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Abstract:

The deliverable is an update to the previous 2.1.1 versions and complements information on the major market trends in online video, requirements of the stakeholders of the project and the legal situation in Europe. It includes a comparison of mobile payment application approaches as well as services and applications for stand-alone P2P delivery. Furthermore it provides comprehensive OPEX/CAPEX analyses of P2P and alternative delivery mechanisms, business plans for the P2P-Next services.

Keyword list:

WP2, Market Trends, Business Models, Legal Environment and Regulation, European Digital Agenda, ICT policy framework, Questionnaire, OPEX, CAPEX, efficiency comparison

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1 Executive Summary

This paper is an update of all former D2.1.1 deliverables. The market watch section includes a study of general technological developments since the last deliverable, a comparison of mobile payment application approaches as well as an examination of services and applications for stand-alone P2P delivery. A survey that was carried out by the work package provides new insights to the NextShare stakeholder's requirements towards Internet distribution systems and P2P-delivery in particular. Another part deals with the results of OPEX/CAPEX analyses conducted to receive information on the cost efficiency of P2P and alternative delivery mechanisms. Further efforts went into the refinement of requirements for P2P-Next in the light of latest media platform developments and the validation of NextShare features through test beds. Finally, the paper gives information on the current status of the legal and regulatory environment.

2 Marketwatch

2.1 General Marketwatch

There are several developments on the market relevant for the project since these are influencing its outcomes and perspectives after its end. One of these is the permanent growth of ***online ad spending***. For the US it is predicted that in 2012 online ad spending will exceed the total spendings on US print magazines and newspapers for the first time ($39.5 billion vs. $33.8 billion)[1].

Also ad supported contents for mobile devices will grow. One reason is the increasing audience for advanced mobile content, but also the existing mobile content formats that are shifting their sources of funding more toward ads (eMarketer, Jan 2012)[2].

In the field of online video ads there was an increase by almost 40% to $1.42 billion in 2010 and were predicted to grow another 52% in 2011.

US Online Ad Spending Growth, by Format, 2010-2015
% change

	2010	2011	2012	2013	2014	2015
Video	39.6%	52.1%	43.1%	35.9%	34.3%	26.0%
Sponsorships	87.5%	26.4%	16.0%	12.3%	11.6%	11.0%
Banner ads	23.1%	22.1%	17.6%	11.0%	10.4%	7.0%
Search	12.2%	19.8%	18.4%	10.7%	7.1%	6.6%
Classifieds and directories	15.2%	15.7%	11.4%	9.0%	8.9%	7.8%
Rich media	2.2%	7.9%	4.3%	0.8%	-0.8%	-2.7%
Lead generation	-7.7%	6.1%	1.8%	1.7%	2.1%	1.2%
Email	-33.2%	-16.5%	-0.5%	3.3%	3.4%	3.1%
Total	**14.9%**	**20.2%**	**17.6%**	**12.0%**	**10.4%**	**8.8%**

Source: eMarketer, June 2011
128167 www.eMarketer.com

US Online Ad Spending, by Format, 2010-2015
billions

	2010	2011	2012	2013	2014	2015
Search	$12.00	$14.38	$17.03	$18.85	$20.19	$21.53
Banner ads	$6.23	$7.61	$8.94	$9.93	$10.97	$11.73
Classifieds and directories	$2.60	$3.00	$3.35	$3.65	$3.98	$4.29
Video	$1.42	$2.16	$3.09	$4.20	$5.64	$7.11
Rich media	$1.54	$1.66	$1.73	$1.74	$1.73	$1.68
Lead generation	$1.34	$1.42	$1.45	$1.47	$1.50	$1.52
Sponsorships	$0.72	$0.91	$1.05	$1.18	$1.32	$1.47
Email	$0.20	$0.16	$0.16	$0.17	$0.17	$0.18
Total	**$26.04**	**$31.30**	**$36.80**	**$41.20**	**$45.50**	**$49.50**

Source: eMarketer, June 2011
128163 www.eMarketer.com

Figure 1: Online Ad Spending Growth by Format, 2010-2015, eMarketer June 2011

When it comes to online contents it is no surprise that ***online video usage*** still belongs to the fastest growing areas: In March 2012 YouTube stated to have 800 mio. unique visitors per month uploading 60 hours of video material every minute[3]. In 2011 more than 50% of US population watched video content online at least once a month (see figure 2)[4].

US Online Video Viewers, 2010-2015

	2010	2011	2012	2013	2014	2015
Online video viewers (millions)	**145.6**	**158.1**	**169.3**	**178.7**	**187.6**	**195.5**
—% change	11.3%	8.6%	7.1%	5.6%	5.0%	4.2%
—% of population	46.9%	50.5%	53.5%	56.0%	58.2%	60.1%
—% of internet users	65.0%	68.2%	70.8%	72.9%	74.7%	76.0%

Note: CAGR (2010-2015)=6.1%; internet users who watch video content online via any device at least once per month
Source: eMarketer, Nov 2011
134293 www.eMarketer.com

Figure 2: Online Video Viewers, 2010-2015, eMarketer Nov 2011

[1] http://www.emarketer.com/Article.aspx?id=1008783
[2] http://www.emarketer.com/Article.aspx?R=1008775
[3] http://www.youtube.com/t/press_statistics
[4] http://www.emarketer.com/Article.aspx?R=1008724

Results from the 2011 Accenture Video-Over-Internet Consumer Usage survey show that catch-up TV is the most important video-over-Internet service feature for users (40%)[5]. This is followed by the desire for a personal video recorder (24%), surfing web on TV (14%), watch contents on multiple devices (12%), and interactive/social networking functions (11%).

The rise in online video usage also comes from rising ***multi-screen*** and ***multi-room usage*** of audio-visual media contents. End devices include set-top boxes, gaming consoles, personal computers, tablets and smart phones whereby mobile access seems to be the main driver of the development: According to Cisco[6] the amount of ***mobile video traffic*** exceeded 50 percent for the first time in 2011. Continuously enhanced video quality that match and even surpass broadcast video push the generated traffic per video allowing forecasts prospecting that over 100 million smartphone users will belong to the "gigabyte club" (over 1 GB per month) by 2012 and that two-thirds of the world's mobile data traffic will be video by 2016.

However, device-independence no longer means availability of contents on mobile devices for out and about; consumers also switch devices in their homes enabled by current set-top-boxes from Reycom[7], Boxxee[8], and others. And also aspirations of Network providers to provide triple / quadruple play that include an OTT video service.[9]

The increase of connected devices with the aim to access Internet and particularly to watch audiovisual contents on TV is visualized below:

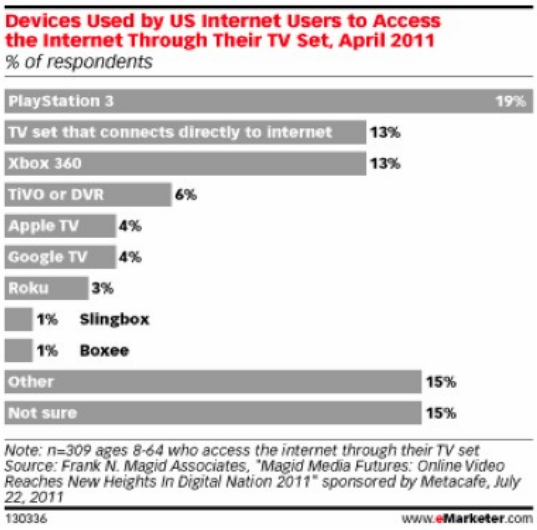

Figure 3: Devices used by US Internet users to access the Internet through their TV set, April 2011, eMarketer July 2011

[5] http://www.accenture.com/SiteCollectionDocuments/PDF/Accenture_Communications_Media_Entertainment_Video-Over-Internet_Consumer_Usage_Survey.pdf

[6] Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2011–2016 http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-520862.html

[7] http://www.reycom.ch/fileadmin/downloads/Reycom%20CES%20Press%20Release_REC2XT_January_2012.pdf

[8] http://www.boxee.tv

[9] Skytide, 7 Online Video Trends to Watch in 2012, http://www.slideshare.net/skytide/7-online-video-trends-to-watch-in-2012

According to eMarketer in 2010 already 30% of US adult Internet users watched audiovisual contents via some type of Internet connection, in 2015 this is expected to increase up to 48%[10]. It was revealed that users care most about convenience, cost and choice, and are interested in viewing options to the extent that they fit in with those demands.

The trends of online video usage and multi-device consumption also apply for the developments in Europe e.g. Germany: The popularity of the ***online services of German public broadcasters*** steadily increases. In 2011 41% of the German Internet-users (age 14 years and older) "at least occasionally" consumed online radio programs live, time shifted or as podcast; for TV programs this number was 54%[11]. The trend that more and more online av media become accessible through TV devices (in March 2011 50% of all new TVs in Germany was Internet-capable) will positively influence these figures. In the meantime all CatchUp TV services of the main German broadcasters have become accessible via Internet-capable TVs.

Also the growing ***HbbTV support*** has finally reached the European and German markets: HbbTV is being pursued by the German public broadcasters as the standard for hybrid TV applications (notably to access CatchUp services from the TV device, by linking the CatchUp Service to the respective TV channel). Currently many HbbTV services are operational in Germany (all main public and commercial broadcasters offer HbbTV services with their programmes), France, Spain and the Netherlands. Test services and/or announced operational services are available in Norway, Sweden, Finland, Denmark, Czech republic, Austria, Switzerland and Turkey (status December 2011); in UK broadcasters partly adopt HbbTV, partly "YouView". The HbbTV specification in the meantime is also supported by many of the well-known CE-manufacturers of set top boxes and IDTVs (about 30 manufacturers currently offer HbbTV products in the German market). In addition to the "traditional" hybrid combination of DVB and Internet also IPTV-providers are evaluating HbbTV-integration for deployment in their set top boxes[12].

HbbTV Members work together to ensure specifications continue to meet market requirements while supporting innovation for the delivery of future TV services. To address *short term* market requirements HbbTV version 1.5, which has been standardized in April 2012, compared to version 1.0 amongst other things will support adaptive streaming (based on MPEG DASH) as an additional feature[13].

HbbTV version 2.0, which will be developed as of 2012, may contain (amongst other things) additional features regarding adaptive streaming as well as the possibility for synchronising streams delivered by broadcast and broadband connections.

Concerning the ***type of content*** provided online by broadcasters it seems that full length episodes are very popular with users: The 20-minute up to one hour videos have higher

[10] http://www.emarketer.com/Article.aspx?R=1008232

[11] ARD-ZDF-Onlinestudie 2011, http://www.ard-zdf-onlinestudie.de

[12] „HbbTV - Status und Ausblick", Klaus Merkel, IRT-Kolloquium München, December 2011, (Downloadable from http://www.irt.de/de/aktuell/kolloquien/rueckblick.html (German only)).

[13] http://www.irt.de/no_cache/en/news/news-ticker/view/article/hbbtv-veroeffentlicht-spezifikation-15.html

completion rates than short form content of few minutes length like episode highlights, webisodes, or previews[14].

In the area of ***3D contents*** the technology becomes more and more common for home cinema and computer. One reason is a decrease in production of 3D video contents, but also the launch of first universal 3D glasses like those from XPAND[15] which supports 3D experience for multiple brands and facilitates the consume of 3D contents at home. This development means that 3D techniques are getting more interesting for providers of online media and thus these contents soon could belong to the standard offer of audio-visual online services.

2.2 Mobile Payment Applications

Mobile payments have had a rather strong development in recent years. Many mobile payment services have been developed using SMS. Some examples are tickets for travels, paying for parking space, donations, music, ringtones, etc. Here the user pays for the service on the mobile phone bill or a registered credit card. In general SMS payment services paid via the mobile phone bill can be rather well suited for small payments due to the relatively high charges in the credit card system. However, costs for handling credit card payments are coming down thus making credit card based micro payments more and more interesting. Below we will describe three different mobile payment approaches.

2.2.1 Approach 1: Customer-to-Customer Payment

In countries where traditional financial services are scarce an approach as the figure below has shown to very useful

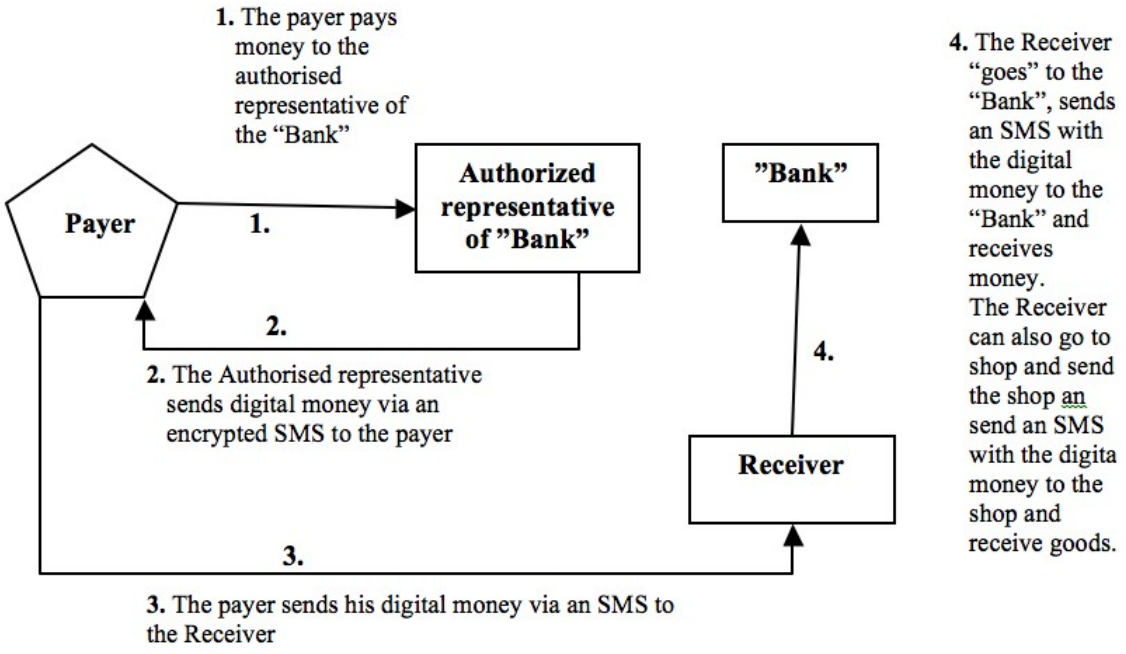

Figure 4: Customer-to-Customer Payment, Source: Dagens Industri

In this Peer-to-Peer (customer-to-customer) payment service the payer pays money to an authorised representative of a "bank" and receives back digital money with an SMS. Using this digital money the Payer can send digital money to anyone with an SMS capable mobile phone who then can use it in a shop to pay for goods or get money from the "bank".

There are many actors with this or similar approaches. A very early actor here is the operator Safaricom with the service M-PESA. An interesting case study of M-PESA can be found at: http://www.slideshare.net/mohitagrawal/mpesa-case-study.

Note: This approach is quite close to earlier attempts (end 1980-ties and early 1990-ties to create digital money. These approaches failed at that time due to that such money was not anonymous.

2.2.2 Approach 2: Nokia Money

Nokia money is another approach. The service builds on a technical platform developed by Obopay[16]. The technology is very similar to PayPal but the use of e-mail as single user identification the user's mobile phone number is used. In principle the service works as follows:

1. subscribe to the service by opening up an account and deposit money in the account

2. Send money to anyone by entering their mobile number, amount, and a PIN on a website from a PC or a mobile phone.

3. The recipient receives a text message (SMS) and is directed to the website of the service to pick up the money.

4. The recipient has two options:

- Transfer directly to the recipient's bank account
- Sign up for an account in the service and the money is transferred to this account

5. Money can be transferred to any bank account.

2.2.3 Approach 3: Credit card based mobile payment services

This type of services has been our focus since this is the only global payment system with reasonable costs and time delays. (Bank transfers are of course also global but too costly and too large time delays to build any real time service around). The drawback with credit card based services as pointed out earlier is that the charges by the banks and payment service providers so far have been rather high, which means that micro-payments can be difficult but can be worked around. And the charges are coming down.

These services are basically built around a couple of patents where Visa, Accumulate AB and JP Morgan Bank (originally Palm Inc.) are typical examples.

[16] https://www.obopay.com/index.php

The VISA mobile account authentication service patent discusses a solution where a user is required to send a password or an answer to an agreed question or a cryptogram stored on a chip card for identification of the user and in this way verify that the user is enrolled in an authentication service for online payments. The service is called verified by VISA.

The Accumulate AB patent discusses a secure solution based on that two parties have a common unique transaction identity. Security is achieved partly by using a personal identification number (PIN) and partly by installing user-transaction software in portable radio communication equipment. The user-transaction software is preferably installed during a visit to a bank office where the identity of the user is checked or internet bank where the identity check is performed using registered mail. Accumulate AB offers mobile payment services but under no particular brand.

The JP Morgan Bank patent discusses a solution with a secure element for transactions stored in the memory of a mobile computing device. This secure element shall contain credit card data among others credit card number and expiry date. The mobile computing device shall also contain a processor arranged so the user can make a purchase directly from an online merchant. So far there is no mobile payment service offered by JP Morgan Bank.

2.2.4 DACC Approach to Mobile Micropayments

It is worth to notice that for mobile payments it is not always necessary to check the identity of the card holder or that the card holder need to give a pin code or a card security code (CSC where the most cited being the CVV or CVV2 code) printed on the credit card. Examples of such services are payments in parking meters and vending machines. This means that micro-payments based on credit card can be made simpler than the present solutions for mobile payments offer today.

DACC has filed a patent application based on that no identity check is necessary and that no check is made of card security code. In brief the patent application is a method and system for a secure transaction using a mobile terminal where the parties are protected against fraudulent behaviours among other using at least two amounts of information – information fragments – stored in different physically locations. The information fragments hold severally necessary information to perform a transaction but each information fragment do not hold enough information to perform a full transaction but the complete combination does. Information fragments are supposed to be parts of credit card data arranged in such a way that if a fragment goes astray it is impossible to guess the missing data. To perform a micropayment the information fragments are assembled at the payment service provider.

2.3 Selected Broadcaster Views and Experiences with P2P

2.3.1 German public broadcasters

From the perspective of the German public broadcasters, P2P streaming can be considered as an alternative transport-mechanism that may or may not be used, depending on various pre-conditions. As a main constraint for P2P streaming, the extreme asymmetric split-up of current DSL-connections is seen, which effectively limits the media bit-rate and resulting quality to a max. of about 500 kbps assuming a coverage of at least 75% of all fixed line DSL-connections in Germany (see also Figure 10 and Figure 11, p.33). With a default media bit-rate of about 1.500 kbps for SD-content (Web L) for HbbTV and PC and 768 kbps (Web M) for PC and Smartphone to be delivered by the CDNs, P2P is believed to have shortcomings in terms of achievable quality within the overall asymmetric German Web-Ecosystem. In comparison of streaming-costs of about 4 euro cent/GB the benefit of helping peers within a P2P streaming network seems to be shrinking dramatically with the current economic situation. Furthermore it was found, that especially cable operators seem to shaping their high-bit-rate IP-connections in terms of throttling Torrent-Usage (see Figure 5 and Figure 6), which currently may not be the case with simple HTTP/RTMP-Streaming.

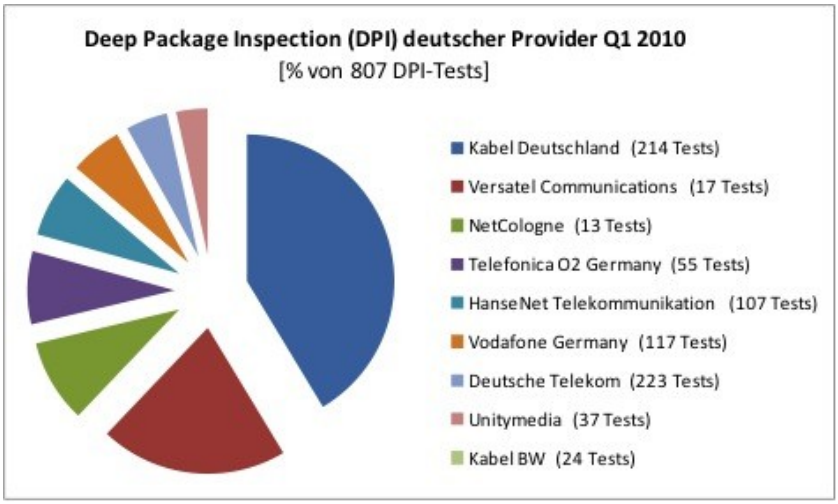

Figure 5: MLab, BitTorrent Throttling by ISPs, Worldwide Glasnost data, Q2 2008 - Q2 2010

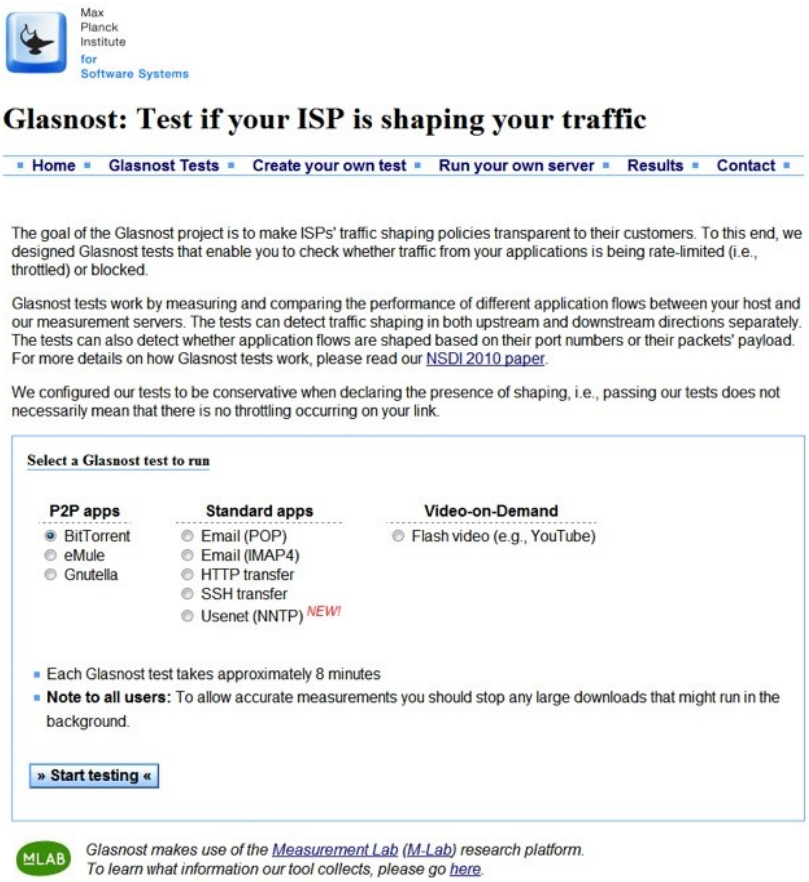

Figure 6: Glasnost: Enabling End Users to Detect Traffic Differentiation

Client-specific problems like standby/idle power consumption or unattended upstream activity not being transparent to the user are noticed as implementation issues which need to be solved by the vendors of P2P-software. Although these issues may not be crucial at first, they are to be implemented and tested properly with hard- and software as precondition for the usage of P2P for delivery of Catch-Up TV-services. Although neither encryption nor DRM is necessary for online delivery of public broadcast content, the anonymity of the end-user as well as the integrity of the streaming-content must be ensured by the system. It is understood, that these features seem to be well supported by the P2P-Next system.

