First demonstration and field trial

Deliverable D6.3

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1 Introduction

In this deliverable, the course of the first field trial at Dranouter Festival is reported. This took place from August 7th – 9th. All partners of the ICoSOLE consortium were present and tested out their first prototypes. Some prototypes were already integrated to some level, which enables us to align our software from very early stages on.

During the festival, a lot of recordings were stored as well. These recordings will be used as a test pool for future prototypes. Furthermore, they can be very valuable to showcase current prototypes on conferences and other events.

Participating in a real event posed a lot of hurdles to overcome, too. Therefore, we started planning every part of the field trial from very early on. We also had a lot of support from the festival organisation, which made this test a real success.
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2 Executive Summary

This deliverable consists of two main parts: the preparation and the field trial itself. The lessons learned and feedback are gathered in D2.4.1.

The preparation was a big part of realising the first field test. We had first meetings with the festival organisation well before the start of the event (as from late 2014), in order to prepare everything as well as possible. We also had meetings with the companies organising the regular audio and video recordings, and we were allowed to use their output as well. There was a legal side to this field test as well. We had to draft a contract with all of the bands we wanted to record. In the end, we succeeded to convince at least two bands a day to allow us to do our recordings, which exceeded our expectations greatly. To test out the user-generated side, we recruited test users and informed them as good as possible prior to the event. To have a clear point of contact during the festival, we organised a manned Wall of Moments booth on the festival site, to inform test users, passers-by, and journalists.

We were present at the event a day earlier, in order to set up all our equipment, and were on-site the full three days. This way, we had the opportunity to redo a test if it failed the first time. We did a lot of different audio and video recordings during the event, professional as well as user-generated. On-site processing was done for testing out the live mixing engine and the live stream. Using this live stream and an online version of the Wall of Moments, we pushed content to outside users, brought up by our test users, as well. During the event, we were constantly pushing updates to the capture app in order to solve shortcomings, pointed out by our test users, quickly. Finally, we conducted an on-site survey concerning the use of apps by attendees during a festival.

During the preparation and the event itself, we recorded what was happening behind the scenes. Afterwards, we compiled an after movie of the event using this content. This deliverable follows the storyline of this video to great extent, and can be found on YouTube (https://youtu.be/VPHgf99pMQs).
3 Introduction

3.1 Purpose of this Document
Report of the first public demonstration and field trial.

3.2 Scope of this Document
Preparation of the field trial, course of the event, and lessons learned.

3.3 Status of this Document
This is the final version of D6.3.

3.4 Related Documents
Before reading this document it is recommended to be familiar with the following documents:
- D2.4.1: Evaluation of this field trial
- D6.2: Demonstration & Field Trial Plan
4 Preparation

Dranouter Festival is an established event, organized by professionals. We learned a lot about the course of events such an organization entails. We planned every detail beforehand, in order to be able to focus on the experiment itself during the event.

For this first field test in the "real world", the following requirements had to be met:
1. A contract with the festival organizer
2. Separate contracts with each of the participating bands on the main stage
3. Invite test users to the festival grounds (target set at about 60 people)
4. A Wall of Moments booth, to inform test users and passers-by

4.1 Contract with the festival organiser

In the contract with the festival organizer the following was agreed on:
- Permission to put up some ICoSOLE screens on the festival grounds, on these screens the Wall of Moments was shown during the three days of the festival
- Permission to put up a Wall of Moments booth on the festival grounds, see VRT on Figure 1
- Permission to put up a container to host the ICoSOLE team members and their equipment
- Permission to access the backstage, frontstage, and artist's village (to collaborate with band managers and to install and configure equipment)

Figure 1: Extract of Dranouter technical floorplan

4.2 Contracts with the bands

Because (almost) every band had a different opinion on how their content needs to be protected, we had to agree on separate contracts for each of them. We had three requests for every band, listed below.

4.2.1 Permission to capture audio and video onstage and in the audience

For this, the tour manager required exact positions of each camera/microphone, and the right to have them changed position or removed altogether. The fact that the cameras were small, and had fixed positions, was a plus in the negotiations.

