Broadcast recording, archiving and video browsing on ProSiebenSat.1

To be able to see when and where programme contents are shown and to comply with the legal requirements of the state media authorities for compliance recording, broadcasting group ProSiebenSat.1 is recording its programmes with an integrated solution which covers tasks such as archiving and video browsing. The digital broadcast recording of all available playout signals (video and audio) can be saved for a period of 90 days, and made available to employees quickly and comfortably as required. In addition to automatic IPTV and IP based recording of all channels around the clock, individual recordings should also be possible.

ProSiebenSat.1 is recording its programmes with a system which also covers tasks like archiving and video browsing for the purpose of documentation and monitoring. Video and audio of all channels played out are supposed to be archived for a period of 90 days and should be accessible to the staff. Beside the automatic IPTV and IP based 24/7 recording of all channels, the system also allows single programmes to be recorded.

Introduction

The IPTV and IP based recording of all playout signals on ProSiebenSat.1 takes place with the digital broadcast recording system iCue-DSS from Teracue, which uses the existing standard IP infrastructure as a distribution and transmission medium. Based on the iCue streaming system it has been integrated in the IT landscape of the broadcasting group and enables the digital distribution, management and recording of broadcast contents. At the same time as the current broadcast recording, employees and editors can access the contents from their desktop during the recording – both live and later on-demand. What was initially only available to employees in the legal department and the area of broadcast technology playout, to be able to see which contents were broadcast when and where, is now available for other departments, to whom the iCue system has been made accessible, in order to realise a company-wide IPTV network.

The system entered operations in 2006, and has since been continuously enhanced with the help of modular IPTV product components and adapted to the growing requirements. In this context the number of recorded channels has grown from an initial twelve (ProSieben, Sat.1, kabel eins, and all TV broadcasters for Austria and Switzerland), to now total 31 channels. After a start in MPEG-2-SD, all signals are now encoded with the new encoder generation (ENC-200/ENC-300 HD) in H.264. The only thing required was an exchange of the encoders – the servers remain unaffected by the change.

Since the start of operations, the systems’ memory requirements have grown on a continuous basis, which has been resolved by the subsidiary company ProSiebenSat.1 Production, which is responsible for all of the playout technology and playout services of the broadcasting group, with a central NAS memory and an HSM (hierarchical storage manager) long term memory.

Originally, it was only playout signals that were recorded. Now, however, live signals from satellites are also subject to an extended monitoring. To this end, “DVB to IP” Gateways and a monitoring recording by Miravid-multiviewers have been set up. The storage for the broadcast recording has been configured for a time frame of 90 days for every broadcaster. The national broadcasters ProSieben, Sat.1 and kabel eins are stored for 180 days. A change and adjustment of these time frames to new requirements is possible at any time.

System

Subsequent to the step-wise development of the system (image 1), a wide range of different video applications are now served. Via the iCue player application, up to 300 people are able to access the recordings directly via their Office PC (status: 2012). In addition to the entire broadcast sector and the technical team, broadcast operations and broadcast management, the sales division is also connected to the system. It is used here to export commercials and small recording snippets, as well as entire commercial breaks or special forms of advertising for the purpose of providing proof for advertising customers and for additional sales activities. In addition to this the system is also used in the legal department to provide proof and in editorial meetings for subsequent reviews, such as in the scope of debriefings for scheduled shows and in research by journalists and editors.

The system architecture is based on a network-based server-client streaming system and uses distribution on video over IP technology. The full system is scalable and can be extended on a modular basis according to requirements. The realisation of the data storage server (DSS) was completed in a multistep process.

Live Input

In the first stage of expansion, twelve SD playout signal sources should be streamed and recorded. In the scope of a compliance recording it was therefore possible to see which signals were transmitted and how. To this end, 14 encoder blades of the ‘Teraedge ENC-100’ type, of which two were intended for cases of failure, were installed. At the beginning the version with SDI input (non-embedded audio) was used, with an integrated embedded real time operating system (eCos on Flash module), which converts audio and video signals such as TV channels or camera and microphone signals in near real time into an MPEG2 multicast transport stream and provides them in the network.