Currently, the main part of live- and on demand-streaming offered the open Internet is delivered by means of unicast over TCP, using either HTTP progressive download (podcast, HTML5 browsers), RTMP streaming to Adobe Flash Player (PC-browser), Apple HTTP Live Streaming (iOS devices) or Shoutcast HTTP streaming (webradio). Windows Media Codecs as well as MMS-Transport has been depreciated lately. RT(S)P over UDP is only considered for mobile phones like Symbian and Blackberry or Windows Phone 7 for mobile cellular usage, as the problem with NAT traversal and port forwarding in routers on the last mile is still seen as a critical barrier for the regular end user, as long as such features are not implemented in the respective devices to work securely by default without any user's interaction. Shortcomings within the Internet are mostly overcome with CDN Providers like Akamai, Limelight and Level 3.

ARD and ZDF as well as their associated technical partners (e.g. Geisendorfer an Leschinsky (G&L)) are well aware that P2P streaming technologies are available. They are informed by IRT about the progress within the P2P-Next project as soon as there are important developments. Apart from streaming events especially in collaboration with the EBU-P2P Group and showcases with Octoshape, at this point in time there is no known 24/7 P2P-streaming service operated by ARD or ZDF in Germany. Most technical efforts are spent within the collaboration between broadcasters, CDN providers and encoding operators especially in the fields of hybrid television (HbbTV), PC delivery via Adobe Flash and HTML5 natively audio/video-supported browsers and new Smartphone-Apps plus HTML5-browsers. Some institutions have ongoing test operations with Adaptive Streaming, especially using the Adobe and the Apple Implementations.

	Bitrate [kbps]				Web S	Web M	Web L	Web XL
Kanaltyp	Nom.	Nutz	Audio	Video	Erreichbarkeit: Video nach Anschluss*			
GSM	9,6	kein IP						Legende:
GPRS	171,2	32						mobil
POTS	56	56	48	32+16	100 %			home
ISDN	64	64	64	32+16	100 %			≤70%
EDGE	473	64	64	32+16	90 %			(% nach Nutzrate)
Dual ISDN	128	128	128	96+32	100 %	100 %		
ADSL	1000	384	256	164+48	100 %	100 %		
UMTS	2000	384	256	164+48	(100 %)	90 %		
ADSL	1000	768	256	512+64		95 %		
HSDPA	3600	1024	256	768+128		70 %		
ADSL	2000	1832	256	1536+192		(100 %)	85 %	
ADSL	6000	3072	256	1536+192			85 %	
HSDPA	14400	4512	256	3300+192			5%	5 %
ADSL	6000	6016	256	3584+192			(100 %)	70 %
ADSL+	6000	16000	256	4352+192			(100 %)	70 %
WLAN 802.11g	54000	18000	256	4352+192			(100 %)	(100 %)

(*) gerundet laut Speedtest.net für Deutschland 4Q2010, Auswertung IRT Juli 2011 für EDGE,UMTS,HSDPA,DSL

Figure 7: Statistical accessibility of ARD AV media formats depending on Internet connection type, speedtest.net Q4 2010

Evaluations by IRT show the accessibility to the ARD AV media formats depending on Internet connection type (see Figure 7). From this table it can be seen that a large percentage of current Internet connections offer end users the access to high quality streams (Web M and Web L) based on unicast traffic. E.g. SD video content in Web L format (brut coding rate of 1832 kbps) can be accessed by 85% of the end users having a ADSL 2000 connection. Any P2P solutions must be able to compete with these numbers.

2.3.2 RTV Slovenia

The development of the networks, small market, strong position of national telecom operator and very few content providers with a lot of content and users are main reasons, that there is no demand for P2P technology. Alternative Internet delivery mechanisms are therefore used by all but RTV Slovenia.

RTV Slovenia has 5 years of experiences with P2P technology. In first 2 years they were using the technology for live broadcasting of 2 TV channels and 7 radio channels, latter they added 1 more TV channel and also video on demand services. There were some considerations about alternative delivery systems, but size of the market and number of users were the key factors,

which determines the cost and P2P solution was more cost effective. In addition they offer "regular" streaming but with lower quality of the picture for those, who don't want to use P2P technology or those with low bandwidth.

The only problem worth mentioning was plug in and usage of bandwidth for others – some users and some medias were complaining, but not for long and not very loud. Otherwise the system was and is stable, reliable and the quality of video is good and improving with higher bandwidth. The critical moments are picks of users. Radio on one side has very stable number of users through the whole day but TV has regularly very low numbers of users and then very high picks (daily for news and some special events, occasionally extremely high picks for important sport events with local competitors – from just a few users to ten thousands in a minute). The system responds very well and works even better with more users. The operators must be alerted in advance for events, when high picks are expected, so they adjust the system.

2.4 Survey: Current and Future Usage of P2P-based Internet Distribution Systems

P2P-Next is seeking to design a successful platform – technically as well as commercially – that meets the needs of both end users as well as content- and service providers. Therefore the project continuously tries to capture the requirements of all stakeholders and to apply these to the project by gathering information internally from the project partners but also from external sources. In 2011, WP2 prepared a questionnaire to conduct a “broadcaster survey” geared to European broadcasters. By this means the work package wanted to get an updated overview on the current and future usage of Internet distribution systems for audio-visual and multimedia service offers in Europe. The complete Questionnaire can be found in Annex 8.1.

2.4.1 Approach

The underlying intention of the survey was to get - as part of the final project status - updated information on the business requirements for audio-visual content distribution. In this regard European broadcasters are one of the most important stakeholders because these shall make their contents available on the NextShare platform. Therefore this group also presented the main target group of the survey.

In order to get as many answers as possible the questionnaire was drafted in a way that it is not too time-consuming for the participants. This was achieved by keeping the amount of questions measured (under 20) and by posing multiple choice questions allowing fast answering. The latter was also needed to allow a valid evaluation of the survey by having pre-defined answers that can be classified and ranked. Another aspect was to pose rather generic questions that do not claim confidential information. At the same time the results of the survey should allow to get a clear picture of the overall use of audio-visual services in Europe as well as the attitude and chances of Peer-to-Peer distribution methods. This led to questions that rather ask for an estimated range than for concrete numbers. Multiple choice questions

concerning the service offer or opinion always included an additional choice “other” or “comments” to give the participants freedom to add aspects that didn't appear in the question.

The resulting structure of the questionnaire was as follows:

The first page contained an introduction with information on the P2P-Next project as well as some words on the survey and its goals.

The questionnaire itself was divided into four parts, starting with some general questions to receive overall information about the participant like the company name or branch. The second part of the questionnaire asked for distribution methods followed by a third part dealing with IP-based content distribution and lastly there was a part with specific questions regarding Peer-to-Peer distribution.

The questionnaire included altogether 19 questions. Below all questions are listed, together with the underlying intention for the study (complete questionnaire see Annex 8.1):

General Information

This part asks for information mainly to get information regarding the size, reach and amount of users of the participant.

1. Company Name & Abbreviation

Purpose: Get general information to distinguish companies plus information e.g. in which country the company is based; option to look up more information if needed

2. Branch (public/private broadcaster, service provider, content provider)

Purpose: Be able to make a distinction between type of broadcaster as well as information on its dependencies concerning budget and content offer (public vs. private)

3. Audio-visual programme offer (amount and type of programmes)

Purpose: Get an impression of broadcasters main activities and amount of contents

4. Reach (local, national, worldwide)

Purpose: Get information on origin of users/viewers, need for/existence of cross-border licensing of contents and suitability for P2P-Next European approach

5. Number of unique users per month (a. today / b. in one year)

Purpose: Gain information on the number of users, need for mass distribution, assessment of future growth and possible change in demand

6. What is the average time per session users spend with your audiovisual services?

Purpose: Get an impression on the dwell time of users to deduce necessary bandwidths; classification into rather lean-forward or lean-back type of users; assessment of future growth of the broadcaster and possible change in demand

Distribution Methods

This part relates to the distribution methods of the participating broadcaster in order to get information on the diversity of their distribution channels.

7. Which types of content distribution does your company currently use?

Purpose: Make an assessment whether the broadcaster's service offer is rather suited for Peer-to-Peer-distribution (on demand, IP-based), rather not suited (live events, non IP-based) or already distributed via Peer-to-Peer technology.

8. How do you make your services and content available to viewers/users?

Purpose: Find out about the distribution channels of the participant and the amount of IP-based services, since only these are suited for Peer-to-Peer. Furthermore the appliance of DRM (geolocation, pay contents, etc.).

IP-based content distribution

This part is specifically asking for the IP-based content distribution as a basis for Peer-to-Peer delivery mechanisms. The aim is to find out about the importance of this distribution channel for the broadcaster by asking for the amount of users and the budget as well as driving aspects and future plans in this area.

9. Number of unique users per month (a. today / b. in one year)

Purpose: Get an impression on the current usage of the broadcasters IP-based services and its expected development.

10. For your companies' IP-based content distribution, please select up to 5 aspects that are most important for you.

Purpose: Receive information on the participants main demands concerning IP-based content distribution for a comparison with the current concept of P2P-Next and the option to make adjustments or suggestions for the future development of the project outcomes.

11. Which region do you mainly try to reach with IP-based content distribution?

Purpose: To find out whether the broadcaster's services fit into the European approach of P2P-Next, only acts national or is a global player. This aspect is also of importance for legal and regulatory aspects.

12. How much is your annual budget for IP-based content distribution?

Purpose: Get an idea on the money spent for IP-based services, also with regard to other non IP-based services offered by the participant.

13. How much of this budget is spent on bandwidth costs?

Purpose: Get information on how bandwidth costs rank in budget for IP-based services and to question how much of the substantial argument of low bandwidth costs for Peer-to-Peer distribution is left.

14. Percentage of IP-based to total distribution efforts (in %):

Purpose: Get an impression on how important IP-based services are for the different participants of the survey.

15. Are you planning to modify your methods for your IP-based distribution in the near future?

Purpose: Verify that mobile content distribution and hybrid services are growing areas and to get to know if there are other developments that should be considered for the future of P2P-Next.

Peer-to-Peer Distribution

With this part we tried to find out how the opinion towards Peer-to-Peer delivery has developed. It shall give a feeling for which cases should be pushed by the project, which aspects (still) act as a deterrent and which areas of Peer-to-Peer might need further development.

16. In your opinion, what are reasons **in favour of** using Peer-to-Peer techniques as a distribution method (multiple answers may apply)?

Purpose: Get updated information on the main aspects for Peer-to-Peer technology in the stakeholders opinion.

17. What are your reasons (based on facts and rumours) **against** Peer-to-Peer as a distribution method (multiple answers may apply)?

Purpose: Get updated information which are the aspects that prevent the participants of the survey from applying Peer-to-Peer technology and enable the project to react on this.

18. If Peer-to-Peer would have the same in-browser experience as streaming video has, would you consider it as an alternative distribution method?

Purpose: Find out whether a Peer-to-Peer offering without further downloads and plugins might override the negative aspects and make this technology more attractive for content and service providers.

19. Any further remarks

Purpose: To put the participants in the position to explain their choice and to make comments or proposals regarding Peer-to-Peer technology, the survey or the P2P-Next project.

2.4.2 Course of Action

The first efforts in form of ideas for the contents and structure of the broadcaster survey were outlined in spring 2011. After the general approach was defined the questionnaire was drafted and fine-tuned in agreement with the WP2 partners.

On 2nd November the questionnaire was sent out to the work package partners and attendees of the survey. Partners who forwarded the questionnaire to associated broadcasters were EBU, IRT, VTT, and MFG. Partners to fill out the questionnaire themselves were BBC and RTV. The deadline was set for the 30th November 2011. However, for some associated broadcasters this was postponed to the 15th of December (or even January 2012) to increase the likeliness of an answer.

For the survey more than 170 people from various companies of the broadcasting branch were contacted via e-mail and asked to attend the survey; ten participated. These were:

MTV Oy, Finland

Sanoma, Finland

ARD Head Office, Germany

Center TV, Germany

Tape TV, Germany

WDR Cologne, Germany

ZDF, Germany

RTV, Slovenia

SRG SSR, Switzerland

BBC, UK

2.4.3 Outcomes and Conclusions

Although only ten broadcasters took part in the survey it could be gained answers from five different countries and drawn some valuable conclusions.

Structure:

- 6 public, 4 private broadcasters
- 5 broadcasters with local or national reach, 5 with woldwide reach

Number of unique users (Question 5): The majority of five broadcasters have between 100.000 and 1 mio. unique users per month, two stated to have more than 10 mio. users. These two participants of the survey also prospect to keep their users over 10 mio., four other participants expect to increase their number of unique users up to 10 mio. or even over 10. mio. in the next year. This outcome is similar to the statements made for the unique users of their IP-based services (Question 9) and thus allow the presumption that IP-based media usage is the main area of user growth.

Time per session (Question 6) (8 answers, 1 with no forecast, 1 with no current status): Five participants indicate that the average time per session of their users is up to 20 minutes while two (TV-) broadcasters have users that consume their services more than 60 minutes per session. Furthermore, the majority of six participants don't see that the time per session will grow. These outcomes confirm a rather short dwell time of users and lean-forward type of media consumption, to be expected especially in the online sector. Still, the users with 60 or more minutes per session shouldn't be neglected: The rising popularity to connect multiple devices – especially the TV screen - with the Internet can also be expected to push the dwell time for IP-based services.

Distribution Methods (Question 7 + 8): All attendees of the survey offer IP-based video on demand, nine of them additionally offer IP-based live broadcasting, while only one broadcaster uses Peer-to-Peer technology. This shows that Peer-to-Peer still seems not an option for most of the market players. However, the share of IP-based broadcasting also

makes clear that Peer-to-Peer technology could be applied almost for every European broadcaster.

The end devices used by the participants asked in question 8 allow some valuable conclusions for the P2P-Next project: There are three participants who offer pay TV and two that offer paid content via Internet. This fact shows that there is a need for payment systems like currently developed in the project with DACCPAY.

Another aspect is the use of online services with restrictions indicated by seven respondents and relating to the approach of P2P-Next to allow different DRM systems in NextShare but not to introduce an own DRM approach for the platform. Furthermore geolocation may apply.

The fact that eight broadcasters indicated to provide their services via 3rd party web portals show that most broadcasters count on a number of distribution channels and suggest good chances that NextShare could become one of them.

IP-based users and regions (Question 9 + 11): Only one of the respondents prospect less than 100.000 IP-based users per month in a years time, three broadcasters even expect a growth from up to 10 mio. to more than 10 mio. unique IP-based unique users. Looking at the overall amount of unique users and its prospected growth in Question 5, the overall number of users is slightly more than IP-based users while the latter one is rather prospected to grow.

The areas that the participants of the survey mainly try to reach with their IP-based content distribution are restricted to national delivery (main reason certainly due to the language of the audiovisual services). One German broadcaster specifies German spoken countries as a main target group while only two broadcasters indicated to reach EU-wide, and none of them strive for worldwide users. For the project this means that the P2P-Next European approach fits every of the polled broadcasters and thus also will be attractive for most other European audiovisual service providers.

Important aspects for IP-based distribution (Question 10): The most important aspects of the broadcasters IP-based content distribution are

a) VoD Streaming (9 answers)

b) Live Streaming (7 answers)

c) Quality of Service / High scalability e.g. to handle masses of users (6 answers each)

d) Adaptive bandwidth (5 answers)

This shows that live streaming on position 2 is an essential aspect for broadcasters. This also applies for quality of service (which for Peer-to-Peer distribution is unfortunately only best effort) and high scalability (presenting one of the main strengths of Peer-to-Peer technology) on the third position. Aspects that weren't ticked by the broadcasters were niche content for few users and closed user groups, whereby the latter might gave too much room for interpretation and thus wasn't clear enough to be selected.

Budget for IP-based distribution and the share of bandwidth costs (Question 12,13 + 14): While for the majority of six broadcasters the annual budget for IP-based distribution is more than 500.000 €, the smallest broadcaster spends less than 10.000 € in this area. However, not all broadcasters with a high budget also spend a very high proportion for

bandwidths (one spends even less than 5%). One reason could be that traffic for some of the offers are low, another reason could be the prices of different service providers. Also one participant states at the and of the questionnaire (further remarks, Question 19) that they have stopped analysing Peer-to-Peer due to strongly fallen CDN costs. Still, three broadcasters (all with more than 100.000 € IP budget) spend more than 50% for their bandwidth. This means that - even if bandwidth costs have decreased in general for online distribution - bandwidth is still a cost factor that could be minimized e.g. by distribution via Peer-to-Peer technology.

Looking at the overall amount of IP-based distribution (6 answers) compared to total distribution efforts of the participants, these are with usually only up to 10% rather low. The one online broadcaster has - of course - a 100% IP-distribution budget.

Plans for modification of distribution methods (Question 15): The main changes in IP-based distribution methods go towards smartphone and tablet access (4 answers). Three broadcasters also indicated to plan the introduction of live broadcasting, making their contents available via hybrid services or via set-top boxes. This means for the P2P-Next project that we should ensure NextShare is accessible on mobile devices and that there is a demand for distribution via set-top boxes. On the other hand none of the participants plans to introduce Peer-to-Peer, which means other issues of NextShare must be convincing.

Peer-to-Peer Distribution (Question 16, 17 + 18): When it comes to the advantages of Peer-to-Peer techniques cost savings in bandwidth as well as mass distribution is seen as most convincing facts (each was selected 7 times). Five participants also see low infrastructure and scalability as an reason in favour of Peer-to-Peer.

The key aspect against Peer-to-Peer techniques seem to be the varying data rates which was ticked by seven participants of the survey. Other aspects seen as main reasons against Peer-to-Peer are the fear of content piracy (security reasons), potential access latencies, and lack of audience tracking (4 answers each). Two broadcasters also state in their comment that the requirement of a plug in is a further reason. This is confirmed by the answers in Question 18, where seven participants state that Peer-to-Peer would be considered as an alternative distribution method if it would have the same in-browser experience as streaming video has.

2.4.4 Conclusion

First, it should be said that the survey did not reach as many answers as planned and thus gives only a small insight to the current situation on the European market. Regarding the structure of participants 60% of them were public broadcasters. These usually have more in-house productions in their programmes and are, due to public funding, not as dependent on advertising as private services. Therefore the outcomes of the survey don't exactly reflect the actual market structure.
Still, the survey helped WP2 to gain a dedicated picture on issues that so far were only derived from market watch and own experiences. It confirmed many of assumptions and known facts but also unveiled some new aspects and gave WP2 more certainty concerning the assessment of the project's chances on the market.
For conclusions of the survey results, please see chapter 8 Conclusions and Recommendations

3 Cost Analyses (OPEX/CAPEX) of P2P Systems

3.1 Executive summary

The aim of the P2P-Next project is to develop an open source, efficient, user-centric and participatory next generation media delivery system using P2P distribution technologies. In order to find out about the financial benefit for providers of audio-visual online contents using P2P instead of alternative delivery mechanisms work package 2 decided to conduct OPEX/CAPEX analyses for a selection of pre-defined use cases.

Starting-point for the project and planning its outcomes was the situation of online video delivery in 2007 and 2008. At that time costs of video production as well as online distribution of audio-visual contents were fairly high. Taking 250TB as a basis for volume, the price for video delivery from CDNs in 2008 was about US$0.65 - US$0.40 per GB[17]. In the area of online advertisement there were only few advertisers relying on online ads. In 2007 the expenditures for online ads reached about US$ 41,038 mio. and thus only counted for 8.6% of global ad expenditure[18].

As a consequence, platforms like YouTube didn't manage to become profitable while new video platforms using P2P delivery mechanisms were seen as forward-looking solutions. Analysts assessed the characteristics of P2P like its accessibility of contents through a distributed network and the reduction in distribution costs as facts that will make this technology a success (see table 4).

Availability of content	On-demand access to vast catalogues of free content, at home
Low distribution costs	Content storage and delivery costs supported by the user
Network externalities	The efficiency of distribution increases with the number of users
Optimised distribution of large files	Hashing files into packets makes it possible to benefit from the community of clients
Robustness	Networks do not depend on a central server

Table 1: P2P success factors, EITO 2006

Unfortunately many of the technical strengths of that time have become out-dated or too complicated compared to current solutions. Joost and Zattoo, for examples, are two services that were established with a strong belief in the future of P2P; but finally they could not maintain their structures because their approach wasn't adopted by users and at the same time overrun by other technologies.

