

## **D6.3 Dissemination report and revised exploitations plans**



## D6.3 Dissemination report and revised exploitations plans

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## 1 Executive Summary (TNO)

STEER aimed to experiment with advanced practices and technological solutions that can improve the user experience of members of the people ecosystem defined by the project as "Social Telemedia". Such an ecosystem is already showing, and steadily reinforcing, a great potential for influencing the relationships that, exploiting informatics tools and communication networks, communities of people worldwide are growingly establishing around shared interests, attitudes or professional occupations.

Besides the achievement of specific research objectives, STEER aimed to pursue a coordinated strategy and actions for the dissemination of results, which involved submissions to relevant journals, conferences and standardization bodies, and (guest) lectures and talks on STEER topics. Opportunities in the market segments where each industrial partner is active should materialize in the proposition of new or enhanced products or services for social media / social TV and consumer / home devices and applications, which the cooperation in the project makes possible.

As a final step in this direction, this deliverable, *dissemination report and revised exploitations plans*, contains an account of the project dissemination activities that include scientific papers, press releases, leaflets and white papers as well as all standardization contributions and potential patents. Furthermore, it present all partners' revised (final) exploitation plans in the light of the outcome of the executed experiments.

STEER partners disseminated actively their results, involving submissions to relevant journal papers, attending and publishing in conferences and standardization bodies, providing lectures on our technologies, and posting regular updates on our communication platforms. By combining computer sciences and communication networks information, STEER proved to be very successful in bringing useful tools to communities of people sharing common interests. These business opportunities have been exploited in many different sectors. In addition to the concrete tools developed under STEER and already commercially available are presented.

This document further has taken into account crucial feedback and comments as expressed by the STEER review committee, during and after the first review of the STEER project, in March 2014. Specifically, this document has presented a fully updated STEER website design, and significantly increased presence on social and video platforms. This document further contains a description of STEER products. Also, the document has presented per-partner exploitation plans, covering both within-consortium follow-up as well as opportunities with external stakeholders. Lastly, this document contains an ethical challenges chapter, including detailed information on how these challenges were met during the experiment, thus providing important information to prospective stakeholders.

## 2 Introduction

Since its debut in September 2012, STEER developed and experimented with several key technologies with the vision of improving the user experience for Social Telemedia services. In this third and final WP6 deliverable, the STEER partners document their efforts to disseminate their activities and progress, to standardize important technological aspects and to valorise their technologies towards exploitation.

This document further takes into account crucial feedback and comments as expressed by the STEER review committee, during and after the first review of the STEER project, in March 2014. Specifically, this document presents a fully updated STEER website design and significantly increased presence on social and video platforms. This document further contains a description of STEER products, including comparisons with commercially available technology. Also, the document presents per-partner exploitation plans, covering both within-consortium follow-up as well as opportunities with external stakeholders. Lastly, this document contains a chapter about ethical challenges, and detailed information on how these challenges were met during experiments.

This document is structured as follows: we first describe the dissemination activities as well as STEER presence and involvement in Dissemination Forums in Chapter 3. An overview of all STEER products is presented in Chapter 4, categorized by partner. The current status of STEER partner exploitation plans is highlighted in Chapter 5. Chapter 6 presents general ethical and legal challenges related to experimenting with STEER technology. Lastly, Chapter 7 contains conclusions.

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## 3 Dissemination

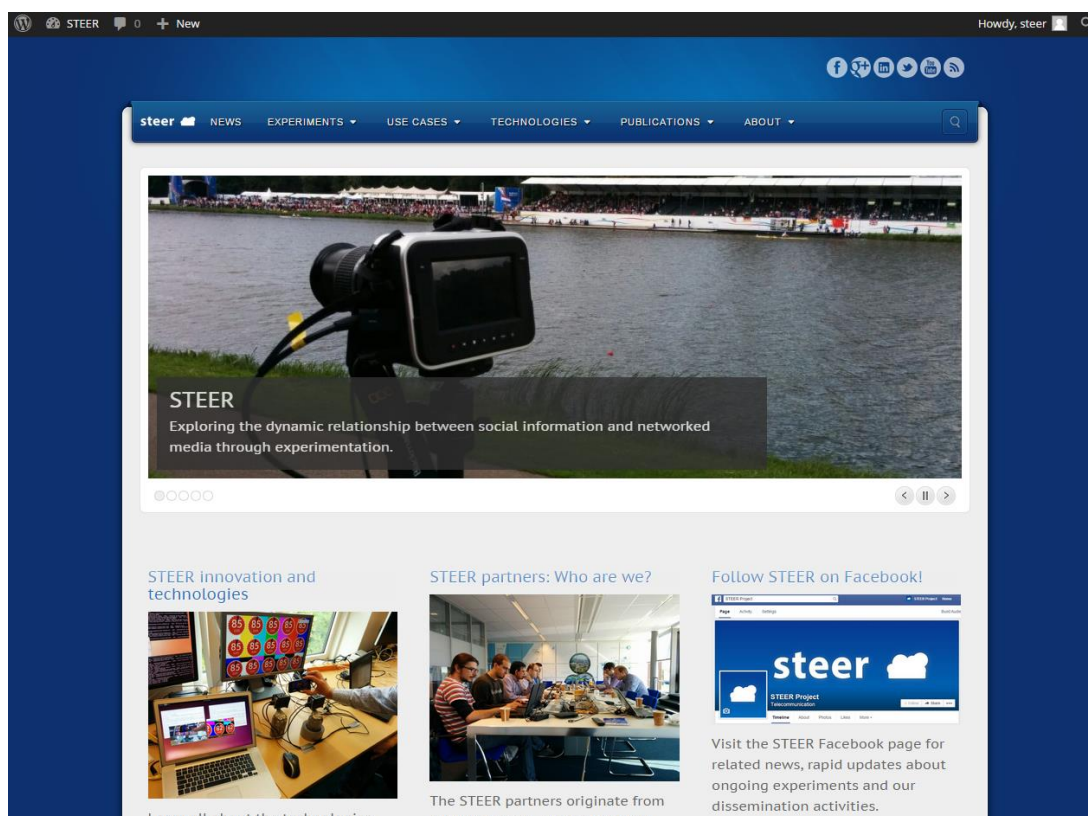
The STEER academic and industrial partners took several actions that, in different forms and contexts, aimed at maximizing the spreading of information about project goals, activities carried on, and results achieved. This section summarizes such actions.

### 3.1 Website and Social Media

As introduced in Deliverable D6.1, the STEER website is the main tool used for communication of project scope, progress and achievements to the outside world. Social media have been also extensively employed to keep the community of project's followers up to date with activity and presence at relevant events.

#### 3.1.1 Website

The STEER website, accessible at <http://fp7-steer.eu/>, has been developed and is maintained with the web software from Wordpress.org. The website, which home page is shown in Figure 3-1, is structured in 6 main sections.



*Figure 3-1: STEER Website: Home page*

- **News:** includes the latest news about STEER, with particular emphasis to key events related to, or produced by, the project

- **Experiments:** highlights deployments of the STEER systems in the “real world”; the experiments carried out in the frame of WP5 are presented in separate sub-tabs.
- **Use Cases:** introduces the use cases addressed by STEER; visitors are presented with a detailed overview of each use case in separate sub-tabs.
- **Technologies:** provides a showcase of the various products developed in the project framework: individual products are further detailed in separate sub-tabs.
- **Publications:** presents a list of the publications produced by STEER, including project public deliverables and scientific papers.
- **About:** provides a general overview of the project and its mainstream; information about project partners are available in a separate sub-tab.

Project partners regularly update the website with content relevant to the STEER community.

A quick overview of website statistics is shown in Figure 3-2: from that, it can be seen that the website is regularly checked by visitors coming from all over the globe.

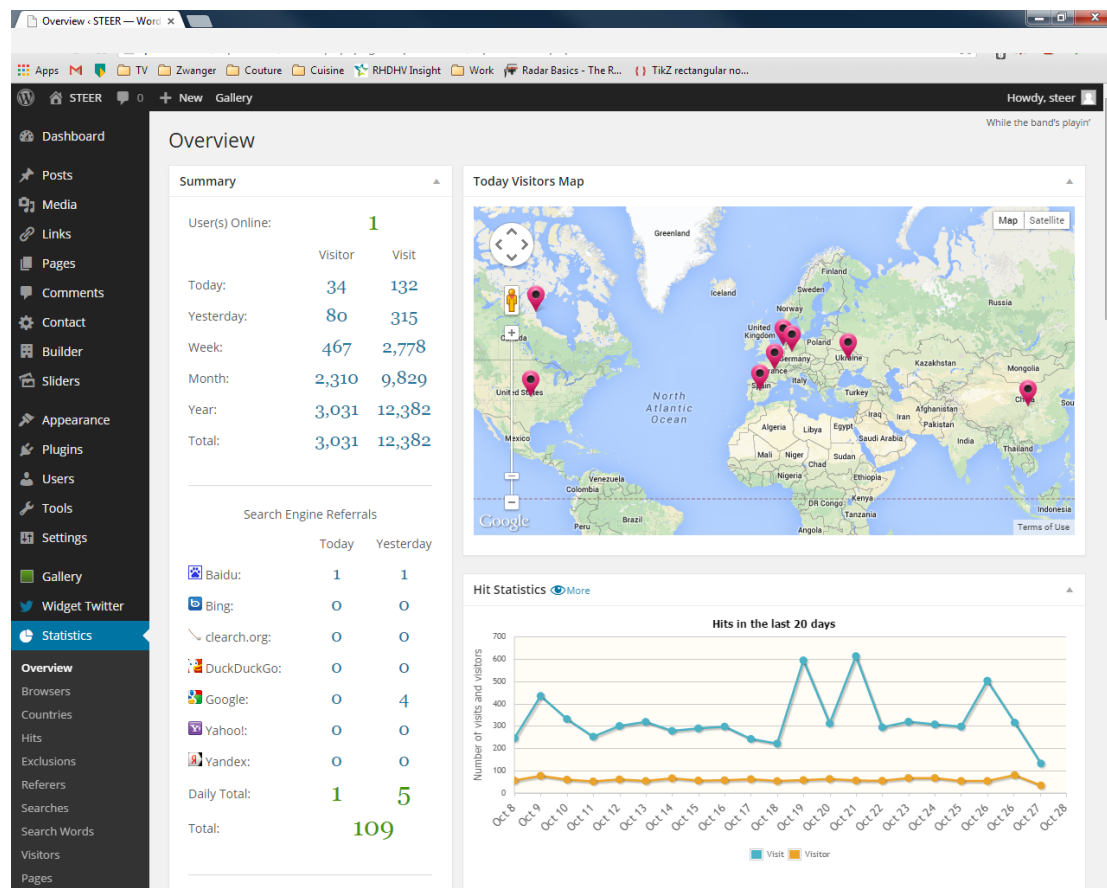


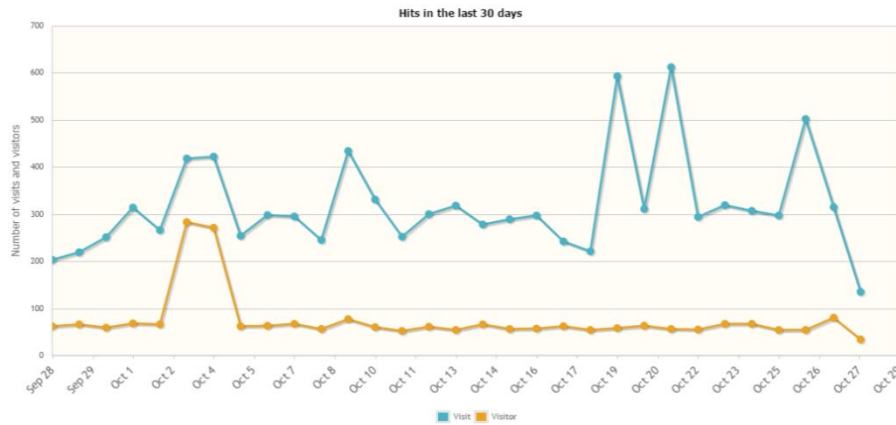
Figure 3-2: STEER website statistics.

By looking specifically at the reported number of visitors, it is also seen that there has been a fairly constant amount of visitors per day (~80), with peaks of interests



### D6.3 Dissemination report and revised exploitations plans

associated to particular events. Data referring to the 30-day period reported in Figure 3-3, for example, shows that the STEER presence at the NEM Summit (29-30 September 2014) significantly brought up the curiosity about the website in the days following the event, with the number of visitors and hits rising to 283 and 418, respectively.



**Figure 3-3: STEER Website 30 days hit statistics**

### 3.1.2 Facebook

STEER uses Facebook as a communication tool to provide our community with the status of experiments and other informal news. For instance, our activities at the World Championship Rowing were updated in real-time during the event by posting regular news and photos in the Facebook page. Figure 3-4 shows the Facebook posts on the F1 race at Silverstone and Schladming night race.

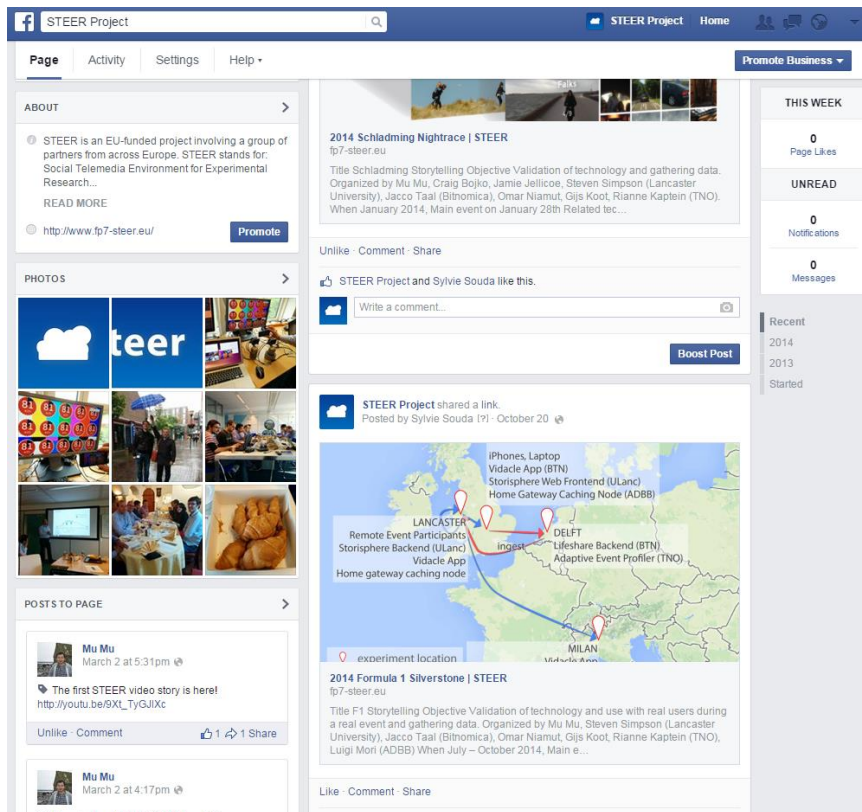


Figure 3-4: STEER Facebook page

### 3.1.3 Twitter

STEER is very active with posting on Twitter. We follow other FP7 twitter feeds related to our project such as @ictexperimedia, @socialsensor\_ip and @vconect. We also follow more general technology related twitter feeds such as @TechCrunch, @ZDNet and @CNET, which provide us with the latest updates in fields of our interest.

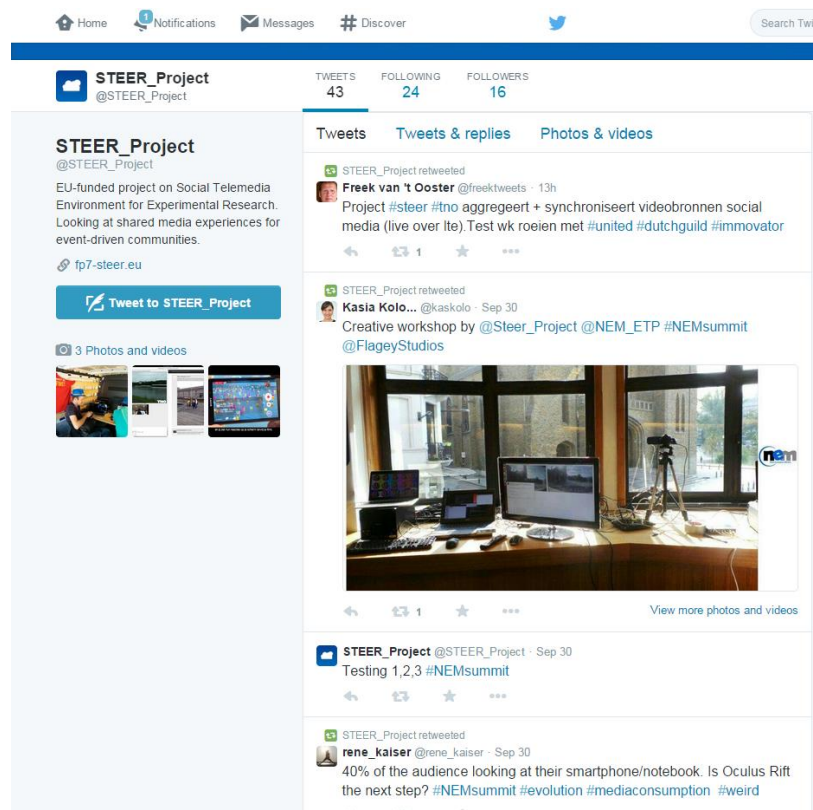


Figure 3-5: STEER Twitter Feed

### 3.1.4 YouTube

The STEER YouTube channel is used to share videos with our community. These videos are usually linked to our website and posts on Social Media. Six main topics are covered in videos, showing STEER products put in practice in various experiments.

