



D3.3.2

RESULTS AND FEEDBACK ANALYSIS – FINAL – 1ST VERSION

March 2015

ABSTRACT

This document provides an overview and a comparison of the results of all experimentations with Smart City Scenarios of FI-CONTENT 2 in Brittany, Berlin, Cologne and Barcelona. It reports on the respective implementation of the experiments and summarizes, in a condensed form, the processes from planning and execution of the experiments to evaluation of the collected user data in the ongoing 2nd experimentation cycle. An updated version D3.3.3 will be provided in M31 including all the experiments incorporating the results of the new open call partners.

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EXECUTIVE SUMMARY

The aim of this document is to provide an overview and a comparison of the results of the second cycle of Experimentations of Smart City Service platforms, which was focused on planning and running large-scale experiments. The document also contains a final report on first cycle experiments that were continued after M12 and became finalized until M24. An updated version D3.3.3 will be provided in M31 including also the two experiment in Fallas, Valencia and Tenerife, incorporating the results of the new open call partners.

The report covers all phases of experimentation, from planning and execution to the evaluation of the collected data, in a condensed form.

Researchers worked with a different set of methods to involve the users and to capture the feedback. The document will put all approaches and results next to each other to allow a comparison of the outcomes and to facilitate the knowledge exchange between all sites. In conclusion, generalized findings and recommendations are presented.

The results especially address new Phase 3 projects, intending to make use of the featured technologies to benefit from the experiences, outcomes and findings.

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ABBREVIATIONS

API	Application Programming Interface
AR	Augmented Reality
CG	Computer Graphics
CENR	Content Enrichment SE
FAQ	Frequently Answered Questions
FI	Future Internet
FI-PPP	Future Internet – Public Private Partnership
GE	Generic Enabler
GPU	Graphics Processing Unit
HTML5	HyperText Markup Language, version 5
OCDB	Open City Database SE
POI	Point of Interest
SCC	Smart City Services
SCG	Smart City Guide
SE	Specific Enabler
SUS	System Usability Scale
UX	User Experience
XML3D	Three Dimensional Extensible Markup Language

1 - FINAL REPORT ON FIRST CYCLE EXPERIMENTS

1.1 - Overview on continued first cycle experiments

Date	Site	Scenario	Leading Partner(s)
September 2013	Berlin	On site visit	Fokus
March 2014	Berlin	On site visit	Fokus
March 2014	Barcelona	On site visit	Fokus, I2CAT
April 2014	Barcelona	On site visit	Fokus, I2CAT
February 2015	Barcelona	On site visit	Fokus, I2CAT

Table 1: Overview on continued first cycle experiments

1.2 - Scenario: On Site Visit (Barcelona, Berlin)

1.2.1 - Introduction to the tested application and the experiment

The Berlin experimentation site was officially opened during IFA, the world's largest trade fair for consumer electronics, which took place in Berlin from 6th until 11th September 2013. Fraunhofer FOKUS demonstrated a very early version of the Smart City Guide (SCG) Web App based on our HTML5 compliant web application. 19 users of different age, gender and background recruited from consumer and trade visitors at IFA 2013 to test the SCG web app. The app offered several functions ranging from access to the Open City Database (OCDB) to receive information on sights, a map to find and localize Point of Interests (POIs) as well as the creation of user generated content. The visitors tested the content creation feature of the SCG app by creating new points of interest, uploading photos and complement existing database entries.

Since the first experiment, further enablers have been integrated into the SCG web app, which are the Content Enrichment (CENR) SE and the Object Storage GE. This second version of the app was tested in the FOKUS iTV lab with five users in March 2014 as a preparation for the Barcelona test at the end of the month. The objective of this experiment was performance and usability testing. We integrate user interactions to like and rate POIs with the app. The CENR SE was integrated and users could mark interesting elements in a photo and give further information to this element.

The experimentation was then brought over to the Barcelona site, for a further round of field tests with users. Two connected experiments were planned, in March and May 2014, to probe deeper into aspects of the user experience with the proposed application. A final user trial, in the shape of a geocaching competition with the SCG, was conducted in February 2015.