4.2.2 Permission to stream the concert on The Wall of Moments website

As expected, this permission was the hardest to negotiate. Managers were very protective, and afraid the material might pop up on YouTube for everyone to see and download.
We were able to convince them by strictly limiting the access to the Wall of Moments website to our test users and some of their friends, instead of putting them online for anyone to see. Every user got unique access through their Facebook account. We knew exactly who had access, and when. Every user also needed agree to a disclaimer that stated downloading material from the website was prohibited. By creating these conditions, all but one of the bands we asked, finally agreed. In return, we offered them free access to the recordings we made of them, to use as they saw fit.

4.2.3 Permission for test users to film Moments during the concert and send it to ‘The Wall of Moments’

Under the above conditions, bands also agreed to this. Some bands even welcomed the user generated filming, and asked us to get the material afterwards. People would capture clips with their smartphones either way, but this way, bands also had access to this (sometimes valuable) content. Every bit of captured content arrived into our backstage container (Figure 2), where we did further processing.

![Figure 2: ICoSOLE backstage container](image)

4.3 Test users

Finding and motivating the test users proved to be a huge challenge. We opted for two types of users: the die-hard fans of the Dranouter Festival, who had already bought their ticket (often for the three days) and people who loved to go to a festival, and were interested to be our ‘test reporter’. We set these reporters one goal: capture interesting moments during the festival (Figure 3).

To find our reporters, we organized an intense media campaign, with a press release and notifications on all our social media. This was even picked up by the national radio news bulletin, which – of course – helped a lot. Three more national radio interviews were the result: two in news programs (‘Vandaag’ on Radio1, ‘Ochtendpost’ on Radio 2), and one on Studio Brussel, a specialized music program. In each of
these communications we advertised 30 free tickets for interested test users. The reaction was immediate: more than 100 test users subscribed.

VRT’s ‘Proeftuin’ was asked to do the intake, and screen these possible test users from the first day onwards. Thus, many data could be gathered (age, social class, family status, music preference). The group was finally narrowed down to half. Each dedicated test user on the Dranouter field could send five invitations to friends, who would then be able to login on the secured Wall of Moments Web site at home. We provided feedback both during and before and after the event via e-mail and Facebook. Afterwards, we conducted a survey both during and before and after the event via e-mail and Facebook.

With respect to iMinds’ WP5-related participation in the Dranouter field trial, a standalone pen-and-paper-based questionnaire was prepared and exploited during the field trial to implement an on-site survey among Dranouter visitors.

Figure 3: User-generated content during a performance

4.4 The Wall of Moments booth

The festival organizers offered us a very convenient location for our booth (Figure 4), right next to the main stage and our back stage container. In this booth our trouble shooting team was continuously present to help out test users with the app. Each test user received some free tickets to buy drinks. They could also borrow charged batteries when their smartphone’s battery died.

Our team also gave information to interested passers-by about our tests, and, if possible, registered them to join our test team. We also put up a FAQ about ICoSOLE and the Wall of Moments at the booth, to be able to inform people very quickly when no one from the team was available immediately.
Figure 4: Wall of Moments booth

To offer help to our test users, we provided live feedback via Facebook and e-mail. Additionally, we provided a “Book of Comments”, as seen in Figure 5, in which passers-by and test users could write their instant feedback on the test.

Figure 5: On-site user feedback
5 Field trial

5.1 System setup

The system setup in Dranouter was influenced by the functional requirements of the components to be tested, as well as conditions such as the available network connection. In particular, the limited bandwidth for uplink required to perform processing where content was available. For user generated content, this meant that content arriving via the dedicated Wifi was processed on-site, while content arriving via 3G/4G networks was processed in the cloud. Professional content was processed on-site, and one output stream was sent to the cloud, where DASH encoding took place.

Figure 6 shows a logical view of the system setup (based on functionalities) at Dranouter, on a service level. Black arrows show the data flow of the system, blue arrows metadata flows and dashed green lines control lines.

![Logical view of the system setup](image)

**Figure 6: Logical view of the system setup.**

Figure 7 shows a hardware-centric view, indicating which services are actually running on which devices. It also shows the distinction between networks: a public WiFi network for the test users, a network for connecting core systems running on-site and a remote network for cloud services. We had a connection to Internet provided by Proximus, and configured a router and firewall to route the traffic and
protect system services from intrusion. With each piece of hardware, the responsible partner is also provided.