The original encoder blades have now been extended with the new generation of ENC-200 encoders for SD signals and for the newly added HD signal sources with ENC-300 encoders, which both support embedded audio signals.

All SD/HD signals are now MPEG-4-H264 encoded and saved in the IP network.
as a live stream. The number of encoders was increased accordingly for the now 31 signals/broadcasters that are to be monitored. This means the video signals are available in near DVD quality and in full screen resolution (720 x 576 pixels and 1980 x 1080 for HD) and movement resolution (25 images per second). SD signals are encoded with a bandwidth of 2.5 Mbit per second, the HD signals with 3.2 Mbit per second. For LoRes signals and backward channels of external TV broadcasters, it is possible for the screen resolution (half D1, SIF/CIF) to be reduced to save storage space and bandwidth. In this context, the transmission speed can be reduced to up to 1500 kbit per second.

The encoder blades have no moving parts such as ventilators or a hard disk, can be operated in a single or multi-blade chassis, and are based on the blade standard of the European card format. They are hot-pluggable, which means they can be exchanged during running operations without having to switch off the entire chassis previously. The aspect ratio of the adjacent signals is automatically recognised, so that the aspect ratio flag in the transport stream is automatically set at 4:3 or 16:9 if it is a PAL source with WSS signal. Playback components such as the iCue player (PC player for streams), which read out this flag during the initialisation, display the video contents in their native resolution. The rapid and straightforward administration and configuration of the encoder is possible using a standard web browser user interface.

For the project, the element manager application (image 2) from Teracue was extended, which is responsible for the monitoring and management of the complete system. With this device, all of the encoders are monitored and displayed in a uniform interface, through which the status of the system and the iCue servers can be enquired after. The monitoring of signals from or to satellites is completed with the help of DVB to IP Gateways. The received satellite feeds are summarised in a Multiviewer screen, and are also streamed and recorded via an ENC-300 DVI encoder. The contents generated in this way serve as an overview and provide proof of the type and kind of the signals that are transmitted, and furthermore enable a targeted search for errors. DVB-C/S/T signals are implemented for the network without transcoding or re-encoding in the original DVB quality. Via the network output, IP streams in the native DVB bit rates are generated from the satellite signals at around 6,000 kbit per second.

Recording, memory management and provision

Two redundantly configured streaming servers and a central file memory with 18 TB were installed in a central position in the playout centre (technical operations) of the ProSiebenSat.1 Production. In order to realise a fail-over system, they are operated in the master-slave group so that an automatic switchover occurs in the case of damage to the server. They record the live multicast streams provided by the ENC and DVB to IP Gateways in the context of a broadcast recording service around the clock without outages. In addition to the automatic long term recording, manual individual recording is also possible in order to archive special broadcasts from one production. The archived videos can also be exported for distribution on DVD/CD or via Email/FTP server and for further use for different broadcast applications.

Playback

Every employee who has the iCue player installed on their workstation (image 3) can view the recorded broadcast recordings or the live signals in DVB quality on their desktop PC. Recorded videos start in under a second via mouse click and the user can...
jump to the required viewing point using a timeline or the go to function without any protracted rewind or fast forward necessary.

On the basis of an interface to the broadcast planning software the daily recordings are automatically linked with the meta and programme data of the broadcast, so that the individual programme elements from a broadcasting schedule within the iCue player can be selected directly with just one click to rapidly reach the required position in a 24 hour recording.

During the playback, SD and HD contents are supported in both the MPEG-2 and MPEG-4-AVC/H.264 format. For detailed analyses, viewing individual frames is possible, in the context of which every individual frame of the recording can be selected (frame FF, frame Rew). The video recordings can also be trimmed directly in the player, individual sequences can be extracted from the continuous recording, and new videos can be created from cuttings of existing videos (multi selection). In addition to this, according to the user rights, complete day archives or freely definable sequences and time spans can be exported directly from the player. A login and rights query which is managed by the iCue streaming server enables a multi-step authorisation and access level for access to protected video contents through different users and departments. The layout of the player can be individually adjusted, with it possible to freely position elements such as video windows, stream/video lists and EPG via drag and drop.

