Prix Europa

— results of the 2006 media streaming trial

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The Prix Europa 2006 opening concert was given on 14 October 2006 in Berlin by a Portuguese World Music group called *Gaiteros de Lisboa*. On the occasion of this one-hour long concert, the EBU organized a technical experiment to distribute multichannel 5.1 audio – coded in HE AAC (High Efficiency Advanced Audio Coding) over the internet using a Peer-to-Peer (P2P) technology from Octoshape.

This experiment is significant because, for the first time, an event was "broadcast" live in 5.1 multichannel format across the Internet, potentially addressing large audiences with high-quality surround sound.

Every year Prix Europa invites the finest European television, radio and Internet productions, as well as their makers and managers, to Berlin for a week of festival and competition. This year, Prix Europa took place from 14 to 21 October 2006, with its opening concert given on Saturday 14 October from 20:00 to 21:00 CET. This event was also broadcast from the ARD transponder on the Astra satellite [1]. Twenty EBU broadcasting organizations were relaying the stereo feed available on the Euroradio network and were re-broadcasting it on their own terrestrial FM/DAB networks.

The event was hosted by ARD and RBB RadioMultiKulti [2].

Prix Europa has staged several "technical firsts" in the past:

- On 11 October 2003, Europe's first satellite radio broadcast in 5.1 using Digital Theatre System (DTS) [1] took place. The DTS audio stream was embedded as a packetized elementary stream in the MPEG-2 video transport stream as a DVB-S service via the Sirius 2 satellite at 5° E. The AES-compatible stream encoded in G.703 at 2 Mbit/s was also available from the Eutelsat W3A satellite at 7° E on a separate data carrier for EBU Euroradio members.
- A year later, in October 2004, the EBU performed a live transmission of the Prix Europa opening concert in Dolby AC-3 from Astra 1H (19.2° E) and in Dolby E via the Eurovision Network [2].

1. Astra 1H 19° East, DVB-S Radio Service, ARD Bouquet, WDR channel, Funkhaus Europa, Channel 1 = Stereo, Channel 2 = 5.1 Dolby Digital AC-3.
2. RBB = Rundfunk Berlin-Brandenburg.

This year, we tried another innovative approach: live streaming of the opening concert over the Internet, coupled with multichannel audio coding (software encoding).

What is P2P and why did we choose Octoshape

There is some evidence now available that the traditional unicast distribution over the internet does not work for large numbers of simultaneous users. Similarly, Content Distribution Networks (CDNs) can provide reliable streaming but are not scalable to large audiences: they are relatively expensive for high-bandwidth streams and large number of streams and storage.

As a solution which is cost-effective and reliable, Peer-to-Peer (P2P) solutions have been proposed [3]. P2P capitalizes on the processing power and storage provided by individual users, so it needs very little additional infrastructure for management and control. P2P is already the most popular application on the internet, representing between 60 and 80 % of total traffic provided by ISPs. People are using P2P to download music (MP3 files), films and video clips (mainly legally these days). The *YouTube* web site is a good example of a success story. However, P2P has been used successfully also for live streaming. For example, the *Eurovision Song Contest* was webcast over the Internet in May 2006 to some 70'000 unique users.

There are several commercial P2P systems available [3] and Octoshape [4] is arguably one of the most advanced grid-based real-time streaming systems. The bandwidth savings (and thus the network cost reduction) are significant and increase with the number of users. The system has proved to be very flexible and reliable on the occasion of several tests that the EBU has conducted so far.

