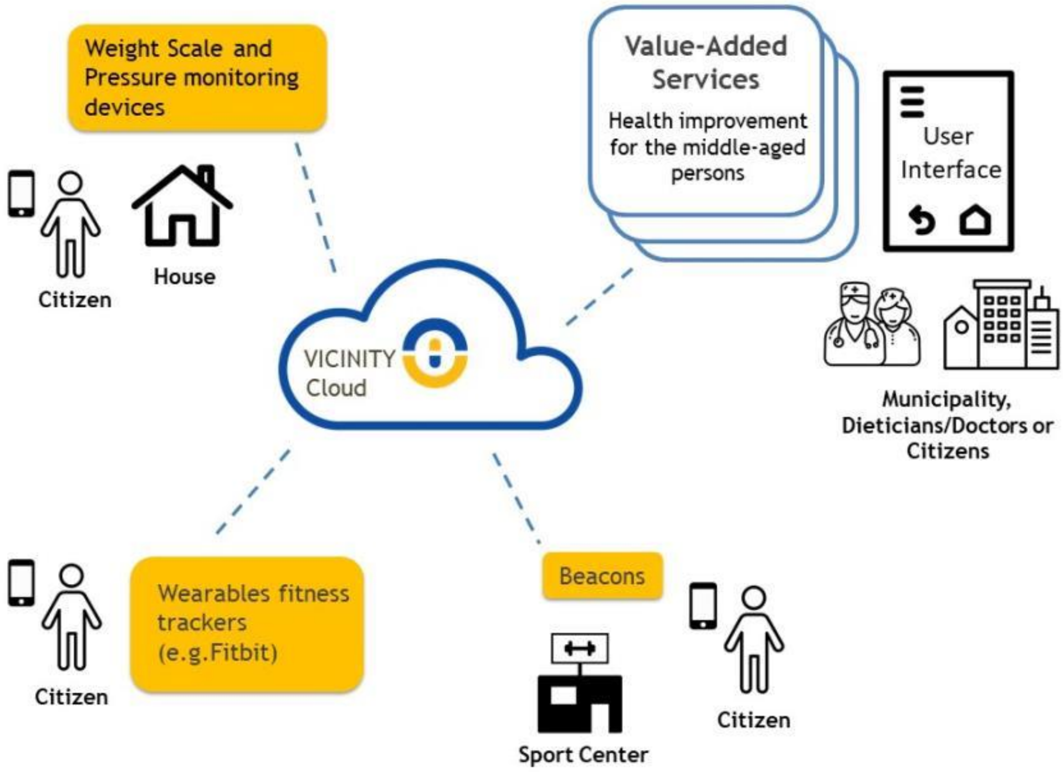


Figure 6-5 Use Case 3.2 Conceptual design

6.3.2. Use Case associated Value-Added services and User Interfaces

For this use case, three VAS will be implemented. VAS 3.2.1 is responsible for gathering the data coming from building and health devices / sensors deployed in-house and in sport centres, and storing them in order to be available for further processing by another VAS. A further scope of this VAS is to strengthen and unify data protection and processing of personal data for all individuals within the Use Case complying to the GDPR, similarly to VAS 3.1.1. VAS 3.2.2 will provide individual statistics for each participant according to the data that are acquired from VAS 3.2.1, such as weekly or monthly statistics for the citizen's improvements. Moreover, it will calculate the participant's rank among the other participants, according to general statistics that are provided by VAS 3.2.3. VAS 3.2.3 is responsible for providing an aggregated statistical analysis of anonymous citizen data concerning their health status and improvement.

Three User Interfaces will be also implemented respectively for each of the three actor categories: Dieticians, Middle-aged citizens, Municipality. Dieticians have the potential to view their patients' data through the web user interface 3.2.1 in the format of detailed graphs and/or tables, exploiting VAS 3.2.2 produced information. User Interface 3.2.2 is a mobile interface dedicated to middle-aged citizens that provides them with their personal data, achievements and rank among the other citizens that participate in the "urban marathon". The third user interface targets the municipality and provides it with aggregated statistical graphs concerning the participation of citizens to activities, the citizen's health status and improvement.