1.2.2 - Update on test objectives

For the first experiment we wanted to know if people with completely different backgrounds would use such a smart city app and on what device they prefer. This was also the first live test out of the Fokus environment of the OCDB for this time interval. We wanted to find out if the OCDB is stable enough to handle many changes and users at the same time.

With the second experiment we developed the SCG with a new JavaScript framework called Meteor. We had this small test to find if the new navigation design is clear to the user and if there are any bugs that should be solved for the bigger experiment one month later.

The objectives of the experimentation in March and May in Barcelona were the validation of user experience (how high users rate several facets of the app), usability (to detect user pain points and figure out ways to solve these), to obtain feedback on functionalities (favorite, least used, suggestions for additional ones), and to generate data on what was missing in the app from the user's point of view (features, information currently not covered or not well covered in the app).

For the final experiment in February 2015, the user trials had two goals: First, to validate a successful field deployment of the demonstrated enablers in a comprehensive and integrated web app. And second, to showcase, via an innovative user-driven experiment format for the SCG, such as the geocaching competition, the flexibility, adequateness, and readiness of the demonstrated enablers to support innovative use cases in the field of geo-located services.

1.2.3 - Update on applied methods and tools for evaluation

At the IFA in September 2013 the users decided by their own if they want to test new FI-CONTENT 2 technologies like the SCG. After testing the app they could fill out a two pages questionnaire.

For the second experimentation the five students with informatics background tested the app on different smartphones and tablets. The bugs were reported immediately in a bug tracking system. Design issues were discussed face to face with the designer and developer.

The methodology used for the first two Barcelona experiments can be described as a task-based outdoors user test. A panel of users were given a set of tasks that they had to attempt to complete, and sent around the city to predetermined POIs. Data from these POIs was collected and analysed by the FOKUS team.

Additionally, after the test, the users returned to the venue and were administered an online questionnaire with overall user experience metrics: System Usability Scale (SUS), recommender score and other aspects of User eXperience (UX). The experiment ended with a debriefing focus group session with the test users, in which the participants were prompted to explain their experience with the test application. A researcher probed further into the recurring issues and topics, and asked users to think about solutions and recommendations.

The evaluation framework of the geocaching experiment was based on a post-event focus group, and an online questionnaire with SUS and UX items. This allowed for a situation in which the qualitative feedback could be used to contextualize and understand the user behavior that was observed through the quantitative analytics.

1.2.4 - Update on infrastructure requirements

For the first test in Berlin in September 2013 the SCG was hosted on *Mashweb*, a Fraunhofer Fokus Server with Port 3008. The Web App was optimized for the Samsung Galaxy 3 (Android).

As an outcome from the first experiment we decided to deploy the SCG on an own server for the next experimentations. The SCG and the OCDB run on the same machine and could be find on scg.fokus.fraunhofer.de and ocdb.fokus.fraunhofer.de

For all three Barcelona tests, each participant was required to provide his/her phone and data connection for the experiment, thus ensuring that a broad range of devices was available for testing. Since the version of the web application that was used for the tests had been optimized for Samsung Galaxy S III, lower-end devices were not recommended; nevertheless, no volunteer was turned away on the grounds of not having a good enough device. The relevant enablers (OCDB) and the experimentation web app (SCG) were deployed on an own server in Fraunhofer FOKUS' premises, to test the performance of the app and its enablers when accessed from a distant location.

1.2.5 - Update on user recruitment and user involvement

The experiment in September 2013 was conducted during the IFA trade fair. Visitors to the FOKUS stand were recruited to test the app, fill in questionnaires and be interviewed. Students from the Beuth University conducted the interviews. FOKUS staff were on-hand at all times to oversee the process and answer any questions or deal with any technical problems that arose in the course of the experiment.

For the second experimentation was decided to act with students of Fraunhofer Fokus. They received different smartphones and tablets to test the app mostly of its functionality.

The participants of the March and May 2014 Barcelona test groups were recruited independently, to avoid learning effects that could potentially affect the validity of usability results. A total of 12 users took part in the experiments, seven in the first and five in the second. The profile of participants was mixed, in terms of professional profiles (including some developers and some frequent travelers, but also professionals from the humanities), socio-demographic composition (with men/women and younger/older participants), and residence (some users were residents of the city and some of them lived outside). Knowledge of the English language was not essential, as setting such a requirement would have skewed the sample heavily towards the college-educated.