#### 3.1.4.1 STEER storytelling experiment in Schladming, Austria

The first Collaborative Storytelling experiment was arranged at Schladming, Austria during the Nightrace 2014 event ([http://www.planai.at/winter/en/planai\\_news/Night\\_Race.html](http://www.planai.at/winter/en/planai_news/Night_Race.html)) to evaluate the storytelling system.

This experiment examined how the design of multimedia systems can help to facilitate social interaction, and how the integration of social context improves user experiences within such a system. A number of test participants travelled from the UK and the Netherlands to the venues prior to the event as the main storytellers while a few others joined the experiment from various locations in the UK. Caching nodes were also installed in Lancaster, UK to study the effectiveness of chunk caching for story playback. In the experiment, a number of STEER technologies were employed, namely Bitnomica's Vidacle mobile application (<http://vidacle.com>), used to capture video footage on iPhones, Lancaster University's Storisphere online storytelling platform (<http://www.storisphere.com>), through which video stories were edited, TNO's adaptive event profiler for social context integration and a caching design contributed by ADBB.

One of the video stories about the event has been added to the STEER YouTube channel and is available here: <http://youtu.be/PjhTPooE7Jw>

#### 3.1.4.2 STEER Silverstone F1 Grand Prix 2014 Experiment

A follow-on storytelling experiment was held at Silverstone, UK during the British Grand Prix Formula 1 racing event on 6th July 2014. The experiment focused on social-aware content annotation, context-aware recommendations, and pro-active caching on ADBB's home gateway equipment. A number of test participants travelled from the UK to the venues prior to the event as the main storytellers while a few others joined the experiment from various locations in the UK. Caching nodes were also installed in the UK, Italy, and the Netherlands to study the effectiveness of chunk caching for story playback.

Video clips have been recorded by participants to the F1 experiment using enhanced versions of the same system components employed in Schladming. One of these clips, exported from Storisphere, can be seen here:

<http://youtu.be/vbimNGikkAs>

#### 3.1.4.3 NEM 2014

The New European Media (NEM, formerly Network and Electronic Media) is one of European Technology Platforms of the Horizon 2020 program dedicated to content, media and creative industries, with the strapline: "Connected media & content for innovation and creativity in digital Europe". The NEM annual summit gathers people interested in Future Internet developments and the fast paced evolution of the European media industry.

STEER took part to the NEM Summit 2014, with presence in the investment forum, creativity workshops and project showcases. Omar Niamut, WP3 leader and partner from TNO, gave 3 minutes pitch about project that was captured in two videos, now available on STEER YouTube channel ([http://youtu.be/XStEkzay-\\_M?list=UUITWpxwNghwKBZV\\_gFtf8QQ](http://youtu.be/XStEkzay-_M?list=UUITWpxwNghwKBZV_gFtf8QQ): presentation slide show; [http://youtu.be/YzHrOmX\\_NAM?list=UUITWpxwNghwKBZV\\_gFtf8QQ](http://youtu.be/YzHrOmX_NAM?list=UUITWpxwNghwKBZV_gFtf8QQ): Omar's speech).

A third video was displayed during the event, providing an overview of the project and the different technologies involved, see ([http://youtu.be/2GtvgRK\\_THM?list=UUITWpxwNghwKBZV\\_gFtf8QQ](http://youtu.be/2GtvgRK_THM?list=UUITWpxwNghwKBZV_gFtf8QQ))

#### 3.1.4.4 STEER CST and LAB demo videos

STEER also took part to the FIA event in March 2014, see section 3.2.1.2. During the workshop co-organized by STEER, many presentations and demos were given. Video material from that event is available here:

<http://youtu.be/og-IDB-YMsw>

[http://youtu.be/fC6CKhBAGgl?list=UUITWpxwNghwKBZV\\_gFtf8QQ](http://youtu.be/fC6CKhBAGgl?list=UUITWpxwNghwKBZV_gFtf8QQ)

### 3.1.5 Google+

The STEER Google + page ([google.com/+Fp7-steerEu](https://google.com/+Fp7-steerEu)) contains photo albums shared on our website.

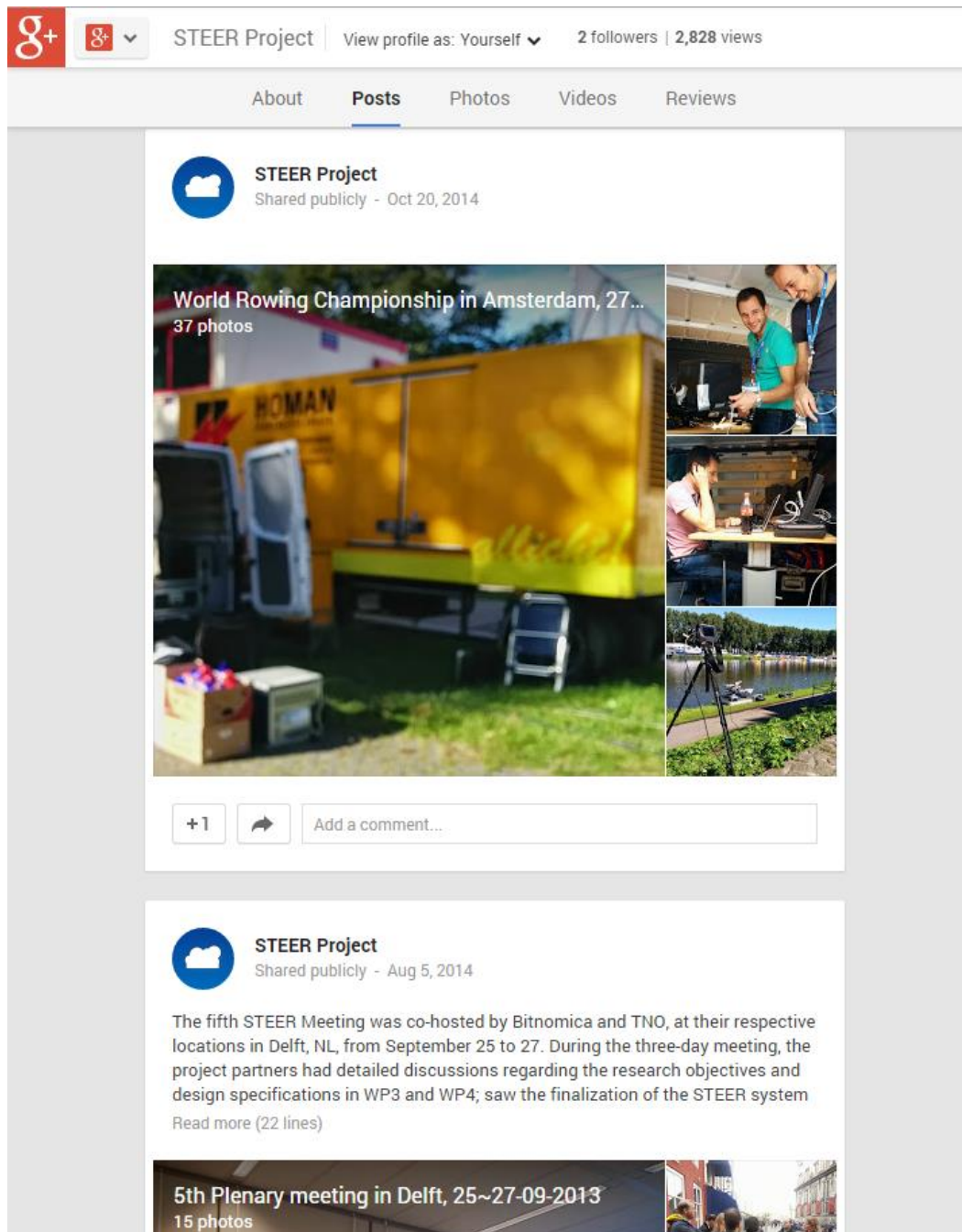


Figure 3-6: Google + screenshot

## 3.2 Dissemination forums

Members of the STEER consortium participated in forums with other organizations (i.e. universities, industrial organizations) and communicated the work carried on in STEER, as detailed in the following sections.

### 3.2.1 FIA

The European Commission, in collaboration with EU Presidency has, since 2008, hosted regular Future Internet Assembly (FIA<sup>1</sup>) events. FIA is a research community-driven initiative supported by more than 150 research projects that have recognised the need to strengthen European activities on the Future Internet (FI) to maintain European competitiveness in the global marketplace. In particular, these projects have identified the urgent need to redesign significant part of the Internet, taking a broad multidisciplinary approach, to meet European societal, business and technology ambitions. Participants are members of the FI community, who include the national and EU project coordinators and partners of FP7 funded projects, both academic and industry researchers.

#### 3.2.1.1 FIA 2013

STEER had a faceted presence at FIA 2013<sup>2</sup> that took place in Dublin from 8<sup>th</sup> to 10<sup>th</sup> May, 2013. STEER partners TNO, UoP and ITI participated in the session “Bringing Users In”, on linking user populations to novel networks in Future Internet research programmes. The session addressed important questions related to understanding and promoting the benefits of user-centricity and user-centred innovation in industries, such as

- How to engage users in research and development? What approaches exist to engage users?
- How these approaches achieve their outcomes? What’s applicable considering the variety of situations?
- How user participation changes at different phases of the RTD lifecycle? How to scale user participation from trials to industrialization and what this means for qualitative and quantitative assessment?
- How user participation is being addressed in the FIRE and FI-PPP programmes and what can be done to improve it?

#### 3.2.1.2 FIA 2014

STEER also participated to FIA 2014, held in Athens from 18<sup>th</sup> to 20<sup>th</sup> March of 2014. STEER partners co-organized a workshop entitled “Cross-breeding social networks and networked media in the Future Internet”<sup>3</sup>. In the context of this workshop (Figure 3-7) we discussed how social media influence social relationships thus changing social structure enabled by technological advances. Additionally we discussed on how these advances transform the environments we are surrounded by, as they introduce new kinds of interactions between humans and objects. Finally we analysed how users in this emerging social cyberspace demand the kind of media experiences they are accustomed to in their daily lives with the community

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<sup>1</sup> <http://www.future-internet.eu>

<sup>2</sup> <http://www.fi-dublin.eu/>

<sup>3</sup> <https://www.fi-athens.eu/program/workshops/cross-breeding-social-networks-and-networked-media-future-internet>

type of communications being at the central stage. The output of the workshop was the determination of objectives that derived from the discussions between stakeholders that took place the years before and what the research community has to do in order to fulfil them.



*Figure 3-7 STEER workshop in FIA 2014.*

In the context of this session, two presentations were given by STEER members and one by the STEER technical manager, reporting about the work done in STEER and the foreseen future steps.

Furthermore, STEER had a significant and complete presence in FIA 2014 exhibition, with a central booth hosting the STEER Collaborative Storytelling demonstration, as well as posters and videos explaining the STEER objectives and work. The booth had a numerous and qualified attendance, and STEER partners had the opportunity of discussing at length with Net Future director Mario Campolargo on the importance of FIRE within the Future Internet environment.



*Figure 3-8 STEER presence in FIA 2014 exhibition.*

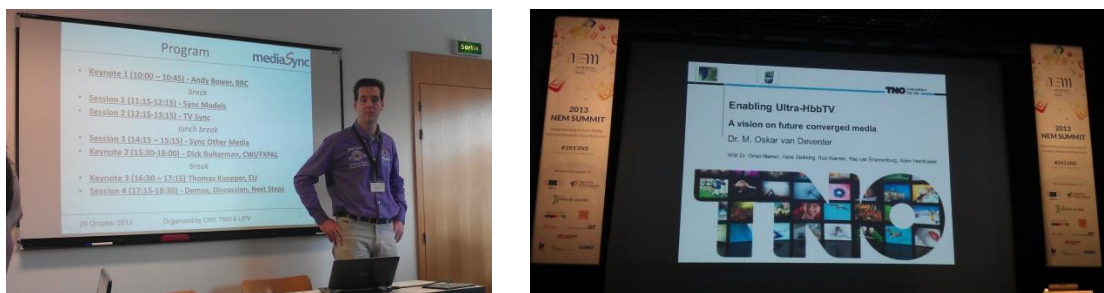
### 3.2.2 NEM Summit

The NEM Summit is organized every year since 2008 by the NEM Initiative in close cooperation with leading industrial and academic players worldwide. It is the “not-to-be-missed” annual event for all those interested in Future Internet developments and in the fast paced evolution of the networked and electronic media industry. Over the years, the NEM Summit has grown to become the key conference and

exhibition to meet and network with the most active stakeholders, access up-to-date information, discover the latest technology and market trends, identify research and business opportunities, and find partners for upcoming EU-funded calls. The event traditionally involves up to 400 attendees, 20 sponsors, 50 exhibitors and 40 speakers and authors selected following a competitive call for papers.

### 3.2.2.1 NEM Summit 2013

STEER was present at NEM 2013<sup>4</sup> that took place in Nantes from 28<sup>th</sup> to 30<sup>th</sup> October, 2013. STEER partner TNO organized a joint booth with Dutch research organization Centrum voor Wiskunde en Informatica (CWI<sup>5</sup>), demonstrating technology from several EU projects, among which STEER. TNO also gave a keynote on Ultra HbbTV, emphasizing the need for media synchronization and combining live professional broadcasts with user generated-content. TNO further co-organized the 2<sup>nd</sup> edition of the MediaSync workshop<sup>6</sup>, which included keynotes by Andy Bower, BBC Head of International Collaboration, and Thomas Küpper, project officer at DG Connect, unit G1. Both TNO and Lancaster University presented papers during this workshop.



**Figure 3-9: - (left) Opening of the MediaSync workshop at NEM 2013; (right) TNO keynote at NEM 2013.**



**Figure 3-10: - (left) STEER dissemination at the joint TNO-CWI booth; (right) discussions on media synchronization technology at the joint TNO-CWI booth.**

<sup>4</sup> <http://nem-summit.eu/past-events/2013-nem-summit/>

<sup>5</sup> <https://www.cwi.nl/>

<sup>6</sup> <https://sites.google.com/site/mediasynchronization/mediasync2013>



### 3.2.2.2 NEM Summit 2014

STEER also had a faceted presence in NEM Summit 2014. STEER partners organized the 2<sup>nd</sup> edition of the workshop entitled “Cross-breeding social networks and networked media for enhanced storytelling and live event broadcasting<sup>7</sup>”. Omar Niamut, from STEER partner TNO, gave a workshop pitch during the NEM plenary session (see the reference to the video in section 3.1.4.3). During the workshop, the STEER technical manager provided an introduction to STEER. STEER partners presented outcomes of the various experiments, and gave live demonstrations of the technologies underlying the two STEER use cases. At the booth, product flyers for all STEER technologies were available. The workshop was attended by interested parties such as BBC and Technicolor.



**Figure 3-11: STEER technology product flyers at the NEM Summit 2014.**

<sup>7</sup> <http://nem-initiative.org/steer-workshop/>



*Figure 3-12: Introduction to STEER concepts NEM Summit 2014.*

### 3.3 Academic Dissemination

Within the scope of STEER, ULANC has successfully delivered several scientific papers in high impact outlets. There are also multiple conference and journal papers in submission. Our work on the topic of social analysis and social context aware content distribution has seen publications in IEEE International Symposium on Multimedia (ISM), ACM SIGCOMM workshop on Future human-centric multimedia networking, ACM International Conference on Interactive Experiences for Television and Online Video (TVX), and ACM International Conference on Multimedia (MM). With respect to the community storytelling use case, we have shown presence in both UK local events (e.g., Digital Economy conference) and international journals such as the IEEE Communications Magazine. We also have a joint paper on multimedia storytelling system in submission contributed by four STEER partners to a special issue of IEEE Multimedia journal. Lastly, we have made great progress on the media synchronization work. Following our initial dissemination at Media Synchronization Workshop of NEM 2013, a joint work between ULANC and TNO has taken place. A paper has been submitted to the ACM Multimedia System conference (MMSYS).