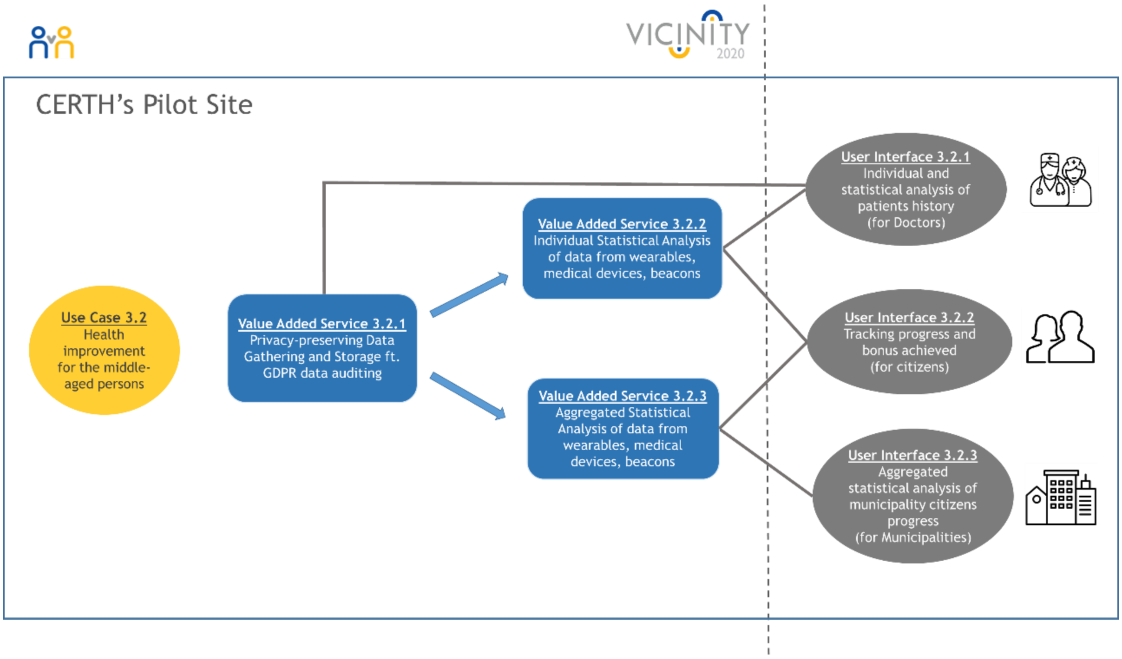


Figure 6-6 Use Case 3.2 associated VAS and User-Interfaces

6.3.3. VICINITY Value-Added Services

6.3.3.1. *Privacy-preserving Data Gathering and Storage ft. GDPR data auditing*

VAS 3.2.1	**Privacy-preserving Data Gathering and Storage ft. GDPR data auditing**
Related Use Case	UC 3.2 - Health improvement for the middle-aged persons
Goal - Scope	VAS 3.2.1 gathers data from beacons, wearables and health devices, and is responsible for storing them in a secure repository/database system, in order for the data to be accessible for further processing by another VAS. The main scope of this VAS is to strengthen and unify data protection and processing of personal data for all individuals within the Use Case in a way compliant to the GDPR. Therefore, access to raw data will be given over a secure protocol and not via a non-secure server-cloud. Taking advantage of the VICINITY architecture, the communication between the VICINITY nodes using the VAS and the VAS itself will be accomplished via VICINITY P2P (Peer to Peer) network. Relevant functionalities that result from the use of GDPR will be implemented. Specifically, the service will include auditing of the data transaction and access control mechanisms for the user to have absolute control of who can access his/her data (concept of consent). In addition, the service will guarantee the compliance to the "right to be forgotten", meaning that in case a user desires to delete his/her account, all relevant data and audit logs will be deleted as well.
IoT Infrastructure involved	• Utilize wearable fitness trackers/bracelets, a trending and very affordable health product able to collect and track vital body measurements 24/7

	• Beacons at fitness spots (gym, track, pool) • Weight scales, Blood Pressure devices
Trigger	See VAS 3.1.1
Pre-conditions / Assumptions	• Right handling and sharing of sensitive personal data • Introduce and facilitate the use of wearables/electronic devices for end-users that are not familiar with the operation of smart phones • Deliver the necessary for the case IoT equipment (e.g. wearables) to the selected participants • Private secure storage of data • Right auditing of data transaction • Compliance with GDPR • Preserving data as long as needed
Success scenario	1. Citizens utilize their mobile device as an "IoT gateway" in order to gather data from: - Blood pressure and weight scale devices available at their homes. Each mobile device will retrieve the corresponding personal measurements from the devices (e.g. through BT Connectivity and pairing with each device) which will then be logged to his/her personal record. Citizens that need to lose weight will be supplied with weight scale devices and/or blood pressure devices if they have hypertension/hypotension. - Wearable fitness trackers pass collective data such as daily steps, sleep monitoring information etc. - Beacons deployed at Municipality's sport facilities. Once the mobile device approaches the specific beacon the relevant information (timestamp and location of sensor) is logged to his/her personal record. 2. VAS receives corresponding data, once generated, from the user's mobile application "IoT gateway" 3. The VAS is storing the data. 4. A dietician, appointed by MPH partner for the case and with full data access rights provided by the citizen, accesses the data related to weight measurements. 5. An audit log is automatically generated for the previous step. 6. The citizen checks the audit logs related to his/her account and finds full access details for his/her measurements, including the audit log generated in step 5.
Key Performance Indicators	• Percentage of right auditing of data transaction • Number of data exposed
Algorithmic Data Processing	See VAS 3.1.1
Responsible Partner(s)	See VAS 3.1.1
Actors Involved	See VAS 3.1.1

