The document will describe the field trials carried out on top of the different pilots involving end-users.
| Editor:       | Carmen López (University of Cantabria)  
|              | Hoang Minh (KAIST)                      |
| Deliverable nature: | Other (O)                              |
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## Revision History

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Executive summary

Wise-IoT innovations aim to address the problem of fragmentation within IoT ecosystems by developing a novel framework to achieve global interoperability and mobility of IoT applications and devices. To achieve this, the work packages of the project have worked on the definition of the architecture and use cases, the development of novel tools, and its integration within a reference architecture. Finally, and as main task of work package 4, all these efforts are assessed in real environments and presented to real users with two main purposes: to test the WISE-IoT developments, and to provide them with new services as examples of WISE-IoT potential for developers. The use cases defined in work package 1 can be split in two main directions: Smart City use cases and Smart Skiing use cases. In addition to these ones, a Lifestyle use case was defined. In D4.2 [12] we focused on the description of the trials with end users of the Smart City and Lifestyle use cases. The present document is an update of D4.2 with the addition of the Smart Skiing use cases.

An introduction with the main objectives of WP4 and of this deliverable opens the document. Following, Section 2 presents the trials description for each of the use cases related to Smart City, Lifestyle and Smart Skiing: Rich Parking, Smart Parking, Bus Information System, Smart Fitness Centre, Smart Skiing and Smart Resort Management. Firstly, descriptions of the use cases are provided since, although they have been described in prior deliverables from different points of view, it makes the document self-contained. Secondly, the different functionalities which are included in the trials, and which are offered to the participants of the pilot, are presented with a description and some images that illustrate how these functionalities are presented in the different applications. Following, the planning for the user engagement to attract these participants and descriptions of the pilot phases are presented. Finally, for each use case, a brief look at the next step is provided: the evaluation phase, which will be presented in more details and with results in D4.3 in month 24.
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# Introduction

## 1.1 Wise-IoT purpose and work package objectives

The rise of Internet of Things (IoT) and its concept of networking of various types of devices, data, and services have led to a substantial increase in the amount of data exchanged and the creation of large-scale platforms for a great amount of assets. However, this comes with the cost of increased complexity in systems, and the need for interoperability between them. The information of each system must be discovered and retrieved, and a common model needs to be made for the exchange of information between them. This poses a serious challenge for developers, as they would have to develop services with careful consideration and would need to study each specific system and standard they are dealing with. This ‘manual’ approach would not be scalable, and may even not be able to solve problems with high degrees of heterogeneity.

In dealing with the aforementioned issues, the Wise-IoT project aims to create a framework in which heterogeneous IoT platforms and services can be combined, and data can be aggregated together to be used for meaningful purposes. This is achieved through the creation of semantic modelling to enable interoperability at the data level; thus reducing the effort needed to develop new applications and services. Also, to create such a framework, the Wise-IoT project closely follows four main themes of interoperability, mobility, trust, and standardization.

This work package’s (WP) purpose is to build representative use cases for the architecture developed in WP1 as part of the WISE-IoT framework, and the technologies and components for federation and interoperability of IoT platforms developed in WP2 and integrated in WP3. More specifically, six use cases are developed: Rich Parking, Smart Parking, Bus Information System, Smart Fitness Centre, Smart Skiing, and Smart Resort Management, deployed in two European and two South-Korean sites involving three IoT scenarios of Smart City, Lifestyle, and Smart Skiing.

In summary, WP4 focuses on the successful achievement of the following objectives:

- **O4.1**: To identify key functional requirements, KPIs and metrics, which will become the bases of the assessment of the use cases running on top of the platforms.
- **O4.2**: To proceed with the deployment of the selected use cases on both continents.
- **O4.3**: To carry out the field trials on top of the infrastructures and platforms providing support to the services driving the use cases and engage significant number of users in the pilots.
- **O4.4**: To evaluate the performance of the solutions, applications and services running in the corresponding sites according to the KPIs and metrics identified in T4.1 “Recommendation service deployment”.

## 1.2 Deliverable contribution

The main purpose of this document is to provide information about the field trials that are conducted by the use cases in the Wise-IoT project. In D4.2 [12] we focused on the description of the trials with end users of the Smart City and Lifestyle use cases. The present document is an update of D4.2 with the addition of Smart Skiing use cases.

First and foremost, these field trials serve as the determination of the degree of success of the proposed functionalities in each use case, and contribute to the evaluation of WISE-IoT objectives such as the
global mobility and remote access to data. At the same time, these field trials allow the demonstration of real-world applications by using Wise-IoT platforms.

To accomplish the aforementioned goals, this deliverable is largely divided into three stages as reflected in the structure of Section 2. These stages include the development of the use cases to carry out in field trials, the engagement of users and pilots, and a first view on the evaluation phase after the pilots.

The deliverable is structured as follows:

- Section 2 presents the details of the field trials for each use case, including Rich Parking, Smart Parking, Bus Information System, Smart Fitness Centre, Smart Skiing, and Smart Resort Management. This includes the information about functionalities, user engagement, pilot, and first insights of the evaluation phase. These trials follow the descriptions of use cases provided in D1.1 [1], and requirements and KPIs outlined in D4.1 [6].
- Section 3 presents the conclusion and future work. This section highlights the main outputs of this document, and the next steps regarding the field trials evaluations.
- Section 4 provides necessary references for this document.
2 WISE-IoT field trials with end users

The following sections provide information about the different trials being carried out with users in the WISE-IoT project. As the use cases have been described in multiple documents from different points of view, here it is provided an introduction to the use cases and their objectives in order to be a self-contained document. Following, and more related to the description of the trials itself, there is provided a description of the tools being provided to the user, defining the functionalities available for them through the trial, and what kind of aspects will be evaluated.

