

Technical trial of the EBU P2P media portal

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The EBU P2P Media Portal (EBUP2P) was developed as a demonstration tool for EBU Member organizations to show their television and radio channels internationally.

A 6-month trial of the portal was set up by EBU Project Group D/P2P in the first half of 2008 to evaluate P2P (Peer-to-Peer) technology – via the example provided by the company Octoshape. This article reports on the outcome of the trial.

EBU Project Group D/P2P (Peer-to-Peer), chaired by Frank Hoffsummer (SVT), was set up in 2006 in order to:

- evaluate newly-emerging peer-to-peer technologies;
- formulate potential EBU requirements for such systems;
- to carry out technical experiments and trials on a working P2P system.

The Group was encouraged by the large attendance at a seminar organized by the EBU Technical Department in February 2006 in Geneva, which identified significant interest among EBU Members in studying this new technology.

The initiative for an EBU Media Portal came from the Group D/P2P at its meeting in June 2007. The Group proposed that EBU Members should come together and set up a common Internet portal through which Members' TV and radio channels could be made available to the general public worldwide. The portal – if ever established permanently as a non-commercial collaborative EBU project – could mean much more than just a technically advanced and innovative project: it could become a one-stop shop window of Members' programming achievements.

What is Peer-to-Peer?

In this article, P2P is considered as an Internet *media distribution* system which relies on end-users' computers to propagate content through existing computer networks. Such a P2P system has nothing to do with napsterization or illegal content-sharing. Quite the contrary, P2P offers an attractive possibility for broadcasters to distribute their content efficiently across the Internet.

As P2P does not require any special emission infrastructure to be installed, the investments and maintenance costs are significantly lower than those of more traditional Content Distribution Networks (CDNs) which may use several thousands of special streaming servers. In addition, P2P does not have a single point-of-failure, so its service reliability is very high.

On the downside, P2P is a relatively new technology which requires a lot of further studies and hands-on experience in order to turn an interesting technical innovation into a viable business proposition.

Prior to the advent of P2P, EBU Members were extensively using different server-client approaches such as CDNs (Content Distribution Networks), IP Multicasting and a great variety of proprietary streaming solutions from Microsoft, Real Networks and QuickTime. A common characteristic of all these systems is that they are relatively expensive ... because broadcasters must pay an ISP (Internet Service Provider) for each connected stream (i.e. user). Thus, the more users there are, the higher the ISP's costs will be. Effectively, broadcasters pay more because of their own success.

As an example, in 2005, the Eurovision Song Contest was distributed via the Internet using a CDN system serviced by Akamai. Being a highly popular event, it generated a lot of interest worldwide (several tens of thousands of Internet users). The calculated cost of video streaming the event was about one CHF per user per hour, which amounted to around CHF 100'000 (€ 65'000) for the 3-hour show.

P2P may change this paradigm radically. Video can be streamed via P2P at a cost that is below € 0.05 per GB¹. As a result of the competition from P2P, the cost of CDN services has also dropped significantly but it is still much more expensive than P2P by an order of magnitude.

In addition to the cost factor, P2P technologies have many advantages compared to other Internet distribution systems: no central server streaming "farm" is required and there is no central point of failure (assuming a decentralised, distributed tracker). However, P2P is still in its infancy and many challenges are still to be resolved. Setting up EBUP2P is only the first step in the direction of gathering experience and solving potential issues relating to P2P.

Requirements for an Internet media-distribution system

Broadcasters have the following requirements for any Internet distribution system they might wish to use:

- low distribution cost (ideally independent of location, time, quality and number of users);
- reliable delivery (no glitches or interruptions, reasonable end-to-end latency, fast zapping);
- high quality levels – SD, even HD (including multichannel audio if required);
- large channel capacity (in principle, there are no frequency spectrum constraints as in conventional broadcasting);
- the largest number of concurrent users possible (several hundreds of thousands of concurrent P2P users have been successfully demonstrated).

The P2P trial

In order to make the whole operation manageable, we had to limit the number of Member participants to about ten (see *Table 1*). The P2P system chosen for the trial was provided by Octoshape, already described in an earlier edition of EBU Technical Review ².

Basic portal description

During the trial, there was a highly-visible vignette "P2P Media Portal Trial" on the EBU's home page, which took the user to the portal's own home page ³. Access to the portal was open to all users worldwide and *Fig 1* shows an earlier design of the home page.