Implementation planning	See VAS 3.1.1

6.3.3.2. Individual Statistical Analysis of data from wearables, medical devices, beacons

VAS 3.2.2	**Individual Statistical Analysis of data from wearables, medical devices, beacons**
Related Use Case	UC 3.2 – Health improvement for the middle-aged persons
Goal - Scope	The goal of this VAS is to provide evaluation of the citizens health status, promote fitness awareness and improve their health based on activity related data (e.g. via wearable activity trackers) performed on daily basis, all monitored by specialized staff (dietician). These data will be dispatched to health care providers and middle-aged people through the VAS. To promote and trigger fitness awareness and healthy lifestyle, "fitness" target group will participate into a "fitness pentathlon", including weight loss, hypertension reduction, measurement of walking distance covered, bike distance covered, urban marathon participation (organized by the municipality). Measurements taken from fitness trackers, beacons and medical devices will be normalized in order to declare the winner. Municipal citizens will use a free mobile application for this purpose. The latter offers the necessary functionality of retrieving the various measurements from the devices to the mobile device. The data are then sent to the VAS in order to be utilized by health care providers and participating citizens.
IoT Infrastructure involved	This VAS receives data from VAS 3.2.1 concerning the IoT equipment described in VAS 3.2.1 under *IoT Infrastructure Involved* section.
Trigger	• Event-driven (once new data are produced) e.g. when middle-age person visits a sport centre or take a new blood measurement
Pre-conditions / Assumptions	All *Pre-conditions/Assumptions* described for VAS 3.2.1 should be fulfilled, moreover • VAS 3.1.1 continuous operation • Definition of the right pattern/algorithm that will reliably combine and objectively evaluate/normalize the results coming from the five "fitness pentathlon" categories in order to produce the final urban marathon ranking.
Success scenario	1. The VAS will retrieve the data measurements for each participant from VAS 3.2.1. 2. The VAS fetches the stored data and then processes them in order to create relevant statistics per participant. 3. The corresponding UIs retrieve and present information accordingly.
Key Performance Indicators	• Number of false measurements automatically detected and rejected • Number of citizens' visits to health care providers avoided • Patient / Health care providers satisfaction • Number of participations to the urban marathon

	• Number of patients actively participating with regular measurements/number of initial participants • Percentage of citizens finishing the urban marathon/citizens initially signing up • Percentage of citizens who decreased their blood pressure/total number of participants who were hypertensive. • Percentage of citizens who decreased their weight/total number of over-weighted participants. • Percentage of citizens who increased their walking/running distance per month/ total number of participants.
Algorithmic Data Processing	Algorithms based on data analytics will be developed. Awarding algorithms will be developed for measuring citizens improvement for which they will get a bonus. Notification system will be implemented in order to inform citizens about their good or bad habits this week.
Responsible Partner(s)	• CERTH will provide its background knowledge in the field of e-health and will be responsible for the development of data processing and individual statistical analysis algorithms. • GNOMON will provide its background knowledge, supporting CERTH in the development of data processing and corresponding algorithms. • MPH (recruitment processes for specialized people from legal services in cooperation)
Actors Involved	• Dietician • Middle-aged people – municipality’s registered population and citizens • Citizens with obesity or needing of weight loss General population for preventive health
Implementation planning	M23-M26: Get sample data and analyse VAS requirements (CERTH, GNOMON) M27-M30: Develop first version of algorithm for clustering data from medical devices, wearables, beacons (GNOMON, CERTH) M31-M33: Continuous evaluation of the developed solution and relevant improvements if necessary (CERTH, GNOMON)