As briefly reported in Deliverable D6.2, in the context of STEER UoP obtained experience regarding distributed algorithms, network modelling, network optimization and applications of control theory to computer networks. UoP lab (Network architectures and Management group) exploits this knowledge by diffusing it to undergraduate students and to postgraduate students writing their PhD thesis.

Furthermore, by exploiting the OpenLab infrastructure, UoP developed several testbeds (congestion control testbed, distributed scheduling testbed, scalable resource management testbed, and distributed graph management testbed) that can proficiently be exploited for educational and experimentation purposes by university students and researchers. Finally, PhD students are able to contribute and

experiment with a real modern media distribution system. In this way they can rapidly gain experience on how a real system is developed and at the same time contribute their ideas towards innovative architectures and algorithms in media distribution.

## 3.4 Contribution to Standards

### 3.4.1 Broadband Forum and Home Gateway Initiative

Deliverable D6.2 anticipated a contribution to be submitted by STEER to the “Media Gateway” project of Home Gateway Initiative (HGI), focusing on requirements for Home Gateways regarding multimedia handling, including transcoding and content protection. Such contribution was made by ADB and TNO and presented during the HGI meeting held in Malta on 17-21 March 2014.

The presentation introduced the STEER project scope, goals, target use cases and overall architecture, and then specifically addressed the role of the Home Gateway in such architecture. Emphasis was put on local storage and media transcoding as means for achieving dynamic bandwidth optimization and overall service efficiency / scalability, and the exploitation of ALLBEST as an efficient, non-invasive real-time bandwidth estimation and monitoring tool. The contribution was well received, with particular interest expressed about the bandwidth monitoring function in view of its exploitation by telecom operators as a means for diagnostics and assurance. The STEER view about a close relationship between real-time diagnostics and media gateway functionality with resource-driven pro-active multimedia manipulation was also supported. On the other hand, the transcoding use case did not gather a strong enough consensus in the audience, and was generally seen as too far future-oriented to be included in HGI's draft guideline document on use cases and business requirements for a media gateway.

On this basis, further contributions are expected to primarily focus on the results obtained in testing the integration of ALLBEST in the home gateway. Due to timeline mismatches, this may happen after the completion of the STEER project, but can be nevertheless carried on in the framework of an enduring collaboration between TNO and ADB. As anticipated in D6.2, the same results should also be relevant for the BroadBand Forum work item about LAN-side diagnostics.

### 3.4.2 MPEG

TNO is an active contributor to standardization of media processing and distribution technology in MPEG. MPEG is currently exploring use cases and requirements for new standards for the advanced synchronization of media, which MPEG calls Timeline Alignment. To better understand the industry development and their additional needs, MPEG has hosted a workshop Media Synchronization and Hybrid Delivery<sup>8</sup>, including demonstrations, during its 110<sup>th</sup> meeting in Strasbourg, from 20 to 24 October 2014. TNO co-organized this workshop and two TNO speakers spoke

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<sup>8</sup> <http://mpeg.chiariglione.org/docs/presentation-materials-seminar-media-synchronisation-hybrid-delivery>

about companion screens and streams synchronization in DVB and media orchestration from capture to consumption. The second talk considered the STEER live augmented broadcast use case and discussed the distributed ingest platform developed within STEER. During the workshop, the Live Augmented Broadcast demonstration setup was shown to the attendees demonstrating frame-accurate hybrid media synchronisation using multiple devices. During the day a large number of attendees visited the booth and the STEER technology was discussed amongst peers from the industry. In general, the demonstration was well received and sparked a number of interesting ideas for future improvements.

MPEG has concluded to conduct a study on the use cases that were presented and to continue exploration in an ad-hoc group (AHG) on Timeline Alignment. Attended by more than 80 participants, this workshop was a success and attendants suggested the organizers to hold a 2nd edition within 2 years. MPEG has also agreed on starting a work item on media orchestration, for which STEER technology forms an excellent basis.

The image shows a presentation slide with a header containing logos for MPEG, TNO, and the date October 22, 2014. The slide content includes a title, a description of the STEER project, a list of experiments, and the STEER logo.

**MPEG** | October 22, 2014 | Rob Koeneke | Media Orchestration | **TNO** innovation for life

**Example: STEER**  
*Live Augmented Broadcast*

- › Social Telemedia Environment for Experimental Research EU FP& project on Collaborative content creation, mixing professional and user-created content
- › Experiments at:
  - › World Rowing Championships
    - › United (production house)
    - › NOS (Netherlands Public Broadcaster)
    - › Steer Partners Uni Patras, BitNomica, TNO
  - › Formula 1 in Silverstone
  - › Skiing in Schladming

**steer**

**Figure 3-13: STEER presented at the MPEG workshop on Media Synchronization and Hybrid Delivery.**



*Figure 3-14: STEER LAB demo at the MPEG workshop on Media Synchronization and Hybrid Delivery.*

### 3.5 STEER Publications

The following scientific publications have been produced in the context of the STEER project.

- [1.] Mu, M., Knowles, W., and Race, N. *Understanding Your Needs: An Adaptive VoD System*. in *Proceedings of the IEEE International Symposium on Multimedia (ISM)*. 2012. Irvine, CA. 10-12 December 2012

**Synopsis:** Video-on-demand (VoD) is becoming a popular service for commercial content distribution by offering end users the freedom to access recorded programmes. The management of on-demand assets is essential to maximise the efficiency of storage and network utilisation as well as advertisement. This paper introduces our recent efforts in design and implementation of an adaptive VoD archive system in an IPTV infrastructure. The system exploits live statistics on the user behaviours as well as the dynamic popularity of VoD programmes. Using the modelled programme popularity function, the VoD archive is capable of managing the VoD repository by adapting to the most recent user requests. The design has greatly improved the activity of VoD repository and user experience in on-demand services.

**Context:** The IEEE International Symposium on Multimedia (ISM2013) is an international forum for researchers to exchange information regarding advances in the state of the art and practice of

multimedia computing, as well as to identify the emerging research topics and define the future of multimedia computing.

**Available at:**

[http://ieeexplore.ieee.org/xpls/abs\\_all.jsp?arnumber=6424668&tag=1](http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=6424668&tag=1)

- [2.] Mu, M., Simpson, S., Bojko, C., Broadbent, M., Brown, J., Mauthe, A., Race, N., and Hutchison, D., *Storisphere: from TV watching to community storytelling*. IEEE Communications Magazine, 2013. **51**(8): p. 112-119.

**Synopsys:** Conventional television services have been increasingly challenged by the more interactive and user-centric video sharing applications. With the growing popularity of social networks and video services, users are becoming the editors and broadcasters of their own stories. User-generated video content, which provides unique perspectives from individuals, is likely to be the new medium to complement professional broadcast TV for story sharing, especially in user communities of specific interest. We have developed Storisphere to provide a web-based collaborative video content workspace for members of a community to compose and share video stories, using desktop or mobile devices. Storisphere is currently being evaluated for video storytelling by various user communities.

**Context:** IEEE Communications Magazine covers all areas of communications such as lightwave telecommunications, high-speed data communications, personal communications systems (PCS), ISDN, and more. It includes special feature technical articles and monthly departments: book reviews, conferences, short courses, standards, governmental regulations and legislation, new products, and Society news such as administration and elections.

**Available at:**

<http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=6576348>

- [3.] Georgopoulos, P., Elkhatib, Y., Broadbent, M., Mu, M., and Race, N. *Towards network-wide QoE fairness using openflow-assisted adaptive video streaming*. in *Proceedings of the ACM SIGCOMM 2013 workshop on Future Human-Centric Multimedia Networking*. 2013. Hong-Kong, People's Republic of China. 12-16 August 2013

**Synopsys:** Video streaming is an increasingly popular way to consume media content. Adaptive video streaming is an emerging delivery technology which aims to increase user QoE and maximise connection utilisation. Many implementations naively estimate bandwidth from a one-sided client perspective, without taking into account other devices in the network. This behaviour results in unfairness and could potentially lower QoE

for all clients. We propose an OpenFlow-assisted QoE Fairness Framework that aims to fairly maximise the QoE of multiple competing clients in a shared network environment. By leveraging a Software Defined Networking technology, such as OpenFlow, we provide a control plane that orchestrates this functionality. The evaluation of our approach in a home networking scenario introduces user-level fairness and network stability, and illustrates the optimisation of QoE across multiple devices in a network.

**Context:** SIGCOMM is the flagship annual conference of the ACM Special Interest Group on Data Communication (SIGCOMM) on the applications, technologies, architectures, and protocols for computer communication.

**Available at:**

<http://conferences.sigcomm.org/sigcomm/2013/papers/fhmn/p15.pdf>

- [4.] Deltouzos, K., Gkortsilas, I., Efthymiopoulos, N., and Denazis, S., *Liquidstream II—Scalable P2P overlay optimization with adaptive minimal server assistance for stable and efficient video on demand*. Peer-to-Peer Networking and Applications, 2013: p. 1-16.

**Synopsis:** In recent years, a number of research efforts have focused on effective and stable P2P architectures aiming at large scale and low bandwidth cost, real time video streaming systems. Particularly, live streaming and Video-on-Demand (VoD) systems have lately attracted much interest. While many efforts mainly focused on the development of distributed schedulers for content exchange among the participating peers, there are still open fundamental questions regarding the graph (P2P overlay) structure that determines the set of peers with which each peer communicates. Additionally, the way that cloud media servers support these systems is still an open issue. In this paper, we consider a BitTorrent-like VoD system and focus on the following questions: (1) how a distributed-scalable architecture can be formed in a highly heterogeneous and dynamic environment such that it dynamically manages the P2P overlay by means of exploiting the available upload bandwidth of the participating peers, and (2) how a cloud media (bandwidth provider) server reduces the amount of the bandwidth percentage contributed to the system in order to support a larger number of peers. To illustrate the success of our approach, we have developed an extensive P2P VoD simulator for demonstrating the efficiency, scalability and stability of our work under variant and dynamic conditions. Our system guarantees the uninterrupted and efficient video

distribution, even in extreme cases of peer arrivals and departures at high rates.

**Context:** Peer-to-Peer Networking and Applications (P2PNA) has received significant attention from both academia and industry in recent years. The aim of the Peer-to-Peer Networking and Applications journal is to disseminate state-of-the-art research and development results in this rapidly growing research area, to facilitate the deployment of P2P networking and applications, and to bring together the academic and industry communities, with the goal of fostering interaction to promote further research interests and activities, thus enabling new P2P applications and services. The journal not only addresses research topics related to networking and communications theory, but also considers the standardization, economic, and engineering aspects of P2P technologies, and their impacts on software engineering, computer engineering, networked communication, and security.

**Available at:** <http://dx.doi.org/10.1007/s12083-013-0230-6>

- [5.] Bojko, C., Mu, M., and Race, N. *Synchronising Video Playback Information within a Distributed Framework in Proceedings of the Media Synchronization Workshop (MediaSync) 2013*. Nantes, France. 28-30 October 2013

**Synopsis:** This paper details a mechanism to distribute time coded objects to devices in order to synchronise and control video playback within a web environment. We comment on a three-tier architecture of server, client and second screen and the implementation of a system that offers the functionality to track playback sessions and distribute them to peer devices in order to fulfil use cases and generate a communal aspect around a particular piece of media content.

**Context:** This workshop is held in conjunction with the NEM Summit, which is organised every year since 2008 by the NEM Initiative in close cooperation with leading industrial and academic players worldwide. It is the “not-to-be-missed” annual event for all those interested in Future Internet developments and in the fast paced evolution of the networked and electronic media industry. Over the years, the NEM Summit has grown to become the key conference and exhibition to meet and network with the most active stakeholders, access up-to-date information, discover the latest technology and market trends, identify research and business opportunities, and find partners for upcoming EU-funded calls. The event traditionally involves up to 400 attendees, 20 sponsors, 50 exhibitors and 40 speakers and authors selected following a competitive call for papers.



**Available at:**

<https://sites.google.com/site/mediasynchronization/mediasync2013>

- [6.] Stokking, H., Kaptein, R., Veenhuizen, A., Spitters, M., and Niamut, O. *Real Time Synchronization of Live Broadcast Streams with User Generated Content and Social Network Streams*. in *Proceedings of the Media Synchronization Workshop (MediaSync) 2013*. Nantes, France. 29 October

**Synopsis:** This paper describes the work in the FP7 STEER project on augmenting a live broadcast with live user generated content. This user generated content consists of both video content, captured with mobile devices, and social network content, such as Facebook or Twitter messages. To enable multi-source synchronization, all content sources need to time stamp the content using synchronized clocks. For synchronized play out we use a synchronization server to control the output timing of the various content. Using social analytics, we determine the most relevant social network messages to present synchronously with the broadcast. A main part of our future research in the project will focus on determining the optimal timing of such social content with a live broadcast.

**Context:** This workshop is held in conjunction with the NEM Summit, which is organised every year since 2008 by the NEM Initiative in close cooperation with leading industrial and academic players worldwide. It is the “not-to-be-missed” annual event for all those interested in Future Internet developments and in the fast paced evolution of the networked and electronic media industry. Over the years, the NEM Summit has grown to become the key conference and exhibition to meet and network with the most active stakeholders, access up-to-date information, discover the latest technology and market trends, identify research and business opportunities, and find partners for upcoming EU-funded calls. The event traditionally involves up to 400 attendees, 20 sponsors, 50 exhibitors and 40 speakers and authors selected following a competitive call for papers.

**Available at:**

<https://sites.google.com/site/mediasynchronization/27-Real%20Time%20Synchronization%20of%20Live%20Broadcast%20Streams%20with%20User%20Generated%20Content%20and%20Social%20Network%20Streams.pdf?attredirects=0&d=1>

- [7.] Efthymiopoulou, M., Efthymiopoulos, N., Christakidis, A., Denazis, S., and Koufopavlou, O. *Scalable Control of Bandwidth Resources in P2P Live Streaming*. in *Proceedings of the MED'14*. 2014. Palermo, Italy. 16-19 June

**Synopsys:** Currently commercial live video streaming systems are based either on a typical client-server or on a peer-to-peer architecture. The former outperforms in terms of stability and quality of service, provided that the system is not stretched beyond its limits, while the latter is scalable and has a much lower cost of operation with regards to the required bandwidth resources. In this paper, we propose a hybrid architecture that combines the best of both worlds. In order to achieve this we developed a scalable mechanism that monitors dynamically the total available bandwidth of the system and a distributed control strategy that dynamically allocates the required bandwidth. To the best of our knowledge this is the first work that applies control theory to P2P live streaming systems. Additionally we provide analytical proof of stability properties of our control strategy and we demonstrate some preliminary results.

**Context:** The Mediterranean Control Association and the Organizing Committee is organizing the MED'14, the 22nd Mediterranean Conference on Control & Automation, to be held in Palermo, Italy, on June 16-19, 2014. This is an occasion for STEER to form and establish networks: to interact with scientists and invited speakers from all over the world, to attend highly qualified scientific sessions and to visit Sicily, unique for its location in the middle of the Mediterranean sea and its history as a crossroad of Northern and Southern people living and ruling the islands for centuries.

- [8.] Stokking, H., Veenhuizen, A., Kaptein, R., and Niamut, O. *Augmenting a TV Broadcast with Synchronised User Generated Video and Relevant Social Network Content*. in *Proceedings of the TVX2014*. 2014. Newcastle upon Tyne, UK. 25-27 June

**Synopsys:** As TNO, we have developed an Augmented Live Broadcast use case, using components from the FP7 STEER project. In this use case, a television broadcast of a live event is augmented with user generated content. This user generated content consists of videos made by users at the event, and also of relevant social network content. The current implementation uses timestamps inserted in the media streams to synchronise related media streams. Social networks are searched using EPG information as a starting point. The presentation of the content is done on a TV (using a PC as a settop box), and on a tablet. We propose the use of a number of components of the Fcontent project to enhance our use case. Fingerprinting can be used to synchronise with an actual broadcast, instead of with a dedicated broadcast. Audio mining can be used to generate additional keywords for the social analytics framework. The TV application framework can be used to port our application to a

variety of TV sets, and the second screen framework can be used to dynamically use tablets as a second screen in our use case. **This paper won the FI Content Grand Challenge.**

**Context:** The TVX2014 Grand Challenge Competition encourages leading researchers and innovators from both industry and academia to propose solutions to a set of technical challenges which are highly relevant to the future of interactive television and online video. The competition comprises challenges set by three organisations, the BBC, BT and the FIcontent project. We are very grateful to the FIcontent project for sponsoring the competition as a whole.