For the February 2015 experiment, a mixed group of 20 volunteers with technical and non-technical backgrounds was sought. About 50% of participants were technology-related professionals (either still in college or already practising). The remainder of the test group had a background in the humanities, the arts, or business services (i.e. human resources).

In sociodemographic terms, the average age was 30.75 years old, within a variable range of 20-45. Despite our best efforts to obtain a gender-balanced mix, the number of men in the test group was larger, in a proportion of 30% women and 70% men.

1.2.6 - Report on running the additional experiments

The first test in September 2013 went technically very well. We properly expected some more testers at the IFA, but we were happy about the qualitative results. The visitors of the IFA spend much time to play with the app and fill out the questionnaires. All participants used the same smartphone devices.

To prepare the third experimentation we tested the SCG on different devices. There were some design issues by displaying the app on the older smartphones and tablets. The participants were in a very close contact to the developer. All bugs were documented at a bug-tracking tool. The participants tested the bug again after the developer marked this specific task as resolved.

The third and fourth experimentation at Barcelona was a little bit difficult. We got the test round in Berlin before with some older devices, but in Barcelona the participants bring their own devices with them. Some of

them got such a bad Internet connection that they were not able to test the SCG and the on-site visit scenario.

1.2.7 - Report on the final outcomes

At the first test in September 2013 the users filled out questionnaires after testing the app. The outcomes of these were that the design was particularly well received by the users. Similarly, the use was rated very positively by the simple operation of buttons. But some actions of the buttons and navigation were unclear. In addition to the graphical properties, it was noted that there is a great interest to use such a smart city app. Particularly the app would be accepted on the smartphone (18), but there is also interest to use it by tablet (5), PC (2) and TV (2) (multiple answers were possible).

With small changes of the design and navigation the users of the second experimentation in March 2014 were more satisfied than the results of the first one. The users found some bugs by the CENR SE feature, which we tried to allocate till the next experiment. The user management worked very well and the manipulation of the OCDB too. The tests also shown, those students mostly like to use the SCG on a smartphone or a tablet. The PC and TV were not interesting for them.

At the Barcelona experiments, the data-generating instruments put in place for the tests allowed for the gathering of useful quantitative and qualitative evaluation data. The log analysis and online questionnaire results were further complemented by the focus group inputs, which provided invaluable information to contextualize user behavior observed in the application logs (i.e. why users seemed to get stuck at particular points).

In the March and May 2014 experiments, a set of UX metrics and user statements (responses to open-ended questions) were collected, indicating that although the concept of a SCG was very attractive to users, there were some critical issues with the test version of the web app that needed urgent fixing. These issues were alone responsible for the lower scores collected at some key usability and user experience metrics, and were deemed to be very likely to improve sharply if these issues were corrected according to the users' contributed suggestions for improvements.

This assumption was proven correct at the final February 2015 experiment, where the SUS scores of the web application rose to an acceptable level (see Figure1 below).