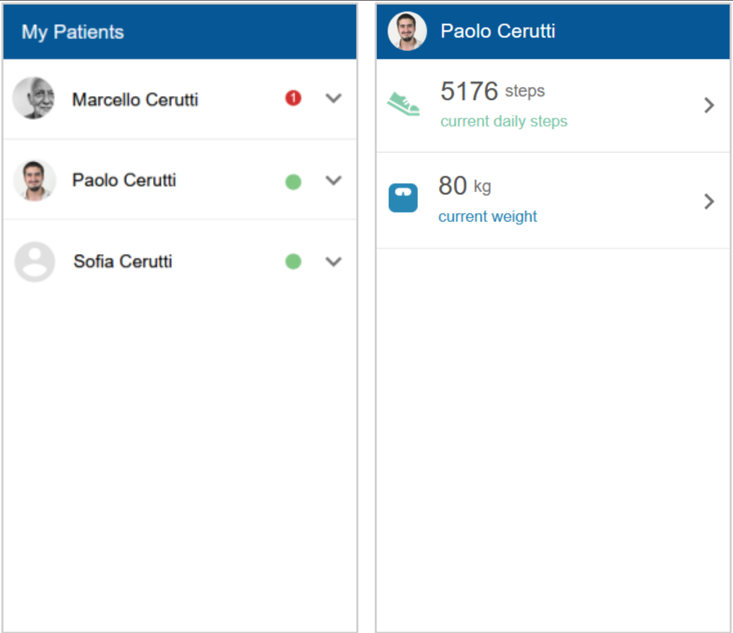
6.3.3.3. *Aggregated Statistical Analysis of data from wearables, medical devices, beacons*

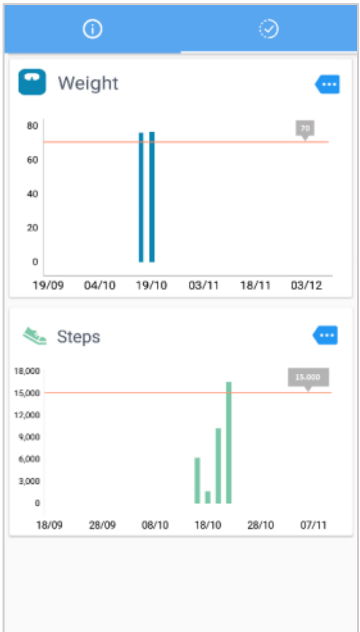
VAS 3.2.3	**Aggregated Statistical Analysis of data from wearables, medical devices, beacons**
Related Use Case	UC 3.2 – Health improvement for the middle-aged persons
Goal - Scope	The goal of this VAS is to gather, anonymously, citizens' data concerning their health/activity status (e.g. through wearable activity trackers and health devices). These data will be collected from the Value-Added Service described in VAS 3.2.1 and will be statistically analysed and dispatched to municipalities, health care providers and middle-aged citizens through the VAS 3.2.1, 3.2.2, 3.2.3 respectively in order to be aware of citizens' health status and to present how the VAS facilitates health improvement of middle-aged people.
IoT Infrastructure involved	This VAS receives data from VAS 3.2.1 concerning the IoT equipment described in VAS 3.2.1 under *IoT Infrastructure Involved* section.
Trigger	- Time-driven (e.g. send collected data every week)
Pre-conditions / Assumptions	See VAS 3.2.2
Success scenario	1. The VAS will retrieve the data measurements for each participant from VAS 3.2.1. 2. The VAS is processing the data and creates statistics per participant. 3. The corresponding UIs retrieve and present information accordingly.
Key Performance Indicators	• Number of citizens that follow a healthier lifestyle in the specific municipality compared with other • Number of visitors to sports centres compared with previous years • Number of early problem detection per year in municipality citizens
Algorithmic Data Processing	Algorithms based on data analytics will be developed. Clustering algorithms for citizens' categorization will be created. Anonymised statistical analysis of the citizens improvements.
Responsible Partner(s)	See VAS 3.2.1
Actors Involved	• Dietician • Middle-aged people – municipality's registered population and citizens • Citizens with obesity or needing of weight loss • General population for preventive health • Municipality
Implementation planning	M23-M26: Get sample data and analyse VAS requirements (CERTH, GNOMON) M27-M30: Develop first version of algorithm for statistically analyse data (CERTH) M31-M33: Continuous evaluation of the developed solution and relevant improvements if necessary (CERTH, GNOMON)

6.3.4. User Interfaces

6.3.4.1. Individual and statistical analysis of patients history (for Health Care Professionals)

UI 3.2.1	**Individual and statistical analysis of patients' history (for Health Care Professionals)**
Related Use Case	UC 3.2 - Health improvement for the middle-aged persons
Related Value-Added Services	VAS 3.2.2- Individual remote activity and data collection from wearables, medical devices, beacons VAS 3.2.3 - Aggregated Statistical Analysis of data from wearables, medical devices, beacons
Description	The user interface for health care professionals is provided by an already developed solution, offered by Gnomon under the name eHealthPass, that will be further extended for the case. The application offers the functionality of connecting the mobile device with various medical devices (weight scale and blood pressure device) and retrieving the equivalent data. In addition, it gathers data from beacons and wearable devices (e.g. to retrieve steps) and processes them accordingly (e.g. translates beacon signals to actual time spent in sport facilities, further correlating data from wearable device etc.). As a result, health care professionals are supplied with options to view the historical, real time medical data and the aggregated statistical analysis of their patients, only with the pre-condition of course that they are given full data access rights by them.
Mock-up screens	

