The launch of HDTV ... in Austria

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ORF

ORF – the Austrian public broadcaster – started in the early 1990s to experiment with HDTV (1250) during the Winter Olympic Games in Albertville (1992). Further productions followed – in cooperation with NHK, Japan – including the famous New Year's Day Concerts from Vienna. Since 2004, ORF has been producing TV programmes in HD on its own, especially major cultural events such as the *Salzburger Festspiele*.

This article describes ORF's experiences in converting to HD – particularly in relation to the Euro-2008 football finals which were jointly hosted by Austria and Switzerland in June 2008.

What would have been the right moment to launch an HD channel in Austria? Usually these things are triggered by a special event and, in the case of ORF, the initial event was the Euro-2008 football competition in Austria and Switzerland. In September 2007, the ORF management decided to transmit the 2008 European Soccer Championship in high definition on one of its own channels. The legal situation in Austria allows for only an HD simulcast of an already existing SD programme. So the channel ORF1 was chosen for the additional HD broadcasts, because this is the channel which carries most of the sports programming, blockbuster movies and imported series. And that is how ORF1HD was born.

Concepts and workflows

The aim of the project was to provide HD operation without any simultaneous SD paths. That means upconverting all SD material before playout. One HD event per day would be distributed during the inaugural phase.

These HD events would consist of live events on the one hand – especially in the field of sports – and films (blockbusters, series, etc.) on the other hand. In-house productions were planned for a later phase, after the HD start. Two major workflows were implemented for ORF1HD – a live work-flow and a film workflow *(see Figs 1, 2 and 3)*.

The new continuity suite for ORF1 was planned and realised in HD and is completely tapeless. All incoming SD material has firstly to be upconverted to HD. At the end of the production chain, the HD material then has to be converted into the required format for satellite distribution (e.g. DVB-S, 576i25 and/or 720p50).

To realise the workflows, we had to choose and install different equipment types and systems in our OB Vans, SAT uplinks, Control Room, Continuity Suite, Edit Suites, Graphics area, Storage area, Ingest area, Playout area and so on – all within a time-frame of eight months. Apart from an HD-SAT Uplink and two HD-ready OB Vans, no HD infrastructure was then available at ORF. You can imagine what kind of a challenge we were facing !

The different coloured boxes in the diagrams are very important as they demonstrate the inhomogeneous codec landscape we were confronted with. That meant a lot of encoding, decoding and transcoding processes, which should really be avoided as much as possible. The FlipFactory was to become the main transcoding engine at that time.