One of the most important aspects of the trials with end users, after having the technologies to be tested, is to encourage them to be participants of the pilots. As this is not a trivial task, developers need to make clear the different steps to follow and the different activities and strategies to attract users. In addition, it is of great importance to set up the process for gathering feedback at the end of the pilot phase, in order to, during the evaluation phase, make the most of it and gather all the information that the developer expects from this step. From the point of view of the trials, three categories of users are defined: test users, who are the ones who help developers to test the application previous to the launch of the application; qualified users, who are the ones interacting with the service during the pilot; and the general users, who are the ones who, although they are not involved on the pilot per se, participate indirectly (e.g. the people anonymously detected by the crowd detectors).

2.1 Rich Parking

Rich parking use case has been described, from different points of view, along previous deliverables (see [1], [2], [3], [4], [5], [6]). As a brief summary, Rich Parking pilot can be defined as the elaboration and deployment of the Rich Parking use case [1] that is materialized in an Android application with the purpose of enhance the parking experience of the drivers in both Santander and Busan. The main objective of this trial is to assess the feasibility of the WISE-IoT developments from WP2 and WP3 related to interoperability, such as ASM or MMG, and self-adaptive recommendations such as IoT Recommender or the Adherence monitoring. Thanks to this integration efforts, which can be consulted in [5], it is possible to achieve global mobility and use the application in both cities, Santander and Busan.

In addition to testing the WISE-IoT components, which other developers are able to use for their own applications and services, the purpose is to use this testing to provide users with an application useful for them. Through a pilot phase and a following evaluation phase, the application is presented to citizens and their experience will be gathered and analysed.

In the following subsections, the different aspects related to the pilot, from the point of view of the functionalities which are provided through the application to end users, and the user involvement are explained. It will not be a description of the technical development and integration since it has been described through already delivered documentation [4] [5].

2.1.1 Rich Parking application

The trials were born from an initial idea on the use case description in D1.1 [1]. Later, after the different developments needed to accomplish the idea of WISE-IoT platform, and the integration of that developments within the Santander testbed [5], finally it was possible to develop and deploy the corresponding trials.
Thanks to the aforementioned integrations, it has been possible to create an Android application with two main objectives: first, to test and assess the success of WISE-IoT developments, and second, to provide citizens with a pilot application that can be the first steps of a future application which allow them to improve their parking experience in the city.

2.1.1.1 Rich Parking application

As mentioned, Rich Parking app is an Android application that provides different functionalities to enhance the parking experience for drivers. Following, they are described the functionalities available to the user through the app.

- **Show parking spots**

Users are able to request parking spots status by clicking the corresponding button on the application. That request is answered by the application showing a pin per parking spot with a colour depending if the parking spot is empty (green) or occupied (grey) (Figure 1). Also, the user can click on the pin and a message with the status is shown. This functionality is referred to the scenario B1.1 “Parking Lot Search” described in D1.1 [1].

- **Show a route from a point to a parking spot**

Users can request a route from one point of the map to an empty parking spot. The departure point is the user location (gathered by the GPS) or other position they decide by moving the departure marker in the map. The application propose, thanks to the IoT Recommender, the nearest trusted parking spot and the less crowded route to arrive to that parking spot (Figure 2). As the previous functionality, this is also referred to the scenario B1.1 “Parking Lot Search” described in D1.1 [1].

- **Monitor the route to provide feedback**

Once the users have been provided with a route, they can activate the Adherence Monitoring service. This activation allows the delivery of their GPS coordinates to the system in order to track the route followed by them and compare their route with the initially proposed by the system (Figure 3 to Figure 9). The main reason of offering this monitoring to the user is to allow them to provide meaningful feedback about their experience. If the application only allows provide feedback to the developer, but the developer cannot check if the route has been followed or not, the information will be very biased. The provision of this information do not mean a lack of privacy.
because of the tracking of the users, since for each request of the user the identifier will be different (there is not a storage of the routes followed by a user) so there is not possible a tracking of the user. At the end of the route, once they have parked the car, the user can stop the monitoring. Once the monitoring is stopped, the user is asked about their willingness to provide feedback about the experience (Figure 10). This functionality is referred to the scenario B1.4 “Parking Lot Experience” described in D1.1 [1].

- Provide feedback

As mentioned, when the user stops the Adherence Monitoring system, they are presented the opportunity to provide feedback. If agree, they are shown a form which questions will depend on the previous behaviour of the user while the monitoring of their route. This means that if the users have followed the route, they are asked about the satisfaction of the route provided and the application. In case they have not followed the route they will be asked about the reason of that behaviour. These forms will use stars rating and questions with proposed answers to make the competition of the form fast and easy, although they also are allow to provide text information if they want (Figure 11). This functionality is referred to the scenario B1.4 Parking Lot Experience in D1.1 [1].
WISE-IoT field trials with end users

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Figure 11. Example of feedback form

- Remember where I have parked my car

Once the users have parked their cars, they have the possibility to make the application remind their location (the car location) in order to be able to show it in the future, when they want to return to their parked car (Figure 12). For this, they only have to click the corresponding button which will change its colour indicating that the position has been saved by the application (this information is not send to any service, it is kept within the phone). This functionality is related to the scenario B1.2 Parking Lot Status in D1.1 [1].

- Set a time to be notified for unparking the car

In Santander there exists some areas where during the day the users have to pay for parking. In the parking area there are machines where they have to pay for the time they expect to be parked. In order not to exceed the time, the application provides the functionality of notifying the user when the ticket is next to expire. Once they know how long they want to pay the parking, they can click on the corresponding button and set the time they have to leave the parking spot and the notification will be launched 10 minutes before the time set (Figure 13). This functionality is related to the scenario B1.2 Parking Lot Status in D1.1 [1].

- Route to the parked car

If the user saved the location of the car, they can request a walking route from their actual location gathered through the GPS or from the location where they locate the departure marker in the map, to the parked car. Note that the walking route is provided by the IoTRecommender which makes use of a routing algorithm (Brouter [8]) which provides walking routes in a beta version (Figure 14).
- Check statistics of the parking areas

Users are able to check the statistics of the area through clicking on the corresponding button (Figure 15). When clicking the area, as a response, the statistics regarding the occupation of the area are presented. This information can help them to take a decision in case they do not want to use the app recommendations. This functionality is related to the scenario B1.3 Parking Lot Information in D1.1 [1].

