

## P2P TV: Evaluating Content Delivery and User Experience

Virpi Oksman<sup>1</sup>, Timo Kinnunen<sup>2</sup>, Chengyan Peng<sup>2</sup>, Tuomo Kivinen<sup>1</sup> and Antti Tammela<sup>1</sup>,

<sup>1</sup> VTT,  
Tampere, Finland  
[Firstname.lastame@vtt.fi](mailto:Firstname.lastame@vtt.fi)  
<sup>2</sup>VTT, Espoo, Finland

**Abstract.** In this paper, we present findings from empirical studies on end users' experiences of peer-to-peer (P2P) networked television services. To explore the quality of user experience and content consumption in the evolving TV system, we have developed a peer-to-peer social media service prototype, which can be used both with regular home computer networks and on mobile devices, providing users a real pervasive, ambient media experience. Our primary goal is to create an understanding of the factors that shape P2P TV experience as a basis for the future design of NextShare, a peer-to-peer social media service. Through this research, we concluded that P2P technology can provide a reliable mechanism for ingestion of time-based TV program as well as VOD content via the Internet. P2P technology is especially suitable for large media content providers. However, in order to create a real business value out of the service, new, innovative content production models and types need to be developed.

**Keywords:** Peer-to-Peer TV, User Experience, Content Delivery, Business models

### 1 Introduction

The idea behind ambient multimedia is that the user is exposed to the actual media in their natural environment rather than computer interfaces. Considering especially consumer and home entertainment services, the development of new IPTV networks provides an important case of ambient media use as it makes it possible for user to access content on-the-move and with a multitude of different devices (the mobile phones, laptops etc.). [1] However, the current infrastructure of the Internet is not suited to simultaneous transmission of live events to millions of people (i.e. broadcasting). Peer-to-Peer (P2P) based technologies can provide efficient and low-cost delivery of professional and user created content. From a technical point of view, the adoption of a P2P paradigm reduces the network costs, pushing complexity from the network to the users, while helping to relieve the bandwidth cost burden at the server. [2]

In order to produce quality services, we need to know more about the content choices and the quality of user experience related to these TV services.

Having a clear understanding of user requirements and the factors that shape the acceptance of P2P services has a lot of benefits. In principle benefits include lower developing costs, shorter developing time, lower maintenance costs, longer product life cycle, a stronger brand and more satisfied customers. [3]

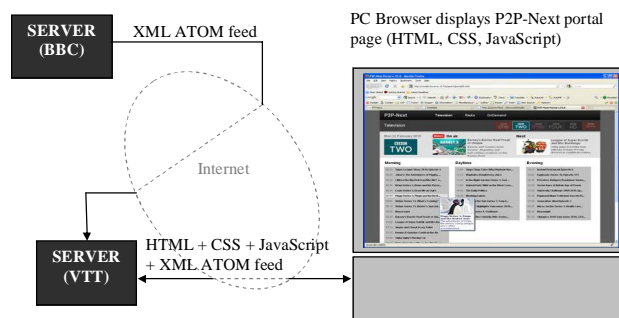
In general, the quality of user experience is a huge competition factor. Ideally, when a product has been developed based on users' requirements, there is a real market for the product.

In our earlier work, we found out that the future P2P TV should combine both familiar and novel features, which support choice, control, interaction and quality of watching experience. The quality of video is one of the most important factors in the whole user experience. In P2P services the video quality is usually is better if there are more users. In addition to the better video quality, the ideal P2P service should offer users a range of varied content, both broadcast and user generated types of content and even new kinds of content genres and production types. [4]

The real significance of P2P and other interactive TV depends on understanding of the uses and problems of the services. [4] Therefore, this paper will present and discuss the findings of empirical field studies on end users' experiences the P2P TV services under development..