![Diagram of system setup]

**Figure 7:** Hardware-centric view of the system setup.

### 5.2 Recordings

Different partners of the consortium made a whole range of recordings. These were audio as well as video recordings, made with professional and consumer devices. Firstly, this was done to test the capture system, in order to enhance it for future events. Secondly, this produced a lot of raw material to run offline tests and refine processing software.

#### 5.2.1 Audio capture

In addition to recordings made by the festival organization, we also put some audio equipment on stage to make more profound recordings. Following extra recordings were done:

- Audio recording in 3D audio format (typically stationary), to capture the environment audio atmosphere, process it later on and create an immersive experience, by DTO).
- Capture of source sounds (i.e., instruments and voices) using existing methods.
- Capture of environment sound at a “navigation” point at event (away from stages e.g. fire tower) for navigation using omni-directional camera and mic array.
- Audio recording of crowd/room ambience with professional microphone arrays and shotgun microphones.
- Video capture.
Audio recording in 3D audio format

To complement the omnidirectional video (ODV) recording, DTO captured the 3D sound field around the ODV camera with an Eigenmike®, as seen in Figure 8. This microphone is a 32-microphone capsule microphone array that allows the capturing of a sound field on the surface of a sphere. Appropriate signal processing algorithms allow the transformation of these raw signals into a Higher Order Ambisonics sound field representation, which is the base of a newly developed and MPEG-H standardized 3D sound field format. It covers the whole chain from capturing via transmission, lossy audio encoding up to 3D audio rendering.

Figure 8: Combination of omnidirectional video camera and 3D audio sound field recording

We made recordings of 13 concerts. After the festival, all recordings have been rendered to a stereo and a 5.0 representation for typical playback situations. All recordings are of very high quality, except the Triggerfinger recording where a vibrating object introduced some disturbing noise, due to the high sound pressure level near the microphone.

5.2.2 User-generated capture

UGC capture app (test users) by JRS and Bitmovin

Consortium members JRS and Bitmovin built a completely new version of the capture app (Figure 9), which allows for adaptive uploading and instant quality control. In this way, users are notified during capture to adjust their camera angle, to hold steady and to look for better lightning. By aborting uploads when the content is unusable, users can save bandwidth as well. Moreover, also sensor data is captured, such as GPS data, orientation and timestamps. Static metadata is sent during initialisation of the app. Under bad network conditions, we found that this is not sufficient, as the actual video data may arrive much later, after the initial session has timed out. Therefore, the app has been updated to send static metadata again during recording.

We gathered a lot of information on how people are actually using the new technology and see how the apps work in the real word, which we’ll use later on to improve them.
Audio recording with UGC equipment (event, interviews, etc.) by DTO
For the development and verification of the audio quality analysis algorithms, different use cases of a smartphone (recording at the event, interview situation, surrounding noise) have been recorded. Especially wrong audio gain adjustments have been executed to achieve some clipped audio recordings.

5.2.3 Atmospheric audiovisual recordings
During the event, multi-angle video-capture was done, using unmanned fixed small panoramic camera rigs as a cost-effective way of producing professional-level content.

iMinds made a number of atmospheric audio-visual recordings of the music festival and its visitors, using both a traditional (i.e., Canon EOS) video camera and a 360-degree or so-called omni-directional video (ODV) camera. In total, 10-minute-long 360-degree video recordings were captured at 11 locations spread out across the festival terrain, and 5-minute-long traditional video recordings at 9 locations. Collectively, the locations that were video captured in 360 degrees form a mesh-like topology that spanned the most interesting spots on the festival terrain.

The resulting 360-degree video footage has been exploited to populate a so-called panoramic map. The panoramic map is a spatial exploration tool that can best be summarized as offering a virtual navigation experience akin to Google Street View, yet hereby relying on 360-degree video footage instead of static imagery as primary content format. The panoramic map links together the 11 locations that were ODV captured at the Dranouter music festival, with users being able to “hop” between locations and to perform unconstrained Pan-Tilt-Zoom (PTZ) viewport modification at each single location. A 2D mini-map, complemented with graphical icons overlaid on top of the 360-degree footage, inform the user of the outbound traveling options at the currently explored location. The traditional video recordings on the other hand have been employed to augment a top-down topographic map of the festival area with atmospheric impressions.
5.3 Processing

5.3.1 Professional content

When we had permission from the bands, we plugged into the front of house of the stage and got direct access to the camera and audio feeds as well. Consortium partner Tools at Work (TaW) tested their live editing tool live on these streams. They took all input video streams directly from the stage to a live mixing application and provided a stream for the Wall of Moments.