Apart from technology issues, also usage behaviour regarding audio-visual content has changed, e.g. towards multi-platform usage and long form video contents. In order to make

[17] http://blog.streamingmedia.com/the_business_of_online_vi/2008/05/cdn-pricing-sta.html

[18] ZenithOptimedia: World adspend to grow 4% in 2008 and 2009 despite economic downturn, Oct 2008

these developments possible some key factors were necessary: One is the fact that expenses for video production have significantly lowered. The same applies for the costs of online delivery which decreased to $0.10 - $0.05 per GB by the end of 2011[19]. Also in the area of online advertisement there was a positive development. Despite the financial crisis online ad expenditures from 2007 until 2011 raised by almost 60% up to US$ 72,842 mio. and thus reaching a share of 15.9% of global ad expenditures[20].

Still, anything that significantly reduces delivery costs is important for audio-visual online offers but it is not as relevant as in 2008. Delivery costs today are only one factor that pays into the profitability of online service offers. Further issues that count today are Quality-of-Service (QoS), Quality-of-Experience (QoE), user analytics as a basis for advertising and audience measurement, social media features, geolocation, DRM, delivery of premium contents, etc..

Meanwhile P2P as a technology for online distribution is no longer a hot topic in venture capital funding. Also most services relying on P2P technology, excepted from from sharing services like BitTorrent, disappeared from the market. The video platform Joost which was launched as P2PTV in 2007 was migrated to use a Flash-based Web player in late 2008 and in 2009 - just after Joost UK filed for bankruptcy - it was acquired by Adconion Media Group. Similar happened to the P2P TV service Zattoo which changed to a browser-based Flash version in spring 2009.

To sum up, P2P technology has been a big topic in 2008 that was predicted to change the existing concept of Internet distribution. Together with the change of technologies, cost structures and user behaviour also the importance of P2P has changed. Although P2P distribution mechanisms still imply a lot of advantages the future development of this technology on the online market is unclear.

3.2 Introduction

3.2.1 Objectives of the Analyses

A basic concept of the P2P-Next project is to use P2P technology as a distribution method for its audio-visual online services. In order to find out about the related costs WP2 decided to carry out analyses that make P2P comparable with alternative delivery mechanisms.

Therefore the two cost levels CAPEX (capital expenditures) and OPEX (operational expenditures) are used whereby CAPEX include all one-time charges like hardware, premises etc., while OPEX is looking at the variable costs that appear during the operation of a service like running (monthly) costs for data traffic.

By calculating these costs for different service approaches and use cases a comprehensive analysis and comparable results are achieved. This helps to unveil strengths and weaknesses of costs related to P2P delivery and to gain a more realistic picture of the chances of P2P-Next

[19] http://blog.streamingmedia.com/the_business_of_online_vi/2011/11/cdn-pricing-stable-in-q4-down-about-20-for-the-year.html

[20] ZenithOptimedia: Quadrennial events to help ad market grow in 2012 despite economic troubles, Dec 2011

outcomes. At the same time it enables the project to define a list of required steps to take for commercial uptake of the project results.

3.2.2 Structure of the Document

As a basis for these analyses in chapter 3.3 a number of use cases are drafted. These shall reflect different types of content providers, which also could be potential users of the NextShare platform.

In chapter 3.4 these cases are examined concerning their one-time costs (CAPEX) compared to the NextShare P2P approach. Services that are considered for the comparison include P2P technology, hybrid CDN, and other solutions.

In the second step (chapter 3.5) the operational expenditures for the use cases and the P2P and alternative solutions that were already introduced for the CAPEX calculations are analysed.

Following this structure we achieve results that can afterwards related to the actual P2P-Next project resulting in activity-oriented guidelines for it.

complementary information to the analyses and its results can be found in the following chapters on efficiency comparison (chapter 4) and refinement of requirements (chapter 5) of this deliverable.

3.3 Video Delivery Use Cases

On the market for online video there exist numerous Web TV and IPTV offers with different approaches and services. Some arose from traditional TV channels; others were established as sole Internet service with on-demand video contents or bundling live TV channels and make these available online. In this chapter are described several types of IP-based services and their characteristics serving as basis for the definition of selected use cases that are needed for the subsequent financial analyses of this paper.

3.3.1 Use Case 1 – Web TV channel

In general, web TV can be defined as a service that offers audio-visual contents only via Internet to its users. Originally web TV services mainly consisted of short-form contents from different producers (also users) offered as on-demand. Famous examples for these services are YouTube or Vimeo. However, today web TV services often also include long-form content like movies or shows as well as live TV broadcasts. In terms of geographical coverage the services are usually restricted due to only national distribution rights but also because of language barriers (most web TV services provide their contents only in one language version). Also the business models of web TV strongly vary from service to service. Most are ad-supported, but many of them also offer paid contents like movie rentals or making available all contents for a monthly fee.

An example for such a service is Netflix (http://www.netflix.com), a US provider of on-demand Internet streaming media offering a broad range of movies and TV shows for a monthly price of 7,99 USD. The service has about 23 million streaming members (status end 2011) and is available in the United States, Canada, Latin America, the Caribbean, United Kingdom and Ireland.

In Europe Headweb (http://www.headweb.com) is a popular on-demand web TV service. The offer includes about 6.000 titles that can be rented or downloaded. In 2010 there were reported 2 million rentals for an average price of 29 SEK (about 3 euros) expected to grow considerably in the future. Headweb is accessible in Sweden, Norway, Denmark, and Finland.

An example for a European live TV service is Zattoo (http://zattoo.com). It offers more than 150 channels for users from Germany, Switzerland, UK, Denmark, Spain, and France. The ad-supported service is made available to its viewers for free and currently has about 9 million registered users.

Looking at these examples it becomes clear that there is no single typical use case that reflects the service offer of a web TV channel. Thus, for the planned OPEX/CAPEX analyses a case is drafted that seems appropriate as a potential service using the NextShare platform. The cases described below are derived from existing services.

Use Case A (musicTV)

The web TV channel that shall serve as use case is an online music channel with about 50.000 on-demand music items only available in German speaking countries (Germany, Austria, Switzerland). Contents are coming from in-house productions and from cooperation with third-party companies. The service is financed through advertisements and thus free of charge for its users. The service has about 3.8 million users per month with an average dwell time of 15 minutes.

Use Case B (musicTV + live)

The offer of the online music channel adds the new feature of live concerts (average duration 60 minutes). These are streamed approximately once a month and afterwards made available as on demand clips.

Use Case C (news.inside)

A European web TV service provides on-demand news and service videos gathered from various producers. The service is available in 8 European countries offering several million videos with an average duration of 2 minutes. Every day there are about 200 new videos added to the service while the oldest ones are deleted. The contents are available on an own platform sorted by language, but also distributed to about 1.500 affiliated websites. Altogether, the service generates about 165 million video impressions per month.

Use Case D (news.inside + live)

The news and service platform expands its service by live-stream newscast of a partnered TV news channel. The live-stream is broadcasted once a day for 15 minutes and only available in France.

3.3.2 Use Case 2 – Media Centre of a Broadcaster

Many TV broadcasters nowadays make their contents also available to their audience via an online media centre. These usually contain all of the broadcasters contents (in-house productions and commissioned work) and make them available for a given time period to its users. In most cases these services are nationally restricted.

The BBC iPlayer (http://www.bbc.co.uk/iplayer) for example is only accessible for UK Internet users. The application for radio and television programmes makes available the broadcasters contents of the previous 7 days offering video on demand, live and catch-up TV.

Another media centre is the ZDFmediathek (http://www.zdf.de/ZDFmediathek) from the public German broadcaster ZDF. On the platform users can watch on-demand contents and selected live streams of 5 public German TV channels made available for 7 days up to 12 month, most of them without geographical restrictions.

Also the Slovenian RTV (http://tvslo.si) has a comprehensive online service providing TV and radio programme to users all over the world. Contents can be watched live and on-demand resulting in a daily offer of 15 hours audio-visual live programme and about 30 on-demand video items.

Use Case A (CBA-TV now)

A TV broadcaster runs an online media centre making available its broadcasting contents live, as catch-up and as on-demand stream for 7 days after broadcast. In addition, there is a rental service for motion pictures that has been broadcasted on the TV channel, for the price of 3,99 Euros a movie is 24-hours available. The content is geographically not restricted. The free streaming services have about 2.3 mio. users with a total amount of 20 mio. video views per month.

3.3.3 Use Case 3 – Cross-platform Delivery

Nearly all Internet video services are available on multiple platforms like mobile end devices and current game consoles. In the area of pay TV the company Sky offers access to its service on various end-devices for all subscribers of Sky TV for free. The Service called Sky Go includes 39 live channels including thousands of hours of on demand entertainment made available for for PC, iPhone, iPad, iPod touch, selected Android phones, and Xbox 360[21]. Also most other services that were mentioned in this paper work on these devices plus Playstation 3 and Nintendo Wii.

This cross-platform approach not only increases the reach of users that can consume video contents device-independent, it also means technical adjustments and additional efforts regarding content distribution and accessibility for the provider. Therefore the third use case deals with the feature of multi-platform distribution and asks for the financial aspects that need to be considered.

Use Case A (musicTV + cross-platform)

[21] http://www.sky.com/products/ways-to-watch/sky-go/facts, http://www.sky.de/web/cms/de/sky-go.jsp

The music channel described in use case 1 decides to make its contents available for following end devices:

Online: working with the browsers Internet Explorer, Firefox, Safari, Opera

Mobile: iPod touch, iPad, iPhone, Android phones and tablets

Game consoles: Xbox 360, Wii, Play Station 3

Set-top box: Apple TV, NextShare TV

With this extension of availability usage in the mobile sector bring additional 1 million users per month watching the contents for approximately 10 minutes per session. In the game console segment 500.000 users consume an average of 15 minutes of the offered contents. However, this also means a slight decrease in ordinary online usage by 500.000 users per month.

Use Case B (news.inside + cross-platform)

The news and service video platform from use case 1 expands its service to following devices:

Online: working with the browsers Internet Explorer, Firefox, Safari, Opera

Mobile: iPad, iPhone, Android phones and tablets

Game consoles: Xbox 360, Wii, Play Station 3

Set-top box: Apple TV, NextShare TV

After one year the cross-platform approach creates additional 35 mio. video impressions reaching overall 200 mio. views per month. This is split into 150 mio. users for the traditional online distribution (-15 mio.), 15 mio. mobile users, 5 mio. game console viewers and 15 mio. users via set-top box.

3.4 CAPEX Analyses

All use cases are following the same investment model. There are cost of the video file storage, the web servers and proxy servers, the security gateway and load balancer and other network equipment like switches and routers. In certain cases there are also initial costs for the ISP's connectivity. Considering the storage first a wide spread of solutions from small setup for the distributed material only to complete solutions including the sources (mpeg2+DV) is useful. The last case lets increase the costs dramatically. The effective influence of the P2P-Next deployment to the bare storage costs is not given. Regarding the CAPEX only network investments are profiting by P2P-Next. The provided capacity of gateways and server infrastructure could be lower because reduced peaks (40-60%) are expected.

3.4.1 CDN Model

The Amazon Web Service (AWS) product "S3/Cloudfront" with its "pay as you grow" model have been referenced to calculate all the use cases. Most AWS offerings are OPEX only and covering traditional CAPEX with the monthly rate. The Amazon price list for web services is

periodically adjusted an also a kind of reference for the industry. To set own investment cost for real equipment into relation to AWS rates then an OPEX/CAPEX split of 35/65 is a suitable consideration. The market for competitive AWS solution is very agile. Investments are almost not needed for AWS users.

3.4.2 Buy Model

The investment costs for storage products vary up to factor 5 - almost so for network products. Crucial is the feature set, the reliability and the service level agreement. Starting from a comparable 36-month AWS situation reduced by 35% real OPEX gives a good position for further consideration. The key players' price tag can be easily discounted by more than 50% if an open-storage-solution is used - may at cost of additional OPEX for maintenance expenses.

The network CAPEX is determinate by the expected peak. The counted rates between less than 10Gbit and more than 100Gbit defining the performance class of switches, routers, gateways and servers. The variety starts at several 10k Euro and goes up to some 100k Euro. AWS includes this entire network CAPEX into the "traffic" cost – a very flexible model with an easy entry strategy.

3.4.3 P2P-Next Model

As mentioned before the use of P2P technology is not changing the costs for storage. Only infrastructure investments for peak handling are expected to be lower in case the P2P-Next advantage reduces the peak load down to the next more economic performance class.

3.4.4 MusicTV

Buy Model

An entry storage solution at several 10k Euro is fitting provision of distributed files only. Additional handling of source files will increase investment up to 5 or 10 times.

Network equipment should be planned between 50 and 200k Euro. Especially the live offerings in addition to the basic load lets increase the bandwidth from 2-4Gbit up to more than 20Gbit. This case is demonstrating the different performance classes very well. The cross platform offering almost not affects the investment costs.

P2P-Next

A P2P-Next deployment is promising peak load reduction between 40 and 60% aside an investment reduction of approximately 20%. Avoiding the 20Gbit limit counts.

3.4.5 news.inside

Buy Model

The analyses show that provisioning low bandwidth files only already results in achieving the petabyte dimension. Including mpeg2-source files 10PB are needed - including DV-files 30PB are reached. A total provision of all files is economically questionable. Monthly costs of 300k Euro without and 3mio Euro with source files are expected to handle the 5mio offered video files.

Compared to the former use case the basic load is doubled and the peak is five folded. Cost for network equipment should be expected at 200-500k Euro.

P2P-Next

P2P-Next deployment is promising peak reduction at 40-60% resulting 20-30% less investment.

3.4.6 CBA-TV now

Buy Model

A mid size storage solution at 100k Euro is capable to fit this use case. The bandwidth peak load however is higher than the former cases. More than 150k Euro is expected for infrastructure.

P2P-Next

To handle more than 50Gbit bandwidth requires disproportionately more expensive network equipment. Therefore expected peak reduction of 40-60% with P2P-Next operation results in more than 30% less investment.

An overview of bandwidth development for different video file sizes is summarized in Figure 8.

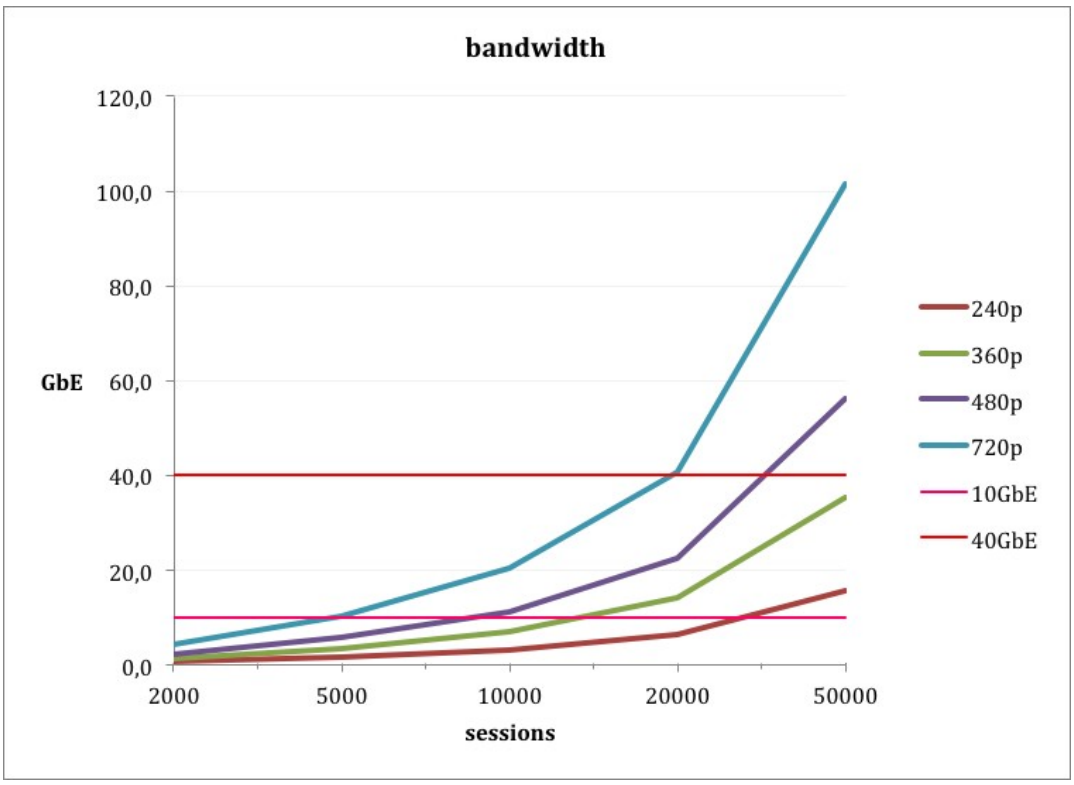

Figure 8: CAPEX analyses – estimated bandwidth for different video file sizes

3.5 OPEX Analyses

All use cases generating running costs for energy, collocation and administration at one side and costs for connectivity at the other side. Running costs for storage are given and neutral in reference to the use of P2P-Next technology. Running costs for infrastructure are almost immune to P2P-Next deployment. Saving resulted by P2P-Next can expected at port side and traffic side.

3.5.1 Special Case CDN Model

Amazons S3/Cloudfront combination offers a very flexible Usage along with a superior service quality and can perfectly combined with the P2P-Next model. The savings are straight and more effective as result of the included original investments – in other words – Amazons primary investment is part of the users OPEX and also reducible. A bigger CDN solution will more costly in long term view and should be discussed in case the core business model allows an in-house operation in terms of qualifications and competences. This long term disadvantage of the CDN more will be levelled again by P2P-Next operations.

3.5.2 Use Cases

Traffic costs for all cases will reach the 5-digits – partly the 6-digit-range. A 3-year period counts up 500k Euro for the smaller case and up to 3M Euro for the bigger ones. P2P-Next deployment reduces this cost significant and saves more than 40% budget.

An overview of the estimated data transfer per month for different video file sizes is summarized in Figure 9.

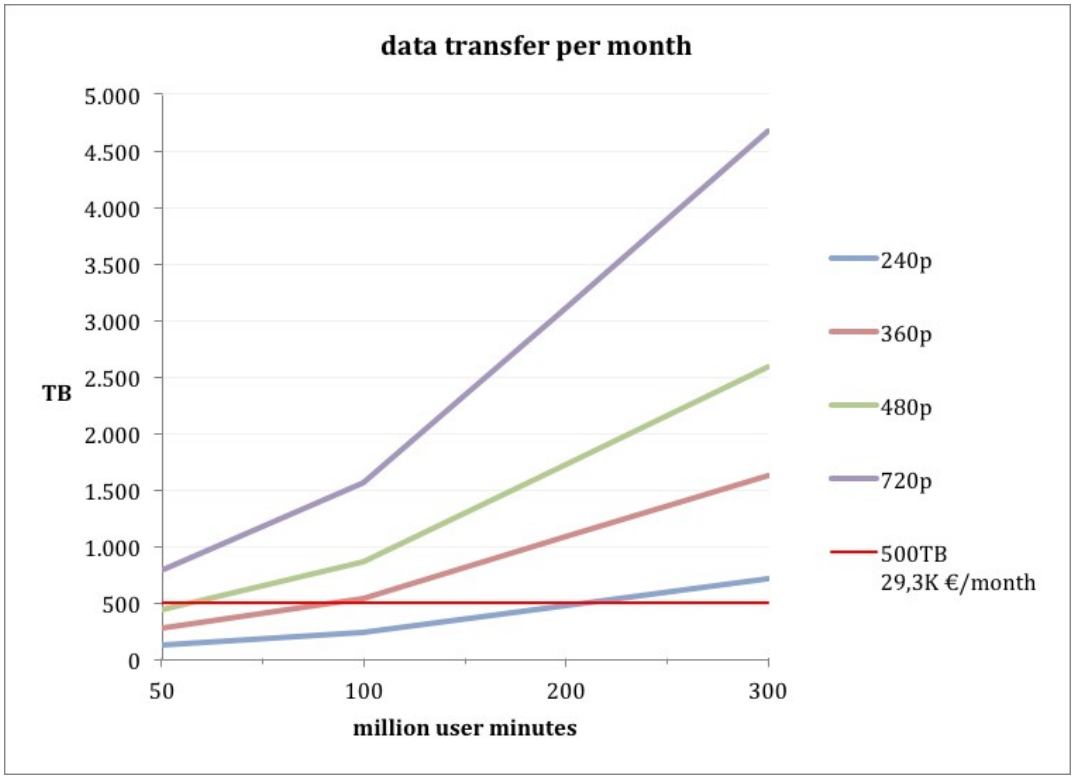

Figure 9: CAPEX analyses - estimated data transfer per month

4 Efficiency Comparison of P2P and Alternative Internet Delivery Mechanisms

4.1 Internet Distribution Situation in Europe

An underlying condition for good online video experience and related services is a broadband internet connection. Therefore this chapter looks at the overall broadband situation in Europe followed by the use cases Germany and Slovenia where also the opinion and experiences with different online distribution methods are described.