### 1.1 The P2P User Interface

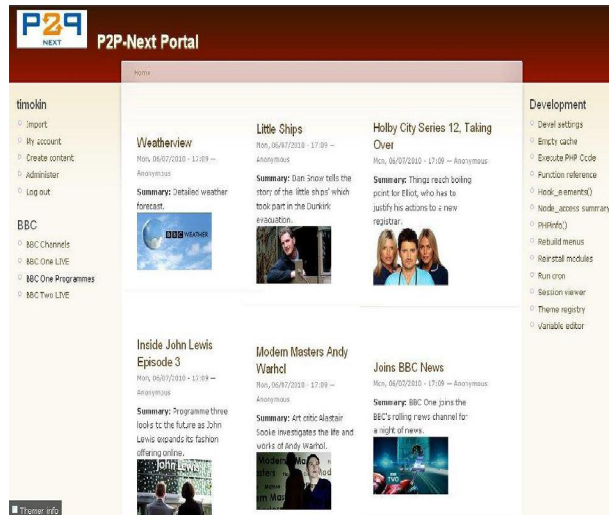
The developed P2P portal user interface is an Ajax implementation to fetch, parse and display the content of Atom feed. It is implemented with plain JavaScript, CSS and HTML, and it uses SwarmPlugin to play embedded torrent files. The original target was to support all major browsers, but eventually we had to flag Microsoft Internet Explorer out from our trial (lack of usable DOM methods when scripting the <object>-element). Following figure illustrates one example where ATOM feed comes from BBC server.



Picture 1. Opening page of P2P-Next portal.

The Ajax approach used here, is valid when users want to only view programmes. When more functionality is requested from portal, such as user accounts and publishing of users own videos in addition to professional content providers, then a real content management system must be used. We decided to use **Drupal** CMS framework to create a new portal, where users are able

to view public content without registering and also register a new account to create and administer their own content.



Picture 2. P2P portal 2010 and Drupal CMS

## 1.2 Content Delivery

During the test there were two types of streaming content available. There was the television channel side that was streaming the newest acquired material and then the On-demand side which had all the material archived (except for the newest material). The TV-channel side acted like live television so when the viewer opened the stream, it started showing the ongoing program from the point it currently was broadcast. On-demand streams started always from the beginning of the program.

The main TV material was shot during the “Ääni ja Vimma” festival - a band contest for 15 to 25 year-old musicians held in April 2010 in Helsinki. In total 15 band performances were shot lasting about 15 minutes each.

Other TV content used in the test was SuomiTV channel (a new TV channel focusing on family content), StadiTV (a local TV channel in Helsinki focusing on culture and events) and FabChannel (live music).

## 1.3 Methods for Evaluating User Experience

We collected and evaluated user feedback and the quality of user experience with different, both qualitative and quantitative methods. At first, in the NextShare adoption phase, we provided the users the opportunity to send immediate feedback and discuss the problems in our open web lab, called Owela. Owela is an online laboratory that utilizes social media features for participatory design and open innovation.

When the users tried the service first time, they were asked to fill in a questionnaire in which they can express their first impressions of the service and evaluate their user experience. The users were asked to evaluate for instance how easy it was to adopt the service, how they did experience the video quality, how logical the user interface was, how much did errors/disturbances during the watching affect the experience, and how interesting did they find the service and content in general. This evaluation was given with a scale from 1-10. Then the users were also asked to answer to some open questions like how useful did they find this service and would they see themselves as using this kind of service in the future.

The log data collection system was also designed to follow the use of the service. The appropriate design of log functions for the evaluations is important and should be done in parallel with the technical development because it may not be easy to add the log functionality to a ready-made system. Consideration should be given to what data is needed and how the data could be automatically collected and converted into a form that is easy to analyze during the evaluation. [6]

We collected log data to reveal the time and duration of actual occurrences of P2P service use. Log data gives specific answers to questions such as: How much the user was using the service during different days of the testing period? What times of the day was she or he using the service? During which weekdays was the user using the service? How did the use change during test period? What kind of content was viewed? How long was the content viewed? The log data on the service use was collected from the P2P service prototype use and then analyzed statistically.

Altogether 91 participants used the P2P service during the test period of one month (from 15th of April to 15th of May, 2010). Their mean age was 28. Their technical expertise was high. 10 persons participated in the Owela discussion groups.

## **2 User Feedback**

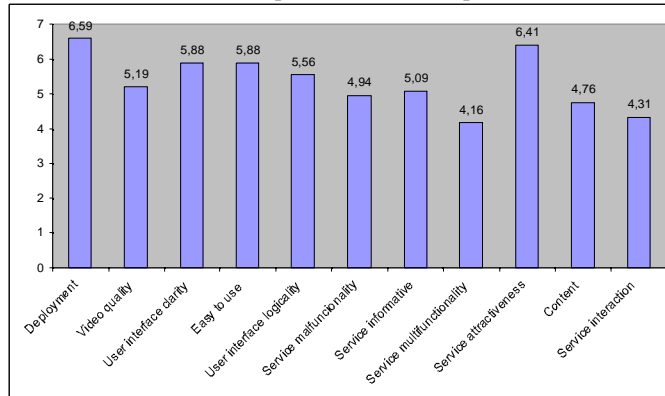
### **First impressions**

User's thought that it was relatively easy start to use the service (Figure 1). Users rated it as 6, 6. However according to the discussions in the open web lab, Owela there were also some problems with deployment. From that reason as an overall conclusion the deployment should be made easier for the next versions.