- Shops recommendations in an area

Chatbot performs a recommender service that provides users the surrounding area information based on their location. Regarding Rich Parking, Chatbot shows different commerce around the location of the user depending on what users are looking for. Users can initiate Chatbot by clicking a Chatbot button in the app. When Chatbot pops up, users can type out their needs and Chatbot will display related information.
2.1.2 Crowd detection system

Crowd detectors are deployed at different places of the city to provide information to the city about the amount of people that can be in a concrete area. This information can provide different possibilities depending on the area. The areas to test the devices are of different nature, and people are there for different reasons. In the parking of the beach it can help consumers of the information to know if the beach is crowded and select other beach or not, in the park it can be useful for emergency teams to know how many people are in the area, or in the square of the city centre it can be interested for the city or the commerce around to know how many people are in the area during the day at concrete times and use this info to promote different activities when more people go through the area.

This service is related to the scenario B.1.5 Crowd Information in D1.1 [1]. However, due to technical issues, it is not integrated within the application. The information will be made available through the WISE-IoT platform but by the moment, it will not be available through the application.

2.1.2 User engagement and pilot phase

As it has been previously mentioned, the main objectives of the pilots are to demonstrate whether the interworking mechanisms sufficiently enable global mobility and remote access, and at the same time provide some services that can be useful for the users.

Initially, from the Description of Action, it was described an amount of 1.5k of users in the city of Santander to be involved in the pilots. In order to encourage as much as users as possible, it is created a bond of unity and compromise with the project to be able not only to have them as testers of the services but also to receive a feedback from them at the end of the pilot phase. To achieve this, different meetings are set up with citizens during the pilot phase.

For sharing the application among the qualified participants, we make use of the beta groups available through Google Play Console. Google Play Console allows the creation of beta groups in order to share applications to be used only by those people within the beta group. In order to take part of the group it is only needed a Google email address. Once the users provide their email, it is added to the group and a link to the application is created. This link is provided to the users, so they can download it through Google Play as any other application.

The main reason of following this process is to be able to control the experiment at different levels. First, we ensure that when the user has provided their email, they have been presented the project and the pilot, and they have provided their consent to participate. In addition, with this process, they exactly know what the expectations of the pilot are and they will be more willing to collaborate within the pilot and provide feedback. Finally, by having their emails, the developers will have a mean to communicate with the participants through the experiment (e.g. if a new version have to be launched) or at the end of the pilot to send them the forms to fill and encourage them to participate in the evaluation phase.

With the objective of engaging citizens to participate in our pilot, there are proposed different activities.

We use the IoT Santander Meetup forum to contact with people who previously have participated in other experiences related to IoT. This Meetup was created with the purpose of approaching the Internet of Things to the citizens. Initially, during the first meetings, citizens could participate in talks about what is the IoT and the benefits that IoT can bring to them. Following meetups presented projects in Cantabria related to IoT that could be of their interest. During the last meetings, users were taught about how to create their own IoT devices through Arduino and Raspberry Pi, in order to offer them the possibility to participate within some experiments/pilots of a finalized IoT European project, SocIoTal [10].
IoT Santander Meetup webpage [7] is the online meeting point of this group, and where the meetups are advertised to the members of the group. When a new meetup (with its description) is set, the platform sends an email to the people belonging to the group. As it can be seen, around 220 people belong to the group. Some of that people are from other regions but have interest of what is done related to the IoT and from these invitations they can access to the project information. Figure 16 presents some examples of the meetings, some of them were more focused on talks and other ones were more focused on tutorials and workshops.

For WISE-IoT purposes, there is being set initially a first meeting, and following ones will be set during the pilot. In addition, through the available forum in the webpage there will be initiated a thread to present the project, the pilots, encouraging members not only to participate in the meetings, but giving them the opportunity to visit our premises and be given an explanation and access to the application. Also, it is provided the option to send us an email, and after send them and receive the corresponding consent documents, add them to the beta group and provide them the link to download the application. For this case, in addition to the link to download the app it is shared a tutorial document.

Other path to engage users is through the faculties at the University. Students are encouraged to participate in the pilots. The way to advertise is through posters and with the help of professors. Through that posters or real time information, they are invited to participate in the meetups or giving also the opportunity to visit our premises or to participate through email.

Additionally, collaborations with municipal services and councillorships, such as neighbourhood and citizen’s involvement, mobility or youth services, are ongoing. Through these collaborations, the project and the application will be presented to a wider number of citizen in January 2018 to further enlarge the user’s basis. For example, through neighbourhood associations we can arrange meetings with people who live in different areas of the city interested on finding easily parking around home or work.

To be a qualified participant of the pilot they have to provide their name and a Gmail account. The reason for asking that information is to have the minimal information to download the app from the beta group and contact them in a not intrusive way. For us is very important to maintain the contact
with them in order to, at the end of the experiment, get on to them and send them the tools to provide us feedback.

During the meetings with users, they are informed orally about the project and the pilot. In addition to the oral explanations, they are provided with information sheets about the project and the pilot, and they are presented documentation to provide consent/withdrawal to participate within the project.

The pilot phase starts with the first meeting with users. And these attendees are the first users to participate, although not the last ones since the engage of the users will be a lively activity during the pilot phase until the evaluation phase. As previously described, there are set different meetings with people belonging to the IoT Santander Meetup, students from the faculty, citizens from the neighbourhood associations, etc. They are approached during the first weeks of the pilot phase, however new people will be invited to participate at any time of the pilot phase. This pilot phase will finish when the evaluation phase starts.