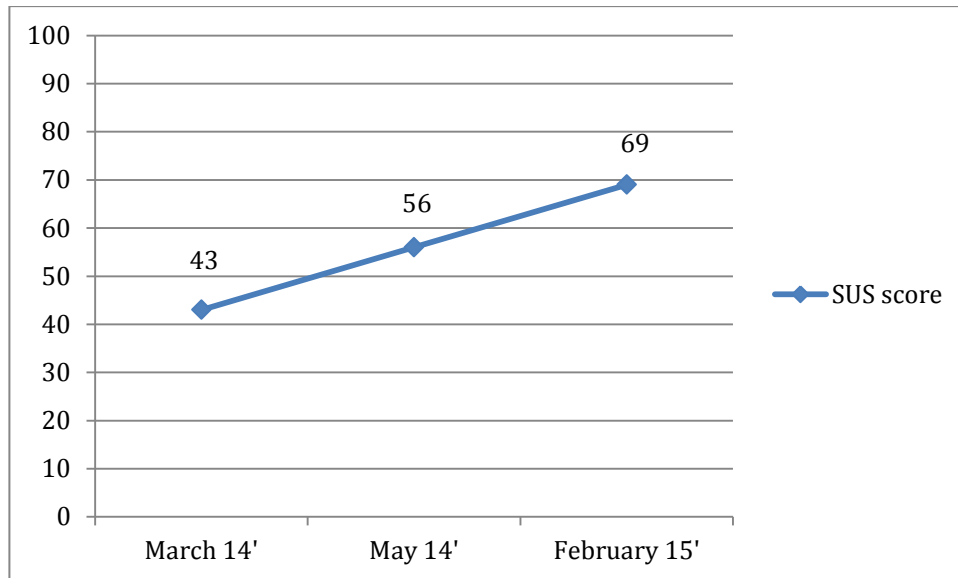


Figure 1 Evolution of System Usability Scale (SUS) scores throughout the experimentation phase

Also, at this final test several key dimensions of the application were also rated favorably by the users, as can be seen below in Figure 2:

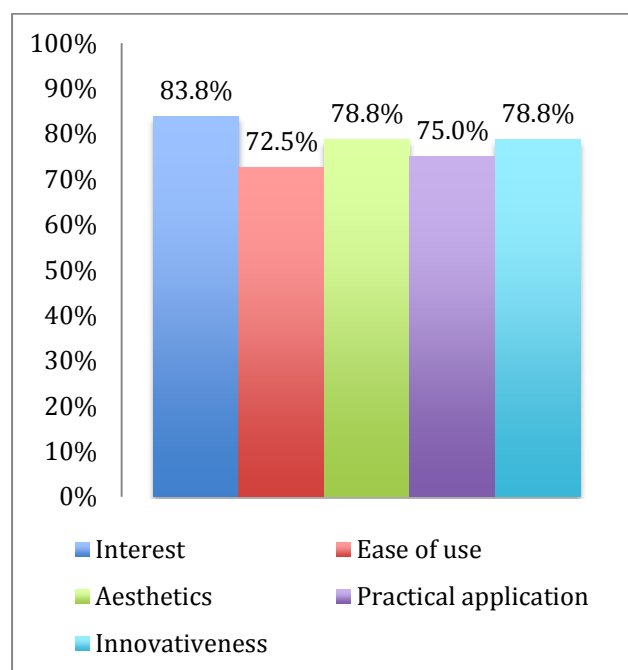


Figure 2 Scores on several dimensions of user evaluation of the SCG

1.2.8 - Summary of findings and evaluation

The first experimentation has shown, that there is really interest in such an application and mostly for mobile devices. But also there were some problems in the design of the button and the swiping thru the layers.

The outcomes of the second experiment were more technical than in the first experiment. The students found bugs and reported them. That helps for a solving of the issues and retesting again. Also it makes the app more stable for the next experimentation.

The March and May 2014 experiments in Barcelona provided valuable data on the application's technical performance in demanding real life conditions, and allowed the FOKUS team to tackle several important issues with the deployment of the enablers. Many usability problems were detected, to which user co-created solutions were worked on. The most troublesome issues were with the responsiveness of the application on different devices, and with some problems with parts of the user interface. On the user experience side, the most important user pain points were spotted, to be addressed in subsequent versions of the SCG. Also, a list of recommendations and suggestions for improvements and enhanced functionalities was compiled, which can provide useful inputs to developers in future work to enrich and complement the web app.

In the final February 2015 experiment, the innovative gamification scheme devised for the user trials succeeded in capturing the attention of the test users. The competitive and ludic social dynamics generated on the SCG application were able to feed the tested technologies (the application and its constituent enablers) with a stream of user-generated activity and data that tested the deployment of the enablers in a demanding real-life scenario.

Overall, the SCG web-based application worked as intended, and was able to provide the innovative technological foundation for the geocaching competition. On the front end, there were some layout and UI responsiveness issues with several devices and browsers, which made it somewhat difficult (but rarely impossible) for some users to take part in the competition. This had a somewhat negative impact in the user evaluation of the application in terms of its ease of use and practical application, but did not affect the positive scores in terms of the application's interest for users, its aesthetic value, and its perceived innovativeness.