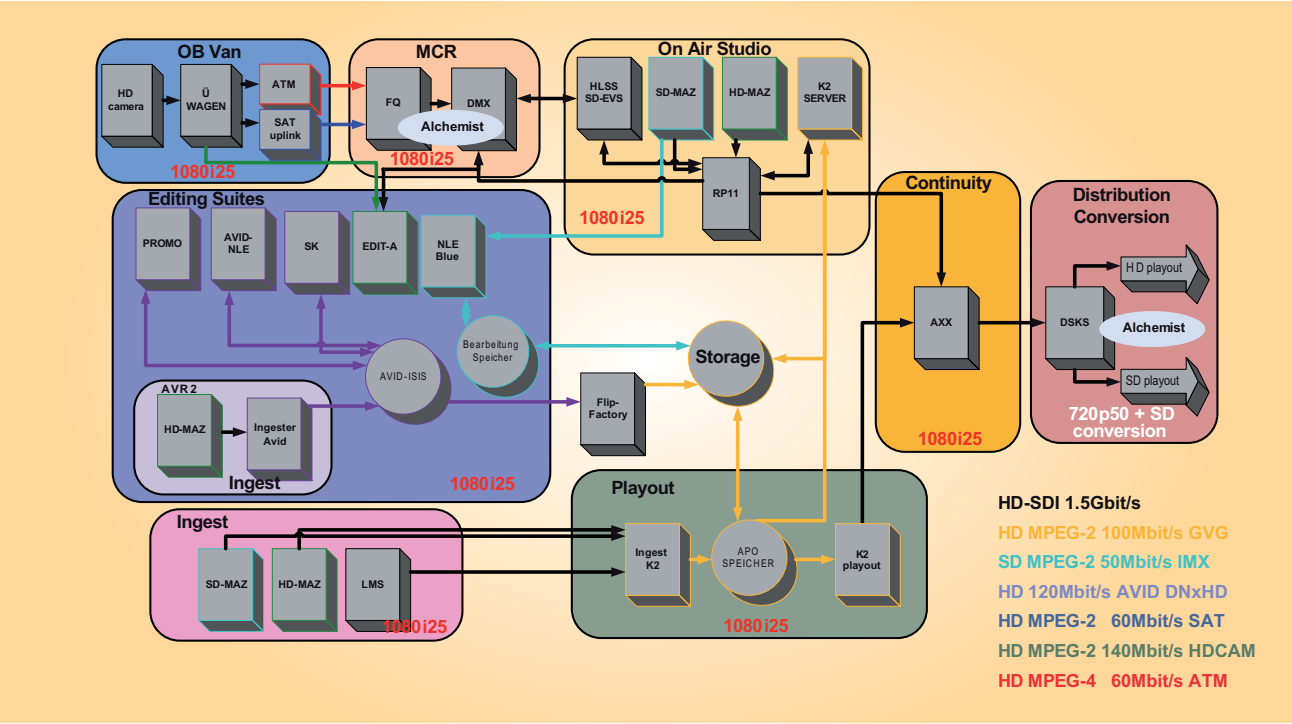

Figure 1
Overview of HD workflows

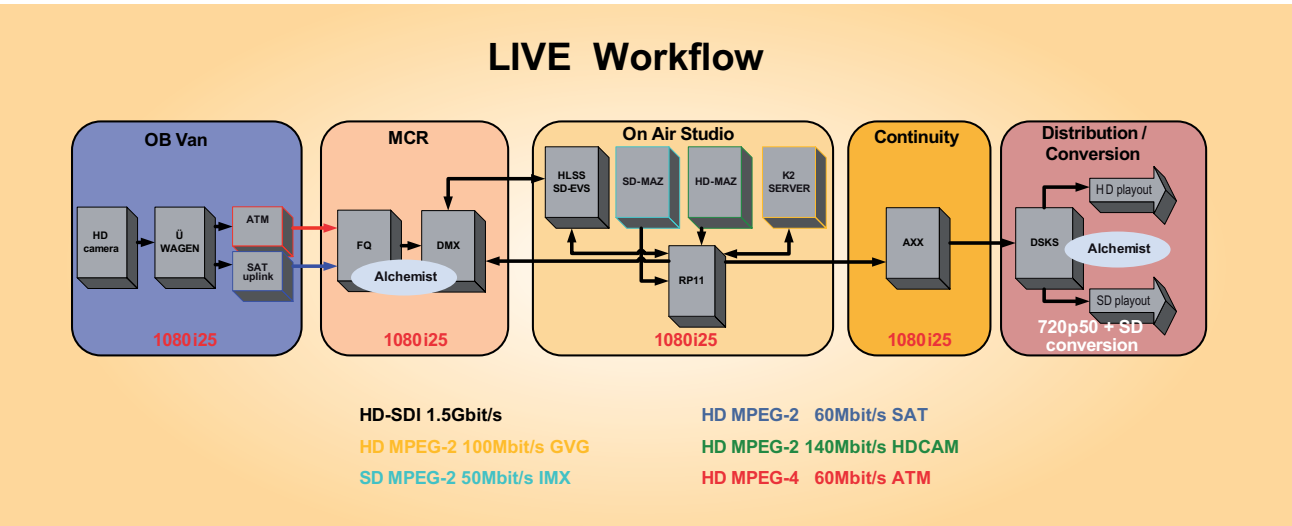

Figure 2
HD workflow for live programmes

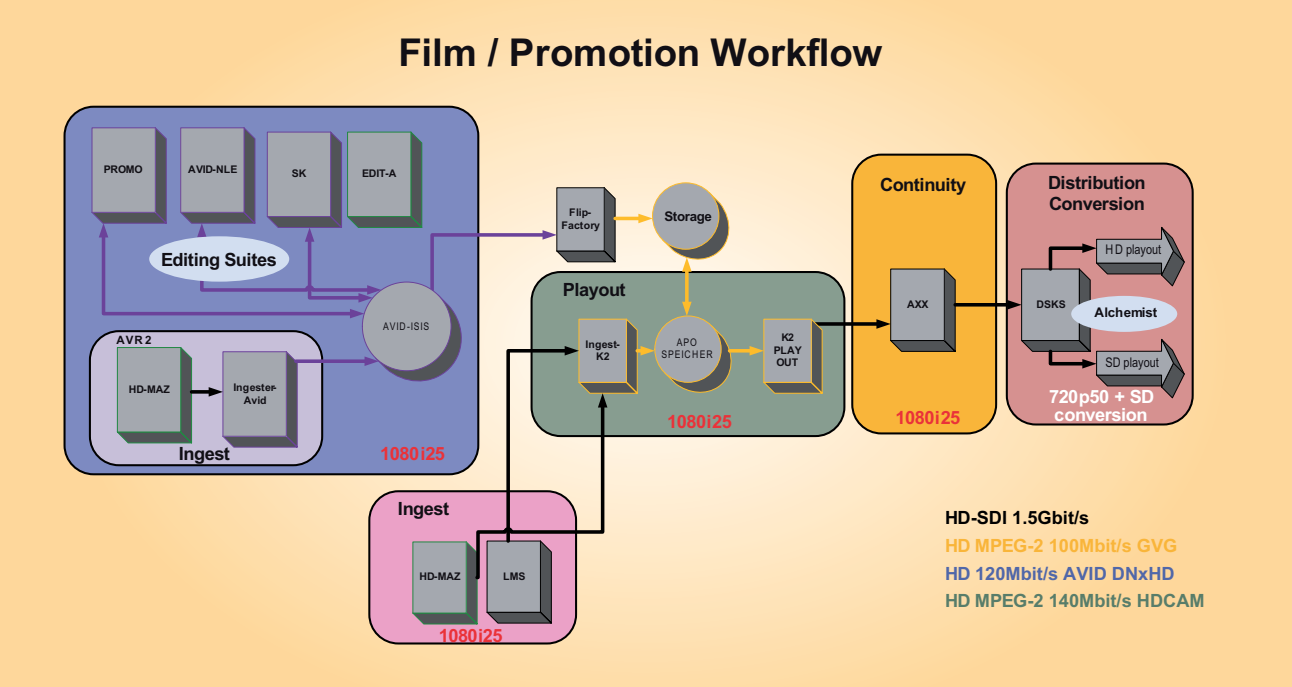

Figure 3
HD workflow for films

HD formats at ORF – 1080i25, 720p50

The question at the time was: *what scanning format would produce the best picture quality for High Definition?* The ORF decided to implement the 1080i25 format for acquisition, contribution and production and the 720p50 format for distribution to the end-user. Both formats have their strengths and weaknesses, and both are based on relevant EBU Technical Recommendations. But why didn't we go for one unified format, rather than two different formats? The results of the intensive encoder tests carried out by the EBU and IRT were conclusive. We thus opted for 720p50 for distribution in accordance with the public broadcasters in Germany and Switzerland.

Where HD production is concerned, we were convinced that the 1080i25 format was the right choice. The main arguments were: 1080i25 equipment was readily available from different manufactures and our tight schedule did not allow for any delays. 1080i25 is widely used as a contribution format in the international arena, such as by the EBU and many rental OB Van providers. HDTV cameras using this format as their native resolution were readily available. The Sony HDCAM tape format was already in use at ORF but HDCAM-SR and its tapes were much too expensive for a large-scale operation. All earlier HD productions by ORF were using the HDCAM format, so there was some HD content already in the archive. Also, for international sales, only 1080i25 was relevant at the time.