The table below shows the number of fixed broadband Internet subscribers per country and per 100 people in Europe in the year 2010[22]:

Country	per 100 people
Liechtenstein	63,8
Netherlands	38,0
Denmark	37,4
Switzerland	37,4
Iceland	34,9
Norway	34,6
Faroe Islands	33,4
Luxembourg	32,9
France	32,8
San Marino	32,0
Germany	31,8
Sweden	31,6
United Kingdom	31,3
Belgium	31,0
Finland	29,1
Andorra	28,9
Malta	27,8
Estonia	24,4
Slovenia	24,1
Austria	23,9
Spain	23,0
Ireland	22,8
Italy	22,2
Lithuania	20,6

[22] Basisdaten Breitband-Internetanschlüsse, website German Federal Statistical Office, source: Weltbank - World Development Indicators https://www.destatis.de/DE/ZahlenFakten/LaenderRegionen/Internationales/Thema/Tabellen/Basistabelle_Breitbandabo.html?nn=50716

Greece	19,9
Portugal	19,5
Hungary	19,5
Latvia	19,4
Croatia	18,2
Belarus	17,6
Cyprus	17,6
Slovakia	16,1
Bulgaria	14,6
Czech Republic	14,6
Romania	14,0
Poland	13,2
Macedonia	12,5
Russian Federation	11,1
Bosnia Herzegovina	10,4
Turkey	9,8
Serbia	8,9
Montenegro	8,3
Ukraine	8,0
Moldavia	7,6
Albania	3,4

4.1.1 Internet Distribution in Germany

A recent survey in Germany on the availability of broadband connections showed that overall 99,1 percent of all German households have the possibility to obtain a broadband Internet connection of at least 1Mbit/s (downstream bit-rate)[23]. In rural regions there is a coverage of about 92%, in big cities (e.g. Berlin, Hamburg) the coverage is 99,9%. The potential availability of broadband connections with bitrates of over 50Mbit/s has increased in the second half of 2011 by 8% up to a total of 48%.

According to the German Federal Statistical Office, 77% of the private households in Germany had an Internet connection, 93% of those being a fast, broadband connection (download data rate of 2.048 Mbps and higher). Of all last mile Internet connections, a large majority of 82% is based on DSL technology[24].

[23] Aktuelle Breitbandverfügbarkeit in Deutschland (Stand Ende 2011) - Erhebung des TÜV Rheinland im Auftrag des BMWi, Bundesministerium für Wirtschaft und Technologie (BMWi), End 2011 (German only)

[24] 28 Millionen Haushalte in Deutschland haben einen Breitbandanschluss, Pressrelease of the German Federal Statistical Office, 19.12.2011 (German only) https://www.destatis.de/DE/PresseService/Presse/Pressemitteilungen/2011/12/PD11_474_63931.html

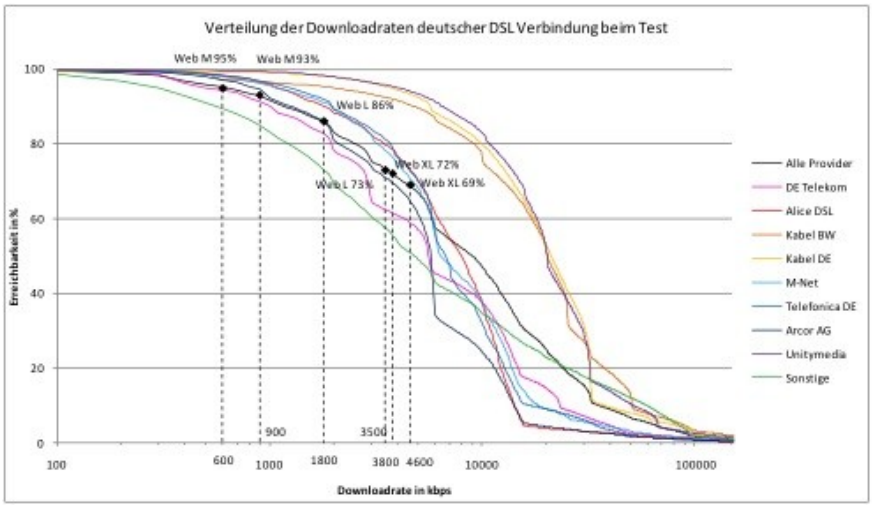

Figure 10: Ookla/Speedtest.net - Q4/2010 (346.079 Measurements, Germany)

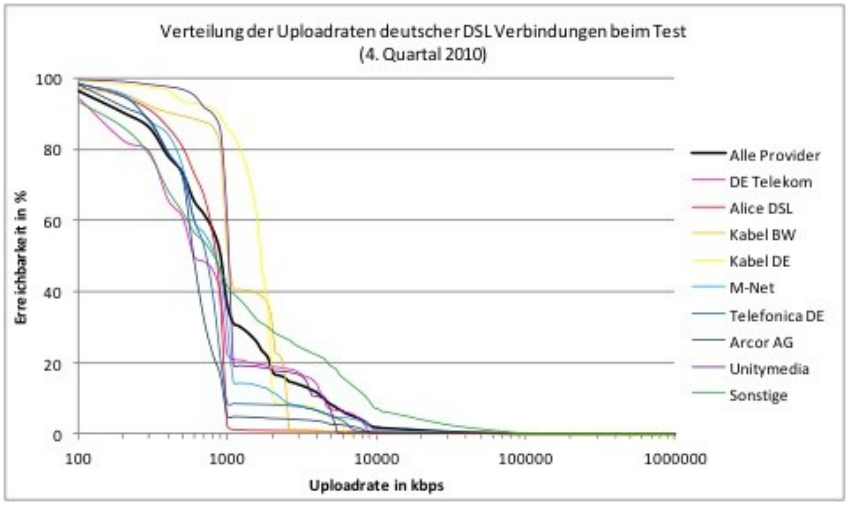

Figure 11: Ookla/Speedtest.net - Q4/2010 (346.079 Measurements, Germany)

Figure 8 and Figure 9 show the distribution of download and upload datarates respectively, for broadband connections of German ISPs (speedtest.net, Q4 2010). Additionally, Figure 8 shows the accessibility to the respective ARD media formats used for AV streams (shown are Web M, Web L, Web XL).

4.1.2 Internet Distribution in Slovenia

In Slovenia there is 2.046.976 inhabitants, around 1.290.000 people have access to the internet (63% of population). The following data are for December 2009 from an IDATE research:

DSL coverage (% population)	92%
DSL penetration (% population)	14%
Cable modem coverage (% population)	54%
Cable modem penetration (% population)	5,2%
FTTx subscribers	68.442
PLC subscribers	0
WLL subscribers	3.279
Satellite subscribers	16
Total	467.724
Total fixed broadband penetration (% population)	22,8%
Mobile broadband subscribers	577.392
Mobile broadband penetration (% population)	28,3%

Table 2: Slovenian Internet coverage 2009, source: IDATE Dec 2010

DSL: Connection speeds are low (512 kbps-1Mbps) with most subscriptions (65%). There is 23,5% DSL connections with download speed over 2 Mbps. DSL remains the most popular fixed broadband access mode, but number of cable modem and FTTx subscribers is growing fast.

Cable: Cable modem access has very low % of actual subscribers. The majority of users have download speeds from 1 to 2 Mbps (45%) and 34% with over 2 Mbps. On national level cable subscribers enjoyed higher download speeds than DSL users.

FTTx: On national level 31% of population could be provided with FTTH (Fiber-to-the-Home) access. Vast majority of users (86%) were subscribed to download speed from 8 to 30 Mbps.

Mobile: 3G/3G+ penetration was 77% of the population. Penetration is higher in suburban and rural areas as a compensation for less deployed fixed broadband access networks in these areas.

It is interesting, that 96% of internet users watch some kind of video content on internet (Source Iprom, Valicon 2010).

99,9% of population is covered by DVB-T. TV market is dominated by cable TV (52% market share), followed by IP TV (41%), satellite TV (5%), MDDS (1,6%) (source APEK).

4.1.2.1 Slovenian P2P-based Internet Distribution Systems

There are many broadcasters in Slovenia and almost all of them offer some kind of service on Internet. The table bellow shows what kind of services there are. Local broadcasters are not included (they cover very small areas, have very small reach and they don't offer advanced web services).

The only broadcaster, which uses P2P technology, is public broadcaster RTV Slovenija. They use Octoshape's solution and still plan to use it although there or some considerations about another distribution solutions (not P2P). Among other broadcasters the most relevant is Pro

plus (having among the others two TV channels with highest ratings in the country) which doesn't use P2P technology and doesn't plan to use it. Others are much smaller and don't invest much effort and money into distribution over Internet and some use others infrastructure, technology and services. It is worth mentioning the largest telecommunication operator, which offers IPTV and some video on demand and it is becoming more and more important even regarding content.

Company	Channels	Reach	VOD	Live Streaming	Uses P2P	Plan to use P2P
RTV Slovenija (public broadcaster)	TV Slovenija 1,2,3 TV MB, TV KP	All country	Yes	Yes	Yes	Yes
Pro plus (commercial broadcaster)	POP TV, A Kanal, Pop brio, etc.	All country	Yes	Yes	No	No
Viasat (commercial broadcaster)	TV 3	All country	Yes	No	No	No
Telekom Slovenije (telecommunication operator)	IPTV	IPTV subscribers	Yes	Yes	No	No
Tele 59, etc. (commercial broadcaster)	RTS	Cable operators, DVB-T east	Yes	No	No	No
IKO Media pro	Šport klub, Šport klub+, Golf klub	Cable operators	Yes	No	No	No

Table 3: Broadcasters Slovenia and their Use of Online Distribution Methods

4.1.2.2 RTV Experience with P2P

The development of the networks, small market, strong position of national telecom operator and very few content providers with a lot of content and users are main reasons, that there is no demand for P2P technology. Alternative Internet delivery mechanisms are therefore used by all but RTV Slovenia.

RTV Slovenia has 5 years of experiences with P2P technology. In first 2 years they were using the technology for live broadcasting of 2 TV channels and 7 radio channels, latter they added 1 more TV channel and also video on demand services. There were some considerations about alternative delivery systems, but size of the market and number of users were the key factors, which determines the cost and P2P solution was more cost effective. In addition they offer "regular" streaming but with lower quality of the picture for those, who don't want to use P2P technology or those with low bandwidth.

The only problem worth mentioning was plug in and usage of bandwidth for others – some users and some medias were complaining, but not for long and not very loud. Otherwise the system was and is stable, reliable and the quality of video is good and improving with higher bandwidth. The critical moments are picks of users. Radio on one side has very stable number

of users through the whole day but TV has regularly very low numbers of users and then very high picks (daily for news and some special events, occasionally extremely high picks for important sport events with local competitors – from just a few users to ten thousands in a minute). The system responds very well and works even better with more users. The operators must be alerted in advance for events, when high picks are expected, so they adjust the system.

4.1.3 Online TV Distribution in the Netherlands (NPO)

The Netherlands is since the start of broadband internet one of the European countries with the highest penetration of fast connection lines to the home. The Dutch public broadcast organisation NPO has the task to maximise audience reach with a multiform editorial content proposition. This resulted in a strong presence of online media offerings of the NPO with a very popular Catch-up service UitzendingGemist.nl (since 2002), 12 thematic live channels, 7 radio channels, and extra content related to broadcasted shows. It won several international prised with online initiatives, most of the consisting out of interactive formats that involve user participation for example via user generated content. All the NPO related data in this P2P-Next documentation is related to the year 2010.

The content available online of the NPO was in 2010 distributed via Silverlight and QuickTime players for personal computers, also websites were used in that year that are optimised for mobile devices and some applications were published for closed platforms. In 2010 236 million streams were started (on a population of about 16 million people) and this was a 19 percent growth compared to 2009. 40 percent of those streams were generated by 25 percent of the content, pinpointing the fact that also the distribution of on demand content is power law driven. The biggest factor of growth that year was not laptop of pc based viewing but the iPhone application of the catch-up service Uitzending Gemist (direct translation Missed Broadcast) that generated 17 million video views in that year. This amount overwhelmed the traffic generated by all the websites that are optimised for mobile devices (750.000 stream starts), showing that newly launched devices and their content distribution environments are able to change the media landscape quickly and can generate extra growth in audience that consumes video online.

The NPO tested P2P distribution via a temporal portal that was available for the public for half a year in 2010. The full report is attached as Appendix 1 in WP9. Even thought the test delivered some promising results the NPO believes at this stage CDN-technology has a higher potential with regard to overall bandwidth efficiency and control of quality of service.

The P2P test proved that the NPO can reduce the necessary bandwidth it needs to upload their content to the internet. But in fact the costs of uploading content have been reduced already in the last years due to an uptake of private peering contracts with ISP's. They both benefit from a direct line, because they do not have to rent bandwidth at the Amsterdam Internet Exchange. Internet as a whole benefits because the chance of congestion at the AMS-IX is reduced when traffic is let around centrally located hub. At the same time P2P generates upload traffic in the ISP network increasing the chance on congestion within their premises (see paragraph 4.2.1.4).

The online content video distribution market seems to move to al layering of CDN's that interconnect. The broadcaster will in that model push the most popular content direct and at the same time into the CDN's of different (global) CDN companies. Telco's and ISP are expected to implement CDN's also and content providers will interface or directly or via a third party CDN with those providers. The CDN can be used to manage traffic without being disruptive for net neutrality principles but by optimising data flows without discriminating other data traffic in that network. When the popular content is pushed deep into the network there is only the last part of the distribution chain (including the last mile) that can disrupt the video experience of the audience.

Another disadvantage the NPO experienced with the P2P technology they used in the test is that they would have to support yet another distribution platform with another player and the audience had to install special software on their devices. This is a counter movement to what is realistic at this moment in time. Broadcasters are working on reduction of costs by optimising distribution via interoperable services. The audience is used to access environments and just push the play button. Problems that perhaps will disappear with the NextShare technology that operates on a lower level and therefore will not function as a separate application layer. At the same time the iPhone results show that people are open to install (user friendly) applications. The software used in the NPO test was not user friendly enough according to the input of the users. One important note here is that Apple is weary of P2P technology because they want to control the content via iTunes (http://www.ip-sharing.com/apple-rejects-pp-app-799.html). Besides the fact if this is true or not we have to take into account it is possible for closed platforms to deny the use of P2P technology.

The 2010 P2P test indicated that the a potential successful On-Demand scenario for P2P is to push the most popular video to (mobile) devices of end users at low internet peak traffic hours. 30 percent of the audience in the test used the P2P player to cache content on their laptop to watch it when they did not have a (fast) connection. For example while travelling. There were also reports of expats in areas that did not have fast internet at all. They could not watch normal streaming video in good quality and would use the player to download high quality video over night and watch it whenever it was available on their laptop. Combined with the fact that about 60 percent of the on demand content consists of episodes from series that people are following, P2P could just be a very good method to reduce data traffic during rush hours of internet and tank devices as a self regulated distribution during the night with content. At this moment the NPO has no plans to investigate this scenario further.

4.2 Comparison between P2P and CDN from ISP point of View

In the last few years online video content assumed the position of the top content in the Internet, both in terms of end user usage and total traffic consumed. This rise of online video is considered lightning fast even in the fast pace development of the Internet. This pace is going to get even faster in the next few years, when more and more video content is going to get accessible over the Internet.

While major changes took place in the online world (see also chapter 2 Marketwatch), little has been changed in the network operators and Internet service providers' business models, and they find themselves required to hold most of the burden, without getting a fair share of the revenue (at least from their point of view).

Although network operators are considered as transport providers only, their effect on the methods and usage of the Internet is considerable (even if it may come into effect in as negative force – such as it may happen in some case for P2P).

4.2.1 Solutions

There are several options that the network operators and internet service providers' may choose to implement within its network in order to work within the changing online environment. In the next section we will try to review several of these options. It is important to note that most of these methods are not contradicting in nature, and may even complement each other, if implemented correctly.

4.2.1.1 More Bandwidth

The most simple and straight forward path is just to install more bandwidth. However, as the backbone of the internet currently seems to be in a relatively good state (37% peak traffic on the 20 highest capacity U.S. routes, implying sufficient growth capacity in the near future[25]), this option is highly expensive and cannot compensate for future traffic demand (Traffic growth CAGR is estimated at 78%, while bandwidth capacity growth CAGR is estimated at 40%).

The capacity growth is even more problematic in the metro and access network, where the physical barrier and the spread of the population require a higher investment rate.

4.2.1.2 DPI, Traffic Shaping and Capping

As network providers seek a cost-effective means to monetize their network the options of DPI (Deep Packet Inspection) with the additional capability to control their subscriber traffic seems as choices that are more and more implemented by the network providers, despite these options bad reputation and the controversy around them.

Amount these methods we can find:

- Intentionally slowing peer-to-peer (P2P) or other types of network traffic[26].
- Bandwidth capping – limiting the amount of data a single user can transfer

[25] Broadband in America 2nd Edition, May 2011

[26] FCC looking into Comcast / Netflix blocking threat, http://www.engadget.com/2010/11/30/fcc-looking-into-comcast-netflix-blocking-threat-level-3-resp

- Bandwidth throttling – Slowing subscriber traffic intentionally after reaching a certain threshold

However, as this option can be implemented on “off-line” types of application, such as P2P download, since the subscriber is not directly perceiving the influence of this methods. “on-line” application as video streaming are more susceptible to this option, and the user will immediately perceive a deteriorated QoE when used. This significantly limits the ability of the network provider to selectively use this option for video traffic.

4.2.1.3 Transparent Caching

Transparent caching (TC) requires service providers to locate storage caches at the edge of their network to store and serve Internet content. These caches should be "transparent," i.e., they should require no change in behavior from users or from the website distributing the content. The user simply requests the content from the website and then receives it as usual, unaware that it is actually being delivered from the local cache.

Transparent caching has several benefits to the network provider:

- Relieve Network congestion
- Reduce Transit and other Traffic costs
- Improve subscribers QoE

4.2.1.4 Content Delivery Networks (CDN)

In its basic form a Content Delivery Network (CDN) is a group of servers located in various location within the network. These server cache content from Content Providers, and delivers it efficiently to the end users. Due to the CDN servers high capacity and their strategic locations within the internet, content delivery can be significantly accelerated.

Operators CDN

While transparent caching addresses the cost implication network delivery, network operators are starting to look into revenue side of content delivery. Since Content Providers currently pays for the delivery of their content only to CDNs, operators are looking implementing their own CDNs. Operators CDN can be more efficient than generic commercial CDNs as they allow the operator to deeply integrate the CDN into their network, resulting in a more efficient and effective infrastructure.

However, this approach is also internally limited, since operator CDN can only deliver content effectively into the network operator’s network. This is a major limitation especially when compared to global CDNs. e.g. Akamai the largest global CDN, is currently deploying more than 100,000 servers in 72 countries.

One way of dealing with this limitation is by building a network of operator CDN that will provide the coverage that a single operator lack. This approach called CDN Federation is currently in its infancy, and there are no known commercial implementation of it.

Licensed CDN

Licensed or Managed CDN is another way of the network operator to implements a globally reaching CDN with their own network. In this approach the network operator is granting a commercial CDN the ability to deploy its CDN service within the network, under a certain commercial agreement between them (e.g. revenue sharing scheme). Although the CDN service is still fully operated by the commercial CDN, it is now can be deployed deeper within the networks and reducing network congestion and providing better end user QoE.

Advantages of CDN delivery compared with P2P

P2P is most efficient in total distributed networks were all hubs are directly interconnected. When this is not the case (as it is in most European countries) the upload factor op P2P can cause congestion because it generates more traffic. The data traffic from one P2P client to the other will have to travel via main hubs to another client. This is not the case with CDN technology because the content is cached further into the network without the need of uploading via connected hubs. For example when someone is using P2P in the Netherlands in a rural city all the traffic will travel via the main Internet Exchange in Amsterdam.

Most networks are a-synchronous which means they have less upload capacity compared to the download bandwidth. On average traditional internet networks in Europe have an a-synchronous factor 1:10, meaning if there is 10 Mbps download bandwidth there is only 1 Mbps upload available. This does not apply for glass fibre networks. Instead of CDN technology P2P uses uploads and a-synchronous networks get more easily overloaded. When the upload capacity is filled up (congestion) packages from end user applications that travel to the serves get lost.

Another argument worth mentioning is the potential lower overhead traffic generated by unicast CDN's that with P2P. This is mostly relevant with live streams. UDP generates about 5% overhead with live streams which for example makes it possible to deliver with 10 Gbps capacity 9500 concurrent views. HTTP streaming creates 10% overhead in the calculation example makes it possible to deliver only 9000 viewers. P2P overhead fluctuates and is dependent on both overhead communication between the peers and the parity traffic that is needed to ensure a fluent stream. In order to make sure that the stream is not interrupted due to peers that get disconnected a reserve set of peers are introduced. The traffic of those extra peers are direct overhead. If for example for the 10 peers you need for a live stream a loss is calculated of 3 extra peers the overhead of those peers only is 30%. Together with a minimal overhead of any application communication of 5% this will lead in this model to 35% overhead making the effectiveness of our calculation example only 6500 concurrent viewers.

P2P makes sure that a content provider ingesting video into the network will need less bandwidth doing so. At the same time the ISP's can be confronted with more traffic in their network and congestion on connection points with other networks when this traffic is not regulated. This opens a business case for to combine CDN with P2P technology as described in the following section of this chapter.

4.2.1.5 P2P Based Content Delivery

P2P Based content delivery, currently mainly used for file sharing, can be also used by content providers or CDN solutions. This allow the content provider or the CDN to reduce their costs, by using end users and networks resources. There are several CDNs offering that uses P2P delivery of video content including even the major commercial CDNs. ISPs are usually not favorable of these offering, as they see them as unfair resource hogging, and they may implement the same interference techniques as used for regular P2P.

P2P is also perceived as not reliable enough with reference to the QoE it may provide.

ALTO approach to P2P

However, there are several propositions that allow the ISP to participate within the P2P use case and benefit both the ISP, the content providers and the end users.

The most mature proposition is the ALTO protocol from the IETF (http://datatracker.ietf.org/wg/alto/). The ALTO protocol aims at allowing P2P and other applications to benefit from topology information-sharing, usually provided by network providers. This information-sharing enables the application to perform better-than-random peer selection, benefiting both the peers and the network providers.