### 2.1.3 Looking at the evaluation phase

As just mentioned, the pilot phase will finish when the evaluation phase starts. In April, all the participants will be informed about the finalization of the pilot, and they will be invited to participate in the evaluation phase. The communications with participants will be through the email they provided for the participation in the pilot. They will be sent an email informing about the finalization of the pilot and also they will be provided a link to a form, built with Google form tools, to provide feedback about the experience. The specific contents of the form will be described through the Task 4.4 and it will be provided, with its analysis and results, in deliverable D4.3. The initial KPIs and metrics were described in D4.1 [6], and this will be the starting point of the evaluation phase. In addition to this form, the users are able to communicate with the developers by email in order to provide feedback or request information at any time during the pilot phase. Finally, other way to provide feedback is through the application, thanks to the feedback tool provided by the SAR component, the user is able to provide feedback about the recommendations provided by the application.

The base for the questions to be included within the feedback form will come from the metrics specified in D4.1 [6] for the use case, and summarized in Table 1.

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<td>Parking use case owner</td>
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*Table 1. Rich Parking metrics*
2.2 Smart Parking

The smart parking use case deployment in South Korea (see clause 2.2.1 and D3.2 [5]) provides parking services to find empty parking spaces of the several parking lots in Busan. There is a parking service infrastructure in Busan city that provides parking data to oneM2M platform instance in Busan. Therefore, this smart parking use case consumes the parking data collected from the oneM2M platform. This parking service is also available for NGSI based applications since the information will be also available at a FIWARE context broker as well as in the oneM2M platform thanks to the Wise-IoT semantic interoperability.

The objective fulfilled by this smart parking use case is to provide GIoTS using semantic interoperability capabilities of Wise-IoT system. As a result, a user having a NGSI app can use the same app in Korea for the smart parking service.

In similar way, in Santander, there is also a oneM2M platform through which the information from both the legacy parking deployment and from the new LoRa parking deployment is available. With this cross-city use case deployment, a user from South Korea having oneM2M app can still get the same service in Santander.

2.2.1 Smart parking applications

The field trials that were firstly described as the smart parking use case have been deployed in both South Korea and Santander. The smart parking service is getting parking data from sensors and storing it into oneM2M platforms. By using this information, and as pilot services, two applications have been developed: one for the driver and other for the parking lot manager.

2.2.1.1 Driver application

A driver, as the major actor of this use case, has the Android application that provides parking lot search, parking status management, etc. The following list provides the features of the driver app.

- Search parking lots
- Show available parking spot numbers on a map
- Move/show adjacent parking lot info.
- Navigate to a parking lot (triggering external navigation app)
- Check-in with BLE trigger
- Keep parking spot info with photo after check-in
- Record parking usage history
- Manage favourite parking lots
- Leave user feedback per parking lot
- Provide multi-languages (Korean, English, Spanish)
- Change the oneM2M platform instance (Korean, Spanish)
Figure 17 shows the main screen of the parking app. On this example, one parking lot with the available spot number is shown on the map. On the left top, there is a search button to find parking lots by test keywords.

![Figure 17. Main screen of the parking app](image)

In the parking lot search menu (Figure 18), names of the parking lot are used as keywords. When there is a match(es), the available spot number is also shown on the right.

![Figure 18. Parking lot search menu](image)

When a parking lot on the map is selected, the detailed information will be displayed as presented in Figure 19. E.g. available spot numbers out of total spot numbers. At the bottom, there is a navigate button that can launch Google Maps or other navigation app having destination as the selected parking lot location.
When scroll-down to the bottom, other nearby parking lots are shown (Figure 20). If the user selects one, then the screen will show the selected parking lot info.

When selecting the car icon on the right top in the main screen, the user information will be displayed (Figure 21). This page includes parking service usage, favourite parking lot or the reviews of the user.
WISE-IoT field trials with end users

From the user info menu, at the right top it is the setting menu icon. In the settings (Figure 22), the user can select the language among Korean, English and Spanish. For the oneM2M platform instance, either Korean or Spanish instance can be chosen.

![User info menu](image)

**Figure 21. User info menu**

2.2.1.2 Parking lot manager application

Following there are enumerated the functionalities available for the parking lot manager. Also, there are presented a couple of screenshots of the web user interface (Figure 23 and Figure 24).

- Monitor one or more parking lots for parking spots and sensors
- Monitor available and total parking spots per parking lot
- Provide mal-functioning parking sensor info.
- Provide statistics on parking usage
2.2.2 User engagement and pilot phase

Citizens of Busan would be the majority users of the smart parking service. Considering the number of parking lots for this pilot, which is 5 off-street parking lots, the number of users are expected to 300.

The smart parking application is developed for Android OS hence the application will be distributed over Google PlayStore. Therefore the point of user engagement plan is how to make them try the Android application.
To engage citizens for this parking service, flyers will be posted at the parking lots. The flyer includes the simple user guide as well as the application link (e.g. QR code) to the app store.

Online promotion could have been considered but it should be less cost-effective to target right users among anonymous users. Offline engagement like the posting flyers in parking lots is the best option cause parking users will come to the parking lots and would be interested in the app for their use. When we consider the size of Busan city (which population is over 5 millions) and the number of parking lots for this trial service, the portion is small so we chose to target specific user groups.

Once the users try the application following the simple guide on the flyer, they should be able to use it later since the application itself has fairly easy interfaces. Online documentation with more details should be available from the link inside the application.

During the pilot phase, it is expected for users to test features provided by the applications. Especially the ones utilizing Wise-IoT platform interoperability like showing parking data of Santander downtown. If applicable, it would be great to have some travelers who use the application in Korea and also in Santander. For example, Wise-IoT project members from Korea visit Santander in January 2018 for the meeting, they can try the driver application with the oneM2M platform instance run by the UC. They should tell us the usefulness of GiOTS concept of Wise-IoT.

### 2.2.3 Looking at the evaluation phase

For the evaluation of the use case, not just the functionality itself but also feedback on the user experiences is needed. The list of the smart parking metrics [6] are listed in Table 2, which were derived from use case agnostic KPIs. Different evaluation tools and owners who will evaluate each metric are defined. The evaluations will be performed during the pilot phase that is from January 2018.