Notwithstanding these choices, our long term target is to produce HD programmes in 1080p50.

Equipment

As mentioned before, ORF had almost no HD equipment and no HD infrastructure when the decision was made to launch ORF1HD. Because of the very short time available for implementing the HD workflows, only a basic infrastructure could be realised, with a view to progressively expanding the infrastructure after the initial period. A team of experts from ORF's planning and design division, and from the production and maintenance departments, was founded to advise on and manage the transition to HD, in a well-coordinated manner. It was not possible to make extended equipment tests and experiments, and the training period for the operators had to be as short as necessary.

Consequently, we chose components, devices and systems that we already used for SD production and which were familiar to us *(see Table 1)*. Nearly all of them were also available in HD.

Table 1
Production equipment used in the initial HD phase

Ingest & Playout	Thomson/GVG K2HD, AVID AirSpeed
Editing	AVID-Mediacomposer/Adrenalin, ISIS (16TB), Protools, EVS XT[2]HD
Video switcher	SONY MVS-8000GHD, N-Vision NV5000-XP-HD
Router	EVERTZ EQX-System, N-Vision NV9000 System
Camera	IKEGAMI HDK-79EXIII / CCU 890
Format converter	Snell&Wilcox Alchemist Ph.C HD, EVERTZ 7710XUDC-AES4-HD
Visualizing	VIZ-TRIO HD / VIZ HD
Compositing	FinalCutStudio HD
VTR	HDCAM (HDCAM-SR)
File-format conversion	Telestream FlipFactory

We had to establish an HD control room for the feed-combining, an HD continuity suite within playout and ingest, and an HD Non-Linear Edit (NLE) Suite for post-production. We also had to upgrade the existing NLE equipment used for channel promotion and to upgrade our two-year-old HD-ready OB Vans.