- [9.] Kooij, W., Stokking, H., Brandenburg, R.v., and Boer, P.-T.d. *Playout Delay of TV Signals: Measurement System Design, Validation and Results*. in *Proceedings of the TVX2014*. 2014. Newcastle upon Tyne, UK. 25-27 June

**Synopsis:** Due to new interactive TV services, synchronizing the playout of content on different TVs is becoming important. To synchronize, knowledge of delay differences is needed. In this study, a measurement system is developed to gain insight into the magnitude of delay differences of different TV setups in an automated fashion. This paper shows the measurement system, which is validated for precision and accuracy. Preliminary measurements results show that regular TV broadcasts differ up to 6 seconds in playout moment and that web based TV broadcasts can introduce more than a minute delay. Furthermore, we measured a broadcasting before encoding and modulation, which resulted in a time about 4 second before the fastest receiver. On a side note, while developing the measurement system we found out that GPS timing on consumer Android devices was inaccurate, with fluctuations of up to 1 second. **This paper got the 'honourable mention', and was chosen as the 2nd best paper.**

**Context:** TVX is the leading international conference for presentation and discussion of research into online video and TV interaction and user experience. The conference brings together international researchers and practitioners from a wide range of disciplines, ranging from human-computer interaction, multimedia engineering and design to media studies, media psychology and sociology.

- [10.] Elkhatib, Y., Killick, R., Mu, M., and Race, N. *Just browsing?: understanding user journeys in online TV*. in *Proceedings of the ACM Multimedia 2014*. 2014. Orlando, USA. 3-7 November

**Synopsis:** Understanding the dynamics of user interactions and the behaviour of users as they browse for content is vital for advancements in content discovery, service personalisation,

and recommendation engines which ultimately improve quality of user experience. In this paper, we analyse how more than 1,100 users browse an online TV service over a period of six months. Through the use of model-based clustering, we identify distinctive groups of users with discernible browsing patterns that vary during the course of the day."

**Context:** Since the founding of ACM SIGMM in 1993, ACM Multimedia has been the worldwide premier conference and a key world event to display scientific achievements and innovative industrial products in the multimedia field. At ACM Multimedia 2014, we will celebrate its twenty-second iteration with an extensive program consisting of technical sessions covering all aspects of the multimedia field in forms of oral and poster presentations, tutorials, panels, exhibits, demonstrations and workshops, bringing into focus the principal subjects of investigation, competitions of research teams on challenging problems, and also an interactive art program stimulating artists and computer scientists to meet and discover together the frontiers of artistic communication.

## 4 STEER products

In this chapter we describe the products that were developed and/or improved within STEER. The STEER system leverages social media and advanced networking technology to enable new application based on the underlying technologies provided by STEER partners and exploiting the research and experiments carried out in STEER. STEER technologies are valuable in their own right. Together, they enable a whole new range of applications. A description of the individual technologies can be found in the table below.

Technology	Partner	Use Case	
		Collaborative Storytelling	Live Augmented Broadcast
<a href="#">Adaptive Event Profiler</a>	TNO	✓	
<a href="#">Content Ingest</a>	TNO		✓
<a href="#">Lifeshare</a>	Bitnomica	✓	
<a href="#">Multimedia enhanced home gateway</a>	ADB	✓	
<a href="#">P2Ner</a>	University of Patras		✓
<a href="#">Storisphere</a>	Lancaster University	✓	
<a href="#">Sync Player</a>	TNO		✓
<a href="#">Vidacle</a>	Bitnomica	✓	✓
<a href="#">Vision</a>	Lancaster University	✓	
<a href="#">Inter-stream media synchronization</a>	Lancaster University	✓	

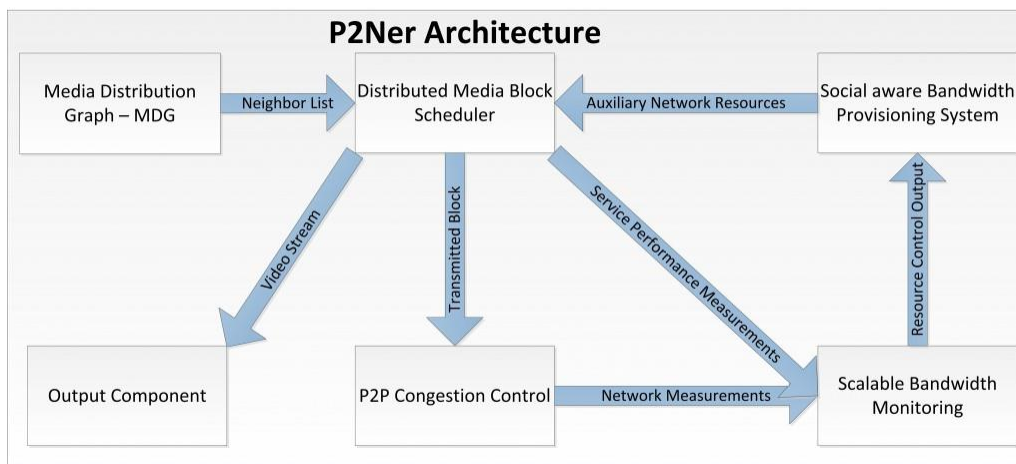
For each STEER partner, product descriptions are given, explaining what is unique and where applicable, comparing them with commercially available technology.

### 4.1 UoP

In the context of STEER, UoP developed a modern architecture for live streaming architecture that achieves:

- **Efficiency and quality of video distribution.** P2Ner maximizes the utilization of the available resources among media servers and peers results in a media distribution system with an optimal trade-off between video quality and cost.

- **Stability.** The total available bandwidth of the distribution system changes quite frequently due to the time-varying performances of the underlying communication networks and the fluctuations in the rate of user arrivals and departures. P2Ner monitors and reacts to these dynamic conditions, in order to preserve as much as possible the stability of the offered Quality of Service (QoS) and Quality of Experience (QoE).
- **Scalability.** This characteristic is determined by the amount of bandwidth, storage and processing capabilities that management and media servers must contribute as the number of participating users and media objects grows. P2Ner achieves a scalable system, distributed and real time management and control of bandwidth resources.



**Figure 4-1: P2Ner - An innovative live streaming architecture**

In order to achieve all the above UoP developed a set of innovative functionalities that makes P2Ner one of most competitive solutions in the area.

In more detail, prior to streaming each media object is fragmented into media blocks. Media blocks are exchanged among participating peers and each peer runs our innovative **Distributed Media Block Scheduler** that collaboratively ensures the timely delivery of every media block to every participating node.

Additionally, we developed an innovative MDG that is the graph in which each node represents a user or a media server (cloud) and each edge represents the unidirectional or bidirectional transmission of media blocks between two nodes. The objective of our MDG is the determination of the set of nodes with which each node will exchange media blocks (neighbours of the node) in order to fully exploit the entire available bandwidth by being in the same time robust to underlying peer arrivals and departures.

The network traffic in P2P real-time streaming is headed towards multiple network destinations (nodes) and is composed of small media blocks requested by peers at arbitrary times, supervised by the Distributed Media Block Scheduler. Our **P2P Congestion Control** is the functionality that controls this new type of traffic in a stable and efficient way while it also monitors the features of each path in the underlying network in order to inform the MDG and Scalable Bandwidth Monitoring.

Furthermore our **Scalable Bandwidth Management** is the functionality that monitors, in a scalable, accurate and dynamic way, the total available upload bandwidth of the peers that participate in each MDG and controls the emitted data to obtain high QoS.

Finally, Social aware Bandwidth Provisioning System is the functionality that, in case there is a deficit in the upload bandwidth in an MDG, determines the set of nodes that will enhance the bandwidth resources of this MDG. Additionally, it determines the set of nodes with which each node will interact.

These functionalities are the core of P2Ner and our strategic advantage in the market and, as we analyse in Section 5, they constitute the foundations of our exploitation plan.

There are several other commercial or free systems that exploit peer to peer architecture in order to do live streaming. Their technical analysis in depth and the research challenges that these systems face has been done from the description of work of STEER. Information relevant with these systems could be found even in the corresponding Wikipedia link (<http://en.wikipedia.org/wiki/P2PTV>). We studied the recent advances in commercial P2P live streaming systems and we observe that the problems that we solve in STEER ( media distribution graph optimization, P2P congestion control, scalable bandwidth and playback rate control) are still considered unsolved from commercial systems and so their solution is our major and strategic advantage between our and their system. On the other hand we want to highlight that, as we had foreseen from the beginning of STEER, none of these systems monitors and controls the resources of participating peers at the micro (p2p aware congestion control) and macro (scalable bandwidth monitoring and control) levels in order to achieve an attractive trade-off between efficiency and stability.

## 4.2 TNO

Within STEER, TNO has developed and improved upon a number of its base technologies.

- ALLBEST; an innovative state-of-the-art bandwidth monitoring tool;
- Hybrid media synchronization; an innovative state-of-the-art media synchronisation platform;
- Adaptive Event Profiler; an innovative state-of-the-art social media analysis platform.

These technologies can now be exploited, and section o discusses TNO's exploitation plans for the bandwidth monitoring and synchronisation technologies. Our adaptive event profiler technology and platform was built as part of the work that was taken over from former project partner UC Davis. As such, this technology is less mature and requires further developments before initiating exploitations discussions with external stakeholders. We foresee continued evaluation usage of this technology beyond STEER by project partners Bitnomica and University of Lancaster.

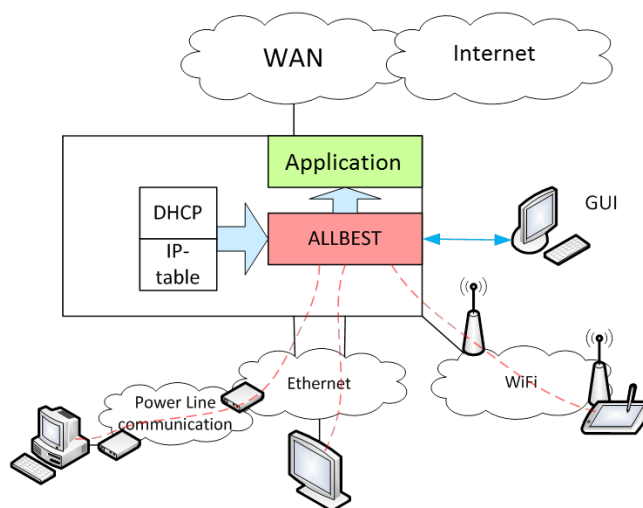
Below, a more detailed description of the TNO technology set.

- **ALLBEST Bandwidth Monitoring**

The STEER bandwidth monitoring tool (ALLBEST) monitors the performance of the home network and can help the home gateway to instruct applications and devices to maintain a positive customer experience. ALLBEST measures the available bandwidth and capacity between the home gateway and the device running an application. With ALLBEST, you can check in real-time the available in-home bandwidth on Wi-Fi and Ethernet connections, e.g. to assist the home gateway in making application-related decisions. Configuration allows for adjusting the probing interval, the amount of probes for performing measurements, the MTU size and the sliding window size. ALLBEST has been thoroughly tested by means of simulations and proof of concept measurements and a reference design for an OSGi-based home gateway is available. Its technology features are:

- Easy to implement: ALLBEST can be installed on any network node; a reference design for OSGi-based home gateways is available
- Non-intrusive measurements: the probing tool does not affect services and has a low payload.
- Fast and accurate: the bandwidth monitoring shows fast convergence and is accurate enough for IPTV service bandwidth measurement.

Existing bandwidth monitoring tools either measure WAN-LAN traffic (such as e.g. NetLimiter<sup>9</sup> and PRTG<sup>10</sup>), or require a dedicated test-setup (e.g. Spirent Test Center<sup>11</sup>), which prevents implementation and integration within home equipment.



**Figure 4-2: ALLBEST architecture.**

<sup>9</sup> <http://www.netlimiter.com/>

<sup>10</sup> <http://www.paessler.com/prtg>

<sup>11</sup> [http://www.spirent.com/Ethernet\\_Testing/Software/TestCenter](http://www.spirent.com/Ethernet_Testing/Software/TestCenter)



## - Hybrid Media Synchronisation

The STEER media synchronisation technology for live event coverage enables to seamlessly combine professional broadcast with amateur videos shot by the crowd, as well as with social media feeds such as Twitter and Facebook streams. In the STEER player, all media are shown synchronised in time, faithfully recreating the entire experience. The technology is distribution agnostic, independent of media codecs and transport mechanisms, and was tested during the World Rowing Championship 2014. Its technology features are

- Distributed content ingest platform: content can be ingested by a local node and/or in the cloud. Ingest nodes work together to achieve frame accurate media time-stamping.
- Frame-accurate synchronisation and playback of media: all media sources can insert timestamps in the captured media streams, all using synchronised clocks. Frame-accurate playback uses these timestamps.
- Multi-device support: the solution supports multiple devices, both on the capture side (professional, iOS phones and tablets) and playback side (Linux systems). Various media streams can be played back on a primary TV screen and secondary companion screen.
- Distribution-agnostic technology: the platform supports a variety of codecs and transport protocols, and can thus enhance any existing media production facility.

Existing media synchronisation technologies are mostly based on a form of audio fingerprinting (e.g. Civolution SyncNow<sup>12</sup>) and audio watermarking (e.g. Technicolor MediaEcho<sup>13</sup>). Such content-based techniques cannot achieve frame-accurate synchronisation, and they require dedicated client-based processes for detection of the inserted markers, which goes beyond simple buffering and timeline adjustment.

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<sup>12</sup> <http://www.civolution.com/solution/digital-watermarking-fingerprinting-for-acr-and-synchronized-ads/>

<sup>13</sup> <http://www.technicolor.com/en/who-we-are/press-news-center/press-releases/technicolor-launches-mediaecho-second-screen-app-enrich-blu-ray-vod-broadcast-viewing>



*Figure 4-3: Hybrid media synchronisation setup.*

#### - **Adaptive Event Profiling**

The STEER adaptive event profiler technology allows you to follow buzz around an event. It allows for emerging event detection through event tracking on social media, and for personalization through ranking and clustering social media posts. Use cases range from the suggestion of related terms to an event for tagging videos, to following social media messages around an event in real-time, to the creation of a dataset of social media data around a topic. The adaptive event profiler allows you to retrieve significantly more social media data than following a single keyword, and was tested during the 2014 Winter Olympics, the 2014 Silverstone F1 race and the World Rowing Championship 2014.

Its technology features are:

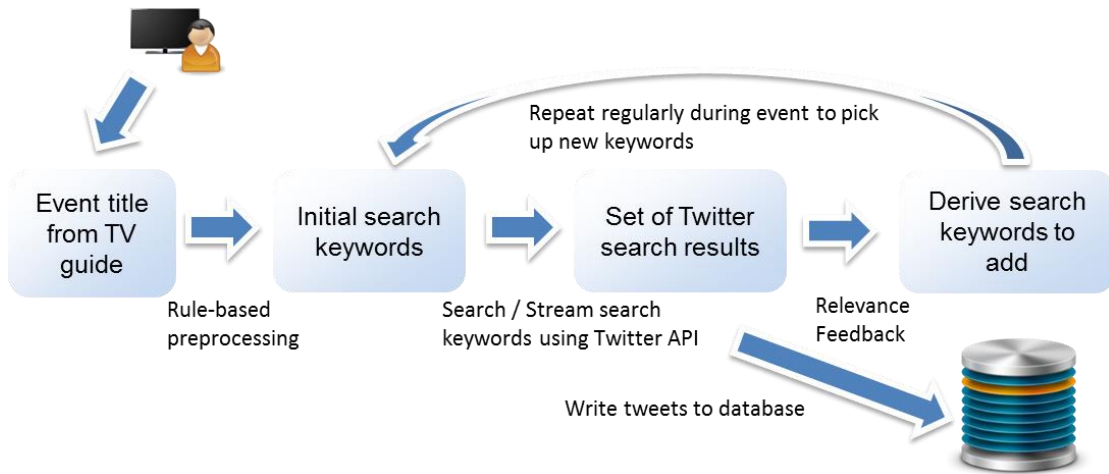
- Retrieve Likeable Tweets: the adaptive event profiler retrieves significantly more likeable tweets than following a single keyword, without introducing too much noise in the dataset.
- Simple and easy Interfacing through Web Services Implementation: the adaptive event profiler runs as a web service on any cloud. The API allows to list all events, create and stop events, check event details and to open specific Twitter streams.
- Works with Twitter and Facebook: Twitter is used as a source of textual content to find related keywords. During public events tweets are continually posted with information on the current events, such as news about the participants and match outcomes. Facebook event pages can be tracked, and images can be resolved

Existing analysis tools for social network analysis are already fairly complete. For example, Coosto<sup>14</sup> provides a complete analysis social media platform for e.g. engagement, brand/campaign/crisis monitoring and data research. However, the AEP's stand-alone and media-specific features allow it to be

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<sup>14</sup> <http://www.coosto.com/uk/>

linked to a variety of cross-over services, where metadata, search and filtering are highly relevant.