1. Octoshape states a price of 2 Eurocents per GB on its website:
<http://www.octoshape.com/>
2. Visit: http://tech.ebu.ch/docs/techreview/trev_303-octoshape.pdf

Table 1
Member participants in the EBU P2P Portal trial

		Channel	Organization	URL	Comment
TV	1	HR	Hessischer Rundfunk (HR)	www.hr-online.de	
TV	2	DW - TV	Deutsche Welle (DW)	www.dw-world.de	
TV	3	TV SLO 1	RTV Slovenia (RTVSLO)	www.rtv slo.si	
TV	4	TV SLO 2	RTV Slovenia (RTVSLO)	www.rtv slo.si	
TV	5	24H tve	RTV Spain (RTVE)	www.rtve.es	
TV	6	DOCU tve	RTV Spain (RTVE)	www.rtve.es	Discontinued
TV	7	TV Ciencia on-line	TV Portugal	www.tvciencia.pt	Since May 08
TV	8	iTVP	Polish TV (TVP)	www.itvp.pl	Since May 08
TV	9	Taiwan TV			Since June 08
Radio	10	radio-suisse jazz	SRG-SSR	www.srg-ssr.ch	MP3, 192 kbit/s
Radio	11	radio-suisse pop	SRG-SSR	www.srg-ssr.ch	MP3, 192
Radio	12	radio 3	RNE	www.rne.es	WM, 96
Radio	13	radio classica	RNE	www.rne.es	WM, 128
Radio	14	youfm	HR	www.hr-online.de	MP3, 160 – up to the end of April 08
Radio	15	RSi	RTVSLO	www.rtv slo.si	WM, 192
Radio	16	Val 202	RTVSLO	www.rtv slo.si	WM, 192

During the trial, the design of the web portal underwent continuous improvements, both graphically and in terms of accessibility and user friendliness. *Fig. 2* (on the next page) shows the current graphical design of the portal, as produced by Nathalie Cullen from the EBU's Communication Service.

Each Member participant is represented by an icon which emulates their logo. On the top right side, there are eight icons representing TV channels, while below them are six radio channels. In this new design, users during the trial had the flexibility of using either an embedded player (which starts playing automatically when you first open the page) or Windows Media Player (which opens in a separate adjustable-size window).

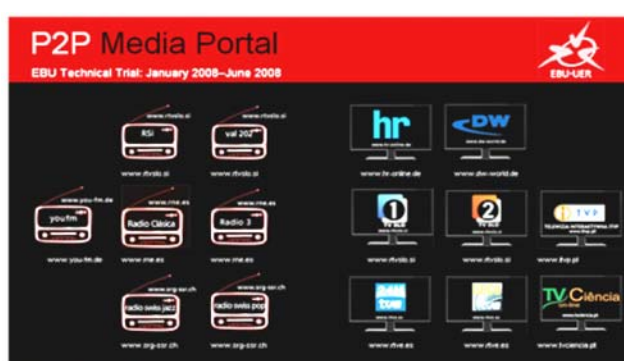


Figure 1
EBU P2P Media Portal - Windows Media Player only (Courtesy: Nathalie Cullen, EBU)

- The deep link to the Media Portal can still be found here:
http://www.ebu.ch/members/EBU_Media_portal_Trial_1.php