OB Vans

Our two OB Vans were equipped as follows:

- HD or SD operation possible;
- Max of 8 cameras (HDK 79EXIII);
- Hybrid or Triax cabling;
- SONY Switcher MVS8000GHD;
- 2 x EVS 6-channel XT[2]HD;
- 4 x HDCAM or 4 x IMX or mixed;
- Dolby 5.1 (Lawo mc^{2}66).

SAT-Uplink

- Uplink of 1 x HD or 2 x SD;
- HD: MPEG-2, up to 80 Mbit/s;
- SD: MPEG-2, 8 - 24 Mbit/s;
- EDIT: EVS Cleenedit, EVS 6-channel XT[2] HD;
- Weight: less than 3.5 tons.

Control room

- Complete tapeless operation / 1080i25;
- SONY MVS-8000GHD;
- EVERTZ-Router EQX 576 x 576 (used: 270 x 324);
- 3 x VIZ-TRIO HD;
- 4 x Stills Stores (VIZ-HD);
- 1 x HDCAM + 2 x IMX for emergency and recording.

Continuity Suite

- Complete tapeless operation / 1080i25;
- N-Vision NV5000XP HD Mixer and NV9000 System Router;
- 3 x VIZ-TRIO HD;
- 4 channels K2 HD for playout;
- Harris Automation;
- Dolby 5.1 / Dolby E.

K2 – Playout and Ingest Server

- Full redundancy (mirrored system);
- HD: 100 Mbit/s MPEG-2 I-Frame;
- SD: 50 Mbit/s MPEG-2 I-Frame;
- 460 hrs storage capacity (100 Mbit/s);
- 2 x HD IN;
- 14 x HD OUT;
- 32 x SD IN/OUT.

Experiences

As with all major installations, there is never a direct path to success without encountering any problems.

The tight schedule made it necessary for us to completely trust the manufacturers … but sometimes during the eight months, that was not very easy. As often happens with new products, we had some teething troubles. But with the help and support of the manufacturers, we were able to solve most of the biggest problems. Additionally, we were on a very tight budget – but this seems to be the norm nowadays.

In the consumer market, the number “720” sounds a lot less than “1080” and not many consumers know the difference between “interlaced” and “progressive”. Most home equipment (satellite

Abbreviations

720p/50	High-definition progressively-scanned TV format of 1280 x 720 pixels at 50 frames per second
1080i/25	High-definition interlaced TV format of 1920 x 1080 pixels at 25 frames per second, i.e. 50 fields (half frames) every second
1080p/50	High-definition progressively-scanned TV format of 1920 x 1080 pixels at 50 frames per second
AVC	(MPEG-4) Advanced Video Coding, part 10 (aka H.264)
CRT	Cathode Ray Tube
DVB	Digital Video Broadcasting http://www.dvb.org/
DVB-C	DVB - Cable
DVB-S	DVB - Satellite
DVB-T	DVB - Terrestrial
GXF	General eXchange Format
LCD	Liquid Crystal Display
NLE	Non-Linear Editing
OB	Outside Broadcast
TFT	Thin-Film Transistor
VITC	Vertical Interval Time-Code
VTR	Video Tape Recorder

receivers, flat-panel displays, etc) need to be set up properly – otherwise, the video quality will not be as good as what it was meant to be. You just need to look at the array of flat-panels in a large non-specialist TV shop to see that, without proper setting up, there can be signifiacant picture-quality differences between the brands and models.

It is important to be careful in using up- and down-converters. Every conversion leads to a loss of picture quality. The high performance of Alchemist from Snell&Wilcox worked nearly perfectly, but visual elements like the vertical lines of a football field, created incredible visual distortions in SD. The possibilities of controlling this were not sufficient. Software changes were necessary. We are still today working with the beta software version.