The BBC used their IP studio framework to capture, encode and process audio and video. The multiple audio feeds from the stage were initially processed by Nuendo (to apply EQ and compression to the audio), captured using IP Studio and then rendered using object-based audio techniques to produce multiple outputs including five channel surround and binaural versions from the same input data. This processing was distributed across a small network of IP Studio workstations.

The BBC and TaW trialled connectivity between their two systems with the video captured and the binaural output produced by the IP Studio framework being fed to TaW's live editing system. This was a very interesting thing to do because the whole system needed to be plugged together in sync to achieve this. Sync was achieved using a network synchronisation mechanism called PTP (The Precision Time Protocol (PTP) is a protocol used to synchronize clocks throughout a computer network. On a local area network, it achieves clock accuracy in the sub-microsecond range, making it suitable for measurement and control systems) which both the IP Studio framework and TaW's live editing and playout systems 'subscribed to' (systems must slave to the protocol to achieve lock).

- Live editing with video streams (TaW): input from iMinds, other camera’s, mobile camera input
- Live playout system (TaW, BIT)
- Capture, encode, process and editing of video and audio (BBC, TaW, BIT)

An evaluation of the live mixing and end-to-end workflow can be found in deliverable 2.4.1, section 3.5.

5.3.2 User-generated content: content selection using Trademark

A drawback of allowing users to contribute content as well is that one cannot take quality for granted. Sometimes, there are audio or video quality issues. This can be due to a smartphone camera of inferior quality, bad lighting, encoding artefacts, etc. As clips are sent wirelessly from a smartphone to our backend system in an adaptive way, quality of the clip can also vary greatly. Aside from quality issues, content can either be relevant and useful or not for the event organizers.

This is where the metadata we also capture comes in: we do some automatic analysis and use it to deduct relevant conclusions, which are translated to ‘tags’ attached to clips. A clip can (automatically) be tagged with tags such as: ‘audio quality: 45%’, ‘video quality: 78%’, ‘shaky’ etc. Subsequently, we use these tags to sort and group user-generated content by usability for different applications. We believe human verification cannot be omitted (yet), so we are relying on automatic analysis for ranking purposes only, making filtering effortless. In future versions, we are considering to implement distributed collaborative filtering, where content would be divided over several trusted users, which can approve or reject.

We have tested the first version of a content selection user interface (UI) to search through content very efficiently and to additionally tag content from within this application. This way, we created a tag ‘The Wall’, which grouped all the content that should be shown on the Wall at our booth. Using metadata, the application proposed which content would be relevant for the Wall, and suggested it to be approved. A mock-up of the first version of this app is shown in Figure 10.
We had some issues processing the incoming content with low delay, however. Due to the fact that the upload is done adaptively in segments, it sometimes took a while to collect all segments. In some cases, segments were lost during transfer, rendering the clip corrupted. These segments were also processed on a first-come first-serve basis, which could lead to long processing times if one segment is delayed for some time. This was not such an issue for small-scale tests, but becomes a real problem on large events, such as the Dranouter Festival, because a lot of content is coming in simultaneously, and peaking at some moments of concerts (cf. the statistics in D2.4.1). Another issue is that users often arrived at the concert with a number of recorded videos, which they had not uploaded earlier due to lack of a proper network connection. Thus, the app also tried to upload these videos when re-entering the Wifi-covered area, and even further increased the number of videos arriving during peak times. We are already taking these issues into account in order to solve them for our next field trial.

5.4 Playout: The Wall of Moments

A live prototype of the Wall was installed at the ICoSOLE booth near the main stage. Also (a selected group of) people at home were able to experience the event using the same prototype instance of the Wall in their browser at home (Figure 11). Additionally, they were able to like, share, and comment on Moments that were coming in.