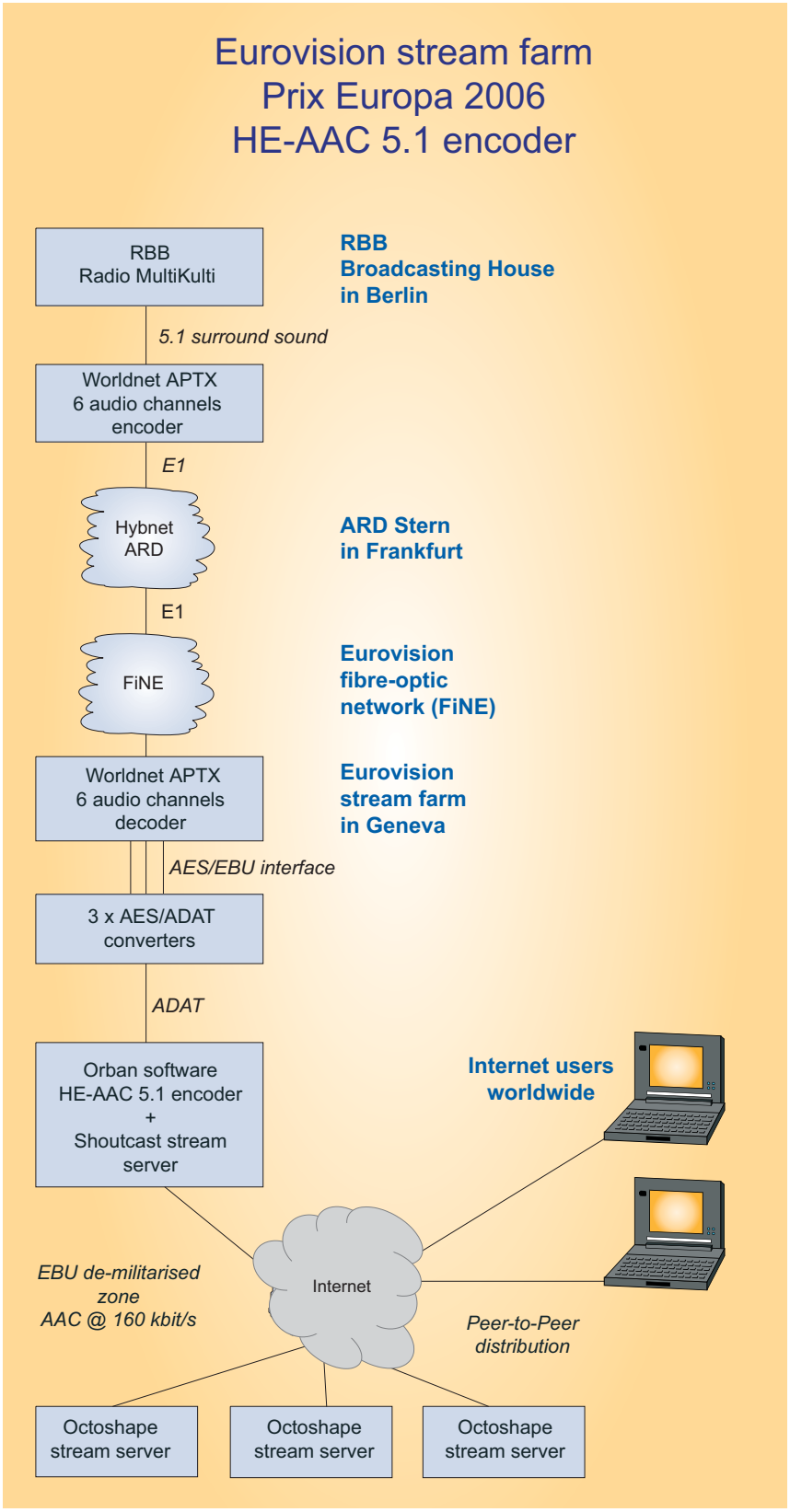
To this end, we decided to give Octoshape an additional opportunity for exposure and to use their technology once again.

Why we have chosen Advanced Audio Coding

As mentioned above, we have been using several advanced multichannel audio systems during our Prix Europa experiments over the past few years. We started by using DTS, followed by Dolby E and Dolby Digital (AC-3).

This year we decided to try the High Efficiency Advanced Audio Coding (HE AAC v2) system as developed and promoted by Coding Technologies [5]. The system exists both in hardware and software real-time incarnations, which is a huge advantage for a practical broadcaster and webcaster. The multichannel AAC can be played back in the well-known WinAmp media player.