2 - SECOND CYCLE EXPERIMENTS

2.1 - Overview on new Scenarios and Experiments in 2nd exp. Cycle

Date	Location	Scenario
December 2014	Brittany	Transmusicales Festival
March 2015	Valencia (Demo)	Data fusion (to be reported in D3.3.3, M30)

Table 2: Scenarios and Experiments in 2nd Experimentation Cycle

2.2 - Scenario: Festival (Brittany Experimentation Site)

2.2.1 - Introduction to the tested application and the experiment

The Festival scenario has been tested during the “Transmusicales” Festival in Rennes between the 4th and the 7th of December 2014.

Each year, this festival gathers about 65.000 attendees. Among them, about 300 have volunteered to test the applications we proposed, and 100 agreed to fill the feedback questionnaires.

During this festival, four apps were tested:

- *Screen*: Enable the broadcast of real-time updates, display social feeds, see the following shows and venues, show festival map and advertising from partners and sponsors
- *Staff/Contributor*: EvenTribe provides volunteers and security staff with an amazing tool to improve their efficiency: they can send live messages to all screens and apps, and manage different crowdsourcing operations easily.
- *Stand*: The staff needs to be focused on their job: serving customers. This app allows them to broadcast offers and messages to all attendees through screens, in a fast and intuitive way.
- *EvenTribe*: A festival is way more than concerts. Let the attendees' benefit of a groundbreaking immersive experience through the app: Augmented reality view, real time updates, social feed, schedule...

List of the tested functionalities:

Screen:

- I see the live map with the affluence level of all services and locations.
- I see logos and adverts.
- I see the planning and venue of the current and next shows.
- I see the news feed the staff decided to put on.

Staff / Contributor:

- My staff or volunteers update the status of each location.
- I can push featured news and update the screen's news feed.

Stand:

- I can identify my location with a QRCode.
- I can push updates with a very simple 3 button UI.

EvenTribe:

- I see the live map with real-time info overlays around my location.
- I can launch the augmented reality view of the map.
- I witness what people are putting on social networks during the festival.
- I check the current shows, and the ones coming right next.
- I see a planning of all the shows of my festival.
- I see my partners logos and a QRCode to share the app with my friends.

2.2.2 - Test objectives and expected outcomes

Through this large-scale experimentation, we aim at:

- Delivering valuable apps, based on FIWARE technology (including specific enablers developed under the FIContent project, to bring new services and create a new experience of festivals for both attendees and staff members.
- Getting information regarding the level of attractiveness and utility of these applications
- Improving the applications by taking into account the feedback of real users.
- Identifying technical problems and evaluating reliability of the applications
- Making the final validation before launching the products and deploying these applications in other festivals.

2.2.3 - Applied methods and tools for evaluation

During development phase:

The first step of the methodology was to collect the needs of festival organizers. We considered that they were best placed to give these inputs. Moreover the festival already had a smartphone application and we should therefore develop applications that provide additional features without competing with the existing application. Several constructive working sessions helped define with the festival organizers the new functionalities they needed.

Then developers from eBIZ built mock-ups to ensure that demands of end customers were well understood. Several intermediate versions were produced, which helped refine the product.

Finally, a final version was produced for experimentation.

Customers would have wished that the application could run on Android and iOS. Unfortunately, deadlines were too short and only the Android version was ready for the December festival.

During and after the experimentation:

To get user's feedbacks regarding the usage and usability of the applications, several methods and tools were used:

- Create log files
- Ask the users to answer to one questionnaire

The log files is the observation of usage statistics from applications, which were provided by eBIZ.

An online questionnaire developed by ILB has been submitted to users at the end of the experimentation to gather the feelings of users. This questionnaire integrates questions to evaluate the user experience in terms of usability, attractiveness and appearance for each of the applications.

100 users have completed the questionnaire.

2.2.4 - Infrastructural requirements

Terminals:

Dedicated to screen App:

13 TV set with HDMI port, Android HDMI key on each

(As the festival took place simultaneously in several concert halls it was necessary to cover these different places).

Dedicated to evenTribe App:

Smartphones (Android) provided by festival attendees

Power Bank (rechargeable batteries): provided by the FIContent Project to attendees, in order to have a self-sufficient energy for the experimentation

Dedicated to staff/contributor and stand Apps:

Smartphones (Android) and tablets provided by the staff and ILB.