Within this prototype, the DASH video player from Bitmovin was also integrated, to allow for adaptive playout on a wide range of platforms, including regular PCs and Macs, iOS, and Android.
5.5 On-site survey

iMinds also conducted an on-site survey among Dranouter visitors to assess their interest in a smartphone application that is able to support them while they are physically attending a music festival. The survey was implemented by means of a pen-and-paper-based questionnaire consisting of 11 5-point Likert scale questions. We collected responses from 50 festival attendees (24 female) in total. In terms of demographics, the respondents were aged between 14 and 55+ and indicated to, on average, spend slightly more than 1 hour per day on consulting Social Media on their smartphone.

Respondents were found to welcome the ability to explore the activities at remote stages by means of professional video (66% positive responses) and professional audio (58% positive responses); amateur video (40%) and amateur audio (38%) were less liked in this regard. Respondents could also envision themselves sharing pictures and videos with friends (66% and 56% positive responses, respectively); sharing such content with strangers was less positively received (22% for pictures, 20% for video). Real-time consumption of (audio-visual) content originating from places other than stages was also deemed a valuable feature (66% positive responses); especially locations that are not accessible by regular festival visitors (e.g., the backstage area) were mentioned as interesting content sources in this context. Finally, the proposition of a tool that would allow a festival attendee to track the location of his or her friends on the festival terrain received 66% positive responses.

Analysis of the survey results did not yield statistically significant differences for any of the variables described above when abstracting the survey respondents into 3 age ranges (i.e., 14- to 24-year-olds, 25- to 34-year-olds, 35 and older). When compartmentalizing respondents based on the amount of time they spend on using social media on their smartphone, we also failed to find statistically significant differences in the collected results. The same outcome holds for correlation. In particular, neither age range nor social media activity level on smartphones was found to show statistically significant correlation with the described variables.

A more in-depth analysis of this survey can be found in deliverable 2.4.1, section 3.1.

5.6 Test users

During the event, 60 test users were capturing Moments using our new capture app. Their clip was automatically (and adaptively) uploaded to our backend systems onsite and in the cloud. We installed a
wireless network, only accessible by our test users to guarantee them fast upload speeds. Also additional 3G/4G bandwidth provided by the local carrier.

When giving out tickets, we learned the following:

- Free tickets only work if you offer them in pairs – many people were disappointed to receive only one ticket.
- Die-hard fans who already had bought their ticket themselves turned out to be much more ‘faithful’ and better test users.

As the festival lasted for three days, we opted to invite 20 test users per day. Of those test users, 10 got a three-day pass, and 10 got a ticket for that day. During the festival, festival visitors signed up to be test users as well. An overview of the received user contribution is given in deliverable 2.4.1, section 4.1.

After the event, we asked our test users to complete a survey to share their experience and give their feedback. Results of this survey can be found in deliverable 2.4.1, section 3.2.
6 Conclusions

Despite being our first real-world field test, everything ran quite smoothly. For a big part, this was due to a good collaboration with the festival organisation from really early on. They supported our test greatly and allowed us to use A/V equipment already present, as well as putting up our own equipment on and off-stage. This made for some truly extraordinary and unique content. We were able to connect different services from different partners together. We had some issues, but were able to solve most of them over time, during the event.

We were able to collect a lot of content (audio as well as video, professional as well as user-generated) to further refine our prototypes. We also shared this content with the respective bands, to be able to experiment with it, making the results of the ICoSOLE project very relevant in real-world scenarios.

A lot of learnings (technical, as well as on the user-side) were deduced from this first field trial. We are already working towards a follow-up (small-scale) field trial on October 14th-16th at the European Committee of the Regions’ (CoR) Open Days event. The focus there lies with user-generated content, and pushing it through the content chain as fast as possible. A big change we are envisioning here is processing every clip asynchronously, starting with the basic information, and adding analysis results later. Due to the good network connection at the CoR event, all processing could be done in the cloud, resulting in a much simpler architecture. This makes this basic information available very fast for other apps to use e.g. the Wall of Moments. An elaborate report of learnings can be found in D2.4.1.

During to this event, we also learned how to work with test users and how to inform them about what we’re trying to achieve during the tests. Thanks to our Wall of Moments booth, we had very direct and personal contact with them, which made for a more committed collaboration and, thus, yielding better test results.

Generally, we can conclude this first field test was a success, and serves as a solid starting point for our fully integrated field test in the summer of 2016.
7 Glossary

Terms used within the ICoSOLE project, sorted alphabetically.

**UGC** User generated content

**Partner Acronyms**

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