The system is part of the internationally standardized MPEG-4 system, specified in ISO/IEC 14496-3. It is also standardized in DVB for both radio and television sound applications (see TS 102005 and TS 101154).



The multichannel version of the HE AAC system was tested subjectively by the IRT in 2004. Compared to Dolby AC-3 and Windows Media, HE AAC came out as winner. The results showed that HE AAC at 160 kbit/s was generally better than Dolby AC-3 at 384 kbit/s (except for “applause”).

The system is already extensively used in many broadcast applications such as XM Satellite Radio, HD Radio (IBOC) in the USA, DRM (Digital Radio Mondiale), S-DMB in Korea, ISDB in Japan and is being considered by the 3GPP Forum for mobile communications applications.

We were impressed by the above credentials of the HE AAC system. To this end, we decided to use it for our Prix Europa experiments this year.

Experimental setup

The experimental setup was relatively complex *(see the accompanying diagram)*. The architecture chosen allows Eurovision in Geneva to play the central role in terms of management, control, formatting and coordination of such webcasts.

This architecture implies that all such events in future should be routed through Eurovision, which can act as a central hub for the programme sources. Following the necessary processing and technical adjustments performed by the Eurovision centre, the signals can then be distributed to the potential users.

For Prix Europa 2006, the multichannel audio programme source – originated at Radio-Berlin Brandenburg – was brought to the Eurovision Centre in Geneva and, following some processing, it was directed to Octoshape in Copenhagen which put the programme live on the Internet.

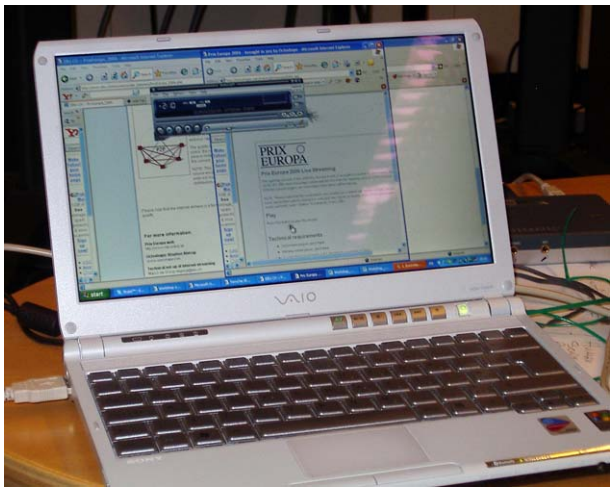
There was an option to bring the signal from Berlin directly to Octoshape in Copenhagen. In this case, Eurovision would not be in control of the whole process, so that option was rejected.

After having decided that Eurovision should be the central point, our initial proposal was to accommodate the Octoshape P2P server in Geneva, rather than in Copenhagen, but due to limited time we were not able to achieve this. For any future webcast events, service hosting should be performed by Eurovision.

The setup architecture consisted of the following five steps:

- **STEP 1:** generation of multichannel audio at the RBB radio building in Berlin and encoding it in APTX format,.
- **STEP 2:** conveying the multichannel APTX signal from Berlin to Geneva. This was done in two hops. The first hop was an E1 connection via ARD Hybnet from Berlin to ARD Stern in Frankfurt. The second hop was to use the Eurovision Fibre Optic Network (FiNE) from Frankfurt to the Eurovision premises in Geneva.
- **STEP 3:** decoding of the multichannel APTX signal and converting it into three pairs of AES/EBU discrete digital signals in Geneva.
- **STEP 4:** real-time encoding of the AES/EBU channels into HE AAC at 160 kbit/s and sending this to a Shoutcast stream server.
- **STEP 5:** sending this signal to Octoshape in Copenhagen and distributing the signal across the Internet using their advanced P2P system.

Finally, the users could play these AAC streams by using a WinAmp media player on their PC.