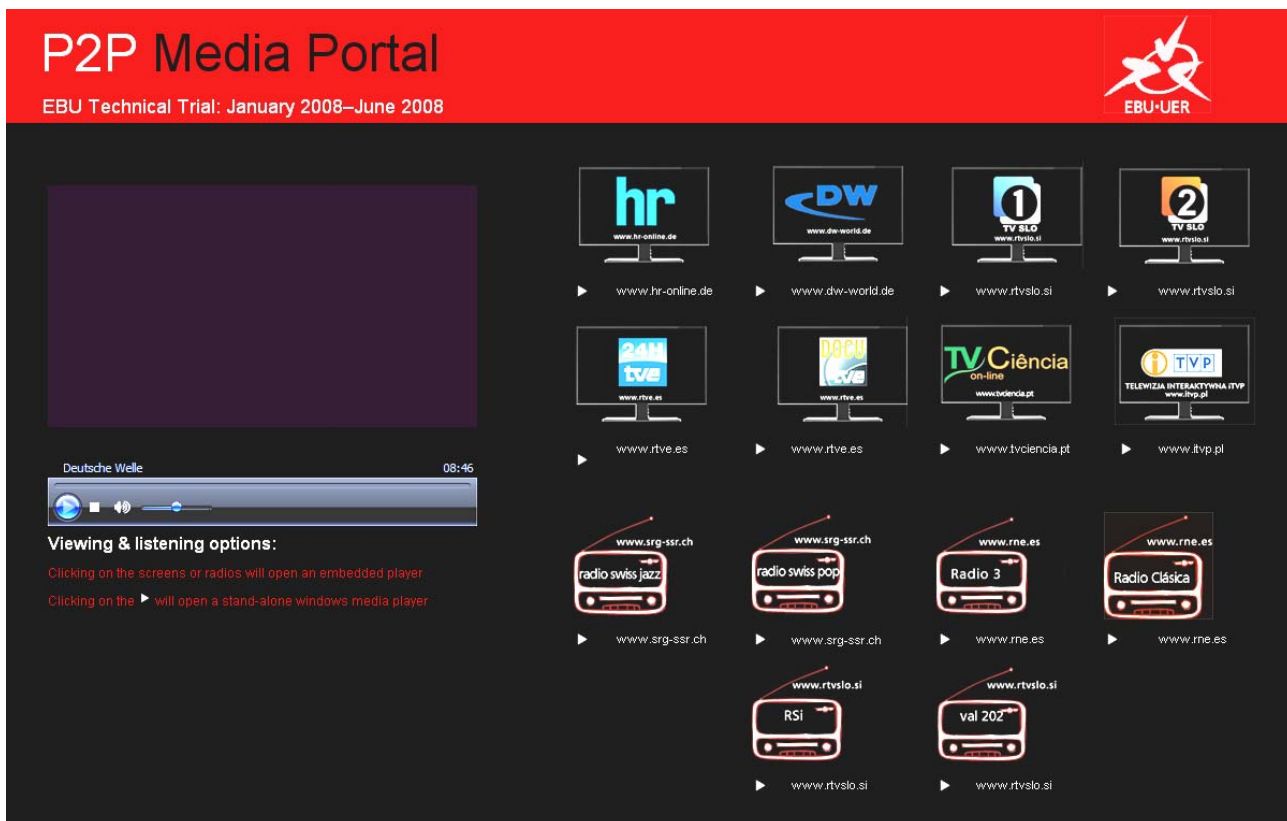


Figure 2

Final design of the EBU P2P Media Portal (Courtesy: Nathalie Cullen, EBU) – which uses either Windows Media Player or an embedded player in the browser

Underneath each logo we put a link to the Member’s URL, allowing the users to consult the schedule of programmes and access some additional information about the channel concerned.

On the bottom of the page we included a temporary link “Your Comments”, allowing the users to send in reports and comments about their viewing experiences. During the trial we received more than a hundred comments which were all consistently positive about the user experience.

The page also included information about what the user needed in order to access the portal content. These are as follows:

- a suitable broadband connection;
- a PC running Windows, Mac or Linux;
- Internet Explorer (IE) or Firefox browser;
- Active X (in the case of IE);
- Windows Media Player (video and audio);
- MP3 player;
- Octoshape plug-in.

Abbreviations

CBR	Constant Bit-Rate	HTTP	HyperText Transfer Protocol
CDN	Content Delivery Network	ISP	Internet Service Provider
CE	Consumer Electronics	P2P	Peer-to-Peer
DRM	Digital Rights Management	SDI	Serial Digital Interface
EPG	Electronic Programme Guide	WM	(Microsoft) Windows Media
FS	Full Scale	XML	eXtensible Markup Language

The trial plan

The first issue in the process of establishing an operational EBU Media Portal was to identify a suitable Internet distribution technology and to agree some operational parameters. A technical trial Group consisting of ten EBU Members held a kick-off meeting on 10 July 2007 in Geneva, in order to define the technical and operational parameters based on peer-to-peer (P2P) technology⁴. Once these parameters had been set, the trial could start informally in autumn 2007 but officially it started in January 2008. It then continued for six months until the end of June 2008.