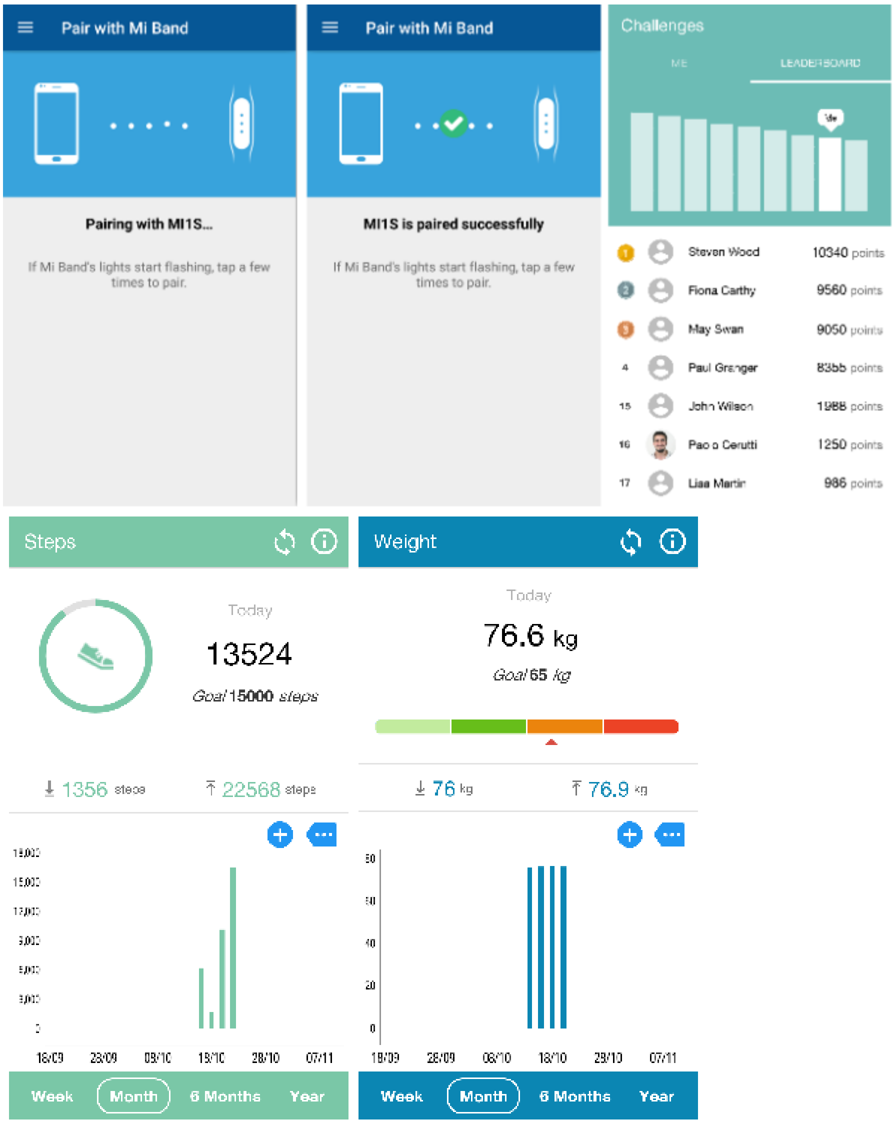




Responsible Partner(s)	• GNOMON will be responsible for the design and development of the respected UIs • CERTH will support the design of the respected UIs
Implementation planning	M23-M26: Prepare and agree on the design of the respected UIs (CERTH, GNOMON) M27-M30: Develop first extension of eHealthPass that will include the respected UIs as well as the relevant functionality (GNOMON) M31-M33: Continuous evaluation of the developed solution and relevant improvements if necessary (CERTH, GNOMON)