The inhomogeneous codec line makes transcoding a necessity. This can result in possible conversion artefacts. But a transcoding platform is to be installed at ORF. We use the FlipFactory as a central element in our HD tapeless workflow. This inhomogeneous codec landscape makes the launching of a tapeless workflow in HD more difficult than in SD. But on the other hand, there is a chance to introduce tapeless operation. The VTR technology on the market is not a real alternative. The manufacturers have to be persuaded to develop devices and systems that allow the use of unique codecs within our workflow.

VITC is not well supported in the HD domain and we had to add some TC inserters because we need VITC for subtitling, for instance.

Of course the picture quality starts with the camera, the control interface and the monitors – which are changing from CRT to TFT panels. This is forcing the camera control operators, for example, to find the right aperture adjustment for the cameras. The aperture is very critical, because we use a CRT class 1 Monitor for camera matching. On such a monitor, a wrong aperture is not visible, but on an LCD or Plasma monitor it could look terrible. So an additional LCD monitor for the camera control operator is very useful for checking the picture quality.

Large TV screens require better frame-stability from the original camera, so it is important to take steady shots when using portable/handheld cameras. You must also take care of the lip synchronisation throughout the whole signal chain – which leads to more timing delays.

Support for Dolby E is often insufficient. Many devices or systems do not, or incorrectly, support Dolby E. The special problem here is the alignment of the guard interval that is mostly not redeemed. The results are disruptions, which don't sound very good. The Alchemist, for instance, is not able to handle the alignment correctly. Therefore, we obtained additional devices from Snell&Wilcox to install a workaround. We hope to have the Dolby E option soon. The AVID AirSpeed can't play out an HD signal with Dolby E, the FlipFactory was not able to transcode an HD file (from a Quicktime Reference File with Dolby E) to a GXF file for playout on a K2. However, 16-bit Dolby E is now possible and 20-bit Dolby E is in the process of development.

In order to increase HD and HD material awareness, you must make sure you work hand-in-hand with the programme and marketing departments. This means creating awareness of original HD

content, deciding on how best to apply HD branding on the screen (the HD channel logo).

When using HD copies from the rental companies, you have to factor in extra charges, which means a flexible budget planning. In this changing environment, it is necessary to find the right mix of SD material – upconverted – in the HD programme stream. There is of course a visible quality difference between the SD and HD material but it is hardly noticeable if good original SD material is used.

Austrian market

Austria has 3.2 million households and around 150,000 HD set-top boxes are in use. This compares with a figure of 1.5 million HD-ready flat-panel screens already sold on the market. In addition to satellite distribution, HDTV is offered via digital cable networks in high density areas. We do not broadcast HD on the terrestrial DVB network.

Next steps

Having mastered the Euro-2008 and, more recently, the Olympic Games from China, we are keen to start increasing the daily number of HD programmes we broadcast, currently running at just one per day.

Major sports events – such as the Olympic Games, the Champions League and the skiing slalom in Schladming – are of course already produced in HD (usually by a host broadcaster). Blockbuster films and popular TV series (bought in) are also nowadays in HD. But our aim was to start broadcasting internally-produced HD as soon as possible.

Our top TV spring event – "Dancing Stars", a live show – started this March for the first time in HD, thus launching our in-house HD productions. We want to continuously expand our inventory of HD-enabled equipment, cabling, studios and other production facilities – as part of the regular renewal process – but this of course will depend very much on the financial situation, going forward.

Manfred Lielacher received his degree in electronics in 1979 and worked for Bosch and Sony Broadcast until he joined the ORF in 1989. Positions he has held include Production Supervision and Broadcast Management.

Since 1998 he has been Head of the ORF TV Production Department, responsible for over 450 employees as well as several large-scale production facilities and OB Vans.

Ulrich Schönfisch studied information technology at the former *Karl Marx Stadt*, Germany, with an emphasis on ASIC design. He then started to work in the field of chromatography.

After his move to Vienna, Austria, he worked as an application developer until he joined the ORF in 1991 as a project manager. In this position, he has been mainly involved in planning and designing of a number of technical facilities at the ORF including, most recently, the coordination of the technical activities of the HDTV launch.

ORF1HD receiving data

- Distribution via DVB-S on ASTRA TP57 (f = 10,832 MHz, SR: 22,000, FEC: 5/6, pol.: horizontal) and also via DVB-C;
- Compression format: MPEG-4 AVC H.264 HP@L4 (14 Mbit/s);
- Distribution format: 1280 x 720p50;
- Conditional Access: cryptoworks;
- DRM: Copy protection must be possible;
- Audio: 2 x PCM, Dolby AC3 Multichannel Audio;
- HD content: live sports events, movies and series, TV shows.