4.2.2 Comparison Matrix

	Capacity Enhancements	Traffic Shaping	Transparent Caching	Operators CDN	Managed Operator CDN	P2P	ALTO + P2P
CAPEX Costs	Smann ISP – None Large ISP – very high	Medium	Low	Medium	Low	Low	Low
OPEX Costs	Small ISP – High (~$10-50K per Gbps of transit connectivity per month) Large ISP – Low, revenue generator for Tier-1 ISPs	Low	Low	Revenue generator	Revenue generator	None	Low
Network Provider Control	Full Control	Full Control	Medium	Full Control	Almost no control	Almost no control	Medium Control
Influence on QoE	Better QoE	Reduce QoE	Better QoE	Medium improve	Medium improve	Reduce QoE	Medium improve
Network Integration	High level of integration	Medium level of integration	Medium level of integration	Medium level of integration	Low level of integration	No integration	Low level of integration
Complexity	High	High	Low				
End User perception	Favourable	Bad	N/A	N/A	N/A	Favourable	Favourable

Table 4: Comparison Matrix P2P and CDN from IPS point of View

4.3 Adaptive Streaming and related Tests

The websites of all major German broadcasters contain, amongst other things, CatchUp Services (accessible by PC, hybrid TV and partly by smartphones) that currently are made available for free as download or streaming using unicast delivery over the open Internet. To adjust to changes within the transmission chain regarding the available transfer rates, at the same time allowing an un-interrupted streaming performance, new adaptive streaming solutions are being considered as an option by German broadcasters. As primary delivery mechanism to any iOS-devices, most German broadcasters which offer VoD-services to the Apple platform, already make use of Apple HTTP Live Streaming (HLS) via HTML5-Webpages or dedicated apps. Some others are introducing Adobe Dynamic Streaming for the delivery of videos to PC-browsers based on the Flash-Player-Plugin. Furthermore the latest generation HbbTV Version 1.5 (April 2012) includes Adaptive Streaming complying to the MPEG-DASH Standard, following the "ISO base media file format life profile" (ISOBMFF), see below. To evaluate the practical benefits and the performance of implementations of Adaptive Streaming currently available on the Web, IRT conducted several test series from mid-2010 till early 2011.

The test material was prepared to match the resolutions and data rates of the seven coding profiles of the coding guidelines called "ARD AV Standard" for online delivery of TV and radio content, which had been agreed upon by the broadcasting corporations forming the association of public-service broadcasters in Germany ("Arbeitsgemeinschaft der Landesrundfunkanstalten, ARD"). ARD applies a limited set of coding profiles to support different predefined AV-formats and qualities for customers having Internet connections with different last mile data transfer rates (ranging from "Web S" for mobile connections to "Web XL" for HDTV quality, see section 4.3.2 of the corresponding paper "IRT Adaptive-Streaming-Tests 2011"[27]). This harmonized approach was found necessary, when all German public broadcasters started to provide their content to the overall ARD Mediathek CatchUp service in order to avoid an inconsistent user experience, when he or she switches from a stream of "broadcaster A" to "broadcaster B". In order to support the institutions and their associated technical partners in realizing the coding guidelines, IRT provides a constantly updated Technical Recommendation (TR) which describes the proposed technical implementation. The TR is available not only for public broadcasters but also for external partners.

Under test were the following HTTP-based adaptive streaming (ADS) solutions: Adobe HTTP Dynamic Streaming, Microsoft Smooth Streaming and Apple HTTP Live Streaming. Also tested were the Codeshop Unified Streaming Platform, a video player from Netview Technologies and a non-adaptive progressive download solution from iTV-solutions known from the VoD-Service Cloud Movies in a Technisat set top box. The practical applicability of all adaptive streaming systems under test in CatchUp services was evaluated in a laboratory setup at IRT with a typical VoD-scenario as required for the ARD Mediathek. Aside from VoD, all Systems except iTV would be able to support Live Streaming as well. The current

[27] „IRT Adaptive-Streaming-Tests 2011", Schmalohr et. al., Technischer Bericht B206/2012, Institut für Rundfunktechnik, January 2012. (downloadable from http://www.irt.de/de/publikationen/technische-berichte.html, German only)

solutions do not distinguish explicitly between the VoD and Live use case, although they could benefit from player-specific optimizations with respect to each scenario. The switching performance of the tested ADS-solutions was examined with respect to audio bit-rate, video format, media bit-rate and video frame rate. Also the delay between a user selection and start of play back (Time To Play, TTP) was determined. Furthermore, the switching performance of all ADS clients at changing transfer rates in a variable "channel profile", applying to two scenarios "mobile" and "home" was measured over time. Some observations, relevant to the P2P case, are given below. The complete results can be taken from "IRT Adaptive-Streaming-Tests 2011"[28].

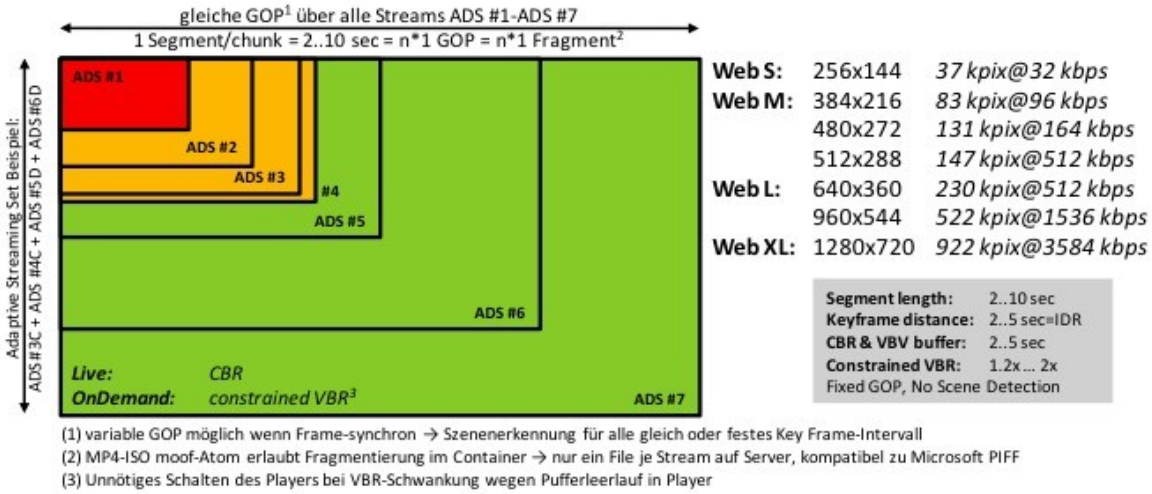

Figure 12: Multiformat-Encoding for Adaptive Streaming Sets (ARD)

(Interoperable Encoding profiles to work with Adaptive Streaming Systems as well as Stand Alone should also work with)

The switching-behavior of an ADS-client is crucial to the perceived quality at the end-users' device. If switching events occur too often, the quality of experience is unreliable. If switching does not follow backdrops of the channel adequately, a gap-less decoding of the stream will not be guaranteed. The result of the tests was, that subjective quality was best with Windows Smooth Streaming, switching fast enough but not too often and reaching the best available quality at least for some period of time. In contrast, Adobe Dynamic Streaming did switching much too often and even worse, it switched from max. to min. quality (Web XS to Web XL) what gave an annoying subjective quality over some time of the player session. Apple HLS did not perform well, as switching was too conservative. It switched infrequently but did neither reach the best quality (HD: Web XL) nor the medium quality format (SD: Web L). Thus, the experience was stable but improper to the given channel performance.

In general only at very low data transfer rates (56kbps) a large TTP (higher than 20 sec.) occurred. At higher data rates the TTP generally decreases: Apple HTTP Dynamic Streaming, Codeshop USP and the Netview player showed a TTP of 3-5 sec at 260kbps and of around 2 sec at data rates over 1Mbps. These solutions start playing a low-quality stream first, and then slowly switch to a higher quality stream. In general, all software solutions achieved a TTP of

[28] See Footnote 16

(well) below 10 sec at data rates of 260kpbs and higher. Also seek (fast forward) response times were measured (Time To Seek, TTS): almost all systems (at data rates of 260kpbs and higher) showed TTS values in the range of 1-3 sec, which is acceptable/good.

In comparison with the iTV solution and the typical progressive download (PSF) like YouTube, the ADS-Systems showed overall comparable playback-delay (TTP), while an ADS player usually started with lower quality and gradually switched up to higher ones during playback. In contrast, a PSF player starts with one fixed stream-quality while the delay depends on the relation between the media rate and the currently available channel rate. Although a good ADS player might be able to maintain constant playback and bridge channel drawbacks as long as the server provides a bitrate-suitable stream, a PSF player generally could buffer up to the whole piece of content in its session-persistent memory and thus is able to maintain one and the same quality over all time, if the channel rate does not drop steadily below the mean media bit-rate

Regardless of the adaptivity of a media transport solution, and of the use case (Live or On Demand), the findings above apply to both ADS, PSF as well as P2P (see section 5.1, IRT NextShare Tests). Irrespective of the technical features, any P2P system faces the issues regarding the competition between channel performance, perceived quality and client hardware limitations, while the perception at the end user's side includes AV-Sync, Playback-Delay (TTP), Navigation-Delay (TTS) in balance with the intrinsic AV quality, relying on the coding efficiency of the encoders implementation. For P2P solutions that would offer adaptation of the AV quality with respect to the available data transfer capacity/resources the IRT Adaptive-Streaming-Tests 2011[29] describes the dynamic behavior of current ADS solutions, which may be used as a reference point.

4.3.1 Optimisations to non-P2P solutions

4.3.1.1 CDN Networks

Conviva offers a tool, with which the transmission of live events via the Internet can be managed[30]. To this end, this tool, "*Event Control Live*^{SM}", combines two additional tools: "*Precision Video*^{SM}" and "*Insights*^{SM}". To realize optimal conditions for each live stream, not only every single request for a video stream is monitored, but in case of traffic bottlenecks, the tools can intervene in the transmission. An improvement of the conditions for streaming can be realized by reducing the streaming quality (bit-rate) or, in case multiple CDNs are at the service provider's disposal, by changing between CDNs. To do so, Conviva monitors the statistics of the geographical working load of the individual CDNs and uses these to decide if a change towards another CDN would be worthwhile for the respective end user. The tool "*Insights*^{SM}" in addition offers comprehensive monitoring; at each point in time it can

[29] „IRT Adaptive-Streaming-Tests 2011", Schmalohr et. al., Technischer Bericht B206/2012, Institut für Rundfunktechnik, January 2012. (downloadable from http://www.irt.de/de/publikationen/technische-berichte.html, German only)

[30] http://www.conviva.com

determine how many end users access each video stream and collect and graphically present information on e.g. start-up errors, buffering time, average data rates and time to play.

Figure 13: Screencapture from Conviva's InsightsSM

The Conviva system is HTML-5 capable and can also be used together with a OSMF (Open Source Media Framework) player, to which end an OSMF- as well as an HTML-5 API is made available. Both can be integrated to focus on specific aspects, depending on customer's requirements.

The result enables producers / service providers to maximize the performance and minimize the cost of their large-scale, live-streamed video events. The majority of Conviva's revenue does not come from live streaming, but rather from video on demand content[31].

[31] Video Optimization Company Conviva Raises $15M: Is There Enough Of A Market For These Services?, Dan Rayburn, 6th February 2012, blog.streamingmedia.com

4.3.1.2 Automatic IP Multicast Tunneling

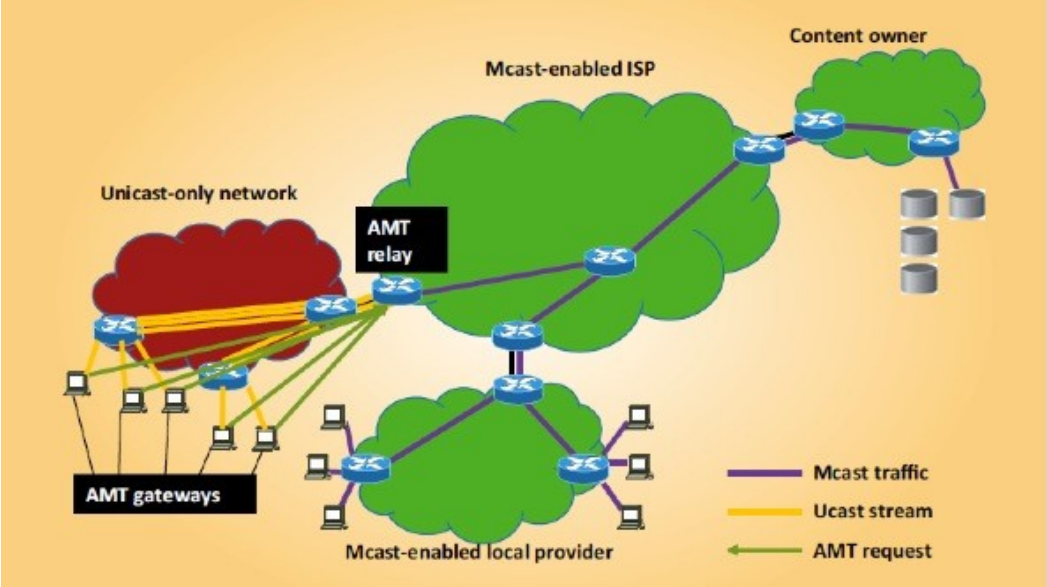

Figure 14: Multicast-enabled ISP providing AMT relay service, source: ATM – Automatic IP Multicast without explicit Tunnels, EBU Technical Review Q4

Native end to end delivery of AV streaming services over the Internet for a long time has been limited to unicast due to the lack of multicast enabled infrastructure, specifically at the network's edge / customer's last mile connection. The Automatic IP Multicast Tunneling (AMT) technology offers a solution to overcome the last mile gap for multicast delivery. As using multicast technology for AV streaming services would mean a significant cost reduction for content providers such as broadcasters, the deployment and economics methodology should be revisited by them to address this opportunity.

AMT uses UDP encapsulation to provide different source UDP ports for the encapsulated traffic, allowing transit routers to perform flow-based load balancing for more efficient link utilization. This has benefits for broadcasters and content owners, enabling access to an infrastructure with minimal bandwidth requirements per stream and affording an opportunity to further improve the quality of the streams that are delivered[32]. AMT is specified in an IETF Internet draft which is currently under development[33].

[32] ATM – Automatic IP Multicast without explicit Tunnels, Thomas Kernen and Steve Simlo, Cisco Systems, EBU Technical Review Q4 2010, http://tech.ebu.ch/docs/techreview/trev_2010-Q4_AMT_Kernen_Simlo.pdf

[33] Automatic Multicast Tunneling draft-ietf-mboned-auto-multicast-12, IETF Internet Draft, February 2012, http://tools.ietf.org/html/draft-ietf-mboned-auto-multicast-12

5 Refinement of Requirements for P2P-Next

5.1 P2P Systems in the Light of the Latest Media Platform Developments

In general, the developments of current media platforms include the decrease of PC usage while mobile usage via smart phones and tablet PCs are growing. At the same time adaptive bitrates getting even more dynamic while online streaming and thus bandwidths are getting cheaper.
Further aspects in this area are already covered with the market watch of chapter 2 and in the CAPEX and OPEX analyses of chapter 3 (Annex 2).

5.1.1 NextShare additional components in broadcast services

In addition to a single video and a single audio stream, broadcast services usually contain additional service components. During the first technical NextShare tests at IRT also the transparent carriage of such additional components in broadcast services was verified[34]. An MPEG-2 TS containing a full DVB-S service was injected into NextShare, using IRTs laboratory IP network for testing to prevent network capacity issues to cause problems[35].

Generally it was observed, that the MPEG-2 TS was transmitted transparently via the NextShare platform. As long as the player is able to access any transport stream component, it can decode and display/render any data that is contained in the MPEG-2 TS in addition to audio and video. Specifically, following observations were made regarding the functionality on the player's side[36]:

- *Teletext*: the DVB-TS was decoded correctly and the Teletext could be presented as video overlay, see Figure 13.
- *Subtitles* via 1) Teletext and 2) as DVB Subtitles: both types of subtitles could be decoded and correctly presented as video overlay, see Figure 14.
- *Additional audio tracks* (e.g. stereo sound, surround sound audio, audio description (for visually impaired consumers), additional languages): the additional tracks of a typical broadcast service (ZDF) could be played back.

[34] „Aufbau und Test eines Peer-to-Peer-basierten Streaming-Systems (P2P) zur Analyse der Skalierbarkeit, Leistungsfähigkeit, Stabilität und Interoperabilität zum Transport öffentlich-rechtlicher Rundfunkdienste über das offene Internet ", Dähmlow, Diplomarbeit IRT, June 2010

[35] A full single program SDTV DVB-service typically needs several (ARD/ZDF up to 9) Mbps transmission data rate

[36] For these tests on the client side a version of the SwarmPlugin was used, which was based on the full VLC-functionality at that time (2010).

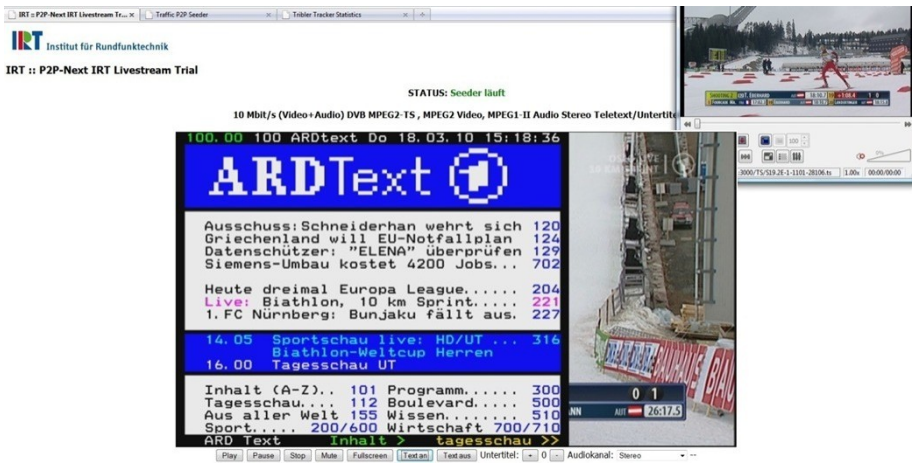

Figure 15: Teletext in NextShare plugin

Figure 16: Subtitles in NextShare Plugin

The requirements for NextShare include Access Service[37]; the IRT experiments showed that this requirement basically can be met by NextShare technology, as long as the P2P Client (NextShare PC / NextShare TV) is able to access all MPEG2- TS components.

The functionality to include and synchronize additional audio tracks with the video would be an additional requirement: As multiple audio tracks would need multiple hundreds of kpbs in additional data transfer capacity, simply including multiple tracks in the MPEG-2 TS for a P2P solution is not an optimal solution. Such additional tracks could be made available "on request", which would mean that the P2P system should be able to find and select the appropriate additional audio stream AND to synchronise it with the running video.

5.1.2 Implementation of the legal constraints for the availability of certain content

As described in more detail in chapter 7.2 (Regulatory Issues) German law specifically restricts the period of availability in relation to the online offers of public broadcasters. The

[37] Content provider requirement no. 14; D2.1.1a p.94 (see also: https://trac.P2P-Next.org/wiki/busreqs/1-014)

NextShare requirements include *DRM support*[38]; any DRM solution used therefore must be able to ensure the time-limited availability of broadcasters content within the P2P system (monitor and implement the expiry time).

Likewise, NextShare should be able to support the regulations regarding rated content and de-publishing of content ("telemedia").

5.1.3 Media coding profiles to be supported

The following figures (15 and 16) show all coding profiles currently used by the ARD German public broadcasters including media encoding, container formats and transport protocols for the different platforms HbbTV, PC and smart phones. The three colors indicate different quality levels from red „Basic", to orange „Standard" and green „Premium", applying to different performances of web connections on the last mile from POTS/Modem up to DSL 6000, for fixed as well as mobile access scenarios.