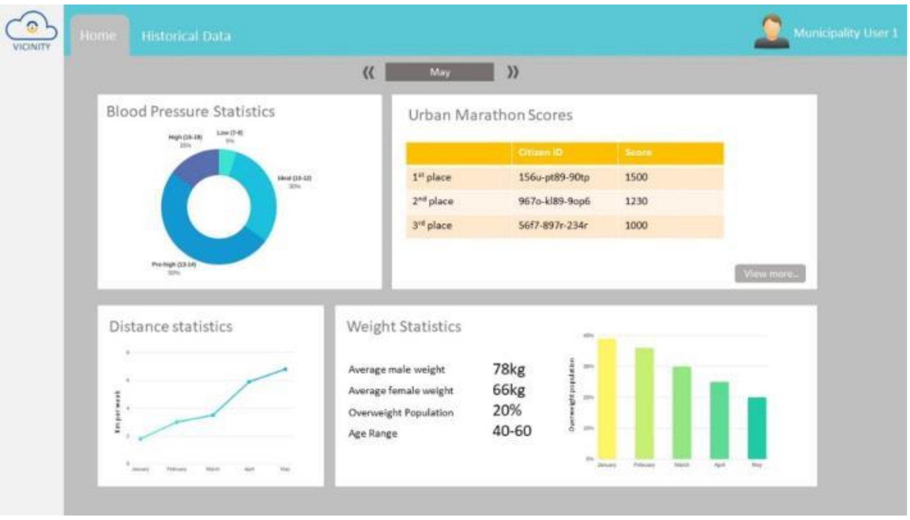
6.3.4.2. *Tracking progress and bonus achieved (for citizens)*

UI 3.2.2	**Tracking progress and bonus achieved (for citizens)**

Related Use Case	UC 3.2 - Health improvement for the middle-aged persons
Related Value-Added Services	VAS 3.2.2 - Individual remote activity and data collection from wearables, medical devices, beacons VAS 3.2.3 - Aggregated Statistical Analysis of data from wearables, medical devices, beacons
Description	The user interface for citizens is a mobile application (Android), specifically, an already developed solution by Gnomon, under the name eHealthPass, which will be further extended for the case. Under this extension, users will be supplied with options to view their data, bonus achieved, ranking among the rest of urban marathon's participants and tracking progress.
Mock-up screens	
Responsible Partner(s)	• GNOMON will be responsible for the design and development of the respected UIs • CERTH will support the design of the respected UIs

Implementation planning	M23-M26: Prepare and agree on the design of the respected UIs (CERTH, GNOMON) M27-M30: Develop first extension of eHealthPass that will include the respected UIs as well as the relevant functionality (GNOMON) M31-M33: Continuous evaluation of the developed solution and relevant improvements if necessary (CERTH, GNOMON)

6.3.4.3. *Aggregated statistical analysis of municipality citizens progress (for Municipalities)*

UI 3.2.3	**Aggregated statistical analysis of municipality citizens progress (for Municipalities)**
Related Use Case	UC 3.2 - Health improvement for the middle-aged persons
Related Value-Added Services	VAS 3.2.3 - Aggregated Statistical Analysis of data from wearables, medical devices, beacons
Description	The user interface for Municipalities is a desktop application with options to view the anonymised statistical analysis of the municipality citizens data and keep track of their health condition and also present how this use case facilitates health improvement of middle-aged people
Mock-up screens	
Responsible Partner(s)	• CERTH will be responsible for the development of the respected UIs • GNOMON will support the design of the respected UIs
Implementation planning	M23-M26: Prepare and agree on the design of the respected UIs (CERTH, GNOMON) M27-M30: Develop first extension of the web application that will include the respected UIs as well as the relevant functionality (CERTH) M31-M33: Continuous evaluation of the developed solution and relevant improvements if necessary (CERTH, GNOMON)

6.3.5. Value-Added Services Deployment Planning

All VAS will be deployed and running on a secure licensed server. The VAS will be first tested at the CERTH Smart House lab at CERTH facilities (in coordination with WP6 activities) and will then be ported on the server.

6.3.6. VICINITY as an Enabler

In this use-case VICINITY enables the development of an e-health, preventive medicine, IoT use case without the need to worry for the support of different hardware or software IoT solutions for the implementation of the respective services. Thus, this makes it a use case that could be easily transferred to other municipalities only with few refinements. It could also be easily extending to support more input data from citizens or even be used in a governmental scope.

Middle-aged citizens of Pilea-Hortiatis municipality will have the ability to improve their daily life by using fitness trackers to follow their daily activity, weight and blood pressure monitor devices to take regular measurements and their mobile device to track the sport facilities they visit. Data collected by all these devices will be transferred to and processed from the respective VAS and then will be forwarded to the respective UIs in order to inform the relevant actors. Moreover, the municipality can offer additional motivation by organizing competitions among the citizens to promote and trigger a healthier fitness lifestyle.