Table 2
Technical tests planned

	Test	Description	Participants
1	Accessibility of contents from the EBU web site	working links, smooth zapping of channels, only one stream at a time	all
2	Overall quality performance (continuity and reliability) under different broadband network conditions	different upstream and downstream capacity, different network load (resulting in packet loss and jitter)	all
3	Scalability: 200 and 700 kbit/s	number of concurrent users	all
4	Different computer platforms/operating systems	PC, Mac, Linux	IRT
5	Different browsers	IE, Firefox, etc	IRT
6	Geolocation (dynamic)	displaying the messages for non-availability of streams	?
7	Rights Management	Different DRM system including MS DRM, DVB CPCM	?
8	Audience statistics	immediate return of data for each broadcaster	All, EBU
9	Pre-roll advertising	Octoshape inserts a up to 3 s pre-roll ad. Content of add should be mutually agreed by channel owner and Octoshape	HR, TVP
10	Audio Watermarking ^a	Embed about 100 bit/s	?
11	Flash codec ^a	In addition to WM, we should test Flash codec	?
12	On-demand delivery ^a	Video on -demand play out of files	?

a. To be tested in the second phase (subject to agreement with Octoshape)

The Trial Group was coordinated by the Author and operated under the auspices of the D/P2P Group. It held three meetings in order to supervise the development and monitor the technical quality of the portal.

The principal objective of this trial was to assess whether or not the Octoshape P2P technology is an efficient and reliable platform for live streaming of Members' television and radio services. We also seized the opportunity to try some peripheral services such as the graphical design and accessibility

4. Octoshape P2P technology was selected on the basis of some comparative tests conducted by Project Group D/P2P during IBC 2006 and also as a result of Eurovision Song Contest events from 2005 onwards, for which Octoshape was very successfully used.

of the Portal (e.g. how the user accesses the site and changes channels – zapping), along with video encoding, geolocation, pre-roll advertising, etc

Based on the above system and the operational requirements, a test plan was developed, as shown in *Table 2*.

Technical specification of the trial

The agreed technical parameters for the audio and video streams is given in *Table 3*.

Table 3
Technical parameters used in the EBU P2P Media Portal

Television	Video		
	Codec	Bitrate	Aspect ratio & resolution
	MS Windows Media	about 700 kbit/s	4:3 480 x 360 px; 16:9 520 x 360 pixels
Radio	Audio		
	Codec	Bitrate	Stereo/Mono
	MS Windows Media 9	64 kbit/s	48 kHz, stereo (A/V) 1-pass CBR
Radio	Audio		
	Codec	Bitrate	Stereo/Mono
	MS Windows Media 9	96/128/192 kbit/s	44.1/48 kHz, stereo (A/V) 1-pass CBR
	Mpeg Layer 3	192 kbit/s	

Players: Windows Media and embedded Octoshape player.

Distribution via Internet: P2P and HTTP.

Distribution of work

The following is the list of tasks that each participant had to accomplish in order to make the trial a successful operation.

Octoshape

Octoshape provided the following services to the Portal:

- Information to the EBU to enable EBU Members to encode their streams in WM;
- Octoshape-specific Source Signal Solution (SSS) software to all Members for encoding their material;
- If required by a Member, performed encoding (or asked third party to do it);
- Information to EBU to inform EBU Members how to send streams to Octoshape;

- User's plug-in (Octoshape-specific) with regular updates;
- Powered the Portal by providing P2P services for live streaming;
- Provided audience statistics on request to all participants;
- Provided geolocation services (if required);
- Provided pre-roll advertising (if required).

EBU staff

The EBU had the following responsibilities:

- Ensured that the technical, legal and programming interests of EBU Members were fully respected and taken into account;
- Coordinated the evaluation process;
- Developed a dedicated website in coordination with Octoshape, and according to Octoshape requirements, and provided a link to the EBU home page;
- Ensured a proper design of the web page, with constant improvements to the look and feel;
- Ensured a balanced (non-discriminatory) visibility to all the channels involved;
- Provided all the information required for the end user to access all the channels and other information required;
- Enabled the user to download the latest version of the required media players and the Octoshape plug-in;
- Reported regularly to the various EBU bodies on the progress of the technical trial;
- Ensured some publicity for the portal in order to maximize the use of the site;
- Promoted the portal at relevant events, EBU seminars, conferences and trade shows;
- Discussed common strategies for pre-operational and regular services with Octoshape, i.e. the future steps and business model options to be considered.