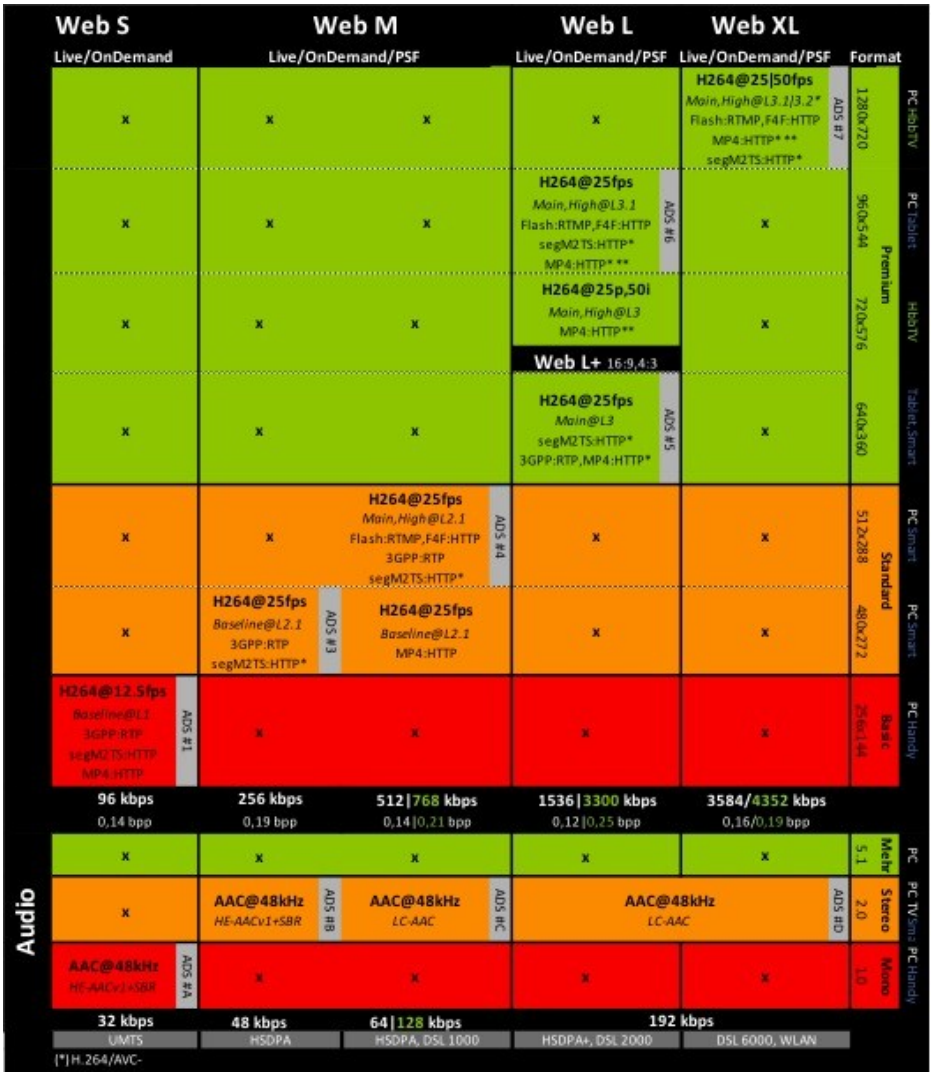

Figure 17: Media Coding Profiles for Video, ARD AV-Standard, 09.03.2012

[38] Content provider requirement no. 57; D2.1.1a p.95 (see also: https://trac.P2P-Next.org/wiki/busreqs/1-060)

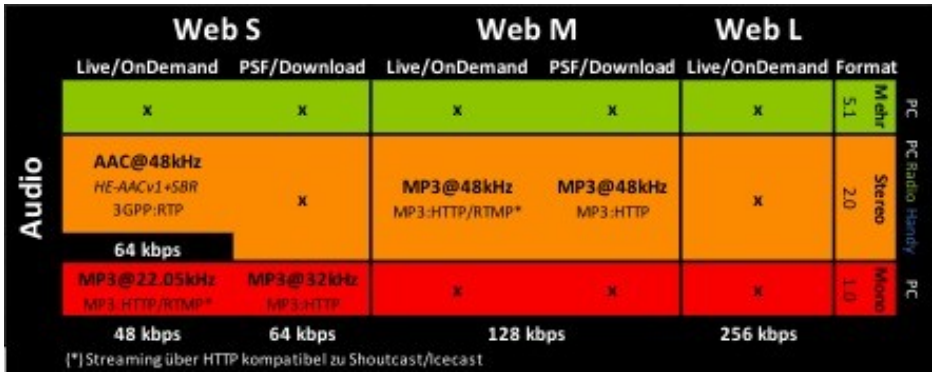

Figure 18: Media Coding Profiles for Audio, ARD AV-Standard, 09.03.2012

There is one table for audio-only content like web radio, podcast and audio streams (Figure 16) and another table for all video services like CatchUp TV, Live streaming and Video-Podcast (Figure 15). All profiles shall be usable stand alone as one stream for a specific usage - as well as being part of an adaptive streaming set to switch between various requested quality levels by the player or the end user. These demands are partly covered in a number of P2P-Next requirements including hybrid delivery, VoD, live streaming, progressive download and reduced bitrate version.[39]

Which profile is used for what specific type of usage and whether or not further restrictions have to be applied (e.g. geo-restricted access, no download of content) is decided by each single broadcaster depending on his needs and service offering.

5.2 Validation of NextShare Features with Respect to Broadcast-related Requirements

5.2.1 Preliminary tests

First technical tests on NextShare were carried out by IRT in 2010[40]. The P2P functionality was analysed with PC clients that were connected 1) in a laboratory setup (having no transfer rate bottlenecks) as well as 2) in the open Internet to verify behavior in an environment with real up- and download restrictions in the last mile. Generally the P2P functionality was found to be in order, the performance however leaving room for improvement. The test results were fed back to the NextShare developers. It was decided to repeat the tests with updated NextShare versions, and to include the NextShare TV clients as well (which were not available during these first tests).

[39] Content provider requirements no.19-22,30; D2.1.1a p.94 (https://trac.P2P-Next.org/wiki/Tasks/T211)

[40] „Aufbau und Test eines Peer-to-Peer-basierten Streaming-Systems (P2P) zur Analyse der Skalierbarkeit, Leistungsfähigkeit, Stabilität und Interoperabilität zum Transport öffentlich-rechtlicher Rundfunkdienste über das offene Internet ", Dähmlow, Diplomarbeit IRT, June 2010

5.2.2 Additional tests

In the course of 2011 the NextShare TV (NSTV) devices became available. IRT took this opportunity to carry out additional NextShare tests, focusing on the AV formats that are used for online distribution of AV content by the public broadcasters in Germany.

The test bed at IRT was operated with two PCs running a P2P-Next Client with VLC, and two NSTV set-top boxes, see Figure 17. To insert the AV signals into the test bed a local server was installed. In addition to the required tools and NextShare AV ingest software an Apache server was installed to provide the torrent and XML files, as well as a DHCP and a DNS server. The DHCP and DNS server were used to force the STBs loading content from the local server. Using this setup it was possible to create both live and on-demand streams for play back on all devices in the tests. The use of a local Ethernet network made sure that the network transfer rate could not be a limiting factor during the measurements. To measure the data transfer rates and also to simulate different bandwidth/datarate restrictions a WAN emulation server was placed between the server and the clients in the test bed. Dummynet (part of IPFIREWALL, which is used in FreeBSD) was run on this machine to restrict the traffic between server and clients in some of the tests.

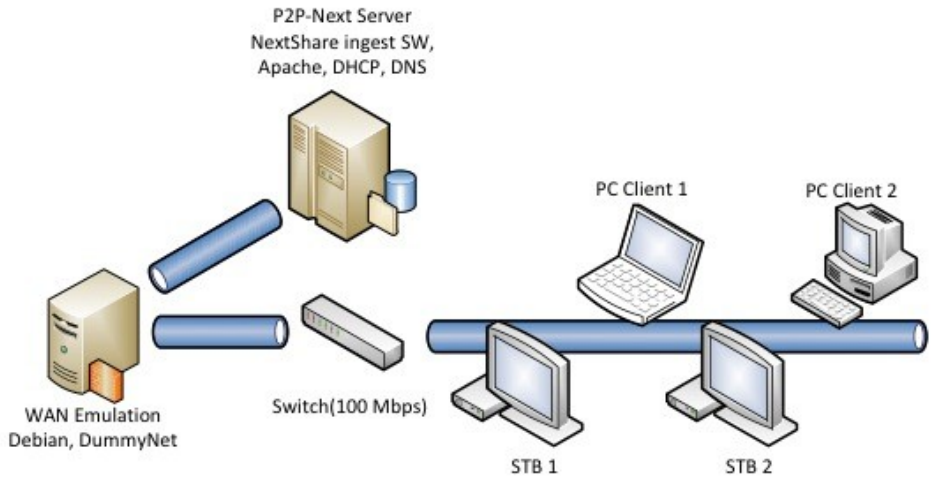

Figure 19: Schematic overview of IRT test bed

To assess the interoperability between the NextShare platform and the video profiles currently used by German public broadcasters the following common profiles were selected for IRT's tests[41]:

- Web M: 512x288, audio bitrate: 128 kbps, video bitrate: 512 kbps;
- Web L: 960x544, audio bitrate: 192 kbps, video bitrate: 1536 kbps;
- Web L+: 720x576, audio bitrate: 192 kbps, video bitrate: 1536 kbps; interlaced, tff, 16:9;
- Web XL: 1280x720, audio bitrate: 192 kbps, video bitrate: 3548 kbps.

[41] Please note that the bitrates mentioned here are target bitrates. The actual video and audio datarates may vary depending on the respective codec.

For the set-top boxes the compatible audio codec MPEG2 and H.264 video codec are specified by the manufacturer. These were also used in the test bed of the IRT.

To assess the distribution of the streams over the P2P network, all transmissions were recorded and analysed by means of Wireshark software.

5.2.3 Test Results – Start and Jump times

The *start time* was measured from the start of play ("pressing the play button") to the first time the video and audio appeared constantly[42]. For the *jump time* the player's stream was forwarded by one minute (moving the "seek indicator" ahead) and the time needed to decode and display the AV correctly was measured. *Switching times* between programs/streams (equivalent to "zapping channels") were not measured, as these would coincide with the response measured with the *start times*: the connection between server and client is the same and differs only in name resolution (DNS). While testing the response times there were no bandwidth/datarate restrictions between server and clients. The summarized results are shown in Figure 18 and Figure 19.

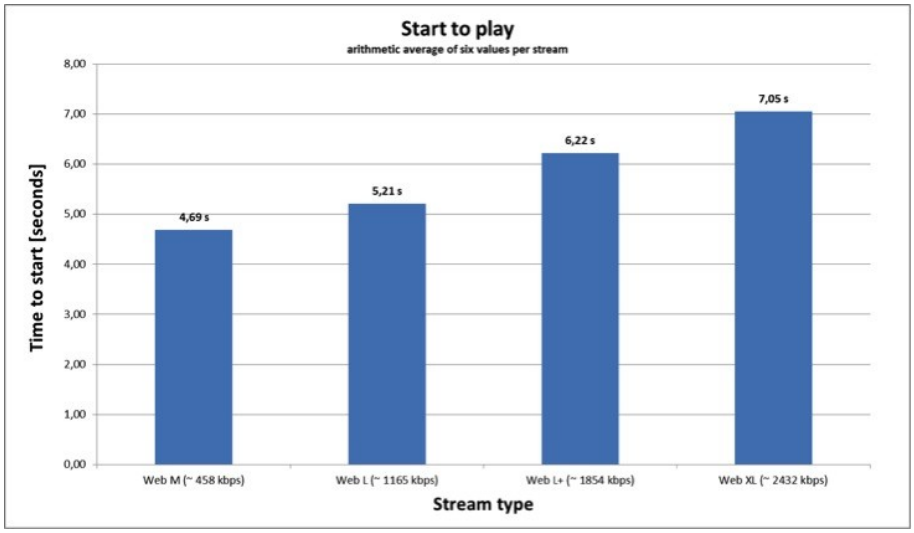

Figure 20: Start time measurements for each AV profile

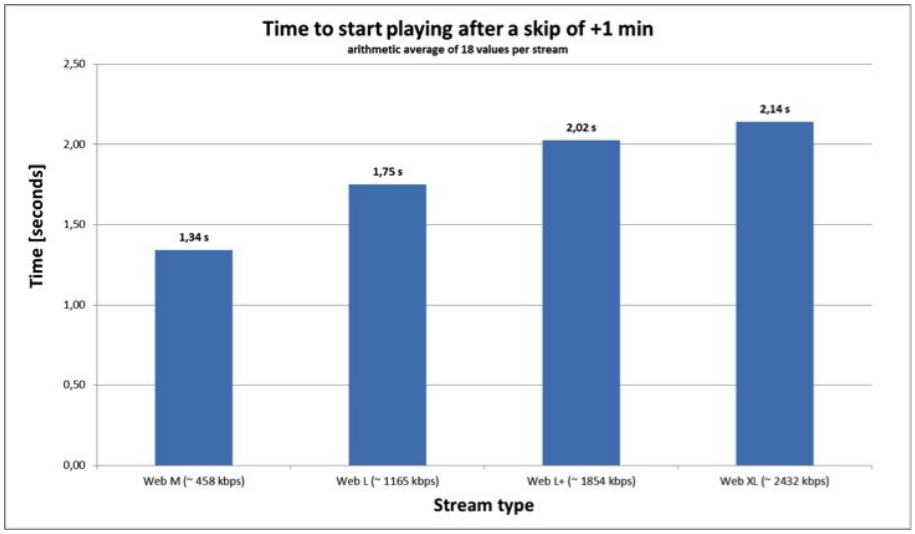

Figure 21: Jump time measurements for each AV profile

[42] This start time is equivalent to the Time To Play, TTP, as measured in the adaptive streaming tests

All four selected profiles could be played back properly. While the video data rate got increased about five times between the measurements for Web M and Web XL, the time needed to start the video only got increased by 50%. A similar observation can be made for the jump time, which indicates that start time and jump time are not dependent on the media data rate but rather depend on the underlying P2P protocol.

5.2.4 Test Results – Peering Behaviour

To gauge the peering (data exchange) between the clients, two additional test series were carried out. In all tests, a live signal was used, which was coded in the Web L profile (media rate 1165 kbps). On all four clients in each test the playback was started simultaneously.

In the first test series, the maximum number of clients that could be served by the server at the same time was limited: in the initial test this number was set to 1 and it was increased up to 4 in the final test (increment by 1 in each test, 4 tests in total). It was found that even with only 1 stream delivered from the server, the peers shared enough data to play the video relatively error-free on all client devices. Also it was found that the NextShareTV set-top boxes generally provide more data for other peers than the NextSharePC clients (see Figure 20 and Figure 21).

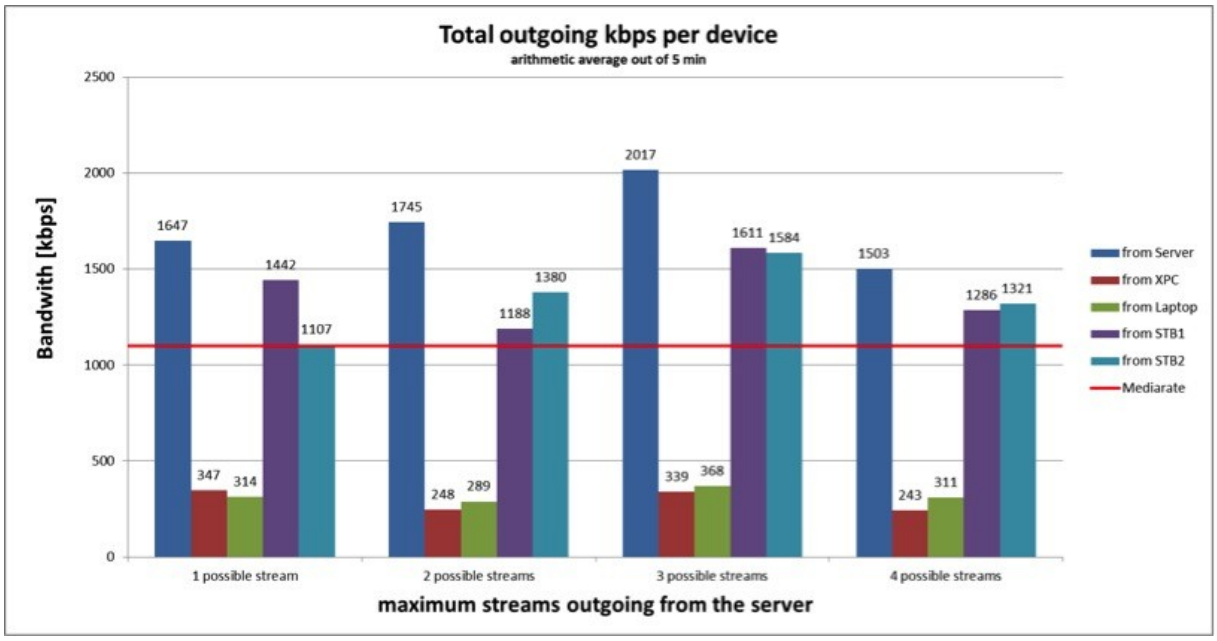

Figure 22: Peering measurements: outgoing data per peer, limited # server-based streams

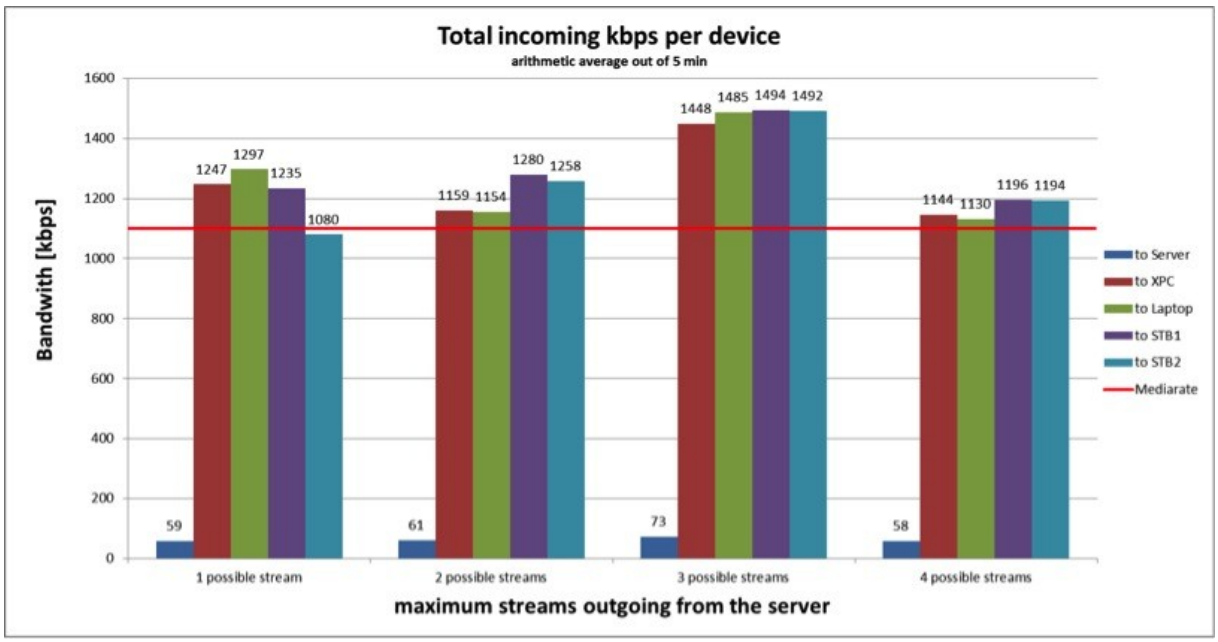

Figure 23: Peering measurements: incoming data per peer, limited # server-based streams

In the second test series the server was always allowed to send up to 4 streams simultaneously. The WAN emulation server with a dummynet installation was connected between server and clients and was used to limit the maximum possible datarate between server and the clients to a fixed value. This datarate limitation was set to about 1.6 times the mediarate in the first test and increased up to 4 times this value in the 4th test (see Figure 22 and Figure 23).

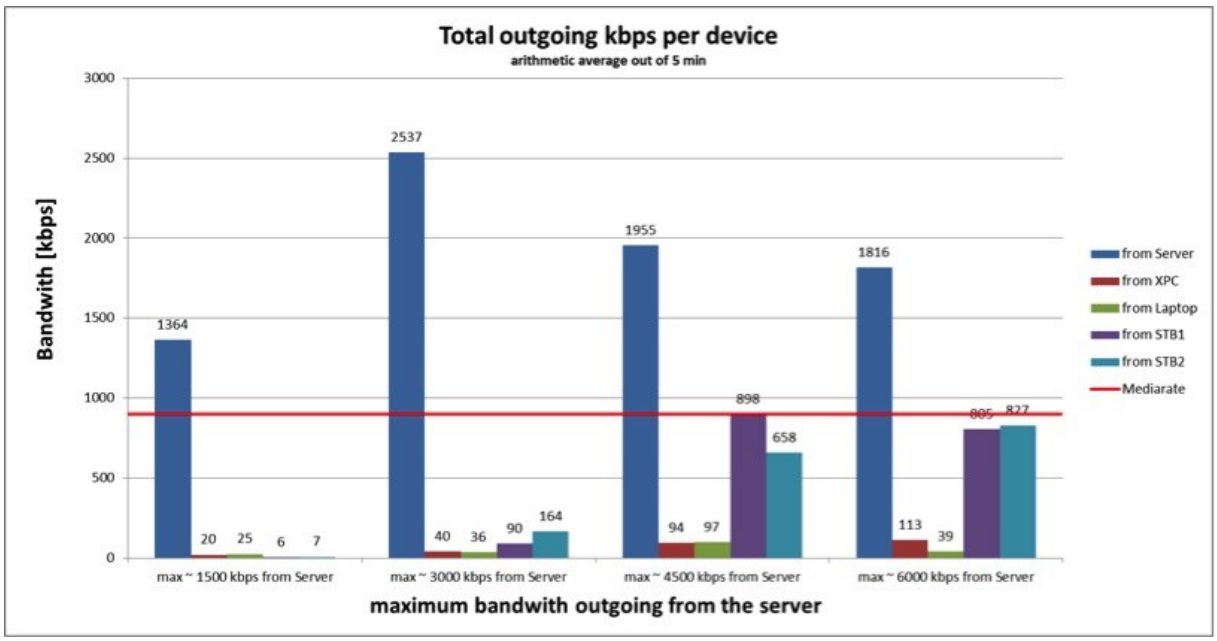

Figure 24: Peering measurements: outgoing data per peer, network limitation in datarate from server

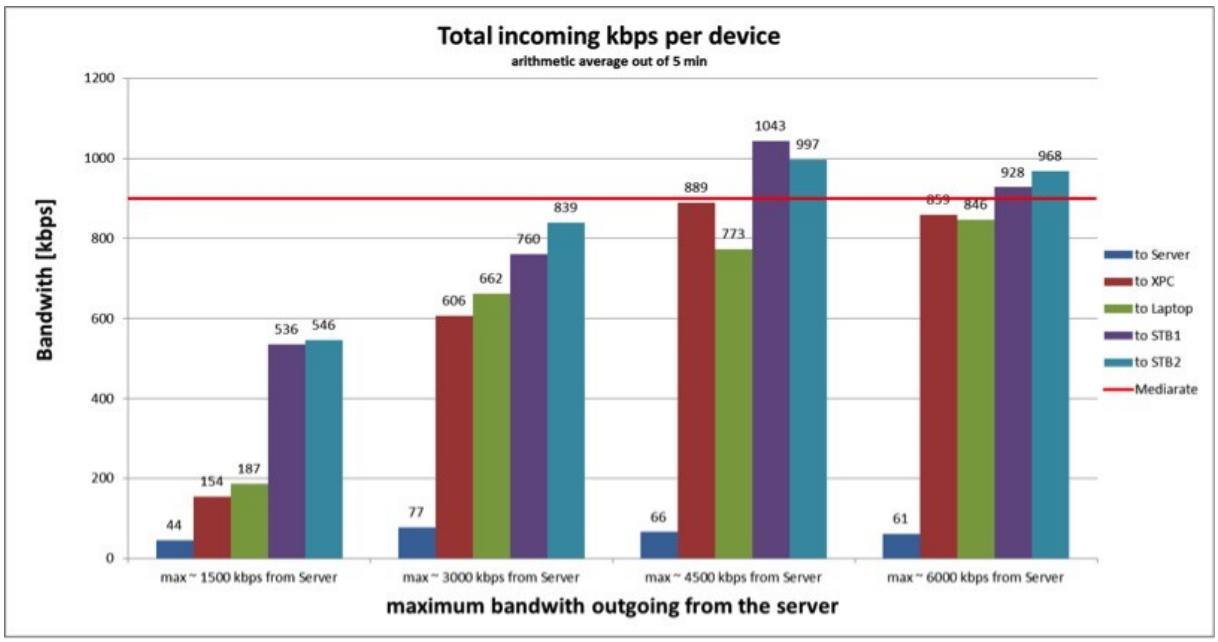

Figure 25: Peering measurements: incoming data per peer, network limitation in datarate from server

In the test run with the bandwidth limitation of about 1500 kbps (1.6 x media rate), the NextSharePC clients showed the stream after about 30 seconds of waiting. The playback, however, was accompanied with many strong interruptions up to 20 seconds. Both set-top boxes couldn't show an image within five minutes. With a bandwidth limitation of about 3000 kbps (3.2 x media rate), the set-top boxes started playing after approximately 20 seconds, the PC clients after 30 seconds. However, there always were small dropouts, too. Figure 19 shows that the peering behavior of the clients does not compensate for the lack in network throughput from the server when the latter is restricted up to 3.2 x media rate. Above the server rate restriction of 4500 kbps (~ 4.8 x media rate) no difference to an unthrottled network between server and clients was found: all devices played the streams flawlessly.