6.3.7. Use Case Business Modelling

As it was described in the introduction of this pilot case, the need for such use case is big, since obesity is increasing more and more each year, causing numerous side effects and health problems. Unfortunately, today's way of life includes sedentary jobs and a lot of hours in front of the computer and /or television.
In this use case municipality of Pilea-Hortiatis takes action by providing to its citizens a "service" for improving their health life and prevent future health problems. Citizens will benefit from this service not only in their future body and health condition but also in the earnings that they will have by needing less medicine or less visits to health care providers or dieticians. This service is valuable not only to the citizens themselves but also to the municipality as it aims to reduce future health service costs.

In a larger scale that breaks the municipality boundaries, similar competitions could be organized in national level, or any kind of larger scale, so that municipalities compete with each other. In such way, except of the benefit to offer a healthier lifestyle for their citizens, municipalities could also have various predefined benefits themselves as well as reduced long-term costs in terms of public health services, etc. thanks to the improved condition of their citizens.

7. Open calls

To extend the **business and technology scope** of VAS beyond the capabilities of the consortium, the project shall apply open calls for third party providers of advanced VAS under management of strategic industrial partner ATOS exploiting its relationships from European Technology Platform NESSI (Networked European Software and Services Initiative) and BDVA (Big Data Value Association). The VICINITY project intends to organize two Open calls:

- The first Open call will be devoted for system integrators for Integration of IoT infrastructures deployed at public facilities
- The second Open call to develop VAS over IoT infrastructure (4.57% in respect to the total budget)

To be more specific, the information provided in this section has the mail goal of establishing the foundations for the second open call.

The main goals of VICINITY Open Calls are to involve new stakeholders, new infrastructures and VAS to the project, in order to implement innovative solutions **using the VICINITY platform** that will increase the value of the VICINITY ecosystem.

Through the Open calls, VICINITY seeks to increase and to leverage the two-sided network effect. Developers attract users and users attract developers. More participants on the platform expand the volume and the variety of services. Correspondingly, the value proposition for all stakeholders involved will be increased leading to benefit for user or costumer, having an impact on society and environment in relation to cost and impact on VICINITY project. Network effects refer to the impact that the number of users of a platform has on the value created for each user.

7.1. The purpose of the Second Open Call

The Open calls open the project research and results to other actors out of the project limits; this is based on the Open Innovation concept.

The basic premise of Open Innovation8 is to open up the innovation process to all active players so that knowledge can circulate more freely and be transformed into products and services that create new markets, fostering a stronger culture of entrepreneurship.

To extend the business and technology scope of VICINITY VAS' beyond the capabilities of the consortia, the project shall apply open calls for third party providers of advanced Value -Added services.

VICINITY expects proposals for innovative services with a high business impact in VICINITY.

In the book Platform Revolution by Parker, Van Alstyne and Choudary, platform is defined as follows:

"A platform is a business based on enabling value-creating interactions between external producers and consumers. The platform provides an open, participative infrastructure for these interactions and sets governance conditions for them. The platform's overarching purpose: to consummate matches among users and facilitate the exchange of goods, services, or social currency, thereby enabling value creation for all participants." In our case, platform VICINITY, will look for independent third parties to build VAS on the platform, allowing businesses to enlarge capabilities easily.

Through the Open call, VICINITY will look to enhance and extend its impact. The Open call allows external participants such as developers and SMEs, established in an EU Member State or in an

1. "Open Innovation, Open Science, Open to the World" European Commission's Directorate-General for Research & Innovation (RTD)

Associated Country, qualified as third party compliant with the rules of participation H2020, to be a part of the project. These participants should complement VICINITY outcomes.

7.2. Open call requirements

The VAS will be developed over one or several of the following subjects:

- VICINITY Pilots domains:
  - Oslo Science Park (NO) - Buildings and Smart Transport
  - Tromsø (NO) – Neighbourhood Smart Parking Assisted Living ecosystem
  - Martim Longo (PO) - Neighbourhood GRID ecosystem
  - Pilea-Hortiatis (GR) – eHealth & Assisted Living
- Cross-domain: The service will enable the sharing of information between different domains which leads to improving the overall quality of services and provide cross-domain services.
- Other domains not included in the VICINITY project such as manufacturing, environment, logistic, etc.
- Technological services: Enhance the current VICINITY platform providing technical services.