<table>
<thead>
<tr>
<th>Metric ID</th>
<th>Metric title</th>
<th>Evaluation tool</th>
<th>Evaluation owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP_001</td>
<td>Diversity of IoT data provided through the app to the user</td>
<td>Self-assessment</td>
<td>Parking use case owner</td>
</tr>
<tr>
<td>SP_002</td>
<td>IoT data for third party developers</td>
<td>Questionnaire</td>
<td>3rd party developer 1</td>
</tr>
<tr>
<td>SP_003</td>
<td>Number of parking spots available through the app</td>
<td>Self-assessment with fact sheet</td>
<td>Parking use case owner</td>
</tr>
<tr>
<td>SP_007</td>
<td>User mobility support</td>
<td>Self-assessment</td>
<td>Parking use case owner</td>
</tr>
<tr>
<td>SP_009</td>
<td>Service availability</td>
<td>Self-assessment (e.g. system log)</td>
<td>The parking app developer</td>
</tr>
<tr>
<td>SP_004</td>
<td>Number of application crashes</td>
<td>Crash report to the app developer</td>
<td>The parking app developer</td>
</tr>
<tr>
<td>SP_006</td>
<td>Response time</td>
<td>Self-assessment</td>
<td>The parking app developer</td>
</tr>
<tr>
<td>SP_008</td>
<td>Number of users</td>
<td>Play Store application download count</td>
<td>The parking app developer</td>
</tr>
<tr>
<td>SP_005</td>
<td>User Experience</td>
<td>Questionnaire</td>
<td>Drivers and parking lot manager</td>
</tr>
</tbody>
</table>

1 3rd party developer group would be selected among the users by the user type information in the questionnaire for SP_005. Then they would get additional questions for the metric SP_002.
2.3 Bus Information System

2.3.1 Bus Information System Application

The main purpose of the use case is to test the interworking components of the Wise-IoT platform including FIWARE, oneM2M, and GS1. As part of the use case, an Android application is developed with two objectives: firstly, to demonstrate the interworking of the components, and secondly, to provide a pilot application as a basis for future improvements for better bus usage experience inside cities.

As aforementioned, Bus Information System (BIS) Application is an Android application that provides various functionalities to improve the bus usage experience for users. As the application is developed based largely on users’ feedback and may be changed continuously until the end of the project, the users’ feedback and reviews will be continuously gathered until the end of the project. The provided functionalities are listed below.

- **Display bus stop information:**
  A user can see the information of any bus stops by clicking on the bus stop on the map. The information is shown in a grey box on top of the bus stop icon (Figure 25). The current information displayed for each bus stop includes bus stop name and the codes based on GS1 standards.

![Figure 25. Display bus stop information](image)

- **Display bus line information:**
  A user can select any bus lines from the list of bus lines in each city (Busan, Santander) as in Figure 26 by clicking on it. The selected bus line will be shown with all of its bus stops (Figure 27). In addition, the information of the bus line itself will be shown at the bottom left of the application screen; currently bus line number, short ID, and a GS1 code are shown.
• Display real-time bus information:

Together with all the bus stops, real-time information of all buses inside a bus line is presented to users. Each bus will be shown next to the bus stop that it is moving towards. Also, the information of the bus can be seen by clicking on the bus icon inside the map. The information is presented on top of the bus icon (Figure 28).
• Display remaining time until arrival information:

Together with the bus information provided above, the remaining time until a bus reaches a bus stop will be provided to the users. By clicking on a bus, the remaining time until that bus reaches the next bus stop will be shown to the user.

• Display current position & Follow position:

Users can see their current position by clicking on the button on the top right of the application screen. When the button is clicked, the map will automatically be centred on the current position, and the current position is marked with an icon (Figure 29).

In addition, users can activate the functionality to ‘follow’ their position by clicking the button below the ‘Display current position’ button. When the button is clicked, the button will turn red and the function is activated; and when the button is clicked again, the button will turn to the original colour and the function is stopped (Figure 30).

• Display all the bus stops within the current screen:

By clicking on the button at the top left of the application, a user can see all the bus stops within the current screen (Figure 31). Only the icons of the bus stops inside the current map screen of the application are shown.
• Register & Login:

Users can register their account (Figure 32) and login (Figure 33) to use the application using their registered information. Currently, the registration (and login) information include email address and password. The registered user information is stored accordingly for the measurement of the number of users that use the application.

2.3.2 User engagement and pilot phase

As aforementioned, the main objective of the application is to demonstrate the interworking of the components of the Wise-IoT platform, and at the same time provide a basis for future improvements for better bus usage experience of users. As it is a bus application, mainly the bus users from the two cities (Busan and Santander) are expected to participate in this engagement phase.

Initially, in the Description of Action, it was described that 1.5k-2k users will be involved in this phase. Although this is quite ambitious, this number will be used as a desired reference number. And not only
do we need the number of users, but also the review results from users are necessary for the pilot. Thus, to achieve this the user engagement phase will be divided further into testing & pilot phases.

As this is a bus application for two cities and can be used basically from anywhere, the application will be uploaded and continuously updated on Google Play. A user will be required to register an email address and a password in order to use the application; at the same time this information will be used to count the number of users that use the application at the end of the project.

The testing phase will be carried out for improvement of functionalities inside the application, as well as receiving feedback necessary for debugging process of the application previous to the final launch of the service. The main users of this phase will be colleagues from the developers laboratory.

Regarding the pilot phase, as the application will be uploaded into Android Google Play, the main focus will be to approach as many users as possible. This will be done mainly through online communication means (e.g. social media), and the starting point will be with friends and acquaintance and the students inside the school. Expected number of users at the beginning will be around 50 friends & acquaintance and around 50 students inside the school.

Necessary documents are contained within the application; currently the plan is to include Complaint Form, Letter of Consent, and Withdrawal Form inside the application.

### 2.3.3 Looking at the evaluation phase

The evaluation phase will be done after the pilot phase. More specifically, the metrics provided in [6] and summarized in Table 3, for Bus Information System use case will be evaluated.