*Figure 4-4: Adaptive event profiler architecture.*

## 4.3 ULANC

### 4.3.1 Vision online TV

Vision is the 3rd generation IPTV platform at Lancaster University designed specifically for research and experimentation. It is a social IPTV research platform tailor-made by researchers and developers at Lancaster University. It offers a production-level live and on-demand streaming service accessed by a large Living Lab user community (over 10,000 potential users). Content metadata and user activities are captured by a bespoke statistics service to study trends of user preferences and social interactions. Specifically, Vision facilitates the following research areas:

- Research and evaluation of new technologies to support professional and amateur content production, collaborative authoring, efficient media distribution in creative communities and the media industry.
- Piloting the integration of new media services, social media and emerging network distribution technologies in large-scale Living Lab environments.
- Engaging user communities and understanding new demands in the digital economy through waves of agile technology deployments and evaluations.
- Highly scalable and responsive statistics and analytics capabilities to improve the validation of new technologies.
- Exploiting multi-modal and multi-disciplinary approaches to study users' experience of emerging media applications across connected devices.

Under the STEER umbrella, most of the research and development in Vision has been carried out to 1) build a bespoke statistics service to capture user activities in an online TV system and 2) analyse patterns and trends of user preferences and social activities. Vision is a unique experimentation platform that is built by

researchers for the purpose of academic research. We have full controls of the entire content delivery chain to integrate and evaluate novel designs. We also appreciate direct communications with our user base to get the first-hand user feedback. Related research mostly relies on fractions of dataset borrowed from service providers. Although such datasets are valuable for offline analysis, they do not provide an online experimentation environment.

### 4.3.2 Storisphere

The Storisphere storytelling platform was initially designed in the UK research project MediaCityUK FIRM. Within STEER project, the storytelling concept has been further strengthened, followed by significant development efforts to realize the backend enabler and frontend user interfaces. Storisphere is now an open platform enabling new designs and media technologies for collaborative media authoring, creative editing, and social storytelling in a highly engaging way. Storisphere encompasses a complete storytelling ecosystem by integrating bespoke mobile applications for capturing, sharing and exploring user generated content, a media asset referencing system that enables video stories to be edited collaboratively, and a story editing and sharing web environment.

Through collaborations with multiple STEER partners under the framework of community storytelling, the storytelling functions of Storisphere can be exploited via standard authentication mechanisms, web services, and other programmable interfaces. These features are invaluable in enabling the integration of third-party applications and improved media distribution strategies in different content networks for future work.

Recent years have seen many storytelling applications sprouting on the market. Facebook timeline<sup>15</sup>, Microsoft Sway<sup>16</sup>, and WeVideo<sup>17</sup> are examples of the storytelling tools. Compared with other applications, Storisphere promotes storytelling using video content and offers an online editing environment based on web technologies. Using server side technologies, the processing and rendering efforts at user side is reduced to minimum for story editing activities. Storisphere is also an open research platform that allows third-party experiments on the topics of social context integration, recommendation, and network caching, which have been demonstrated in STEER experiments with multiple STEER partners.

### 4.3.3 Inter-stream Media Synchronization

At Lancaster University, we design and implement an open and lightweight inter-stream media synchronization framework using web technologies to enable orchestrated media experience. It employs efficient sync signalling mechanisms, play out and buffer management functions, and a bespoke QoE impact function derived from subjective user experiments. The impact function balances the accumulative impact of the re-synchronization process and non-synchronicity to

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<sup>15</sup> <https://www.facebook.com/about/timeline>

<sup>16</sup> <https://sway.com/>

<sup>17</sup> <https://www.wevideo.com/>

D6.3 Dissemination report and revised exploitations plans

ensure the synchronicity between media streams whilst minimizing the perceptual impact to the user.

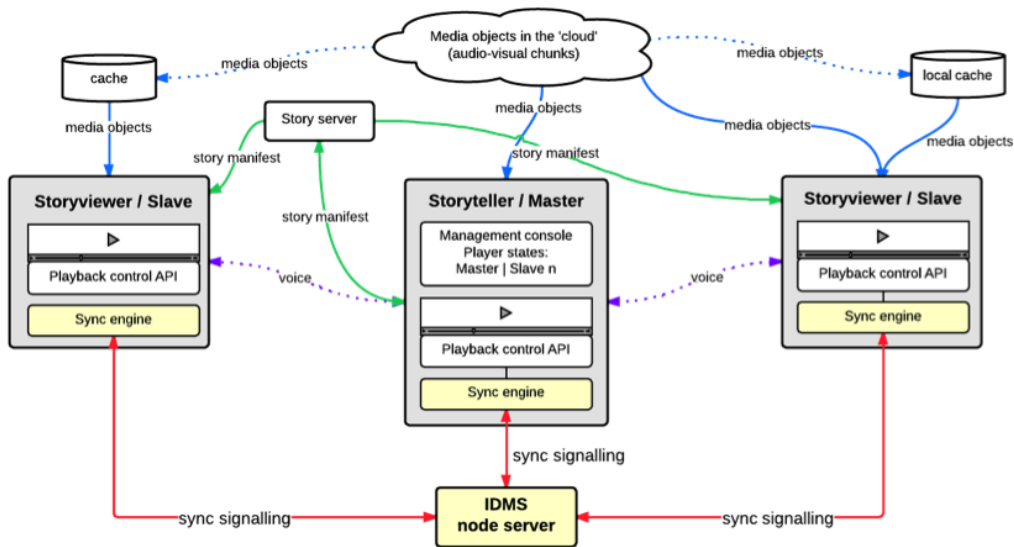


Figure 4-5: Inter-stream media synchronization

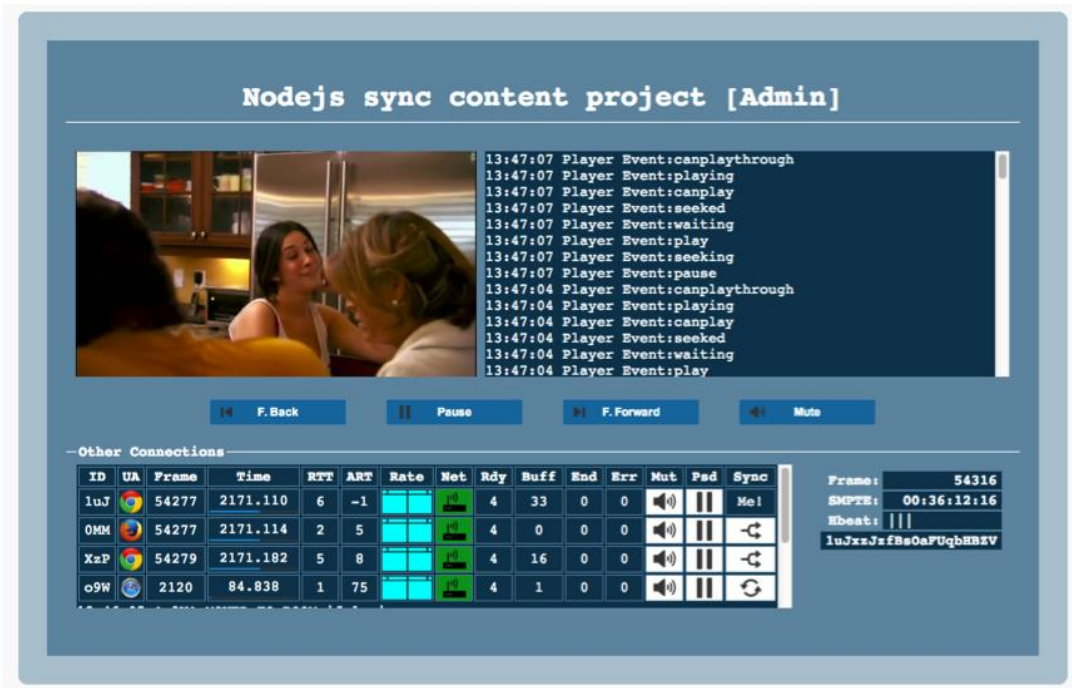


Figure 4-6: Admin console of the synchronization framework

The synchronization framework is one of the first of its kind to have been built using web technologies. This design allows any user device with modern web browsers installed to participate in synchronized media applications orchestrated by the framework. From the research perspective, we demonstrate the first study of the joint psychological impact of non-synchronicity and playback adjustments of multiple media streams in a shared physical location.

## 4.4 Bitnomica

### 4.4.1 Vidacle



Figure 4-7: Vidacle Screenshots

Vidacle is a mobile application for the consumer market and is built around the storytelling concept. It helps the user in recording important or fun moments and creating new stories in an easy and compelling way. Stories are easily shared over many social networks. You can create and tell your stories together with your friends, family or with event participants. Vidacle records your video together with timing, and geo-location information and makes videos accessible by different ways of searching: on time, location, event, story, keywords, etc.

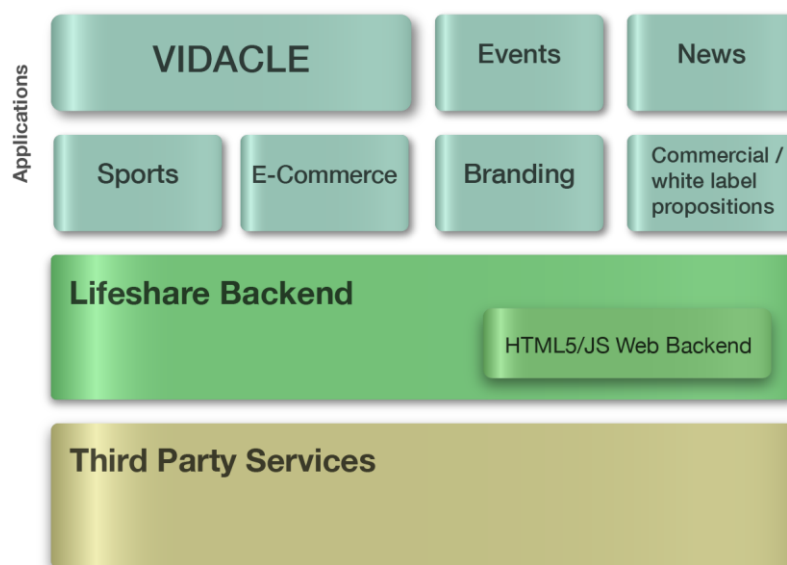


Figure 4-8: Vidacle is built on top of Bitnomica's Lifeshare platform

The roadmap for Vidacle includes:

- Collaborative storytelling. Easily invite others to cooperate.
- Advanced search mechanisms based on geo-info, time, keywords, etc.
- GEO-based browsing
- Separate portals for different markets and uses cases (for instance sports, e-commerce, and news).

#### 4.4.2 Lifeshare

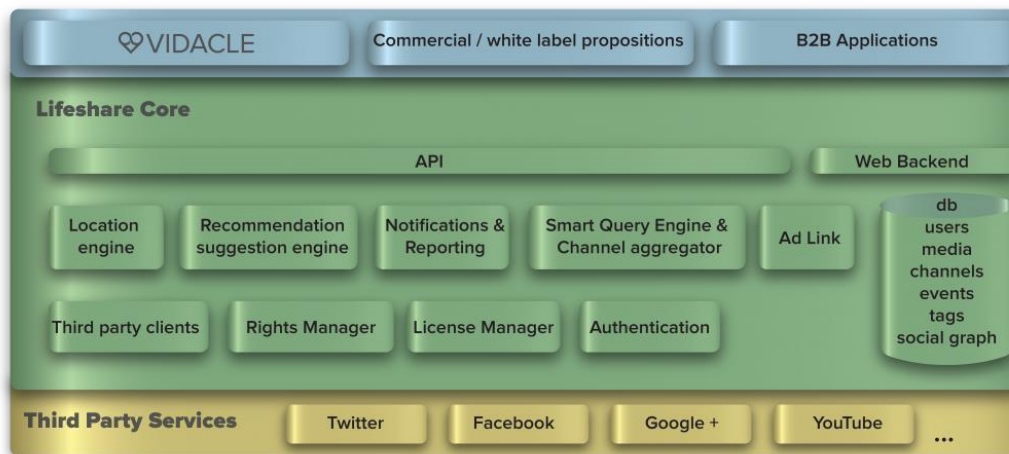
Lifeshare is a multi-channel micro-video platform, which is designed from the onset to tackle the challenges of mobile video. It provides new ways to add relevance to mobile video by offering powerful aggregation and search, based on time, location, camera viewpoint, social data and keywords.

The most important strengths are:

- Search & Aggregation of videos based on
  - Keywords / topics,
  - Time, location & camera orientation.
- Keep track of
  - Social interaction with video
  - Popularity of videos, channels and stories
- Multi-User
  - Give access to other users
  - Rights & license Management
- Ad Targeting functionality
  - based on time & location, user interest
  - Communities

Lifeshare is designed to handle different applications in different domains and different use cases on a single platform. The advantages are that this is

- scalable,
- takes the benefit of doing Cross-Domain search & aggregation, and
- creates a large & Growing user-base



*Figure 4-9: Lifeshare Architecture and component overview*

#### 4.4.2.1 Assessment of Competition

Lifeshare is specifically designed to combat the challenges imposed by massive use of mobile video in relation with the use of video in social networks. This justifies a different architecture as well as a different business proposition than incumbents offer. It is hard to point to a direct competitor. Lifeshare has a role between the major social networks, publishers, content providers, and video sites.

In some respects, Lifeshare's main competitor is YouTube. However Youtube is its own channel, and leaves little room for content providers and publishers to show their own brand, and to create their own user experience. Others offerings are mainly focussing on the service of streaming video, and leave all user experience and application building to the customer. Lifeshare takes a middle-ground approach: it provides the technical service of streaming mobile video as well as providing a common user interface containing content of all providers, while still leave room for providers to build their own environments. Furthermore, the Lifeshare system is able to connect between and search through all data of all publishers hosted by Lifeshare. The rationale behind this is our belief that if you want to offer a truly engaging experience, a walled garden approach is not the solution, but offering premium content in combination with (mobile) user generated content from your target groups, will. Lifeshare is especially designed to see a video every video asset in relation with other assets. Collaborative Storytelling is a good example, of an application that is directly supported by Lifeshare. In a sense, Lifeshare offers streaming video and hosting functionality plus the social layer required to build true mobile video applications.



## 4.5 ADB

### 4.5.1 Multimedia-enhanced Gateway

Participation in the STEER project allowed ADB to evaluate improvements and extensions to the functionality of its home gateway hardware and fully manageable, modular software architecture. This resulted in the concept for an Advanced Triple-Play Home Gateway with modular add-on components for local storage, video transcoding, multimedia distribution caching, and Home Network bandwidth estimation (see Figure Figure 4-10: ).



*Figure 4-10: Multimedia enhanced home gateway*

In particular, the gateway

- provides fine-grained distributed social-aware caching within the Storisphere Community Storytelling Environment (University of Lancaster),
- supports real time, on the fly media transcoding of multimedia social contents through a cost-effective, retro-fittable pluggable module
- coupled with transcoding, the integration of the ALLBEST real-time bandwidth estimation tool (TNO) allows for QoE assurance and network resource optimization.

The add-on components have been added to a market-ready device offering broadband networks connectivity through VDSL2/ADSL2+ and Gigabit Ethernet WAN ports, and providing home devices with Data, Voice and Video services through high-speed interfaces (Ethernet, dual-band concurrent Wi-Fi Access Point).

The gateway incorporates the award-winning Epicentro<sup>®</sup> networking stack, which supports IPv4/IPv6 dual-stack routing, QoS, security, and standard-based remote management. Native modularity and an integrated OSGi Framework allow easy

deployment of applications for Security, Home Automation, Health Care, Energy Management, etc.

In particular, exploiting the Epicentro<sup>®</sup> Stack modular architecture, the components developed for the STEER use case have been added as fully integrated, manageable and dynamically deployable packages (OS-native or OSGi bundles).

“Pluggable” video transcoding, USB Network Attached Storage (NAS) based caching, and bandwidth estimation between the gateway and home network nodes nicely fit together as value-added features for multimedia sharing.

The combination of such features is not known to be currently available in other products of the same typology. Transcoding, for example, is implemented in Set-top boxes and will be most probably part of future Media Gateways (see Section 5.5), but is not found in, even high-end, residential gateways. Bandwidth estimation, especially provided through tools that operate on the LAN-side with no involvement or support required by user device, is also not a common feature of commercial home gateway; on the contrary, it is believed to be of great interest for operators, since, as just an example, it allows separating the contributions introduced by the home and the access network (of which only the latter strictly falls under operator’s responsibility) to possible bottlenecks across an end-to-end communication link. Finally, video caching is also not employed in common device applications, where a gateway-attached NAS, if present, is normally used for basic file sharing or to support a DLNA server, where content is only locally exchanged.

## 5 STEER Exploitation plans

In this chapter we outline exploitation plans for STEER technology, per partner.