The APTX system [6] used for the contribution circuit described in Steps 1 to 3 was incarnated as the WorldNet Oslo encoder/decoder. It is a modular, multiple channel audio multiplexer designed to transport high-quality content over various digital networks. It uses the proprietary apt-X coding system, delivering real-time, near-lossless and low-delay audio on up to 28 channels. It is used by many EBU broadcasters to provide an audio link between the studio and the transmitting sites. Audio can be transported via synchronous or packet-switched networks with support for interfaces such as E1 (2 Mbit/s) and Ethernet (IP). In addition to supporting mono and stereo for FM, HD Radio and DAB, the WorldNet Oslo system is also designed for 5.1 multichannel applications.

As for the AAC encoding in STEP 4, we had a choice of two possibilities: hardware and software. The hardware multichannel audio HE AAC encoder was kindly provided by Mayah [7] who offered a multichannel audio gateway codec called Centauri II. Although this appliance can handle a range of different codecs and networks including ISDN, X.21, IP and E1, we had insufficient time to make it "talk to" Octoshape.

Consequently we were forced into using a software encoder provided by Orban [8]. This codec is not yet commercialised and it was available to us as a beta version, just a few days before the event. There was no guarantee that it would work at all and indeed there were many problems to be resolved before the codec was able to deliver a reasonably stable sound quality. Even so, it was necessary to reset it every hour or so. In the end, the software encoding proved to work fine,

although the choice of multichannel audio bitrate was limited to 160 kbit/s (which was judged by some ”golden ears” as being too low).

Some results of the trial

The main purpose of this technical experiment was to integrate a multichannel and HE AAC-encoded sound programme with a P2P streaming server and then webcast it across the Internet. This objective was achieved. Many listeners were impressed by the high quality and smoothness (no interruptions) of the sound delivered.

On the downside, however, the number of users was not impressive at all.

- Number of unique users: 52;
- Number of sessions: 914;
- Number of different countries: 13;
- Average session duration: 10 min 44 sec;
- Peak number of users: 11.

Because of the very low audience participation, the network part of the experiment was rather non-conclusive. The signal contributions from other peers were small. Practically all contributions came from the main server.

The reasons for such a low audience are similar to those already encountered on previous events. We are not able to bring together sufficient numbers because we do not target the right people and our announcements are too late.

Because the system became operational only one day before the event (actually on the Thursday evening), we could not announce this event well in advance, so very few people were actually informed about it.

In addition, no signal was available during the Saturday (i.e. the day of the event), so the potential users were unable to carry out any tests. Those who wanted to see how the system worked during the day, could not get any audio signal and may have been discouraged to try it again during the evening.

Also, Saturday evening is normally devoted to family events and is probably the least suitable for going on the Internet, except if you are a streaming enthusiast. On Saturday evenings, people generally do not care about technical experiments – they probably prefer having a good dinner.

The type of music broadcast might not have been the most attractive or popular either (but this is a matter of taste).

Conclusions

This experiment showed that the Internet is a mechanism which is able to provide excellent quality for live streaming of multichannel audio, while serving a large number of people worldwide in a cost-efficient manner. The experiment was the world’s first attempt to integrate HE AAC software encoding with P2P internet distribution using Octoshape technology, all in real time. The sound quality of AAC at 160 kbit/s was outstanding for the whole duration of the event (one hour), in spite of the fact that the AAC software was only a beta version.

In future, we need to find ways of engaging more audience participation, in order to obtain more valid P2P statistics. We should endeavour to host P2P services from the EBU in Geneva.

And finally, we should consider implementing a live streaming event of high-quality video (together with multichannel audio). A dedicated internet event (which is not simulcast by any traditional chan-

nels) should be identified, offering attractive content.

Acknowledgements

The authors would like to thank all colleagues who contributed to the success of this experiment. It showed that there are many technical enthusiasts in the EBU, and elsewhere, who are willing and capable of helping when you most urgently need them. They are too many to be listed here.

However, special thanks should go to the managements of Eurovision and the EBU Technical, Radio and Communications departments.

The EBU team at Prix Europa 2006
(Clockwise from the left) : **Mrs de Giorgi, Franc Kozamernik, Hans Hoffmann, David Wood and Marco de Giorgi**

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[6] APTX: **http://www.aptx.com**

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