Furthermore, all the proposals should demonstrate their capacity to:

- Validate and evaluate the technologies introduced in the VICINITY platform
- Provide a convincing business model.
- Demonstrate the Business impact.
- Attract end users
- Have impact on society and benefit user or customer
- Be novel compared to the state-of-the art market
- Successfully deliver the promised results

7.3. Schedule

- The VICINITY 2nd Open Call will be launched during the Second Half of 2018.
- The expected duration of the projects is 6 Months.
- Around 3 projects will be funding with a maximum of € 80.000 available per each external entity that will qualify through the open calls procedure.
- Planned Dissemination tools: Webinars, web sites, newsletters and direct emails

7.4. How the Open call projects will benefit VICINTY

The intention is to fund projects with the potential to develop excellent services, which will result in added value to the VICINITY platform.

- The project will test, and evaluate the VICINITY platform
- Enhance the VICINTY impact through innovative offerings that amplify customer engagement and satisfaction.
- Bringing new data to the platform

Through successful development of external entities and integration of VICINITY, developers or other IoT infrastructures could be attracted to use VICINITY Platform as well.

8. Conclusions

The goal of D5.1 is to provide a detailed definition of the VAS to be implemented in the scope of each defined pilot Use Case and further cross-domain applications and examining the potential of VAS, based on the requirements and pilot sites surveys results. In D5.1 these objectives were achieved by providing detailed explanation of each VAS of the Use Cases per pilot site and the “added-value” brought by the VICINITY Platform in the implementation and realisation of the services.

Implementing and utilizing the recommended VASs could make issues and problems from the use cases more feasible and less complicated extending and adding value to primary services, and would not be feasible without this level of connectivity and analytical intelligence spending less resources avoiding point-to-point integrations and customer specific customisations. Each of the foreseen value-added services that will be implemented in the scope of each of the pilot Use Case, further define the functionalities that they will provide.

For each Pilot site, Use Cases and VAS were defined and explained along with the Use Case’s conceptual design and associated VAS and User Interfaces schemas. In an attempt to better determine the meaning of the VAS the goal and scope of each is described as well as the IoT infrastructure involved. User Interfaces that displays the outputs of the VAS are presented in a structured way for the involved actors. Users of the use cases have the ability to access through the UIs processed data like clustered and statistical ones derived from the VASs while profiting from economic and social aspect. Implementing the VASs for each use case will assist in issues like resource management, data analytics, energy efficiency, health problems etc. covering different domains. Unwanted events could be prevented by notifications and alarms sent to UIs of each Use Case. Moreover, through the VASs users can decide whether they allow authorized parties to have access on their data covering privacy issues and could be given motivation to improve their everyday life and health.

In order to promote and integrate more VASs to VICINITY also from different domains and to extend the business and technology scope of value added services beyond the capabilities of the consortium, the project shall apply open calls for third party providers of advanced value. Open Calls will be based on the Open Innovation concept being aligned with the necessary requirements.

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9. ANNEX

9.1. Value-Added Services Template

VAS x.y	**Name of the VAS**
Related Use Case	*Use case related to the VAS*
Goal - Scope	*A short paragraph describing the basic idea of the VAS and its goal*
IoT Infrastructure involved	*A paragraph recording the IoT infrastructure involved with the VAS*
Trigger	*How are the events triggered e.g. The data acquisition process can be driven by data requests from other users or platforms or by a contributing user*
Pre-conditions / Assumptions	*What must be true before and after the use case runs*
Success scenario	*Is a case in which nothing goes wrong*
Key Performance Indicators	*Key performance indicators that are related with the VAS*
Algorithmic Data Processing	*Description of any data processing components that will need to be implemented, in order to support the realisation of the value-added service. This could refer, for example, to a back-end software component running as a service implementing real-time data processing, big data analytics, clustering algorithms etc., allowing the correlation of information and extraction of useful results based on the IoT collected data.*
Responsible Partner(s)	*Description of each responsible partners' tasks*
Actors Involved	*Identification of the actors that will need to be involved in each pilot site in order to guarantee the successful deployment and realisation of the specific value-added services. There should further be a detailed plan on how they will be approached and committed to actively participate throughout the project lifetime and the different project phases (such as deployment, training and realisation)*
Implementation planning	*MXX-MXX: a short description of the planning on the efforts required for the implementation of the value-added service's sub-components*

9.2. User Interfaces Template

UI x.y.z	**Name of the UI**
Related Use Case	*Related Use Case for the UI*
Related Value-Added Services	*Related VASs for the UI*
Description	*Description of any front-end software modules that will need to be implemented to allow the interaction and presentation of information to the end-users. This could be either mobile apps and/or web/desktop applications.*
Mock-up screens	*Examples of the UI interface*
Responsible Partner(s)	*Description of each responsible partners' tasks*
Implementation planning	*MXX-MXX: a short description of the planning on the efforts required for the implementation of the value-added service's sub-components*