### 5.1 UoP

As we analysed in Section 4, the major work of UoP in STEER that could be commercialized was the development of P2Ner. P2Ner is an innovative live-streaming architecture that in a nutshell allows high quality and stable and server-less live streaming. Every algorithm in P2Ner is distributed and scalable so P2Ner inherits and maintains the scalability that systems with peer to peer architecture have. Furthermore we don't have just a set of algorithms but we have also implemented and performed the initial test of a complete efficient, stable and server-less live streaming system that is able to act as a standalone product.

By considering all the above our exploitation plan is based in two axes. The first is to contact with Greek operators and inform them about the product that we have in order to allow them to exploit it for live streaming. The second is to contact SMEs that already try to provide peer to peer live streaming services and inform them for the technology that we have in order to start a process under which they can embed it in their products.

### 5.2 TNO

TNO has used the LAB experiment, taking place during the World Rowing Championships in Amsterdam, to make contact and discuss STEER technology exploitation with appropriate stakeholders in The Netherlands. We have made contact with United Broadcast, service provider KPN and Dutch news broadcaster NOS.

- United Broadcast is *'a full service organisation in the field of facilities, and technical and creative support for media and broadcast organisations'*. They often facilitate the broadcasting of large sports events, typically on behalf of the NOS. As such, their activities are related to the STEER live augmented broadcast use case, as United fulfils the complete technical recording of the broadcast of such live events. In a number of interactions we have discussed the STEER LAB use case and its implementations, and United agreed to cooperate with us during the WC Rowing. They supported us during the experiments, are interested in STEER ingest and synchronisation technology and we are currently considering looking at future cooperation. One of the events we are now looking at is the start of the Tour de France 2015, in Utrecht, The Netherlands in 2015. This gives us ample time to further mature our technology developed within STEER, and work towards actual product usage and potential licensing of the technology.
- KPN Broadcasting Services supply broadcasting companies with network connectivity. As evident from our experiment during the World Rowing Championships, one of the main hurdles for the STEER LAB use case is sufficient network resources for live upload of streams. KPN was interested

in our experiment and agreed to give us several unlimited LTE test subscriptions for the duration of the experiment. During the experiment, we used these test subscriptions to transmit more data than any current commercial subscription allows, i.e. over 30 GByte in a few days. Our experience with using LTE for local video contribution is interesting for KPN, and we have scheduled follow-up meetings to discuss this further.

- NOS is the Dutch public broadcaster and as such, they are a typical rights holder for many of the Dutch sports events. For TNO, to get our technology further towards the market, we need good formats. Through our experiments, we have realised that it is not easy for a spectator to capture an interesting video. We plan to discuss this topic with NOS in the future more extensively.

TNO has further discussed usage of STEER technology with Dutch news providers NU.nl and ANP. This has led to the preparation and submission of a joint proposal for the Dutch Stimuleringsfonds voor de Pers. The proposal **Cameraad - Breaking video**<sup>18</sup> aims to reuse STEER live ingest and synchronization technology for enabling live user-generated news contribution.

Within STEER, TNO has closely worked with ADB on integrating its bandwidth monitoring tool in the ADB home gateway. As such, these activities provide a natural basis for continued conversations on follow-up and joint exploitation. Beyond the STEER partners, for TNO's bandwidth monitoring technology ALLBEST, several telecom operators (Vodafone, KPN, BT and TeliaSonera), and vendors (Alcatel-Lucent and Ikanos) have expressed interested in the bandwidth monitoring tool. For operators, in-home bandwidth availability is key in delivering a high service quality to its customers. As an outcome of our efforts in STEER, we now have a proof of concept version of ALLBEST running in a home-environment of Vodafone and we are currently investigating other ways to exchange ALLBEST prototypes with interested companies. Within STEER, the integration of the ALLBEST technology as an application on a commercially available home gateway has made it to more interesting for operators and vendors. TNO is initiating discussions on integration of ALLBEST into other gateway, and the STEER experience allows us to provide interested parties with adequate consultancy.

### 5.3 ULANC

ULANC will further exploit the storytelling social TV technologies developed in STEER in collaborative research with research institutes and industries. Specifically, we will work with ethnographers and social scientists to study the impact of a storytelling system to social behaviours. We have also plans to work with local councils and local media organisations to explore the potential of using the storytelling system as a multimedia social platform to enhance the tourist experience and help promote local businesses. To this end, early discussions of exploitation plans have been carried out with SMEs such as LancashireOne

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<sup>18</sup> <http://www.persinnovatie.nl/17283/nl/cameraad-breaking-video>

(www.lancashireone.com) and HW Communication (www.hwcomms.com). Furthermore, we will continue to maintain the open social TV research platform and offer third-party support to better understand user behaviours in such online TV service and to evaluate novel designs in a Living Lab setup. An example is our previous work with the BBC to trial features that could be exploited by the BBC iPlayer.

## 5.4 Bitnomica

Bitnomica, as the SME in STEER, has had all focus on its two products, Lifeshare and Vidacle. The ambition is to leverage the Lifeshare platform, which has a Business-to-Business focus, with the Vidacle Consumer Application, which is in principle freely available in the Apple App Store. During the STEER project, we were able to incorporate the generated the knowledge into our products, as well as to carry out field-tests with our technology under challenging conditions. Not only did we prove the viability of our products, we also ripened them, and improved their stability. Especially the field test in Schladming taught us how to deal with challenging WiFi conditions in a Social Video application (Vidacle). Furthermore, we now know the impact of socially enhanced metadata, by the integration with TNO Adaptive Event Profiler. Finally, integration with Storisphere, taught us how to integrate with third party social applications in a scalable and user-friendly way. The field-test in Silverstone also learned us that providing a good user experience, especially when dealing with a mash-up application like Vidacle+Storisphere, is a very difficult endeavour.

The next steps with Lifeshare and Vidacle are to connect more partners to the Lifeshare Platform. Lifeshare is designed to become a single mobile video platform, to which publishers, major brands, communities and role models can connect to engage their target groups and monetize on them. Vidacle plays the essential role of both being a showcase of our technology, as well as being the primary frontend for user generated video ingest and video consumption.



### Markets

Lifeshare and Vidacle are designed to provide functionality for monetizing mobile video, both premium content and user generated content. We recognize the following markets: Sports, Social Networks, News, E-Commerce, Branding and Events. In these markets we seek deals in the form of partnerships, joint-ventures and licenses. Furthermore, for some use cases a premium, paid Vidacle application will generate revenues. The applications we envision that can be built on top of lifeshare are for instance:

- Sports and Social Events Engagement
- Citizen Reporting

- Storytelling
- Brand Engagement
- Corporate Channels
- Product Presentations

## 5.5 ADB

ADB offers a combination of equipment, software, systems and services for connected homes and connected lives, touching on all aspects of enterprise and consumer solutions for deployment and unified management of broadband networking and multiscreen video broadcast.

ADB considers the home gateway as a service aggregation point that enables the deployment of a variety of new, cloud-assisted value-added services for the home network, such as home automation, remote surveillance, and energy consumption management and optimization. Combining in a single “media gateway” device the routing and residential network management capabilities of an advanced gateway with the features typical of a set-top box, further allows optimizing the video experience in the home, whether the content is being streamed to devices like a tablet or laptop or displayed on the television.

With a complex offer of multiscreen TV, premium entertainment, personal multimedia and home management, a key factor of differentiation is the ability to provide a managed service with monitoring, notifications and command and control functions blended into a consistent and unified user experience that take responsibility for QoE and customer care, preventing complaints by customers about e.g. excessive buffering delay or jittered audio/video rendering. As an example, this means having an understanding of what is happening on the home network and on client devices, and being able to inform customers about possible forthcoming service issues due to a poor configuration of the home network.

This kind of proactive monitoring down to device level is recognized as a desirable practice for multiscreen TV. Most importantly, by ensuring that premium entertainment remains simple to use and reliable, it is also a fundamental capability in the hands of service providers to differentiate themselves from pure online media companies and cement relationships with their customers. This is becoming a key element in the operators’ effort to widen opportunities for competitive differentiation and tackle the rapidly approaching market saturation of core broadband or pay TV services, proposing themselves as the super-aggregators of content services, including from famous companies like Netflix, and the aggregator of Smart Home services and the gateway to them.

The activities carried on in STEER nicely fit with the picture delineated above, and the accumulated knowledge and achieved results can be directly exploited in that framework, albeit in different forms.

In particular:

- The experience gained in the integration of the caching and bandwidth estimation applications as OSGi bundles made in cooperation with external

partners helped in better understanding both the advantages and the points of attention of that approach to software modularity in collaborative environments. The use of a known and standardized development framework has proven to be convenient in reducing interactions with third party programmers during the initial phase of software development. On the other hand, the specific STEER applications required a higher computational burden and/or a deeper interaction with native OS services with respect to those typically employed in the Smart Home environment, for which ADB had accumulated a better experience so far. This highlighted the constraints imposed by the employed framework in terms of execution load capacity, providing indications about the refinement of guidelines and recommendation to developers, and a possible opportunity for the further framework optimization.

Since software modularity has become a key feature and selling point for home gateways, any progress in the stabilization and performance improvement of solutions in this area is likely to have a direct impact on market opportunities, and is therefore quite valuable for ADB

- According to the considerations made above, systems that offer tools for QoE improvements through pro-active diagnostics associated, but not limited to, multimedia applications in the home have a widely recognized added value. The ALLBEST application has therefore all the capability to become a key asset for a home gateway, especially if it is integrated in a more ample QoE framework. This has incidentally been confirmed by the good acceptance of the STEER contribution to HGI, as reported in Section 3.4.1. ADB is already selling a series of diagnostics tools for performance evaluation of the home gateway WAN connection aligned to the BroadBand Forum specifications. The possibility of extending the coverage of this tool suite on the LAN side, especially with a facility that does not require support by user devices in the home and whose usage does not impact active services is clearly highly valuable already in the short term. Preliminary contacts with some of the ADB customers seem promising for a concrete interest about such opportunity. The prospect for an extension of the collaboration between TNO and ADB initiated in STEER for the further assessment, improvement and evolution of ALLBEST is therefore being strongly considered.
- The deployment of transcoding functionality as a simple retrofitting option for existing and/or in-field home gateways, which has been initially foreseen as one of the motivations for developments in this area, is now becoming more questionable from a commercial standpoint. As anticipated in Deliverable D6.2, ADB had planned the realization of a fully integrated, optimized architecture for a media gateway product that combines the routing and residential network management capabilities of an advanced home gateway with features typical of a set-top box, and hence also incorporates transcoding. The work in this direction has recently been accelerated, and is likely to absorb most of the resources in this development area. However, the results achieved by STEER activities has

shown that a solution with a lower degree of complexity than a full media gateway, although deserving further consolidation and improvement, is fully viable and can be consolidated in case opportunities for its deployment will show up. Furthermore, the architecture solution employed in STEER based on inter-process communication through the home gateway data model, exploiting by either internal services or applications residing on external hosts via HTTPs/JSON messages, is going to be deployed on a larger basis for both the media gateway and other high-performance gateway devices.



## 6 Ethical and Legal Challenges

Understanding the ethical and legal issues of a piece of software or service is crucial for its exploitation. The issues relating to exploitation are often different to those relating to the experimentation that has been performed up to this point. For instance, when experimenting with the number of users may be much smaller and potentially more data may be gathered on the users in order to monitor and understand what is occurring.

In this chapter we identify and assess the ethical and legal challenges that STEER faces. In section 6, we provide an overview of relevant outcomes from the EXPERIMEDIA project. Then, in section 6.2, we analyse and discuss how these outcomes are related to the STEER experiments by using an ethical checklist. This allows potential users of STEER technology to consider these aspects.

### 6.1 EXPERIMEDIA outcomes

The EXPERIMEDIA project produced four public deliverables highlighting and explaining legal and ethical issues in the context of the Future Media Internet:

- D5.1.2: Ethical, Legal and Regulatory Framework for Social and Networked Media<sup>19</sup>
- D5.1.5: Final Legal and Ethical Framework for the Deployment of EXPERIMEDIA Testbeds and Experiments<sup>20</sup>
- D5.1.7: Legal and Ethical Aspects of Experiments including Policy Recommendations v1.0<sup>21</sup>
- D5.1.8: Final Ethics Review Report<sup>22</sup>

These documents must be read in detail to understand and mitigate any issues arising from exploitation in STEER, but a summary of their content may be found below.

#### 6.1.1 Ethical, Legal and Regulatory Framework for Social and Networked Media

The EXPERIMEDIA legal analysis from April 2012 focused on the explanation of the most important legal concepts that would inevitably impact on the scenarios and experiments in EXPERIMEDIA and similar facilities. The most important aspects were:

- Content regulation
  - Television without Frontiers (TWF) directive

<sup>19</sup> EXPERIMEDIA D5.1.2: <http://www.experimedia.eu/deliverables/#d512>

<sup>20</sup> EXPERIMEDIA D5.1.5: <http://www.experimedia.eu/deliverables/#d515>

<sup>21</sup> EXPERIMEDIA D5.1.7: <http://www.experimedia.eu/deliverables/#d517>

<sup>22</sup> EXPERIMEDIA D5.1.8: <http://www.experimedia.eu/deliverables/#d518>

- AudioVisual Media Services (AVMS) directive
- Two tiered regulation
- Technology neutrality
- Copyright, including sports events rights and user generated content
- Privacy policies, including location based services
- Liability, including caching, hosting and data protection regulations.

The TWF directive applies to traditional linear broadcast services and was later extended by the AVMS to encompass all AV media services including on-demand (non-linear) systems. This creates a so called “two tier” regulation system with additional rules for linear services. The regulations apply irrespective of the platform or technology used to deliver the services (“technology neutrality”). The cases that the regulations apply to and the associated obligations are summarised in the document. For STEER, both TWF and AVM are relevant as we consider both live and on-demand scenarios.

Copyright, and in particular rights relating to user-generated content (UGC) is an important issue for services such as those in STEER. The document explores the most important concepts of copyright law which is not fully harmonised across Europe. Unfortunately, due to the differences in copyright law, not all content is protected. Only the content which fulfils the necessary criteria of a particular country falls under the protective shield of the law. Second, it is possible that some content can be under protection in one (or several) Member States but not in another.

Generally, for UGC, it is the author of the work who holds copyright. Adding such UGC to a social network however normally means accepting a set of terms and conditions associated with the social network and thereby often permitting others to re-use the content at will (depending on the T&Cs). Particular terms apply to UGC at sports events: the events are not actually protected by copyright (as they are in an odd sense not “original” as they follow sporting rules) but they are often covered by exclusive licensing deals that are enforced through law in other ways. The rights should not deny citizens from shooting videos of the atmosphere surrounding an event however.

Any data collected on “natural persons” must comply with data protection law which confers certain rights upon the data subject. The definitions and characteristics of the “data controller” and “processor” are explained and the importance of “consent” is discussed. Informed consent for data collection and processing through a written consent form was recommended for experiment participants and the ability for a participant to revoke their consent is also emphasised. The concept of “proportionality”, in that data must be adequate, relevant and not excessive in relation to the purposes for which it is collected and processed is described. Location based data is of particular sensitivity and specific provisions are made for it in legislation. Consent should be obtained for processing of location data.

Finally, the document discusses the liability of service providers, in particular how the situations arising from a user transmitting harmful or illegal information through internet services can be dealt with. There are three cases all of which are explained in detail: mere conduit, caching and hosting. That there is no general obligation to monitor content but an obligation to do something when informed of alleged illegalities is also described.