5.2.5 Test Results - offset to the live signal

During the test runs on each device the temporal offset of the playback on the respective client compared to the live signal was measured four times, see Figure 24.

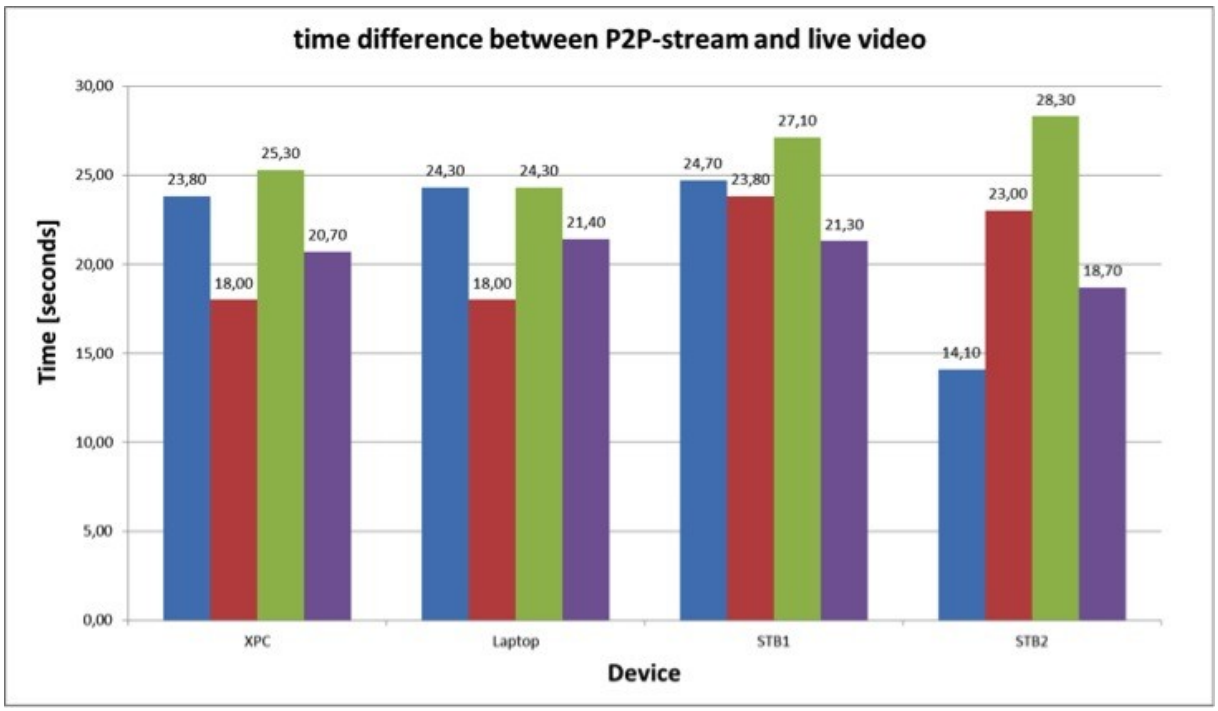

Figure 26: Time offset measurements (client playback compared to live signal)

The arithmetic mean of all measurements is 22.30 seconds. About two seconds are needed on the server for encoding.

5.2.6 Test results summary

The test results show that the NextShare P2P algorithm is working well when there are no network restrictions. The use of NextShare clients can save around 50-75% on the server output data rate. All tests were carried out within a controllable environment and a full 100Mbit Ethernet connection between the clients. A regular DSL home connection is only capable to upload with a much smaller data rate than download, so it is likely that the performance of the NextShare platform will significantly decrease when deployed in the World Wide Web. The start and switching times are slightly higher than those of adaptive streaming protocols (see chapter 4.3). The average offset of 20 seconds to the live signal is too high for a “live” TV service.

6 Business Models

An important issue to turn the outcomes of the project into marketable products was to analyse the final status of the P2P-Next services with regard to business aspects and to draft business plans for their exploitation.

The P2P-Next services include:

- An Operating Service (FairShare Media World),
- an Interactive Service represented by BBCs LIMO tool,
- a Payment Service
- and an associated Pay View + Free View Service

These are meant to be complemented by third party development arrangements and their integration into P2P-Next.

The services mentioned above were developed on the basis and with the aim to enable the 6 generic P2P-Next business models, that were developed during the project and that have been described in detail in previous 2.1.1 deliverables:

BM1 = Free content distribution

a) Give Away Models
b) Attention Grabbing Models

BM2 = Advertising supported distribution

a) Advertising Models
b) Advertising Funded Programming (AFP), incl. Sponsoring Models

BM3 = Pay-per-view distribution

a) A la Carte Models

BM4 = Subscription based Distribution

a) Flat Rate
b) Use of Large Repositories
c) Bundling
d) Premium User

BM5 = Circular Content

a) Superdistribution of Content
b) Superdistribution of Recommendations / Community Distribution
c) Long-Tail

BM6 = Licensing

a) XaaS

The key service of P2P-Next is the Operating Service which was realized in form of DACCs FairShare MediaWorld (FSMW) approach. All other services are accompanying enhancement services that can be optionally applied.

A detailed description on the final P2P-Next Service approaches can be found in the deliverables 2.5.1d and 2.5.2d.

7 Legal and Regulatory Developments

7.1 Current Issues Concerning Legislation and Regulation

With the whole process of pushing the digital agenda (regarding cross border licensing, orphan works legislation etc.) more or less in limbo, despite the many beautiful words and aspirations in different document from DG Market, all we can do is sum up the arguments for swift movement in these areas, IF all the work put into developing a pan European delivery platform for content is to be widely adopted. The potential benefits of P2P-Next will be severely limited if there is NOT movement in these areas.
The determination to act so clearly stated in the October 2010 Reflections paper seems to have withered away. We need to firmly stress the connection between legislation that simplifies cross border movement of content, and the potential value of systems that facilitate the same.

7.1.1 Regulations for Internet Traffic / Net Neutrality

In a Europe-wide data collection by BEREC (Body of European Regulators for Electronic Communications) on reported Internet traffic management practices was carried out jointly with the European Commission[43]. The picture emerging shows a very diverse range of commercial and/or technical practices being used by European operators in the different national markets.

The preliminary findings show, that many operators infringe the principles of net neutrality. The most frequently reported traffic management practices are the blocking and/or throttling of P2P traffic, on both fixed and mobile networks, and the blocking of Voice over IP (VoIP) traffic (mostly on mobile networks, usually based on specific contract terms). When blocking/throttling is implemented in the network, it is typically done through the use of controversial means such as deep packet inspection (DPI). BEREC also found a wide variety of data caps and “fair use” practices - these were not the main focus of its investigation, since (with some exceptions) in general they do not imply differentiated treatment of traffic.

BEREC is currently in the process of validating, consolidating and categorising the data, and intends to publish its findings during the second quarter of 2012. This European overview will also feed into other BEREC work streams on the subject of net neutrality.

7.2 Selected Country-by-Country Use Cases

7.2.1 Germany

[43] BEREC preliminary findings on traffic management practices in Europe show that blocking of VoIP and P2P traffic is common, other practices vary widely, Pressrelease BEREC, March 2012

The broadcast service provisioning in Germany is part of the constitutional law and is based on the basic right on freedom of information as described in the German constitution. The Interstate Treaty on Broadcasting and Telemedia – and amendments thereof – implements the respective paragraphs of the constitution and contains general provisions applying to both public-service and commercial broadcasters as well as provisions applying to public-service broadcasters only, and provisions exclusively applicable to commercial broadcasters. Public broadcasters have the obligation to ensure basic service provisioning for the whole population with the whole spectrum of TV and radio services. Starting in the 1990s the German broadcasters have continuously increased their service offering via the Internet, known as "Telemediendienste" (telemedia concepts) in Germany. Against this background of online service development and increasing media convergence, the range of the regulation has been discussed controversially by various players in the German media market. Specifically the online service offering of public broadcasters is said to compete with offers of media publishers.

The 13th amendment to the Interstate Broadcasting Treaties entered into force on the 1st of April 2010[44]. The regulation principally only allows online service offerings by German public broadcasters when these are tightly related to their program; before other online offers from public broadcasters are allowed, they must be separately verified through a committee called "Rundfunkrat" with a so-called "3-Stufen-Test" as a three step approach to explicitly allow the publication of online offers on the Internet content by content. The committee has to review:

1. to what degree the offer conforms to the democratic, social and cultural needs of society,
2. to what degree the offer contributes to editorial competition in a qualitative manner, and
3. what financial expenditure is required for the offer.

The regulation specifically restricts the period of availability in relation to the online offers. For the telemedia concepts of ARD and ZDF the following restrictions are given:

- In general, provision of services on demand for up to seven days following transmission, with following exceptions:
  - Matches of the 1st and 2nd German football divisions ("Bundesliga") for up to 24 hours after the event;
  - Major sports events (such as Olympic Games) for up to 24 hours after the event;
- Telemedia with contents relating to a specific program for up to 7 days following transmission;
- Reports, documentaries, consumer information etc. for at most one year;

[44] "Interstate Treaty on Broadcasting and Telemedia (Interstate Broadcasting Treaty) in the version of the 13th Amendment to the Interstate Broadcasting Treaties", die Medien-Anstalten ALM GbR: http://www.die-medienanstalten.de/legal-basis.html

- Unrestricted availability including contents of contemporary history and cultural history.

The availability can be additionally limited by the respective copy rights, which in many cases must be cleared separately by acclamation of the respective 3rd parties. The public broadcasters are obliged to implement the technical realization that handles the expiration of the above mentioned periods. Additionally, arrangements must be made that allow de-publishing of telemedia independently of these expiry times on demand. For the protection of minors, the German public broadcasters have the obligation to implement a time-based limitation of the access to rated content. E.g. in case a crime series is transmitted after 8pm on linear television, a CatchUp service should only "unlock" the according stream to be online after 8pm. The ARD CatchUp service ("Mediathek") implements this requirement.

7.2.2 Slovenia

Slovenia has two laws, which are in phase of important change. One is Media law and another is law about Public broadcaster. The law about PBS brought many changes, including limitations on offering services in web, but was then blocked on public referendum (from other reasons, not connected with internet). It is now impossible to do any changes in period of 12 months after referendum. But since this was intention it could be expected that sooner or later this will be enforced. The valid law predicts that PBS offer web services but it doesn't specify it, so it is very much in hands of PBS, what and how they will do. Commercial companies probably want to limit PBS.

Media law is now in parliament procedures and it is hard to predict, what will happen. But one of the intentions is to limit concentrations of media ownership. For now, web is not mentioned in details as radio and TV, but it also might happen, so we can expect some changes on that field, too. At the moment the most inflectional commercial company with 2 TV channels with highest ratings owns also the most visited web page and some more in TOP 10 most visited Slovene web pages.

7.3 Summary from the First Digital Agenda Assembly, Brussels 16-17 June, 2011

The Digital Agenda is Europe's strategy for the digital economy. It was published in May 2010 and contains 101 actions. A list of the actions and their status can be found at http://ec.europa.eu/information_society/digital-agenda/scoreboard/docs/101actionsoverviewtable.pdf.

The 101 actions are more that just something the European Commission aims to achieve on its own. The Commission wants all concerned stakeholders concerned to join in. The general idea is to create interest for a broad movement among all those concerned and thereby create a dynamic evolution to meet the challenges of the information society: copyright, broadband, privacy, security, health, research, energy efficiency etc. Head of the Digital Agenda is Commissioner Nellie Kroes and the main DG involved is DG Information Society and Media headed by Robert Madelin.

The overall aim of the Digital Agenda is "to deliver sustainable economic and social benefits from a digital single market based on fast and ultra fast internet and interoperable applications." The full text of the Digital Agenda for Europe can be found at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52010DC0245R(01):EN:NOT.

To get things started in a broader sense the Commission arranged a Stakeholder Day 24 - 26 October 2010 for stakeholders to come up with new "big ideas" to support existing actions or address important gaps in the list of 101 actions. P2P-Next participated with three ideas, which were reported in WP2 update Legal and Regulatory Environment third and fourth quarter 2010.

The Digital Agenda Assembly 16-17 June 2011 is the first assembly in a series to follow up the progress of the actions. The assembly was organised in four parts

Morning day 1: Parallel workshops

01. Open data and re-use of public sector information

02. What next for e-Identity and e-Signatures?

03. Interoperability and standards: making it happen

04. Cybersecurity: barriers and incentives

05. Financing and facilitating broadband projects

06. Partnership-based ICT research and innovation

07. Social networks, a driver for economic and political change?

08. Mainstreaming e-Learning in education and training

09. Access and digital ability: building a barrier-free digital society

10. Addressing demographic change: a socio-economic challenge and opportunity for Europe

11. Greening ICT

12. Towards smart mobility: increasing the speed of intelligent transport systems take up in Europe

Afternoon day 1: Plenary I. Digital Agenda for Europe: assessing progress

- *Neelie Kroes,* European Commission Vice-President responsible for the Digital Agenda: Digital Agenda for Europe - state of play and challenges ahead
- *Zsolt Nyitrai,* Minister of State for Infocommunications, Hungary
- Open Data Challenge and Hack4Europe! Awards
- Feedback from morning workshops
- *Piotr Kołodziejczyk,* Undersecretary of State, Deputy Minister for the Interior and Administration, Ministry of the Interior and Administration, Poland

- Results from the ICT Finance Market Place Venture Academy and Investment Forum.
- *Panel discussion*: Stimulating ICT research, investment and innovation
  - Malcolm Harbour, Member of the European Parliament
  - Markku Markkula, Committee of the Regions
  - Wim De Waele, Director of the Interdisciplinary institute for Broadband Technology, Ghent (Belgium)
- Conclusions of the day and information on the rest of the programme

Morning day 2. Parallel workshops

13. ICT and management of creative content
14. Building confidence for the digital single market
15. IPv6 deployment in Europe
16. Every European child safe online
17. Spectrum for wireless innovation in Europe
18. Towards a cloud computing strategy for Europe: Matching supply and demand
19. Future digital economy: a chance for competitive and innovative European entrepreneurs and organisations
20. Digital literacy and e-Inclusion
21. ICT for the Single Market: e-Government driving Innovation
22. Women for smart growth
23. The Digital Agenda for Europe: building an open and global marketplace
24. The Digital Agenda for local and regional development

Afternoon day 2: Plenary II Digital Agenda for Europe: the challenges ahead

- Recap on previous day, programme of the plenary
- Charlotte Sahl-Madsen, Minister for Science Technology and Innovation, Denmark
- Feedback from morning workshops
- Panel discussion: Social impact of ICT
  - Staffan Nilsson, President of the Social and Economic Committee
  - William Kennard, US Ambassador to the EU
  - Diogo Vasconcelos, Cisco
- Graham Walker, Government Director at UK Digital Champion / Race Online 2012
- Vincent Van Quickenborne, Minister of Economy Innovation and Administrative simplification, Belgium
- Robert Madelin, European Commission, Director-General for the Information Society and Media: close of the first Digital Assembly; next steps.

DACC took part in workshops 11 Greening ICT and 13 ICT and Management of Creative Content and the two Plenary sessions.

Day 1 Workshop 11 Greening ICT

The aim of the workshop was to create "consensus among industry stakeholders on the adoption of a common methodological framework for capturing the energy intensity and carbon emissions of ICT."

The general approach will be to cover the ICT industry first and then generalize the methodological framework to other industries later.

ICT has a two-edged position regarding energy efficiency and GHG (Green House Gases (CO2))

1: ICT as industry uses more and more energy

2: ICT provides solutions for other industry sectors to be more energy effective.

Particularly "the Cloud"[45] brings about more and more centers that use more and more energy. For the cloud it is difficult to judge if the energy consumption will go up or down. It may be so that the total number of computers will go down and thus less energy is needed.

JRC[46] has developed an industry wide methodological framework to measure the environmental footprint of products and organizations. There is now a need to have pilot tests of these methodologies.

Various standardization organizations have made efforts in the field and are prepared to cooperate to make a coherent and compatible set of methodologies covering energy consumption and GHG emissions for the entire ICT sector, its global operations and LCA (Life Cycle Assessment) of its products and services.

ITU-T (C. Bueti)

In short, ITU-T study group5, Environment and Climate Change[47] studies the environmental impact (energy and GHG) of

- ICT goods, networks and services
- ICT in organisations
- ICT in projects
- ICT in countries

with a life cycle assessment approach.

[45] http://en.wikipedia.org/wiki/Cloud_computing

[46] European Commission Joint Research Centre. As a service of the European Commission, the JRC functions as a reference centre of science and technology for the Union.

[47] ITU-T study group 5 is responsible for studies on methodologies for evaluating the ICT effects on climate change and publishing guidelines for using ICTs in an eco-friendly way. Under its environmental mandate this study group is also responsible for studying design methodologies to reduce environmental effects, for example recycling of ICT facilities and equipment.

The work follows the general principles in the ITU L1400 Recommendation "Overview and general principles of methodologies for assessing the environmental impact of ICT"[48] - and is in compliance with ISO 14040 "Information technology -- Open Systems Interconnection – Systems management overview"[49] and ISO 14044 "environmental management -- Life cycle assessment -- Requirements and guidelines"[50].

All ITU standards are checked regarding energy efficiency.

IEC (O.Namikawa)

IEC Technical Committee 111, Environmental standardization for electrical and electronic products and systems has developed two documents

TR 62725 Quantification methodology of green house gas emissions (CO2e) for electrical and electronic products and systems[51]

and

TR 62726 Quantification methods of green house gas emissions (CO2e) reductions for electrical and electronic products and systems for the project baseline[52]

TR 62725 and TR 62726 will be ready by December 2011 and offered to EU for pilot tests.

ETSI (B.Gorini)

Technical Committee Environmental Engineering[53] has developed

- Guidelines for improvement of energy efficiency of telecom equipment
- Guidelines for improvement of energy efficiency in telecommunication infrastructure
- Guidelines for alternative use of energy sources

The guidelines include measurement conditions (input voltage; climatic conditions) both for wireline and wireless systems and covers transport and customer premises equipment.

Use of alternative energy sources

- Infrastructure concerns such as diesel running time and use of batteries.
- Installation concerns such as power and cooling and waste

Specification for better power supply: 400V DC. The use of DC for powering ICT equipment is more energy efficient than AC when Uninterrupted Power Supply is required.

After the presentations by the ICT sector there was a session on how to link the ICT efforts and industry wide initiatives:

Carbon Trust (A. Stephens)

48 http://www.itu.int/ITU-T/workprog/wp_item.aspx?isn=7515

49 http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=24406

50 http://www.iso.org/iso/catalogue_detail?csnumber=38498

51 http://www.iec.ch/dyn/www/f?p=103:38:0::::FSP_LANG_ID,FSP_ORG_ID,FSP_PROJECT:25,1314,IEC/TR%2062725%20Ed.%201.0#

52 http://www.iec.ch/dyn/www/f?p=103:38:0::::FSP_ORG_ID,FSP_LANG_ID,FSP_PROJECT:1314,25,IEC/TR%2062726%20Ed.%201.0

53 http://portal.etsi.org/ee/ee_tor.asp

Carbon Trust does not develop standards but guidelines.

The guidelines covers Products (goods and services), Carbon (GHG) and Footprint (Measurement). Carbon Trust follows ISO 14040 and ISO 14044.

- GHG Protocol Product Accounting and Reporting Standard (drafts 2009 and 2010 and a final version autumn 2011)
- PAS 2050 (PAS 2050 has been developed by the British Standards Institute (sponsored by Defra and Carbon Trust) in conjunction with extensive consultation from industry. PAS 2050 came about in response to broad community and industry desire for a consistent method for assessing the life cycle GHG emissions of goods and services[54])
- ISO 14067 Carbon Footprint of Products
- iNEMI[55] Green Grid Green Touch (?)