Wifi Network:

A dedicated Wifi Network was deployed for the experimentation, to allow attendees reaching the evenTribe APP without bottleneck phenomenon.

Servers:

Servers were provided by eBIZ.

2.2.5 - User recruitment and user involvement

An information message dedicated to the FIContent2 experiment was put in line on the Transmusicales Web Site and on the Images-et-réseaux blog (Le mag numérique) some weeks before the festival, as well as through the social networks. In this message, it was asked for interested people to register on the ImaginLab Portal. So, we got 256 registrations before the beginning of the festival. In addition we let the opportunity for people to register directly at the FIContent2 booth during the 3 days of the experiment. Thus, around 300 people were involved in the experiment.

Two days before the event, registered people were asked, through a mass mailing, to download the EventTribe App and to join the FIContent2 booth when arriving at the festival in order to check that the app was downloaded and running properly. A Powerbank (high capacity charger for smartphone) was available for interested people. People were informed at the same time that they would be asked to answer a questionnaire at the end of the experiment.

Most of the testers came as soon as the first day of the festival and could experiment during two or three days. Some of them came only the second or third days.

2.2.6 - Report on running the experiment

A FIContent2 booth was set up for the whole duration of the experimentation, where the users could find all the technical support (by eBIZ) and logistical support (by ILB) they need.

The most positive effect of the experimentation was the fact that new users came to the booth to register.

On the other hand, some users got trouble with their smartphones which were too old to run these new apps which required an android version ≥ 4.0

2.2.7 - Report on Outcomes

Two days after the end of the experiment, a survey was sent to the users registered for the experiment. At the end, we finally got exactly 100 answers with the following users profiles.

2.2.7.1 - Users Profiles:

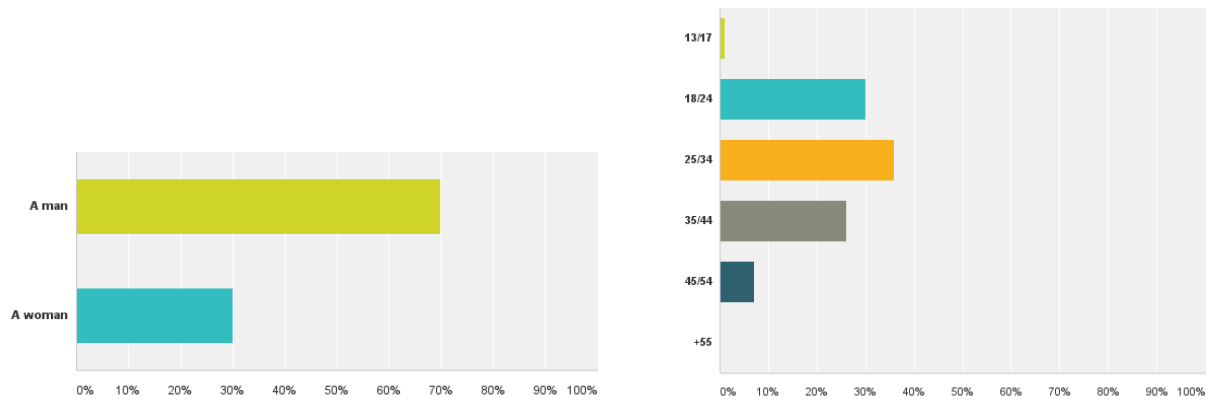
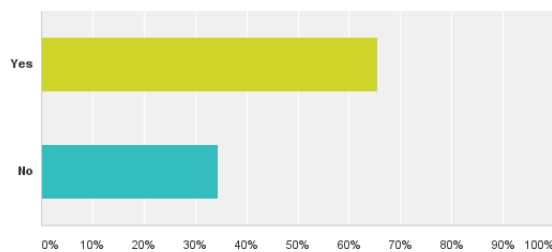


Figure 3: Users profiles (genre and age)

2.2.7.2 - General feeling about evenTribe App

66% of the users said that this application made their festival experience globally more comfortable