<table>
<thead>
<tr>
<th>Metric ID</th>
<th>Metric title</th>
<th>Evaluation tool</th>
<th>Evaluation owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUS_001</td>
<td>Data availability</td>
<td>Self-assessment</td>
<td>Bus use case owner</td>
</tr>
<tr>
<td>BUS_002</td>
<td>Diversity of information to users</td>
<td>Self-assessment</td>
<td>Bus use case owner</td>
</tr>
<tr>
<td>BUS_003</td>
<td>Number of application crashes</td>
<td>Self-assessment &amp; user reports</td>
<td>Bus use case owner</td>
</tr>
<tr>
<td>BUS_004</td>
<td>Processing delay</td>
<td>Self-assessment</td>
<td>Bus use case owner</td>
</tr>
<tr>
<td>BUS_005</td>
<td>User experience</td>
<td>User reports</td>
<td>Bus use case owner</td>
</tr>
<tr>
<td>BUS_006</td>
<td>User mobility support</td>
<td>Self-assessment</td>
<td>Bus use case owner</td>
</tr>
</tbody>
</table>
2.4 Smart Fitness Centre

Smart fitness trial has been described in previous deliverables [5] within the framework of Lifestyle use case. The smart fitness trial is accomplished using the PIQ device for the tennis. The Tennis show room use case is created at the Daegu global healthcare center living lab (Daegu GHC living lab). The PIQ device is installed at Daegu GHC living lab (Figure 34), and communicates with the MAPHIS (Most Advanced Personalized Healthcare Intelligent Service) platform. In order to support smart fitness use case, tennis activity data is sent to the PIQ server and the data is then stored at MAPHIS healthcare platform. The smart fitness pilot can be defined as the deployment of the PIQ device for the tennis for the purpose of monitoring and enhancing the tennis activity of the tennis player. The objective of the smart fitness use case is to assess the feasibility of the smart fitness using PIQ device and IoT-based healthcare platform.

Figure 34. Smart Fitness application installed in Daegu GHC living lab

In the following subsections, there will be more detailed descriptions on the pilot that includes the tools provided to the user, and procedures of the monitoring and displaying the fitness activities using PIQ device and applications, and evaluation metrics.

2.4.1 Smart Fitness Centre Application

As mentioned before, the smart fitness use case is accomplished using the PIQ device for the tennis, which is created at Daegu GHC living lab. The procedure for using the PIQ device and tools for monitoring the user activities are as follows:

- Users first provides their credentials (name, e-mail, left or right hand) and then places PIQ Robot on their wrist using a specific accessory (Figure 35).
WISE-IoT field trials with end users

Figure 35. User create (right/left hand, name, e-mail)

- PIQ Robot recognizes the motions and computes the metrics and sends the data to a tablet using a BLE connectivity (Figure 36).

Figure 36. Recognize motion and display data

- The tablet runs a dedicated application (Figure 37).

Figure 37. App launch on tablet

- The tablet is also used to create a short video of the users during their motion (Figure 38).
The motions and video can then be sent to the user. The overall data of the users can be used for other analysis (Figure 39).

2.4.2 User engagement and pilot phase

Since the smart fitness use case is created at Daegu GHC living lab, the number and type of users are variable. We expect that the number of users will be slowly increasing as the PIQ device for tennis will be advertised along with other IoT healthcare devices installed at Daegu GHC living lab. The type of the users includes students, ordinary people and so on. In December 2017, there will be two advertisements of Daegu GHC living lab, on Electronic Times News Paper, which is one of main technical newspapers in Korea. Other event of launching of MAPHIS (IoT Healthcare Platform) is also scheduled in December 2017.

2.4.3 Looking at the evaluation phase

For the users, there is a questionnaire sheet for gathering user’s feedback on the use of the PIQ device for tennis. The questionnaire includes both quantitative and qualitative questions regarding to the usage of PIQ device for tennis. This feedback from the users will be collected and analyzed statically for the evaluation of the smart fitness use case.
2.5 Smart Skiing

The Smart Skiing use case aims at setting up a testbed in Chamrousse, a ski resort close to Grenoble in France. The main idea of the use case to be tested is to gather data related to the skiing performance of the skiers by using connected sensors carried by the users and to use the information for various purposes, such as providing recommendations to improve the skiers' performance, to compare their performance with others, provide the location information of the user and/or friends and family, provide the slopes' crowdness information to the ski resort, etc. The use case has been detailed in D1.1 [1]. Thanks to the roaming function provided by the LORA tracker devices developed in the project, the devices can be used seamlessly both in Korea and in France. In addition, the interoperability layer provided at the application level by the OneM2M standard allows reusing the same ski monitoring application both in Chamrousse, France and in Alpensia, Korea. The interoperability has thus been ensured both at the device and application level.

In Chamrousse, the skiers are intended to wear two devices, i.e., a LoRa tracker and a PIQ Robot. The first one allows to retrieve the GPS location of the skier. The second one gathers data about the skills of the skiers on the slopes (Figure 40). The data is displayed in a web application. The application is a web application allowing everyone to run it on their smartphone. We choose this format because the skier is usually a non-permanent person who does not stay all the year in the station. Thus, this format is less restrictive than installing a complete application. We also choose to target the smartphone because the skier will more likely use this interface on the slopes than a desktop computer with a larger screen.

The Chamrousse testbed includes data from sensors and feedback from the users. The data is stored either in the sensiNact platform or in the SAR system. Based on those data, the application can display multiple interfaces. The next section details the various screens that the user can encounter.
2.5.1 Smart Skiing application

As depicted in Figure 41, the Home Page displays the ski resort map of Chamrousse. The map is based on OpenStreetMap, a collaborative map in which the slopes difficulty is displayed using colours (green is for beginners, blue is for average skiers, red is for advanced skiers, black is for expert skiers).

Figure 41. Home Page presenting the ski resort map

Once the users are on the Home Page, they have access to a menu listing a restricted set of features available with no authentication (Figure 42). They can locate themselves using the standard web browser API, modify the preferences related to the navigation system, i.e., choose the maximum slope difficulty they want to encounter when navigating from point A to point B, and look at the scoreboard.