Easiness of use to use was rated 5, 9. The clarity of the user interface was about the same. Service had some problems during the use and therefore malfunction was rated only 4.9. Service interaction functions were rated only 4.3. Overall service usability factors could be better.

Video quality was rated 5, 2. In the future as an entertainment service the video quality must be better. Clearly, the users were not satisfied with the content. Content was rated 4.8. and informativeness of the service 5,1. The whole attractiveness of the service was rated 6, 4 which is however a little bit better.

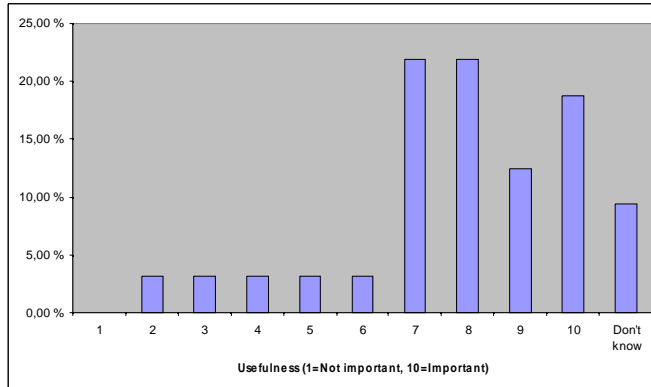
**Figure 1.** Different aspects of user experience of a P2P TV service prototype.



## Usefulness

*“The content of course determines if the service is interesting or not. It’s also interesting how this kind of service would scale up for larger crowds.”*

According to users the service concept itself was quite useful (picture 22). 75% of the attendees thought that the service usefulness was from 7 to 10, when the scale was from 1 to 10. 15,7% of the users experienced that the usefulness was from 2 to 6.



**Figure 2.** Evaluated usefulness of the P2P service concept.

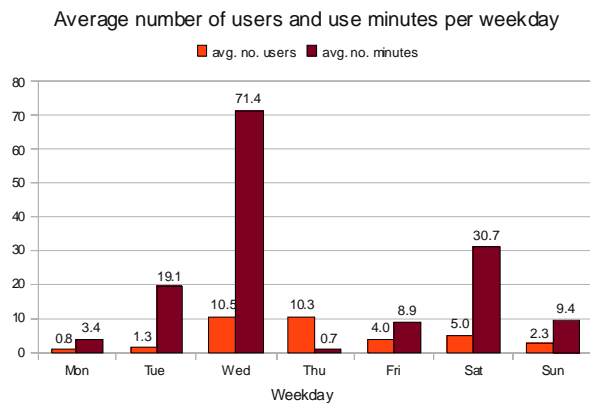
Users expected a multitude of end devices and operating systems; ability to experience audiovisual content from PCs, laptops, media players and mobile or smart phones.

*“Everything in the same place, quick search, diverse, support for local download, simple.”*

*“Multi-platform! In addition to computers, should be viewable on various IPTV set-top-box solutions.”*

*“I’d hope for administered entities, clear menu structures, diverse content and easiness of taking into use. A service that both young and old feel comfortable to use.”*

The service was most used during in the middle of week and during the weekends. (see figure 3)



**Figure 3.** The average number of users and use minutes per day.

### 3 Payment methods

Most users were willing to pay a fixed price from this kind of peer to peer service. However, because there were many differing opinions it is important to give users options. Some people just want to subscribe to their favourite series sometimes; others may want to pay for all at once. Many were not satisfied with the current TV license system and wished for completely different kind of payment model for the whole TV.