And 70% shared the application with other people around them

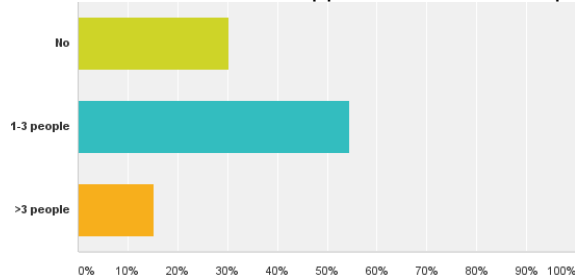


Figure 4: General feeling about evenTribe App

2.2.7.3 - Most attractive features:

When asked about their favourite features, festival attendees answered that they preferred information about current (90 %) and future (86 %) programming, and then about the affluence to the various points of interest, as shown by the following figure.

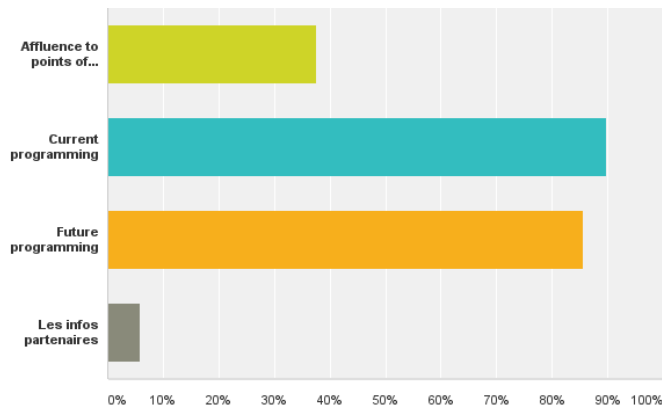
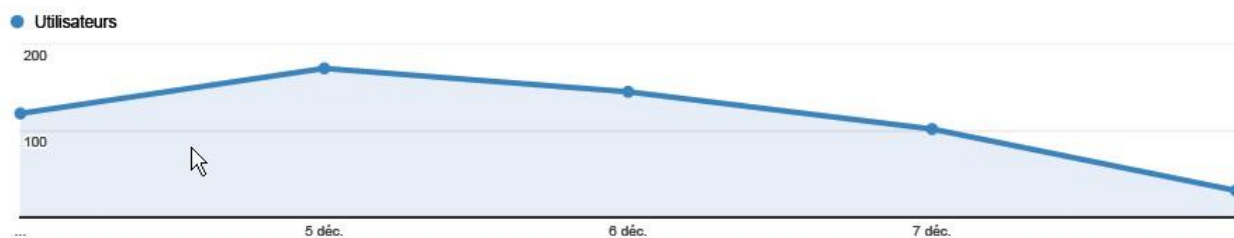


Figure 5: Most attractive features

2.2.8 - Traffic observed during the experiment

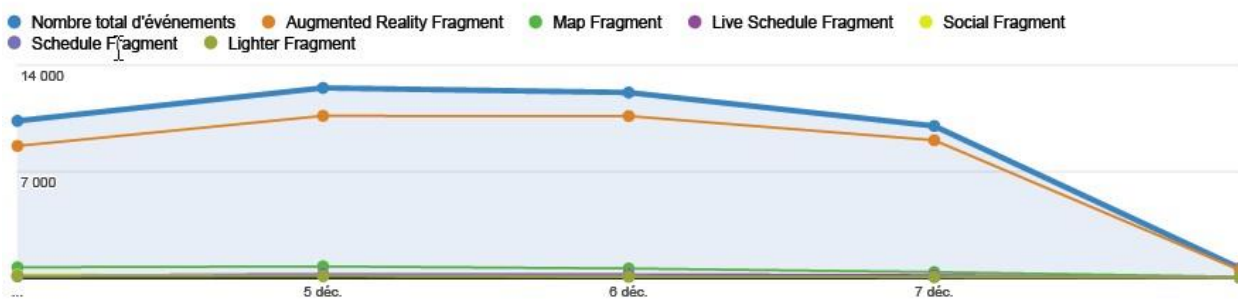
Number of users:



Registered Users	Opened Sessions	Visualized screens	Screens/session	Average length of sessions
279	4203	5799	1,38	6 mn 51 s

Number of events recorded on the server:

Statistics stored on the server have shown the number of requests to the server by each feature during the experiment. It seems the Map 3D is by far the one that consumes the most resources and probably explains the limitations observed with some older smartphones.