EBU Members - Trialists

The EBU Members that participated in the trial coordinated their activities through the EBU Technical Department. Participants conducted the following activities:

- Provided the content, i.e. selected the TV/radio channels or any other streaming content they wished to publish on EBU website ⁵;
- Granted rights to the EBU for their content to be published on the EBU website;
- Encoded their streams (by using appropriate technologies);
- Forwarded their streams to Octoshape;
- Defined the coverage constraints (if and when required) and instructed Octoshape how to apply geolocation filtering;
- Provided a link to the EBU website on their own website, so that users in their country could easily access other EBU Members' content;
- In the case of pre-roll adverts, Members performed editorial control of the ad content.

5. Generally all webcasts should be available for 24 hours a day but it is up to the individual Members to decide on their webcast times. In the latter case, information should be given about the broadcast times.

Legal matters

Throughout the course of the trial, legal matters – particularly copyright issues – played an important role in our discussions. Initially, EBUP2P thought we could be considered a kind of re-broadcaster of EBU Members' content and be treated as a cable network. To this end, the EBU (as owner of the portal) needed explicit permission from Members to re-broadcast their channels. If required, the EBU also needed to clear the rights issues with the collecting societies. All participants were required to sign a rights clearance form that there were no legal obstacles for the EBU to make the TV channel(s) available to the general public, free of charge and in unchanged form and simultaneously with the terrestrial broadcasts of these channel(s).

A later discussion showed that, in practice, the end user who clicks on the icon on the EBU website to access a certain TV channel is merely redirected to the original stream of the actual content provider. Therefore, the EBU is not re-transmitting the stream. It was agreed to publish a disclaimer which reads:

It should be noted that the users are redirected to the original stream of the actual content provider and the EBU is not re-transmitting the stream.

Another solution for a future portal would be for the EBU to simply provide the links to the Members' web pages containing embedded players.

Evaluation results

Audience

The table below shows how many unique users were able to join the trial across all channels offered during the January - June 2008 period. It also shows the aggregate time (in hours) of user media consumption for each month.

Month	Unique users	Total hours
Jan	9'072	32'375
Feb	8'157	39'777
March	8'652	44'898
April	7'031	41'519
May	3'808	26'247
June	2'936	24'184

Fig. 3 shows an example of the audience variations on two Hessischer Rundfunk channels, one TV and one radio, during the political campaign before the elections at Hessen, Germany. Members of political party SPD were able to watch the TV stream via our P2P stream, as they did not have TV sets in their offices.

Please note that the Octoshape system was limited to serve no more than 600 concurrent users, as the broadcaster did not notify Octoshape in advance (see the section on "Scalability" below).

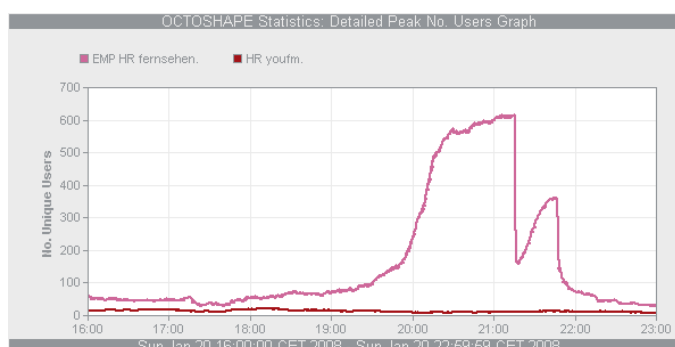


Figure 3
Audience variations on HR's radio and TV channels

Accessibility

All web links were working satisfactorily, zapping of channels was smooth and only one stream at a time was available (as required). Some occasional glitches (e.g. missing sound, lip-sync problems) occurred due to poor encoding. The Spanish Documentary channel is not available outside of Spain, due to copyright, and the geolocation filtering was applied to implement this. The end user was informed about this via a message that popped up “This stream cannot be viewed in your country”.

Several users had problems with downloading the Octoshape plug-in. Some people, particularly those located in large corporations (including some large broadcasting organizations) could not download the plug-in at all, and consequently were not able to access the Portal services. This element of the Octoshape system needs to be considered, as it represents an obstacle to audience acceptance.

Overall quality performance

There has been no evidence that network traffic load, asymmetry or last-mile issues affected the overall quality performance of the Octoshape system in any significant manner. It should be stressed however that only large-scale laboratory tests, allowing for controlled repeatability of results, could yield scientifically-valid results. According to the reports received, our experience about the service quality was positive – we can deduce that Octoshape performed correctly on all networks.

The service quality therefore mainly depends on the encoding quality. We detected some errors performed by Members in encoding video material, in particular regarding the correct aspect ratio when the source material was produced in HDTV (16:9).