The legislation examined in this document was the following:

- Media regulation:
  - Directive 89/552/EEC of 3 October 1989 on the coordination of certain provisions laid down by law, regulation or administrative action in Member States concerning the pursuit of television broadcasting activities, O.J. 1989 L298/23; amended by Directive 97/36/EC of 30 June 1997, O.J. 1997 L202/60 and Directive 2007/65/EC of 11 December 2007, O.J. 2007 L332/27; codified by Directive 2010/13/EU of 10 March 2010 the coordination of certain provisions laid down by law, regulation or administrative action in Member States concerning the provision of audio-visual media services (AVMS Directive), O.J. 2010 L95/1.
- Intellectual property rights regulation:
  - Directive 2009/24/EC of April 23, 2009 on the legal protection of computer programs, O.J. 2009 L111/16;
  - Directive 2006/115/EC of December 12, 2006 on rental right and lending right on certain rights related to copyright in the field of intellectual property, O.J. 2006 L376/28;
  - Directive 93/83/EEC of September 27, 1993 on the coordination of certain rules concerning copyright and rights related to copyright applicable to satellite broadcasting and cable transmission;
  - Directive 2006/116/EC of December 12, 2006 on the term of protection of copyright and certain related rights, O.J. 2006 L372/12;
  - Directive 96/9/EC of March 11, 1996 on the legal protection of databases, O.J. 1996 L77;
  - Directive 2001/29/EC of May 22, 2001 on the harmonisation of certain aspects of copyright and related rights in the information society, O.J. 2001 L167/10;
  - Directive 2001/84/EC of September 27, 2001 on the resale right for the benefit of the author of an original work of art, O.J. 2001, L272/32.
- Data protection regulation:
  - Directive 95/46/EC of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data, O.J. L281/31;

- Directive 2002/58/EC of 12 July 2002 concerning the processing of personal data and the protection of privacy in the electronic communications sector, O.J. L201/37;
- Directive 2006/24/EC of 15 March 2006 on the retention of data generated or processed in connection with the provision of publicly available electronic communications services or of public communications networks and amending Directive 2002/58/EC, O.J. L105/54.
- Liability of Intermediaries
  - Directive 2000/31/EC of 8 June 2000 on certain legal aspects of information society services, in particular electronic commerce, in the Internal Market (Directive on electronic commerce)

### 6.1.2 Final Legal and Ethical Framework for the Deployment of EXPERIMEDIA Testbeds and Experiments

The second public EXPERIMEDIA legal analysis was published in May 2013 and focused on the main legal developments in three areas: privacy and data protection, liability of internet intermediaries and media law. Additionally, it addressed the issue of compliance with terms and conditions for API by application developers. Parts of the document described ongoing legal work and proposals that had not at that point come into force. These legal developments should potentially be monitored by those partners seeking to exploit their STEER software.

With respect to the Data Protection directive, the document clarifies two aspects: the definition of “personal data” and when and how to notify a country’s data protection authority (specifically for Austria, Spain and Greece where the EXPERIMEDIA but also some STEER testbeds were based). Proposed changes to the directive are discussed, including the “right to be forgotten” and a relaxation of notification rules.

Proposed reforms to the E-Commerce directive and the AudioVisual Media Services directive are described. In particular, potential clarifications in the liability of internet intermediates and possible additional regulations on non-linear media services are made.

Finally, the document describes issues surrounding the terms and conditions for API developers: for instance people writing software that interfaces to Twitter. It is highlighted that there are in general no exceptions created for research activities in services T&Cs. The T&Cs of services often change and the only solution proposed is that the research projects must pay constant attention to T&Cs of the targeted platforms and react promptly to their changes. If such need occurs, a research project could also contact the targeted platform provider and enquire about special conditions for scientific purposes. There is however no guarantee that such exception will be granted

### 6.1.3 Legal and Ethical Aspects of Experiments including Policy Recommendations

The final EXPERIMEDIA deliverable we consider here was published in September 2014 and summarises the fundamental legal research conducted in the EXPERIMEDIA project by the legal partner ICRI-KU Leuven. It also contains a list of policy recommendations that were articulated on the basis of the conducted legal research as well as the lessons learned when assisting the EXPERIMEDIA experiments in achieving legal compliance.

Whilst the recommendations provide clues as to how the legal landscape may change in the future, the document itself does not have any impact on the immediate exploitation of STEER results.

### 6.1.4 Final Ethics Review Report

In the EXPERIMEDIA project, each experiment was assessed by a dedicated Ethics Advisory Board of independent experts, chaired by the legal partner, KU Leuven. By the third round of experimentation the essential points to attend to had been codified into a checklist that was presented to the second open call applicants. At the end of the EXPERIMEDIA project a final report was produced in preparation for the Open Access phase supported through the EXPERIMEDIA Association.

The document includes three useful appendices:

- Ethical Guidelines for undertaking ICT research in FP7
- Legal requirements for privacy and data protection
- Checklist for the Experimenters

The checklist is as follows:

#### **Checklist for general ethical issues:**

- It must be specified what the key values are behind the service/application;
- It must be specified what the conditions are for participating;
- It must be specified where the data will be located;
- It must be specified what the content is of the processing of data;
- It must be specified what the purpose is of the processing of the data;
- It must be specified what the data lifetime is;
- It must also be specified how the informed consent is obtained;
- It must be specified whether the consent must be written or not, whether a pop-up screen type is considered to be good enough;
- It must be specified who the participants of the experiments are.

#### **Checklist for location data issues:**

- It must be specified whether or not it is necessary to store the personal data;
- It must be specified when the data should be stored;

- It must be specified whether the user have any choice;
- It must be specified if the consent can be withdrawn;
- It must be specified whether or not the data will be erased;
- It must be specified whether it is possible for the user to opt-out for one day, or it must be stated that such an 'opt-out' is a permanent yes or no choice. In the former case, it must be reviewed how long you can keep the information when the server is switched off;
- It must be specified whether a user can use a pseudonym which changes every day;
- It must be specified who has access to the data, whether if it is only the administrators or also other persons, e.g. the stalkers-case;
- It must be specified if there is an admin log for every data file. It must also be specified who can change these log files, who can access them and who can delete them;
- It must be specified for how long the log data are stored;
- It must be specified if the administrator can manipulate them.

#### **Checklist for profiling issues:**

- It must be specified whether if it is possible to connect the data from different locations;
- It must be specified what about the use of the data for profiling: is location data used to reach other inferences: e.g. is the person rich? Does he live nearby?
- It must be specified if the processing of the data is only for improvement of content or also for tracking characteristics/traits of persons;
- It must be specified if the service needs to know the real identity of the users or can they use nicknames;
- It must be specified to which other data sets the feedback of the users will be linked to. This consideration was made since the linking of the user's feedback on different information feeds can be useful to learn whether it is always the same user.
- It is necessary to log who accessed the ECC. It must be clear who can access what data alter that data or delete it.

#### **Checklist for tracking issues:**

- It must be specified whether the user will be followed between two usages of the service or not. This question is asked since in case of tracking stricter requirements will apply. It must therefore be carefully reconsidered whether such tracking is really necessary;

- Location should only be stored when the user asks for information about a location – not otherwise, e.g. not while being on the move in between the locations about which information is asked.

**Checklist for consent issues:**

- If consent is given for participating in the experiment with a mobile application, it must be specified what happens when the mobile phone is given to someone else;
- It must be specified whether the user must be reminded of his given consent every day. WP29 recommends to remind the user about it once every month (but this has to be checked with the Austrian, Spanish and Greek law);
- The practical implementation of giving consent: it is not necessary to have the real name of the user since the email address can be used to offer a user channel to exercise the users rights;
- Potentially there can be two user groups: a group with and one group without an account. Inform user during app installation about the informed consent. It is important to list the assumptions/limitations of risks of the project.

**Checklist for anonymisation issues:**

- Some data cannot (automatically) be anonymised (e.g. textual feedback which refers to names, photos and videos where applicable);
- It must be specified where the data will be kept, whether it is in one territorial location or more. In this matter it must also be reviewed if there is a cross-border exchange.

## 6.2 Ethical assessment of STEER experiments

In general, using STEER components without considering ethical and legal issues is impossible. Such issues always exist, and they need to be addressed per case. To clarify how STEER dealt with these issues in its experiments, we consider the specific STEER experiments against the EXPERIMEDIA Checklist for Experimenters (see section 6.1.4). These answers will provide potential users of STEER technology with the ethical challenges they may face.

Thus far, as STEER and FIRE are experimental platforms, we were working under the assumption that any other party that wants to use STEER components is doing so for an experiment, which means they have to follow the same checklist and guidelines as the STEER partners. For agreeing on and documenting legal/ethical issues for STEER products in a commercial setting, typically a legal expert creates an End User License Agreement (EULA). Within STEER, such EULA's have already been designed for commercially available products, such as the Vidacle application from Bitnomica (see Appendix B.2) and ADB home gateways.

### 6.2.1 Collaborative Storytelling experiments

The ethical issues for the Silverstone Experiment were assessed by using the Ethical Checklist. Vidacle, the user application for ingest and consumption used in the Schladming and Silverstone experiments has an End-User License Agreement (EULA) which users have to consent with. This EULA already covers many of the privacy concerns related with data collection, since the user expressly allows use of his data and content for showing to other users and for data collection in general. The Vidacle EULA is shown in Appendix B.2 For those concerns not covered by the Vidacle EULA, the experiment participants signed a consent form, which is shown in Appendix A.2 The answers to the ethical checklist with respect to Lancaster Universities policy can be found in Appendix A.1. The answers to the ethical checklist with respect Bitnomica's policy can be found in Appendix B.1.

### 6.2.2 Live Augmented Broadcast experiments

The ethical issues for the World Rowing Championship 2014 LAB Experiment were assessed by using the Ethical Checklist. The answers to the ethical checklist with respect to TNO policy can be found in Appendix C. Similarly, the answers to the ethical checklist with respect to UOP policy can be found in Appendix D. Note that the LAB experiment was only carried out with participants originating from the STEER project.



## 7 Conclusions

This deliverable provides an overview of our dissemination, standardization and exploitation activities, including our current use of social media, STEER website and active presence at various relevant forums. Thanks to our effective social media management and our tools, STEER has sparked interest within both research and industrial communities dealing with the cross-over between social and networked media. Ongoing dissemination activities have produced ten publications and presence at a large number of conferences and workshops.

Through our standardization efforts, we have had impact on concrete developments within both the Home gateway Initiative and MPEG. Our products are shown to be unique in the current market, and our current exploitation plans show the different market opportunities where STEER industrial partners are active to produce products and services for social media / social TV and consumer and home devices.

This document further has taken into account crucial feedback and comments as expressed by the STEER review committee, during and after the first review of the STEER project, in March 2014. Specifically, this document has presented a fully updated STEER website design, and significantly increased presence on social and video platforms. This document further contains a description of STEER products. Also, the document has presented per-partner exploitation plans, covering both within-consortium follow-up as well as opportunities with external stakeholders. Lastly, this document contains an ethical challenges chapter, including detailed information on how these challenges were met during the experiment, thus providing important information to prospective stakeholders.

# Appendix A Ethics assessment Lancaster University

## Appendix A.1. Ethical Checklist

**Lancaster University's checklist for CST Experiments, especially the Silverstone experiment. The answers only reflect Lancaster University's involvement in the experiments, i.e., other STEER partners may have extended / different answers to these questions.**

### Checklist for general ethical issues

- What are the key values behind the service/application?  
Improve social experience by allowing users at events to capture, author and share unique user experience through video storytelling.
- What are the conditions for participating?  
Users must have had travel plans and access to the event. Users must be enthusiastic about activities at the event. Users must be able to operate applications of the experiment.
- Where will the data be located?  
Video content and accompanied metadata captured and authored by users using STEER applications will be stored at backend servers located at Lancaster University, Lancaster, UK.
- What is the content of the processing of data?  
User generated video content and metadata such as annotation, GPS coordinates.
- What is the purpose of the processing of the data?  
Enabling users to create stories through retrieval, previewing, editing, etc.
- What is the data lifetime?  
Data will be stored beyond the STEER project as part of the Storisphere services to the end user and also for product demonstration, subject to any user request.
- How is the informed consent obtained?  
User study consent form.
- Must the consent be written or not?  
Yes.
- Who are the participants of the experiment?  
Members of the public.
- Which entity is responsible for the processing of personal data (data controller)?  
Lancaster University and its partners in STEER project, subject to any user request.
- Are you going to obtain data from Social Networking Sites?

Not by Lancaster University.

- If yes: what types of data? On what basis (e.g. consent requested through application installation process)? Only from publically available profiles or also private profiles?

#### **Checklist for location data issues**

- Is it necessary to store the personal data?  
Personal data is not necessary to perform the experiment. Personal data may be embedded voluntarily in the user-generated content.
- When should the data be stored?  
Data will be stored permanently, subject to any user request.
- Does the user have any choice?  
Yes, user can request any related data to be removed.
- Can the consent be withdrawn?  
According to the consent, user can request any related data to be removed.
- Will the data be erased after use? Or after a certain period?  
Data will be stored permanently, subject to user requests.
- Is it possible for the user to opt-out for one day or is such an opt-out a permanent choice? And in the former case, how long will you keep the information when the server is switched off?  
User can opt out at any time of the experiment without giving any reason.
- Is it possible for the user to change its pseudonym on a daily basis?  
Yes.
- Who can access the data?  
Publicly accessible without explicit associations between any user content and user identity, subject to user requests.
- Is there an admin log for every data file? Who can change these logs? Who can access them and who can delete them?  
Logs are accessible by researchers at Lancaster University.
- For what time period are the data stored?  
Permanently, subject to user requests.
- Can the administrator manipulate the data?  
Yes, subject to user request.

#### **Checklist for profiling issues:**

- Is it possible to connect the data from different locations?  
Yes.
- Is the data being used for profiling? Is location data used to reach other inferences: e.g. is the person rich? Does he live nearby?  
No. Data may contain voluntarily included information related to user profile.

- Is the processing of the data only for improvement of content? Or also for tracking characteristics/traits of persons?  
Not for characteristics/traits of persons.
- Does the service need to know the real identity of the users? Are nicknames enough?  
No.
- To which other data will the users' feedback been linked to?  
No other data.
- Who can access the service?  
Members of the public who have registered with the service. Registration is open and free.

**Checklist for tracking issues:**

- Will the user be followed between two usages of the service?  
Yes, subject to user requests.

**Checklist for consent issues:**

- What happens when the mobile phone (or other device) is given to someone else?  
We do not prevent users to share experimentation devices with someone else.
- Real name? E-mail address?  
Real name and email address, if given by users, are stored by the service but not explicitly associated with any data. They are stored to allow customer services.

**Checklist for anonymisation issues:**

- Will the data be anonymized?  
Users may voluntarily reveal their identity in user data (videos). We do not make explicit association between user data and user identity.
- Where will the data be kept? Is this a territorial location? Is there a cross-border exchange?  
Data will be stored at Lancaster University, Lancaster, UK.

## Appendix A.2. Silverstone Experiment Consent Form



### User Study Consent Form

#### [Community storytelling]

The European Commission sponsored STEER project<sup>1</sup> and Lancaster University invites you to participate in a research study relating to community storytelling. The purpose of the study is to understand how mobile and multimedia technologies help users to capture and share their experience in live social events.

Your involvement in this study will require you to record audio-visual content. The content you record, along with any associated metadata (such as geographical location) for the study, will be uploaded to the Storisphere storytelling platform. The uploaded content will be publically accessible and used for research activities related to the topic of community storytelling. Your name will not be publicly associated with the uploading of any content without your consent. The researchers may interview you to better understand the context behind your shared content. Your responses to the interview will be anonymised. Only cursory information about your identity (such as gender) will be used.

In order to take part in the study please read the following statement and sign if you agree to participate.

'I freely and voluntarily consent to be a participant in the research on the topic of community storytelling to be conducted by Lancaster University and the STEER project. Specifically, I have been asked to record my trip to the *2014 Formula 1 British Grand Prix* and my recordings, along with associated metadata, will be uploaded to the Storisphere storytelling platform for research purposes.

I understand that if at any time during the task I feel unable or unwilling to continue, I am free to leave. I understand that my participation in this study is completely voluntary, and I may withdraw from it at any time without negative consequences. In addition, should I not wish to answer any particular question, I am free to decline. Should I not wish to have any of my content publically accessible, I can have the corresponding content removed. My name will not be explicitly linked to any research materials, and I will not be explicitly identified or identifiable in any report subsequently produced by Lancaster University and/or the STEER project.

I have read and understood the above consent to participate in this study. My signature is not a waiver of any legal rights.'

\_\_\_\_\_  
Participant's Signature

\_\_\_\_\_  
Date

<sup>1</sup> <http://fp7-steer.eu/>

## Appendix B Ethics assessment Bitnomica

### Appendix B.1. Ethical Checklist Bitnomica

**Bitnomica's checklist for CST Experiments, especially the Silverstone experiment. The answers only reflect Bitnomica's involvement in the experiments, i.e., other STEER partners may have extended / different answers to these questions.**

#### **Checklist for general ethical issues**

- What are the key values behind the service/application?  
Improve social experience by allowing users at events to capture, author and share unique user experience through video storytelling.
- What are the conditions for participating?  
Users must have had travel plans and access to the event. Users must be enthusiastic about activities at the event. Users must be able to operate applications of the experiment.
- Where will the data be located?  
Video content and accompanied metadata captured and authored by users using STEER applications will be stored at backend servers located in the Netherlands.
- What is the content of the processing of data?  
User generated video content and metadata such as annotation, GPS coordinates, keywords.
- What is the purpose of the processing of the data?  
Enabling users to create stories through retrieval, previewing, editing, etc.
- What is the data lifetime?  
Data will be stored permanently, subject to any user request.
- How is the informed consent obtained?  
User study consent form issues by Lancaster University. Furthermore, users of the Vidacle App have to accept the general End-User License Agreement (see appendix Appendix B.2)
- Must the consent be written or not?  
Yes, for the Silverstone consent form.  
No, for the in-app EULA of Vidacle.
- Who are the participants of the experiment?  
Members of the public.
- Which entity is responsible for the processing of personal data (data controller)?  
Bitnomica and its partners in STEER project, subject to any user request.
- Are you going to obtain data from Social Networking Sites?  
No.