3D MAP	39502
--------	-------

2D MAP	2424
CURRENT PROGRAMING	712
SOCIAL BUZZ	468
FUTURE PROGRAMMING	442
TOTAL	43458

Figure 6: Traffic observed during the experiment

2.2.9 - Summary of findings and evaluation

Function “Affluence to point of interest (2D Map)”

82% used it and found it interesting.

And 90% found it innovative.

But it had an impact of their wanderings for only 38% of them.

Suggested improvements:

- To be able to locate friends on the map
- To give the name of the artists by clicking on the "Hall" icon
- Having access to concerts and restaurant menus by clicking on the icons
- Issuing an alert when the gauge is almost reached for the next concert taking place in 15 minutes
- Linking programming and halls fill rates
- Colors of pictos: take into account the needs of color-blinds.

Function “Affluence to point of interest (3D Map)”

This function could be launched only on 69% of the smartphones (not on the oldest one).

82% of those who tested it found this function innovative.

But 87% considered it's doesn't help them in their wanderings (ergonomic limitations?).

Suggested improvements:

- To optimize the application so that the less powerful phones can have optimal and fluid rendering
- Zoom too large, difficult to identify in relation to the whole site

Function “Social buzz”

Users have predominantly (> 40%) not used this feature, either because they did not understand how to use it, or because they considered that it did not bring improvement compared to already existing functions.

Suggested improvements:

- Enable to click on the pictures to enlarge them
- It would be nice to allow users to interact with each other like a forum

Function “Schedule”

The users deemed this feature most useful. More than 80% of them have used it.

Suggested improvements:

- To simplify presentation for readability
- To be able to put alerts on certain groups to be notified a few minutes in advance of their stage

- It would be nice to address directly the current concerts rather than always the 1st schedules.
- Indicate for each artist: music genre, a small summary, as can be found in the official program.

Function “Screen

Nearly 70% of users have enjoyed this feature that seemed to them innovative and useful although some of them would have wished larger screens.

Suggested improvements:

- To have larger screens for better visibility
- To have on the same screen at the same time the concerts and affluence

3 - SUMMARY AND CONCLUSION

3.1 - Scenario: On-Site Visit

The on-site visit scenarios were very user-oriented. We got very technical tests in Berlin in a lab-test and also tested the scenario with non-technical participants in Berlin and Barcelona in field trails. Mostly we got between 5 and 19 testers. The results we collected were documented in questionnaires and bug-tracking systems. It was also a very close work between the two experimentation sites. For this scenario we tested three enablers:

1. Open City Database SE
2. Content Enrichment SE
3. Object Storage GE

The two SEs were deployed at a Fraunhofer Fokus Server in Berlin. The Object Storage was deployed at the Xifi Node Berlin. For our testing the Object Storage worked well, but it was a lot of work to integrate it in our scenario. We only used the Object Storage GE to push there uploaded media files. In this case other web solutions may be more comfortable and easier to use.

3.2 - Scenario: Festival

The experiment carried out during the Transmusicales festival has shown how easy it was to develop applications very quickly in the area of festivals with FIWARE generic enablers and FIContent Specific Enablers.

The tests conducted with users during this large-scale experiment highlighted the strengths and weaknesses of the application both technically and in terms of usages. The results of the experimentation are briefly summarized as follows:

- Users mostly perceived the functionalities as innovative (specially the 3D map) and very useful, but some of them got difficulties to run these functionalities properly due to technical limitations of their smartphones.
- For companies who would use the enablers, the recommendations are:
 - to associate users to the early phases of development to be sure that the developed product meets expectations of users
 - as far as you are developing apps for smartphones, it is important to find the right compromise between new technologies and performance provided by a heterogeneous fleet of smartphones
 - to ensure compatibility of enablers with smartphones and to be precise on the minimum system requirements

After taking into account corrections and changes proposed by the users during the experimentation, eBIZ plans to make of evenTribe a marketable product dedicated to all festival organizers.