*"I don't like to finance others people's TV watching so pay per view."*

*"Fixed monthly or annual fee, limited access to all contents"*

*"Some kind of pre-paid card. It could be used to access to all channels. You could spend the saldo for the time used for watching."*

*"60% sponsored by commercials, 40% pay what you view."*

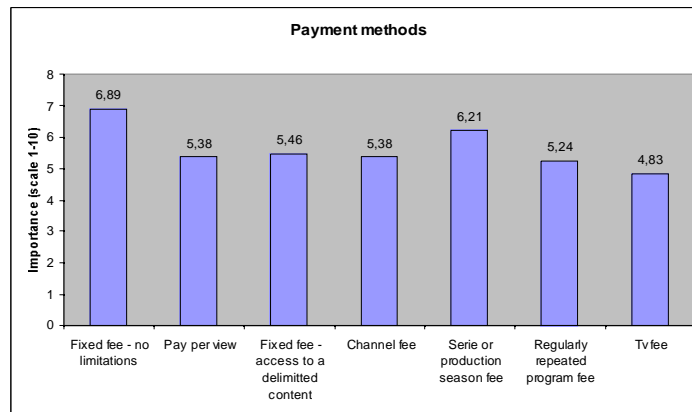


Figure 4. Preferred payment methods

### 3 Conclusion and Future work

The test users saw a lot of potential in P2P type of television service. The overall rating for usefulness of the service concept was relatively high. However, there was also a critical feedback towards the user interface and its usability problems, picture quality and especially towards the chosen operating systems (by that time no open source options provided).

The test users expected P2P TV services to offer additional content delivery services to conventional TV and media portals in the Internet (such as Youtube and public/commercial broadcasters). The band contest videos were not seen as interesting enough to motivate the test users to use the system for longer time periods. Thus there is a high demand for a wide range of interesting contents for all age groups to motivate a critical amount of users to participate. With a small number of users the real benefits (i.e. better picture quality) of using P2P system cannot be gained.

There is of course a real challenge of finding a wide range of fresh, original and appealing contents for users, taking into consideration current copyright limitations. The present media environment already offers a multitude of different media contents in the Internet for free. How it is possible to develop a service that could serve users better than for instance YouTube or public and commercial broadcasters? It would be difficult to compete with the content offerings with these services, however the new P2P service could be developed for certain, smaller use segments with the possibility to new, innovative content production. Users are interested in diverse content that is not easily available under one service; for instance quality local channels, foreign channels, news, programs, movies etc. In addition, there should be programs for all age groups.

In fact, it appears that users are willing to pay for a good content service and better picture quality. The payment system should be made as easy as possible. It is important to give users different options: some people just want to subscribe to their favourite series; others pay for all at once.

In addition, copyrights restricted the implementation of the service. Content providers worried and wondered what would happen to their content once their content was ingested to the open Internet. Music video had extreme copyright problems. In our case, we had to ask permissions from all the bands and their members.

Through this trial, we concluded that P2P-next platform can provide a reliable mechanism for ingestion of time-based TV program as well as VOD content via the Internet. Peer players can constantly access to streamed torrent data. P2P-next platform is especially suitable for large content providers.

**Acknowledgments.** Part of this work is supported by the European Commission in the context of the P2P-Next project (contract no. 216217). Further information is available at <http://www.p2p-next.eu/>. The heading should be treated as a 3<sup>rd</sup> level heading and should not be assigned a number. References

1. Lugmayr, Pohl, Muehhaeuser, Kallenbach & Chorianopoulos., Ambient Media and Home Entertainment. Ubiquitous and Pervasive Computing: Concepts, Methodologies, Tools, and Applications. 717-729. (2007)
2. Alessandria; E., Gallo; M.; Leonardi, E., Mellia; M. Meo, M. 2009. P2P-TV Systems under Averse Network Conditions: a Measurement Study. Proceedings IEEE Infocom'09, Rio de Janeiro, Brazil, Apr. 2009.
3. USINACTS – Usability in the Information Society CD. 2000. The USINACTS project was funded by the European Commission under the ACTS programme
4. Oksman, V., Tammela, A., Mitchell, K., Ishmael, J., Rouncefield, M., Race, N. User Perception and Requirements for Future IPTV services – Case Studies from Finland and UK. European Conference on Interactive Television. Proceedings of the 8<sup>th</sup> International Conference on Interactive TV & Video, 2010, Tampere, Finland, June 05-11, 2010
5. Bernhaupt, R., Obrist, M., Tscheligi, M. 2007. Usability and Usage of iTV Services: Lessons Learned in an Austrian Field Trial. 5, 2, 6, ACM, New York, NY, US. Conference on Interactive TV & Video, 2010, Tampere, Finland, June 05-11, 2010
6. Kaasinen, User Acceptance of Mobile Services – Value, Ease of Use, Trust and Ease of Adoption. Helsinki: VTT Information Technology, 2005.