- If yes: what types of data? On what basis (e.g. consent requested through application installation process)? Only from publically available profiles or also private profiles?

#### Checklist for location data issues

- Is it necessary to store the personal data?  
Yes. Personal data may be embedded voluntarily in the user-generated content.
- When should the data be stored?  
Data will be stored permanently, subject to any user request.
- Does the user have any choice?  
Yes, user can request any related data to be removed.
- Can the consent be withdrawn?  
According to the consent, user can request any related data to be removed.
- Will the data be erased after use? Or after a certain period?  
Data will be stored permanently, subject to user requests.
- Is it possible for the user to opt-out for one day or is such an opt-out a permanent choice? And in the former case, how long will you keep the information when the server is switched off?  
User can opt out at any time of the experiment without giving any reason.
- Is it possible for the user to change its pseudonym on a daily basis?  
No.
- Who can access the data?  
Publically accessible without explicit associations between any user content and user identity, subject to user requests.
- Is there an admin log for every data file? Who can change these logs? Who can access them and who can delete them?  
Logs are accessible by Bitnomica.
- For what time period are the data stored?  
Permanently, subject to user requests.
- Can the administrator manipulate the data?  
Yes, subject to user request.

#### Checklist for profiling issues:

- Is it possible to connect the data from different locations?  
Yes.
- Is the data being used for profiling? Is location data used to reach other inferences: e.g. is the person rich? Does he live nearby?

No. Data may contain voluntarily include information related to the user profile.

- Is the processing of the data only for improvement of content? Or also for tracking characteristics/traits of persons?  
Not for characteristics/traits of persons.
- Does the service need to know the real identity of the users? Are nicknames enough?  
No
- To which other data will the users' feedback been linked to?  
No other data.
- Who can access the service?  
Members of the public who have registered with the service. Registration is open and free.

**Checklist for tracking issues:**

- Will the user be followed between two usages of the service?  
Yes, subject to user requests.

**Checklist for consent issues:**

- What happens when the mobile phone (or other device) is given to someone else?  
We do not prevent users to share experimentation devices with someone else.
- Real name? E-mail address?  
Real name and email address, if given by users, are stored by the service but not associated with any data.

**Checklist for anonymisation issues:**

- Will the data be anonymized?  
Users may voluntarily reveal their identity in user data (videos). We do not make explicit association between user data and user identity.
- Where will the data be kept? Is this a territorial location? Is there a cross-border exchange?  
Data will be stored in a datacentre in the Netherlands.

## Appendix B.2. Vidacle end user license agreement

Vidacle is licensed not sold, to You for use only under the terms of this license, unless a Product is accompanied by a separate license agreement, in which case the terms of that separate license



### D6.3 Dissemination report and revised exploitations plans

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Apple is a third-party beneficiary to this Agreement. Upon your acceptance of this Agreement, Apple will have the right (and will be deemed to have accepted the right) to enforce this Agreement against you as a third-party beneficiary of this Agreement.

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The VVS is a Service provided by Bitnomica to you. Bitnomica may examine your Content and determine, in its complete discretion, whether there are technical or non-technical issues with hosting your Content. If there are no disqualifying issues with your Content, Bitnomica will host your Content (hereinafter Content).

Bitnomica may select, in its complete discretion, Content uploaded to The VVS to be displayed on its website, or in the Vidacle application.

##### ii. Representations And Warranties.

You represent and warrant that (a) you are 17 years of age or older; (b) the uploading and use of your Content on or through Bitnomica's VVS does not violate the privacy rights, publicity rights, copyrights, contract rights, intellectual property rights or any other rights of any person; and (c) the uploading and use of your Content on or through Bitnomica's VVS does not result in a breach of contract between you and a third party.

##### iii. Review Of Content Uploaded To VVS.

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##### iv. Use Of Your Content By Bitnomica.

Bitnomica does not claim ownership of any Content you upload. However, Bitnomica does need certain rights from you, with respect to your Content, in order to operate The VVS. Therefore, with respect to your Content, you grant Bitnomica a worldwide, royalty-free, non-exclusive, fully sub-licensable license to use, distribute, reproduce, modify and publicly display your Content (in whole or in part) for the purposes of operating The VVS and enabling your use of The VVS. For example, if your uploaded Content is deemed acceptable (see Section 5.B.iv), then Bitnomica will host your Content and you will be able to share your Content via e-mail or other social media networks with your family, friends, and the public – all of whom can view your uploaded Content.

Vidacle and The VVS display advertisements and promotions, and you agree that Bitnomica may place such advertisements and promotions on, about, or in conjunction with your Content. The manner, mode and extent of such advertising and promotion are subject to change without specific notice to you.

You agree that Bitnomica shall have the right to archive copies of any Content you upload to The VVS, and to use a copy of that Content to promote this Software now and in the future.

You agree that Bitnomica shall have the right to display any Content you upload to The VVS on the Bitnomica website or on the Vidacle website.

You agree that Bitnomica can track voting upon any Content you upload using whatever tools are available.

##### v. Use Of Your Content By Others.

You hereby grant other users of The VVS a worldwide, royalty-free, nonexclusive license to view any Content you upload that is hosted by Bitnomica.

You agree to permit other users of The VVS to vote upon any Content you upload using whatever tools are available.

vi. Use Of Your Personal Information.

In order to upload Content to The VVS, you are required to provide an e-mail address or grant Vidacle permission to access your Twitter account, using the Single-Sign-On feature of Twitter. In no circumstance Vidacle will ask your Twitter password. If you choose to grant access to your Twitter account, you can revoke this access at any time in the Twitter account settings on the Twitter website. If you choose not to provide an e-mail address and not to grant access to your Twitter account, you may not be able to use certain features of Vidacle or The VVS. By entering your e-mail address or granting Vidacle access to your Twitter account you agree that Bitnomica can use your e-mail address or Twitter account to identify your Content and to send you electronic communications, with opt-out details, concerning Bitnomica, Vidacle and Services. Bitnomica will not distribute, rent or sell your e-mail address. No other personal information will be collected by Vidacle.

You have the option of utilizing Vidacle or VVS to share your uploaded Content with your friends, family and the public through e-mails and social media networks including Facebook and Twitter. In order to facilitate the sharing of your Content on social media networks, Vidacle may store your social media network information on your Apple Computing Device. This information will also be transmitted to the Vidacle Service.

We may place e-mail links or forms in Vidacle or VVS to allow you to contact Bitnomica. It is always your choice whether or not to provide any personal information.

Location Based Information. You agree that Bitnomica collects location-based data related to the Content you record through Vidacle, and may use this information, as long as it is in a form that does not personally identify you (see Section b.). You will have the ability to utilize social media network location services which inherently share personally identifying location-based data, and are governed by EULAs, Terms & Conditions and Privacy Policies specific to those services.

International Transfers. Your e-mail address and non-personally identifying location-based information collected through Vidacle or VVS may be processed in the Netherlands, the United States or another country outside the one in which you reside. By using Vidacle or VVS, you agree to any such transfer of information outside of your country.

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Should you wish to have your Content removed from The VVS, please e-mail Bitnomica [remove@vidacle.com](mailto:remove@vidacle.com) with your request to have any Content associated with your e-mail address removed. Bitnomica will remove your Content as soon as practicable.

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## Appendix C Ethical Checklist TNO

**TNO checklist for LAB Experiments, especially the WCR2014 experiment. The answers only reflect TNO's involvement in the experiments, i.e., other STEER partners may have extended / different answers to these questions.**

### Checklist for general ethical issues

- What are the key values behind the service/application?

Improve TV viewing experience by allowing viewers to see live video streams from event visitors, as well as relevant social media posts, all synchronized with the live TV broadcast.

- What are the conditions for participating?

The LAB experiment at WRC2014 was open to a limited set of users, originating from or close to the project. At the event, users must have had the Vidacle app installed on their iPhone, and the phone had to be provisioned with access details for the cloud ingest. In The Netherlands, viewers must have had the STEER player installed on a laptop and have had certain NAT rules provisioned on their home gateway. Users must be willing to view content for at least 5 minutes and users must be able to operate applications of the experiment.

- Where will the data be located?

Video content and accompanied metadata captured will be stored at the distributed ingest, located partly on TNO machines at the event, and partly at an Amazon AWS cloud instance. Measurements were stored on an ECC server instance on an Amazon AWS cloud instance.

- What is the content of the processing of data?

Professional broadcast-grade content, user generated video content, and social media posts. Measurements of bandwidths and delays. No personal details have been recorded, but publicly available Twitter messages are shown to users.

- What is the purpose of the processing of the data?

Enabling users to view additional content, next the live TV broadcast.

- What is the data lifetime?

As agreed with rights holders, professional broadcast video data will not be stored permanently. User-generated content is stored only for the analysis and use in controlled experiments, and deleted afterwards. Similarly, Twitter posts are stored for a limited period.

- How is the informed consent obtained?

Given that all experiment participants were (close to) project members, no user study consent form was used. Informed consent can readily be added using a pop-up screen or notification when launching the Vidal live video contribution module or app.

- Must the consent be written or not?

No; can be done via user approval when starting the Vidacle application.

- Who are the participants of the experiment?

Project members and colleagues from the STEER partners TNO and UOP.

- Which entity is responsible for the processing of personal data (data controller)?

TNO, UOP, Bitnomica and their partners in STEER project, subject to any user request.

- Are you going to obtain data from Social Networking Sites?

Yes, from Twitter.

- If yes: what types of data? On what basis (e.g. consent requested through application installation process)? Only from publicly available profiles or also private profiles?

Using the STEER Adaptive Event Profiler (AEP), a subset of Twitter messages from publicly available profiles is analysed for relevant keywords. Using these keywords, the subset is further filtered, to select a number of Tweets to present during TV viewing.



### Checklist for location data issues

- Is it necessary to store the personal data?

No. Personal data is not required to live stream, the discovery and selection of available streams is anonymized. To contribute via social networks a publicly available account is needed, which may require storage of personal data.

- When should the data be stored?

User-generated contributions and social media posts are stored for research and demonstration purposes.

- Does the user have any choice?

The user can choose not to contribute any material to the system, for example after reading the consent notification.

- Can the consent be withdrawn?

Consent can be withdrawn, but the live nature of the LAB system cannot post-priori prevent live streaming of video contributions.

- Will the data be erased after use? Or after a certain period?

As agreed with rights holders, professional broadcast video data will not be stored permanently. User-generated content is stored only for the analysis and use in controlled experiments, and deleted afterwards. Similarly, Twitter posts are stored for a limited period.

- Is it possible for the user to opt-out for one day or is such an opt-out a permanent choice? And in the former case, how long will you keep the information when the server is switched off?

User can opt out at any time of the experiment without giving any reason.

- Is it possible for the user to change its pseudonym on a daily basis?

Yes.

- Who can access the data?

Only Experiment controllers can access the video data.

- Is there an admin log for every data file? Who can change these logs? Who can access them and who can delete them?

Logs are accessible by researchers at TNO, UOP and Bitnomica.

- For what time period are the data stored?

Permanently, subject to user requests.

- Can the administrator manipulate the data?

Yes, subject to user request.

**Checklist for profiling issues:**

- Is it possible to connect the data from different locations?

Only implicitly via optional metadata in social media posts.

- Is the data being used for profiling? Is location data used to reach other inferences: e.g. is the person rich? Does he live nearby?

No. Social media data may contain voluntarily included information related to user profile.

- Is the processing of the data only for improvement of content? Or also for tracking characteristics/traits of persons?

Not for characteristics/traits of persons.

- Does the service need to know the real identity of the users? Are nicknames enough?

No real identities are required.

- To which other data will the users' feedback been linked to?

The user's identify may be disclosed when filming him/herself, or by

appearing in scenes filmed by other event participants.

- Who can access the service?

Only project partners.

**Checklist for tracking issues:**

- Will the user be followed between two usages of the service?

Yes, in the sense that the availability of streams is discovered by the system.

**Checklist for consent issues:**

- What happens when the mobile phone (or other device) is given to someone else?

We do not prevent users to share experimentation devices with someone else.

- Real name? E-mail address?

Real name and email address, if given by users, are stored by the service but not associated with any data. They are used to inform and update participants regarding experiment progress.

**Checklist for anonymisation issues:**

- Will the data be anonymized?

Users may voluntarily reveal their identity in user data (videos). We do not make explicit association between user data and user identity.

- Where will the data be kept? Is this a territorial location? Is there a cross-border exchange?

Data will be stored in TNO systems, either at the event, in our Delft office, or in a cloud instance managed by TNO.

## Appendix D Ethical Checklist UoP

**UoP checklist for LAB Experiments, especially the WCR2014 experiment. The answers only reflect UoP's involvement in the experiments, i.e., other STEER partners may have extended / different answers to these questions.**

### Checklist for general ethical issues

- What are the key values behind the service/application?

Improve the trade-off between scalability, stability and efficiency in live streaming through an innovative social aware media distribution architecture that we designed (P2Ner).

- What are the conditions for participating?

The LAB experiment at WRC2014 was open to a limited set of users that were all were members of NAM group of University of Patras. All, viewers must have had the STEER player installed on a laptop and have had certain NAT rules provisioned on their home gateway. Users must be willing to view content for at least 30 minutes and must be able to operate applications of the experiment.

- Where will the data be located?

Video content and accompanied metadata captured will be stored at the distributed ingest, located partly on TNO machines at the event, and partly at an Amazon AWS cloud instance. Measurements were stored on an Openlab server on the premises of UoP.

- What is the content of the processing of data?

Measurements have to do with technical metrics concerning live streaming (i.e bit rates, graph representation, delays, blocks sent, blocks received). No personal details have been recorded at all.

- What is the purpose of the processing of the data?

Evaluation and improvement of algorithms that improve efficiency and stability of an innovative live streaming architecture that our University developed.

- What is the data lifetime?

Live stream was not stored at all at the user locations. It was just a simple view of the stream.

- How is the informed consent obtained?

Given that all experiment participants were lab members, no user study consent form was used.

- Must the consent be written or not?

No; can be done via user approval when starting the P2Ner application.

- Who are the participants of the experiment?

Project (STEER) members, UoP reseach group members and members from TNO.

- Which entity is responsible for the processing of personal data (data controller)?

There were no personal data.

- Are you going to obtain data from Social Networking Sites?

No.

- If yes: what types of data? On what basis (e.g. consent requested through application installation process)? Only from publically available profiles or also private profiles?

#### **Checklist for location data issues**

- Is it necessary to store the personal data?

No.

- When should the data be stored?

N/A

- Does the user have any choice?

No.

- Can the consent be withdrawn?

Yes. We could and we can remove the data anytime upon user request.

- Will the data be erased after use? Or after a certain period?

As agreed with rights holders, professional broadcast video data will not be stored permanently. Technical metrics that concern users can be deleted any time upon user request.

- Is it possible for the user to opt-out for one day or is such an opt-out a permanent choice? And in the former case, how long will you keep the information when the server is switched off?

User can opt out at any time of the experiment without giving any reason.

- Is it possible for the user to change its pseudonym on a daily basis?

Yes.

- Who can access the data?

Only members of STEER team of UoP can access the data by requesting explicit permission from Spyros Denazis (technical manager of STEER).

- Is there an admin log for every data file? Who can change these logs? Who can access them and who can delete them?

Logs are accessible only from members of STEER team of UoP can access the data by requesting explicit permission from Spyros Denazis (technical manager of STEER).

- For what time period are the data stored?

Permanently, subject to user requests.

- Can the administrator manipulate the data?

Yes, subject to user request.

**Checklist for profiling issues:**

- Is it possible to connect the data from different locations?

No.

- Is the data being used for profiling? Is location data used to reach other inferences: e.g. is the person rich? Does he live nearby?

No.

- Is the processing of the data only for improvement of content? Or also for tracking characteristics/traits of persons?

The processing of the data was only for the improvement of our algorithms.

- Does the service need to know the real identity of the users? Are nicknames enough?

No real identities are required. Each user was represented from a capital letter (i.e. User A, User B, etc.)

- To which other data will the users' feedback been linked to?

There will be no link

- Who can access the service?

Only UoP STEER group.

**Checklist for tracking issues:**

- Will the user be followed between two usages of the service?

Yes, in the sense that the availability of streams is discovered by the system.

**Checklist for consent issues:**

- What happens when the mobile phone (or other device) is given to someone else?

There weren't mobile devices that can be lost or stolen.

- Real name? E-mail address?

There were no names or e mail addresses. Each user is represented from a capital letter.

**Checklist for anonymisation issues:**

- Will the data be anonymized?

Yes the data are anonymized as already explained.

- Where will the data be kept? Is this a territorial location? Is there a cross-border exchange?

Data will be stored in UoP premises.