ICT4EE Forum (T. Fukamoto)[56]

Link ICT to EU climate and energy policies and economic development:

- Commitment of ICT sector
- Solutions for energy efficiency
- Own energy efficiency processes
- Help ensure coordination

Working Group 1: Measuring energy efficiency of ICT processes

Scoping and framework methodology (ITU-T, IEC, ETSI, GDMA, Green Grid, Green IT standards promotions Council)

Working Group 2: Energy Efficient Solutions in other sectors. Transport, Bulidings, energy production.

By 2010 the WG expects to generalise the findings in the transport sector to buildings and energy sectors

Working Group3: Policy and Technology for the future.

This working group will develop timelines and policies for transformation e.g. behavioural change and available technologies.

EU plans to pilot methodologies (C. Maloney)

(Official launch of the pilots)

[54] http://www.bsigroup.com/en/Standards-and-Publications/How-we-can-help-you/Professional-Standards-Service/PAS-2050

[55] http://www.inemi.org

[56] http://ec.europa.eu/information_society/activities/sustainable_growth/docs/ict4ee_forum/ict4ee_forum_roadmap.pdf

- develop a robust measurement framework to capture energy consumption and GHG (Green House Gases) emissions of ICT
- assess if the ICT sector has complied and if not develop legal measures.

Roadmap:

September 2011: Compile contributions and all standards to set up a draft methodology

October 2011: start a pilot phase

Methodologies to be tested in the pilot phase:
ITU-T SGT Q18L
ETSI/LCA
GESi/Carbon Trust

December 2011: draft an IEC methodology for the quantification of GHG for electrical and electronic products and services.

Timeline:

Call for tender (Support): June 2011

Call for volunteers: September 2011

First tests: October 2011 – January 2012

Second tests: January 2012 – April 2012

High level conference: April 2012.

Discussion

There was an opportunity for the audience to pose questions to the speakers.

One important question was about how to measure energy efficiency and GHG delivered by other service providers' services:

Example 1: Power distribution for a data centre. Answer was to rely on standards.

Example 2: The cloud. Answer was that there is no knowledge today on the energy efficiency and GHG emissions for such dynamic services.

Day 1 Plenary Session

It is difficult to do full justice to the session but here are a few highlights form the speakers and the discussion.

N. Kroes made a few statements:
- ICT creates two new jobs for each job that disappears.

- It was pointed out that East countries produces products, Western countries develop content[57] while Europe consumes

[57] content is a misleading word – art is a better word (Lars-Erik Eriksson note)

- Children must be protected and one click abuse report should be available by October. And furthermore that profiles of children should be private by default.

Z. Nyitrai

Discussed a lot about radio spectrum and wanted that Poland (takes over the presidency of EU Council of Ministers) to drive the issue to free up radio spectrum for broadband services.

Awards ceremony

Awards were given to a number projects among others Open Data Challenge[58] and Europeana[59] and activities in Hack4 Europe.

Day 2 Workshop 13. ICT and management of creative content

The workshop is a report from the European Publishers Council (EPC) project "The Answer to the Machine is in the Machine." This project was selected at the Digital Agenda Stakeholder Day in October 2010 to go forward as a project under the EU Commission Digital Agenda.

The three proposals from P2P-Next to the Digital Agenda Stakeholder Day were assimilated into this project (see Concluding Remarks at the end of this paper.)

The project has two major goals[60]

1:¨to advance essential work in standardising rights expressions and automated transactions, including licensing"

2: "to demonstrate the feasibility and benefits of implementing and integrating this in order to build an open communications infrastructure to support the development of content businesses online"

The basic idea behind this is if one looks at content online there is most certain that one will find terms of use, licensing rules or something similar. These rules are readable for humans and with today's technology the rules should also be machine readable and understandable. However, having read many such "terms and conditions for use" and licensing rules they differ a lot and are not seldom lengthy, very complicated and difficult to understand since publishers may have considerably different requirements. If online content shall have a bright future, i.e. creators shall have a possibility to earn money; the rules for use must be easy to understand and communicated to the user. As we move more and more to Machine-to-Machine (M2M) communication such rules must be machine readable and understandable and the business to handle copyright must be machine-negotiated. In a broader sense this is important not only for media content but also for other types of M2M communication such as in Internet-of-Things.[61]

EPC (M. Bide)

[58] www.opendatachallenge.org

[59] www.europeana.eu

[60] http://www.epceurope.org/factsheets/the-answer-to-the-machine-is-in-the-machine-faqs.shtml

[61] http://en.wikipedia.org/wiki/Internet_of_Things

The workshop started with a presentation by M. Bide who presented the project[62] and also some demonstrations:

- The Lancet provided a long list of possibilities to have a license with many possible choices and prices.
- Similar demonstration was done for Elsevier. Elsevier had a kind of questionnaire to find the correct licensing and price. An observation here was that the questions were quite personal and that here is an issue on privacy.

To build technical demonstrations on how machine-mediated processes for handling copyright is key to the project to be able to get support for the ideas among the stakeholders. This is necessary because the way forward for the project is to examine the ground for stakeholders to accept automated rights management and organise conferences to obtain broad acceptance.

Question: The last ten years there have been at least three similar projects and they have all failed. Why will this one be successful?

There was no straight forward answer to this question.

An observation from the audience: There are no representatives from the users in the project. Generally speaking if users are not part it will probably be very difficult to gain acceptance from the users.

EMI (A. Bebawi)

Presented the Global Repertoire Database (GRD). The goal with the database is to collect and administer musical works rights and ownerships on a global scale. The database will make it easier for companies looking to distribute music over the Internet and make it easier to compensate those who created the music. Around 20 big companies are active in this work to establish GRD.

Panel 1:

The overall impression from the panel discussion was that all panellists embraced the general goal of the project but expressed concerns about transparency. How transparent will a machine-mediated rights clearance process be and how fair? Information to the consumer is key. Otherwise it will not be possible to "compete with free."

Other comments expressed concerns that standardisation of machine-mediated rights clearance may not lead to new business models. There is a need for several business models.

A question to the panel was about copyright levies on ISPs. There was a "united response" – NO. Such levies can not be the way forward. It will lead to market distortion.

Panel 2:

Only selected statements from some panellists are presented here. Other key points from the discussion can be found at the Workshop 13 official workshop report: http://ec.europa.eu/information_society/events/cf/daa11/item-display.cfm?id=5994

MEP C. Wikström:

[62] http://www.epceurope.org/factsheets/the-answer-to-the-machine-is-in-the-machine-faqs.shtml

She presented the view of harmonised European copyright for European creators and consumers. She was convinced on music licenses granted on a pan-European basis with the motivation “music shops in Sweden sell also to tourists without Swedish passports.” The European single market for goods is working – now a single market for digital content must be solved.

She shared her views on music, books and all other digital content. Why US content – why not European?

A. Cecil (Amazon):

All starts with the customer. Can I find the content? How easy? Do I want to buy, rent or…? In essence he expressed that the project (“The Answer to the Machine is in the Machine.”) should make it easy for the customer.

T. Myrup Kristensen (Microsoft):

Creators should have fair reward. The project has an excellent framework but there are issues, e.g. language barriers, orphan works, piracy.

He expressed the view that Microsoft will implement rights management on their platforms.

V. de Dorlodot (RTV):

Commercial broadcasters distribute a lot online. New DRM methods are under discussion and can slow down piracy.

Discussion:

Some short highlights from the discussion.

One comment was that when someone searches for content the first found is the illegal. This should be something for the search engines. Ms. Wikström was not in favor for this because Internet should not be censored!

Providers shall not be judges over content (illegal or not) – it is the digital culture that shall be fostered.

About how to establish trust on the net: One can not only have lawyers to handle this. (R. Madelin)

There is too much talk about enforcement – there should be much more talk about customer experiences instead. (A. Cecil)

Concluding remarks:

P2P-Next had made three proposals to the Stake holder day in October 2010. The proposals are presented below.

Together with the Global repertoire Database the project The Answer to the Machine is in the Machine seems to solve at least a few issues in the proposals.

If the project is successful it may help

- creators to get a better understanding of copyright issues in different countries (in proposal 1 below)
- creators to establish contacts and agreements with content owners (in proposal 1 below)
- to solve both proposals 2 and 3 below.

Proposal 1: Copyright helpdesk

Releasing the millions of audio/audiovisual works held in archives by broadcasters, libraries etc. would provide a major contribution to creativity & innovation in the EU. But Copyright constraints are providing ever greater hinders. Suggest that EU initially finances a Copyright Helpdesk to help creators to 1) to get a better understanding of copyright issues in different countries, 2) establish contacts and agreements with content owners, 3) get a kind of official confirmation that serious efforts have been made to find Copyright owners and show that if infringement later becomes evident the intent is not malicious, and 4) to find compromises with owners of content if an infringement has occurred and the intent is not malicious.

Proposal 2: "Simplifying start-up conditions for new digital online content service initiatives."

Numerous initiatives to provide innovative digital services with texts,sound and audio-visual content have never survived due to problems of rightsclearance. Some 80% of rights for music and film are held by a handful ofglobal conglomerates who have been very unwilling to accept most newwould-be distributors and their competition. The few exceptions have had toaccept all the demands of the major players (e.g. share of equity, largeannual down payments) having a negative effect on smaller content producerswishing to find new distribution channels. The mere risk of content owned bya major global player finding its way into a new initiative has been enoughto force many innovations to close. The digital agenda should find ways tohelp such initiatives to flourish instead of dying

Proposal 3: “Simplified copyright clearance mechanisms for heritage content held in archives”.

"Releasing the millions of audio/audiovisual works held in archives by broadcasters, libraries etc. would provide a major contribution to creativity & innovation in the EU. But IPR constraints are providing ever greater hinders. Uncertainties in the market regarding simple cross border licensing, no orphan rights regime and the willingness of large rights holders to use IPR to control/stop usage rather than to stimulate creativity must be addressed. A simple EU wide "making available" licence for content should be proposed as a form of compulsory license unless copyright holders can agree to a market solution by a specific date. This would

help to concentrate their minds and contribute hugely to the ability of citizens to become creators and thus boost Europe's competitive advantage."

8 Conclusions and Recommendations

8.1 Conclusions from Marketwatch

General conclusions that can be derived by WP2 market watch are:

- Online video and online ad spending are still growing
- Users today strive for catch-up TV, connectivity between TV and Internet as well as multi-device and multi-room usage of audio-visual media
- "Traditional" hybrid combination of DVB and Internet also IPTV-providers are evaluating HbbTV-integration for deployment in their set top boxes

Mobile Payment

An area that is an important element of NextShare and which is gaining significance in the business world are mobile payments. This development is profiting from lower costs for handling credit card payments as well as developments in data protection. For P2P-Next and its platform NextShare DACC filed a patent application using a mobile terminal where at least two amounts of information (information fragments) are used stored in different physically locations.

Broadcaster Views and Experiences with P2P

Many European broadcasters are still sceptical about P2P technology and do not see it as a delivery method worth to further investigate.

One main constraint in using P2P in Germany is the asymmetric split-up of DSL connections, which limits the media bitrate. The benefit of helping peers within a P2P streaming network seems to be shrinking dramatically with the current economic situation of streaming-costs of about 4 eurocent/GB. To make p2p technology a real alternative it must be feasible to provide a high share of high quality streams, which is cannot be ensured today.

In Slovenia there is a small TV market with a strong position of national telecom operator and very few content providers with a lot of content and users. These are the main reasons, that there is no demand for P2P technology in this country. Still, RTV is a positive example for the use of P2P technology providing a stable system with good quality videos.

Survey on Current and Future Usage of P2P-based Internet Distribution Systems

Looking at the evaluation of the broadcaster survey it could be confirmed that IP-based online services are a growing market. In terms of user structure, content offer and their regional coverage the existing European IP-based services seem suited for P2P distribution. Also the approaches of P2P-Next regarding a dedicated payment system and the support of SotA DRM systems apparently fit the demands of European audio-visual online services. Similar applies for the European approach of the project, since all participants of the survey indicate to have their main audience in Europe. Concerning bandwidth costs there exist big differences that allow the conclusion that this is still an issue that for some service providers even today counts for more than 50% of their budget for IP-based distribution. On the other hand P2P is

not attractive enough to be seen as an alternative to alternative distribution methods, led by the requirement for a plugin and varying data rates linked to P2P technology.

8.2 Conclusions from Cost Analyses

As basis for the OPEX/CAPEX analyses WP2 drafted use cases with services related to real life and viable to be included in the NextShare platform. CAPEX analyses found out that while the distribution method of audio-visual material is not relevant for storage costs, P2P technology can have signicicantly lower the costs for gateways and server infrastructure (up to 60%). Similar applies for the OPEX analyses where energy, administration and similar operating costs are seen not effected, but network traffic can be reduced to more than 40% for the given use cases.

8.3 Conclusions from Efficiency Comparison

Looking at the at the Internet Distribution in Europe it is clear, that even today broadband Internet as a condition for a good online TV experience is not very widespread. In almost half of the European countries less than 20 people out of 100 had a broadband Internet subscription in 2010. However, coverage seems to be much higher and steadily grows. This also improves the conditions for P2P distribution and HD online video offers. The same applies for mobile usage and connectivity.

Based on rather positive experiences of RTV with P2P technology and the outcomes of the OPEX/CAPEX analyses of chapter 3, one might conclude that P2P should be more popular. However, too many issues like decreasing bandwidth costs and uncertainties in the usage of P2P (see broadcaster survey chapter 2.5) prevent service providers to use this technology. For P2P-Next this means that the service offer and functionalities must be rather convincing than the fact of using P2P technology.

8.4 Conclusions from Refinement of Requirements

Looking at the content provider requirements defined at the beginning of the project (d2.1.1, p.94f), these generally are still valid. It is natural that over time details have changed due to developments on the market and in the design of the NextShare platform. Some are addressed in chapter 5 and can be concluded as follows:

- Access Service - IRT experiments showed that this requirement basically can be met by NextShare technology. An additional requirement in this regard would be to include and synchronize additional audio tracks with the video, made available on request to keep bandwidths low

- DRM support: e.g. time-limited availability of broadcasters content – This should also include the support of regulations regarding rated content and de-publishing of content ("telemedia")
- Hybrid Delivery / Video on Demand / Live streaming / Progressive Download / Reduced bitrate version – All media coding profiles provided by the system shall not only be utilised individually for a specific usage but also as part of an adaptive streaming set to switch between various levels.

The tests on NextShare by IRT described in this chapter confirm that start and jump times as well as peering behaviour were acceptable as soon as there are no network restrictions. These tests are related to existing P2P-Next content provider requirements like "contemporary content distribution" and "continuity of service".

8.5 Conclusions from Business Models

The generic structure of business models could be retained until the end of the P2P-Next project. They give enough room for future developments and consider rather new approaches like XaaS models. A concrete implementation and verification of the business models within NextShare will only be possible after the platform and related services are up and running.

8.6 Conclusions from Legal and Regulatory Developments

After all, the legal situation in Europe remains difficult. The Digital Agenda is more or less in limbo and regulation for new media and net neutrality in the individual countries is not clearly defined or simply ignored. The potential benefits of P2P-Next will be severely limited if there is no movement in this field.

9 Annex

9.1 Annex 1: Broadcaster Survey – Questionnaire

Introduction to P2P-Next Broadcasters' Survey

About the P2P-Next project

Distribution of radio and television programmes, movies, and various data applications to the general public today is possible via a variety of dedicated networks and special end user terminals. As broadband Internet becomes ubiquitous, many content distribution services are combined and conveyed to the general public using the Internet as a common distribution medium. The technologies used for distribution include unicast, IP multicast, content distribution networks, and - most recently - Peer-to-Peer (P2P).

The EU funded project P2P-Next has built on P2P-technology to create a next generation content delivery platform called NextShare, which has been designed, developed, and applied jointly by a consortium consisting of high-profile academic and industrial players with proven track records in innovation and commercial success.

About the survey

P2P-Next is seeking to design a successful platform – technically as well as commercially – that meets the needs of both end users and content- and service providers. Therefore the project continuously tries to capture the requirements of all stakeholders and to apply these to the project by gathering information internally from the project partners but also from external sources.

With the attached questionnaire we want to get an updated overview on the current and future usage of Internet distribution systems by European broadcasters for their audio-visual and multimedia service offers.

Thanks for your participation.
Your P2P-Next team

For more information visit our Website http://p2p-next.org

Questionnaire
Current and Future Usage of Internet Distribution Systems

General Information

1. Company name & abbreviation: _____

2. Branch (public/private broadcaster, service provider, content provider):

   _____

3. Audio-visual programme offer (amount and type of programmes):

   _____

4. Reach (local, national, worldwide): _____

5. Number of unique users per month (estimated, please tick one):

   A. Today
   - ○ Less than 10.000
   - ○ Up to 100.000
   - ○ Up to 1.000.000
   - ○ Up to 10.000.000
   - ○ More than 10.000.000

   B. In one year
   - ○ Less than 10.000
     Up to 100.000
   - ○ Up to 1.000.000
   - ○ Up to 10.000.000
   - ○ More than 10.000.000

6. What is the average time per session users spend with your audiovisual services?

   A. Today (please tick one)
   - ○ Less than 5 min
   - ○ Up to 20 min
   - ○ Up to 60 min
   - ○ More than 60 min

   B. In one year (please tick one)
   - ○ Less than 5 min
   - ○ Up to 20 min
   - ○ Up to 60 min
   - ○ More than 60 min

Distribution Methods

7. Which types of content distribution does your company currently use (multiple answers may apply)?
   - ☐ Video on Demand / IP-based
   - ☐ Video on Demand / non IP-based
   - ☐ Live Broadcasting / IP-based
   - ☐ Live Broadcasting / non IP-based
   - ☐ Peer-to-Peer

   Comments: _____

1/4

8. How do you make your services and content available to viewers/users (multiple answers may apply)?
   - ☐ Free TV
   - ☐ Free TV with restricted access, e.g. via geolocation
   - ☐ Pay TV
   - ☐ Free Internet
   - ☐ Free Internet with restricted access, e.g. via geolocation
   - ☐ Paid content offerings via Internet
   - ☐ Internet-based, via own websites
   - ☐ Internet-based, via portals of other parties
   - ☐ Mobile end-user devices, e.g. Smartphones and Tablet PCs
   - ☐ Hybrid services linked to broadcast

IP-based Content Distribution

9. Number of unique users per month (estimated, please tick one):

A. Today	B. In one year
○ Less than 10.000	○ Less than 10.000
○ Up to 100.000	○ Up to 100.000
○ Up to 1.000.000	○ Up to 1.000.000
○ Up to 10.000.000	○ Up to 10.000.000
○ More than 10.000.000	○ More than 10.000.000

10. For your companies' IP-based content distribution, please select up to 5 aspects that are most important for you:
    - ☐ Live Streaming
    - ☐ Video on Demand - Streaming
    - ☐ Video on Demand - Progressive download
    - ☐ Offer of a high-quality (HD) version
    - ☐ Offer of different AV qualities
    - ☐ Multiple / adaptive bandwidths
    - ☐ Low-cost bandwidths / Cap of bandwidth expenses
    - ☐ Quality of Service
    - ☐ Content Protection / DRM
    - ☐ Open standards
    - ☐ Net neutrality
    - ☐ Closed user groups
    - ☐ High scalability / Feasibility to handle masses of users
    - ☐ Niche content / Feasibility to provide service to only few users
    - ☐ Other: _____

2/4

11. Which region you mainly try to reach with IP-based content distribution (please tick one)?
    - ○ Nationwide
    - ○ EU
    - World
    - A number of selected countries, namely:

      _____

12. How much is your annual budget for IP-based content distribution (estimated, please tick one):
    - ○ Less than 10.000 €
    - ○ Up to 100.000 €
    - ○ Up to 500.000 €
    - ○ More than 500.000 €

13. How much of this budget is spent on bandwidth costs (please tick one)?
    - ○ Less than 5 %
    - ○ Up to 25 %
    - ○ Up to 50 %
    - ○ more than 50 %

14. Percentage of IP-based to total distribution efforts (estimated):

    _____%

15. Are you planning to modify your methods for your IP-based distribution in the near future?
    - ○ No
    - ○ Yes, namely (multiple answers may apply)
      - ☐ Introduce Video on Demand
      - ☐ Introduce Live Broadcasting
      - ☐ Introduce Peer-to-Peer
      - ☐ Make contents available via Set-Top Box
      - ☐ Make premium contents available via Internet
      - ☐ Make contents available via Smartphones and/or Tablet PCs
      - ☐ Make available hybrid services linked to broadcast

Peer-to-Peer Distribution

16. In your opinion, what are reasons **in favour of** using Peer-to-Peer techniques as a distribution method (multiple answers may apply)?
    - ☐ Cost savings in bandwidth
    - ☐ Low infrastructure requirements (servers, etc.)
    - ☐ Scalability (of clients and bitrates)
    - ☐ Advantages in mass distribution (e.g. live events)
    - ☐ Global reach (no proprietary hard- or software)
    - ☐ Accessibility to new target groups
    - ☐ Support of live streaming
    - ☐ Other: _____

3/4

17. What are your reasons (based on facts and rumours) **against** Peer-to-Peer as a distribution method (multiple answers may apply)?
    - ☐ Bad reputation
    - ☐ Security reasons / Fear of content piracy
    - ☐ Dependency on users
    - ☐ Varying data rate (Best effort delivery)
    - ☐ Potential access latencies
    - ☐ Lack of audience tracking (and measurement)
    - ☐ Own user structure does not correspond to demands of Peer-to-Peer technology (e.g. too less viewers)
    - ☐ Other: _____

18. If Peer-to-Peer would have the same in-browser experience as streaming video has, would you consider it as an alternative distribution method?
    - ○ Yes
    - ○ No
    - ○ Already use Peer-to-Peer as a distribution method

19. Any further remarks:

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