Should there ever be a regular service, the question of correct encoding requires extremely careful consideration. Differences between different sources should be avoided, so that zapping from one channel to another does not result in level and other differences. Broadcasters should adopt a common set of coding parameters. Square pixels should be consistently used.

Resolutions: 4:3 — 512 x 384 pixels

16:9 — 512 x 288 pixels

De-interlacing problems should be handled in the hardware (encoder card). Complexity coding should be enabled. If possible, performance could be enhanced by a 2-step encoding. Use of SDI sources is highly recommended while composite sources (to reduce cross-colour and cross-luminance interference) is to be avoided

Audio level: 0 dB FS level (full scale).

Scalability

On a major Internet event in May, HR experienced a service breakdown. Octoshape explained that the 600⁶ user limit was configured on the Octoshape P2P network by default (which means that the service was effectively cut down when more than 600 peers joined the network). This was explained as a normal precautionary measure, as Octoshape does not know the network (ISP) limits which may vary from one network to another. Octoshape is however able to scale bandwidth to the ISP limits.

6. Octoshape explained that the number 600 is really arbitrary and can well be set to a much higher value if required (especially for live events).

Such a service breakdown could have been avoided if Octoshape had been informed in advance of an event where it was likely that a larger number of peers may join. Octoshape can scale down the quality from 700 kbit/s to 200 kbit/s ⁷ either automatically or manually.

In order to implement the scalability and ensure continuous services (even when the number of users increases), it is necessary to encode the streams in two (or three) bitrates. In this way, Octoshape can perform an automatic switch to a lower bitrate, as soon as the number of peers reaches a certain limit.

It should be pointed out that dual bitrate encoding can be implemented by a single PC.

Octoshape has already demonstrated on a number of occasions that it is a very scalable system, e.g. for the Eurovision Song Contest during which it was able to support around 45'000 simultaneous streams without any problems.

Computer platforms and browsers

There was no evidence of any problems resulting from the use of different computer platforms, operating systems and browsers.

Geolocation

Throughout the trials, the Group gave very serious consideration to issues relating to geolocation filtering, as this tool is essential to limit coverage to specific areas, mainly for copyright reasons. The geolocation system must obey very strict requirements in terms of security, accuracy and reliability, in order to prevent any leakage of content outside the granted zone.

The Octoshape geolocation system is an advanced commercial product called "IP2location". This system enables identification of the geographic location and Internet domain name by means of an IP address. The IP2location database is used to match an incoming IP address to the country, region, city, latitude, longitude, zip code, Internet Service Provider (ISP), time zone, network speed and domain name of the Internet user. Octoshape merely provides an interface to this database. Octoshape believes that the geolocation system they are using provides excellent accuracy and security. In the many years that they have been using this system, no difficulties have been experienced whatsoever. If necessary, the Octoshape system would be able to interface to any other geolocation system including Akamai or Quova if required. Members agreed that EBUP2P should meet the highest level of geolocation performance and security as required.

In the case when geofiltering is applied, copyrighted content is only available within the copyrighted zone, whereas outside this zone a message board should be displayed on the screen. The text on the message board may say the following:

"Due to copyright restrictions, the currently broadcast programme is only available within the authorized zone. Your location lies outside this zone, therefore at the moment you have no access to the content. We apologize for any inconvenience."

Preferably the above message is shown in the national language and in English; other languages may be added of course. Geofiltering can only be applied to video, while leaving the audio available.

The scheduling of geofiltering could be two-fold: [a] pre-scheduled (pre-determined start and end times) or [b] flexible (time stamps or manual activation of geofiltering).

7. The lower limit of 200 kbit/s has been increased to 350 kbit/s to improve the lower quality limit.

Rights management

Digital Rights Management (DRM) was not tested: it is independent of the P2P system in use.

Pre-roll advertising

A pre-roll system is an example of a business model in which the end user receives all video and audio streams for free. For the testing of EBUP2P, Hessischer Rundfunk used a 5s pre-roll service. Octoshape confirmed that they were able to provide a pre-roll advertising technology which is very similar to the Zattoo one. However, if pre-roll is to be used for an operational service, several related open questions apply:

- Who provides the pre-roll ad content?
- Should the ad content be adapted to the destination market?
- Is the ad content both channel- and zone-specific (leading to different pre-rolls for different markets)?