Figure 42. Menu without authentication
Users can also log in, using the credentials provided when they received the devices, i.e., LoRa tracker and PIQ Robot (Figure 43).

![Connection to the account of the skier](image)

*Figure 43. Connection to the account of the skier*

When the users are connected (Figure 44), they have access to more features such as the statistics obtained during their descent, as well as location information of one or several LoRa trackers (e.g., their own location information + location of objects, assets, family members, friends, etc.)

Users' location data is available by the LoRa tracker they are wearing (Figure 45). To get a place, by pointing it on the map, the corresponding route consisting of the slopes and ski lifts available in the station are suggested on the navigation display. (Figure 46). When the user leaves the navigation system, i.e., clicking on “Leaving the navigation”, a form is displayed to get the feedback from the user about this route recommendation.
Figure 44. Complete menu of the application

Figure 45. Displaying the user location
In the *My Statistics* menu (Figure 47), the skier can have a look at the height they just went down, the maximum carving angle from the vertical, the angular entry speed into a turn, the maximal force of the entry into the turn, the airtime, the acceleration at landing, and type of jump he did during the descent. The values of the statistics are reset on every descent.

The statistics are used to create the scoreboard of the station (Figure 48). The scoreboard allows skiers to compete in a friendly way to “conquer the slope”.
2.5.2 User engagement and pilot phase

Initially, in the Description of Action, it was described that an amount of 50 users in the ski resort of Chamrousse will be involved in the pilot. In order to involve as many skiers as possible, multiple channels have been used.

The first one is the organization of a hackathon (Figure 49 and Figure 50). During this 1-day event, the idea was to test the application in Chamrousse and receive feedback for possible improvements in the same day. Thus, the participants had access to the devices, could wear them and use the application. They could also access directly the data on the platform to create new services. They have brainstormed with new interesting application cases. The winning idea was “dynamic slope ranking”, which was about ranking the slopes from 1 to 10 based on some dynamic difficulty parameters such as snow quality, number of people on the slope, weather, etc., instead of having only the usual 4 levels: green, blue, red and black. The winning team won a 1-season ski pass from the Chamrousse station.
The hackathon was the beginning of the long term trial season, which continued with the second channel of communication, which was to ask seasonal skiers in Chamrousse to wear the devices and use the application. Even if Chamrousse is not officially part of the project, they helped a lot for the installation of the infrastructure and the communication with the skiers.

The final channel of communication used to recruit skiers is through the sport association of the CEA that spends 2 days per week (Wednesday and Saturday) skiing in Chamrousse for teaching adults and children how to ski. The trial is still ongoing, we are continuously gathering feedback.

### 2.5.3 Looking at the evaluation phase

The Smart Skiing metrics [6] are listed in Table 4. They are derived from use case agnostic KPIs. The use case owner and the skiers will evaluate the testbed and the defined metrics. The evaluation will be performed before the end of the pilot phase, i.e., end of May 2018.

<table>
<thead>
<tr>
<th>Metric ID</th>
<th>Metric title</th>
<th>Evaluation tool</th>
<th>Evaluation owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>SK_001</td>
<td>Scoreboard of the ski slope</td>
<td>Questionnaire</td>
<td>Skier</td>
</tr>
<tr>
<td>SK_002</td>
<td>Connection availability</td>
<td>Self-assessment</td>
<td>The smart ski use case owner</td>
</tr>
<tr>
<td>SK_004</td>
<td>Privacy policy</td>
<td>Self-assessment</td>
<td>The smart ski use case owner</td>
</tr>
<tr>
<td>SK_005</td>
<td>Interoperability</td>
<td>Self-assessment</td>
<td>The smart ski use case owner</td>
</tr>
<tr>
<td>SK_006</td>
<td>Number of users</td>
<td>Self-assessment</td>
<td>The smart ski use case owner</td>
</tr>
</tbody>
</table>
2.6 Smart Resort Management

As a brief summary, the smart resort management pilot can be defined as the elaboration and deployment of the initial idea called Smart Skiing use case [1]. As a brief summary, smart resort management pilot can be defined as the elaboration and deployment of the initial idea called smart skiing use case [1]. Basically, this use case is materialized in a web application to enhancing the traceability of resort assets, valuable belongings, children, disable or senior people location for the resort visitors and managers at Alpensia, which is one of the ski resorts in Pyongchang Olympic area. The main objective of this trial is to assess the feasibility of the WISE-IoT developments from WP2 and WP3 related to interoperability among the oneM2M platform (Brightics IoT - SDS), sensiNact platform (CEA) and LoRA protocol. Once the IoT tracker collects the data on the LoRA protocol, the interworking proxy entity transforms the data into oneM2M standard for Brightics IoT. On the other hands, if SensiNact collects the location data of skiers as a gateway platform and sends the data to Brightics IoT in the manner of oneM2M standard to achieve the interworking cross continent scenario, the location data will be displayed on resort management application providing the traceability of Chamrousse. However in this section, the testbed is intended for testing resort managers oriented use cases. The skiers use cases are handled at the EU site, in Chamrousse (see Section 2.5).

In the following subsections, the different aspects related to the pilot, from the point of view of the features which allow end users to monitor the location of IoT trackers in the resort management application are explained, as well as the user engagement. There will be no description of the technical aspects and integration since that part has been described in already delivered documentation [2] [3].

2.6.1 Smart resort application (IoT Tracker Service)

The smart resort application gets the location data from LoRA trackers and stores it in the Brightics IoT oneM2M platform. By using this information, and as pilot services, two applications have been developed: one for the resort managers and the other one for the resort visitors.