Preliminary conclusions

The principal conclusions of this trial can be summarized as follows:

- EBUP2P represents a state-of-the-art technical solution and fulfils all the tested technical and operational requirements – in terms of the service quality, scalability, video and audio quality, accessibility, security and user-friendliness.
- EBUP2P has no technical limitations regarding the number of radio and TV channels to be accommodated in a Portal. Members can flexibly join in and opt out at any time.
- EBUP2P can fulfil our requirements concerning copyright, by applying territorial filtering (geolocation) and watermarking.
- EBUP2P enables a number of business models.
- EBUP2P is future proof and will be extended towards CE (consumer electronics) devices.

In spite of the very limited human and financial resources available for conducting the EBU P2P Media Portal trial, we brought the trial to a successful end, according to the schedule planned. The participants in the trial performed a large number of technical and operational tests.



Franc Kozamernik graduated from the Faculty of Electrotechnical Engineering, University of Ljubljana, Slovenia, in 1972.

He started his professional career as an R&D engineer at Radio-Television Slovenia. Since 1985, he has been with the EBU Technical Department and has been involved in a variety of engineering activities covering satellite broadcasting, frequency spectrum planning, digital audio broadcasting, audio source coding and the RF aspects of various audio and video broadcasting system developments, such as Digital Video Broadcasting (DVB) and Digital Audio Broadcasting (DAB).

During his years at the EBU, Mr Kozamernik has coordinated the Internet-related technical studies carried out by B/BMW (Broadcast of Multimedia on the Web) and contributed technical studies to the I/OLS (On-Line Services) Group. Currently, he is the coordinator of several EBU R&D project groups including B/AIM (Audio in Multimedia), B/VIM (Video in Multimedia) and B/SYN (Synergies of Broadcast and Telecom Systems and Services). He also coordinates EBU Focus Groups on Broadband Television (B/BTV) and MultiChannel Audio Transmission (B/MCAT). Franc Kozamernik has represented the EBU in several collaborative projects and international bodies, and has contributed a large number of articles to the technical press and presented several papers at international conferences.

The number of participating EBU organizations was restricted to about ten. We could not accept more participants, as our logistic resources are so limited. Also the number of end users were quite modest, as we did not carry out any significant promotion of the portal.

These EBU tests cannot be considered rigorous scientific tests. They were more akin to “proof of concept” and “experience-gathering” evaluations. Octoshape is not the only commercial P2P system available in the market but we selected it because our previous experience with this system was positive.

The main conclusion of the trial is that Octoshape is an excellent Internet distribution system for carrying audio and video streams to PC users. The system is scalable, reliable, easy to manage and interoperable with a number of codecs, operating systems, browsers and geolocation systems. In the course of the project a large number of issues were successfully resolved, although several issues were left open for future activities (*see the next section*).

The P2P Media Trial has shown that Octoshape can be used by our Members as a viable and technically appropriate system for the distribution of audio and video streams across the Internet. It can be used either as a standalone distribution system or in combination with some CDN or IP Multi-casting technologies.

Required future work

Running a Media Portal is a complex issue and technologies evolve very rapidly. It is not enough to show that the P2P distribution system functions correctly and according to our expectations. For a possible future commercial portal, the following additional issues may also be considered:

- Watermarking (and Fingerprinting) – optionally embed audio watermarking signals to detect the originator of the content (if required);
- Allow for both customized media players (which open in a separate page) and embedded players;
- Optionally embed DRM in the stream (if required to control consumption of the media received) ⁸;
- Develop an XML-based template for EPGs and optionally provide an EPG (daily, weekly) for each channel;
- Provide additional coverage of special events (if required);
- Extension of portal services to embrace content downloading and VoD (on-demand) services (documentaries, archives, recorded sports events, etc);
- Hybrid TV receivers with broadband (Ethernet or Wi-Fi) connection: embedded P2P client in commercial TV sets and set-top boxes (such as in DVB);

Acknowledgements

The EBU would like to thank all participants for their very kind cooperation in this field trial. Particular thanks should go to the Octoshape staff – Stephen Alstrup, Theis Rauhe and Lasse Riis – for their fast and efficient resolution of all problems that may have arisen during the tests. Many thanks also go to Nathalie Cullen from the EBU Communication Service for the attractive and functional web design of the portal. And last (but not least), thanks should also go to the EBU management for providing continuous support and encouragement for conducting this project.

8. Participants will be able to apply different DRM (digital rights management) tools in order to protect their content.