2.6.1.1 Application for resort managers

Resort managers in Alpensia have suffered from a lack of traceability regarding missing belongings, children, and even corporate vehicles within the Alpensia resort. When IoT trackers are attached to whatever they want to know the current location of, resort admin applications offer the features below, providing a monitoring service via a web application

- Users management
- IoT device management
- Show IoT trackers location and lending status on a map
- Show an IoT tracker location history
- Show the person info. Who borrowed the IoT tracker
- Record IoT trackers usage history

Figure 51 shows the main screen of the smart resort management app. In this example, the location of each IoT tracker is shown on the map. On the left side, there is a search area to find a specific IoT tracker by search keywords. In the search menu, names of the IoT tracker are used as keywords. When there is a match(es), the searched IoT tracker is shown on the map.
By selecting a marker in the middle of the map, the tracker information will be displayed (Figure 52). This page includes the number of the IoT tracker, the name of the user and the latest update date and time. At the bottom, there is a button named “location history” that loads historical data of the IoT tracker.

When the location history button in the information window is clicked, the detailed information will be displayed as presented in Figure 53. On the left side, there is a historical data list of the IoT tracker sorted by recent date and time, and all the location points during the period will be shown on the map.
Figure 53. Location histories of an IoT tracker on the map

Figure 54 shows the heat map for resort managers. By collecting all the location data from IoT trackers, the heat map is displayed in a graphical manner. It can be seen where the hottest spot is and how much data is exchanged at Alpensia via the heat map service.

Figure 54. Heat map service for resort managers

Of course there is a rental service in the resort admin application for resort managers who work at the concierge service at the front desk. To use the Wise IoT location tracking service for monitoring purposes (e.g., tracking valuable belongings or child), users' room number, where they are staying, is required. After that the resort manager who is in charge of lending IoT trackers needs to put some information of visitors into the resort admin application (Figure 55) such as the room number, telephone number, email and the number of the IoT tracker. When the resort manager clicked the Lend it button on the bottom, the lend record is stored in the system.
2.6.1.2 Visitors mobile application

Following there are enumerated the functionalities available for the visitors who want to use the IoT tracker service. Also, there are presented a couple of screenshots of the mobile phone user interface (Figure 56).

- Show IoT tracker’s current location on a map
  - When users log-in via google account / kakao account
- Show IoT tracker’s location history
  - When users click the marker which represent location of current location in the middle
  - Blue dots on the screen indicates the location history during an hour
- Wise IoT project introduction
- Information about Alpensia resort

Figure 55. Lending service screen capture

Figure 56. WISE-IoT resort mobile screen captures
2.6.2 User engagement and pilot phase

Resort managers and resort visitors are the majority of users of the smart resort service. There are almost 100 resort managers who are working at the front desk, are relative with the IT tasks, facility management and rescue job as well. Initially, in the Description of Action, it was described that an amount of 150 users (resort managers and visitors who borrow IoT trackers) in the ski resort of Alpensia will be involved in the pilot.

To engage visitors for this location tracking service, an X-banner (Figure 57) has been posted at the front desk in the Alpensia resort. The X-banner not only advertises the IoT tracker service to visitors but also includes a simple user guide, how to get the IoT tracker, as well as the purpose of the service. Even if Alpensia is not officially part of the project, they helped a lot for the installation of the infrastructure and the communication with the visitors.

Since the Pyeongchang Winter Olympics, which is an international winter multi-sport event, was held between 9 and 25 February 2018 in Pyeongchang County, we decided to open the WISE-IoT tracker rental service as a pilot project for free during the Paralympics period by ourselves to promote our service and engage more users. Since IoT tracker is very helpful for disable people to track their location, we targeted Paralympics instead of winter Olympics. Once we opened the IoT tracker rental service and project promotion booth at the Alpensia Welcome Centre (Figure 58), there were many visitors who borrowed an IoT tracker to trace the location of children and preparing for missing children. Another visitor worried about the backpack which included valuable belongings. He lent an IoT tracker to secure the location of his bag.

Figure 57. IoT tracker service X-banner
2.6.3 Looking at the evaluation phase

The smart resort management metrics [6] are listed in Table 5. They are derived from use case agnostic KPIs. The use case owner and the resort managers will evaluate the testbed and the defined metrics. The evaluation will be performed before the end of the pilot phase, i.e., end of May 2018.
**Table 5. Summary of metrics for Smart resort management use case**

<table>
<thead>
<tr>
<th>Metric ID</th>
<th>Metric title</th>
<th>Evaluation tool</th>
<th>Evaluation owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>SK_001</td>
<td>User Experience</td>
<td>Questionnaire</td>
<td>Resort managers</td>
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<td>SK_002</td>
<td>Connection availability</td>
<td>Self-assessment</td>
<td>The smart resort use case owner</td>
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<td>SK_004</td>
<td>Privacy policy</td>
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<tr>
<td>SK_005</td>
<td>Interoperability</td>
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<td>SK_006</td>
<td>Number of users</td>
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</table>
3 Conclusions and Future Work

As a follow-up to D4.1 Service Requirements and KPI [6], and as an addition to D4.2 [12], in this deliverable we have provided information regarding the phases of the field trials to be conducted for the Smart City, Smart Skiing and Lifestyle use cases. This includes the descriptions of the functionalities of the pilots, information about the user engagement and pilot phases, and some insights about the future evaluation steps.

As these trials will be largely based on the users’ feedback and reviews during testing and the pilot phases, the functionalities may be improved whenever necessary. Regardless of the changes, these use cases are designed based on the use case descriptions provided in D1.1 [1] and to satisfy the requirements and KPIs outlined in D4.1 [6].

The described trials are to be conducted for Smart City, Lifestyle and Smart Skiing settings, at two sites in Europe and two sites in Korea. These trials serve as demonstrations of the Wise-IoT architecture, and at the same time they offer services for end users at the trial sites. The results of these trials will lead to a twofold objective: serve as basis for further improvement of the use cases and WISE-IoT architecture and developments, and obtain the basis for the evaluation of the success of WISE-IoT concepts, which will be presented in future deliverables. More specifically, this work will be reflected in D4.3 “Field Trials Evaluation”.
4 References

12. WISE-IoT D4.2 – “Field trials with end users”, 2017