**System upgrades**

With the integration of the new encoder, the architecture which is initially configured on MPEG-2-TS was upgraded with the ability of processing other digital streaming formats such as H.264 streams in this case. The devices tested and approved by Teracue create transport flows that conform with ISO standards and are supported by the complete system as well as the workflow. Since this is an open standard system, it is also possible to use encoders or DVB Gateways from third party service providers. No upper limit is intended for the number of ENC encoders supported by the complete system as the volume of the live stream is only dependent on the available bandwidth of the network.

**Saving**

The saving and archiving of the recorded transport streams occurs with the help of a combined system which is based on the redundant combination of the two iCue servers, as well as one of the NAS systems provided by ProSiebenSat.1 Production. The online memory currently offers a net storage capacity of 18 TB. This memory is used for the broadcast recording of all channels, valuable additional recordings and the recording of the Multiviewer return

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**Table 1. Video memory calculated for a system consisting of two iCue servers**

<table>
<thead>
<tr>
<th>Model</th>
<th>Total video memory</th>
<th>Number of days for a maximum of 1 channel</th>
<th>Number of channels for a maximum of 90 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICue-DSS-160</td>
<td>5 TB (2 x 2.5 TB)</td>
<td>175 days</td>
<td>2 channels</td>
</tr>
<tr>
<td>ICue-DSS-320</td>
<td>10 TB (2 x 5 TB)</td>
<td>350 days</td>
<td>4 channels</td>
</tr>
<tr>
<td>ICue-DSS-500</td>
<td>18 TB (2 x 9 TB)</td>
<td>640 days</td>
<td>7 channels</td>
</tr>
<tr>
<td>ICue-DSS-750</td>
<td>28 TB (2 x 14 TB)</td>
<td>995 days</td>
<td>11 channels</td>
</tr>
</tbody>
</table>
The selected video signals are saved on the central NAS memory by one of the two streaming server systems for the duration of one day. At the end of the recording phase, this task is taken over for the next 24 hours by the second server. During this time, all necessary system checks and diagnoses are completed on the server that is currently inactive. All in all it is possible to hold video material from around 35 days online on the NAS memory.

The recorded videos get an automatic archive date (iCue function: Archive Date): today plus thirteen days. After this period, all of the material is transferred from the iCue server to an HSM system which is also provided by ProSiebenSat.1 Production. As the material has to be held for a total of 90 days, a capacity of approx. 55 TB is made available by the HSM system in order to cover the remaining 75 days.

Video data which is older than 14 days is automatically deleted from the online memory (iCue function: Deletion Date). The deletion of video material which is older than 90 days is completed by an automatic job on the tape robot. This combination of online memory and HSM long term archive is integrated in the iCue system via an API. It enables every user to see what material is available online and what is archived on tape. If archived material is required, the user can transfer the required sequences back to the online memory themselves (Partial Restore is easy and straightforward via mouse click from the Nearline/Offline memory).

In order to realise the described archiving for the saving of the data on the servers (day 1 – day 14) and the HSM/NAS system (day 14 – day 90), as well as the integration with the iCue system, the HSM system has to fulfill the following requirements:

- The network drive (UNC path) is continuously accessible and available.
- iCue has to be in the position of writing, reading and also deleting data on the HSM system.
- To be able to use the archive and restore functions (copying, outsourcing and restoring) and quickly carry out copying tasks, access to and by the system (depending on the volume) must occur with a minimum of 60 Mbit per second. A higher rate of transfer is favourable.
- Queries for file sizes/file properties have to be possible on the bit level to be able to check original, archive and restore files for transfer and copying errors.
- A test of the interface between the iCue system and the HSM system has to be planned and must occur.

On the servers the material is held in the online memory for a maximum of 35 days but archived after 14 days. If the HSM is not available in the case of maintenance for example, the clip is not archived temporarily and remains in the online memory until the system is available again.

Security

The monitoring of the signal inputs and the encoder occurs via the element manager software (see image 2). Defective system components – such as the complete failure of an encoder or the omission of an adjacent encoder signal – are recognized and compensated by the network-based remote control and management of the reserve encoder. So that these are provided with the correct input signal, the upstream video router is simultaneously toggled.

Further disaster prevention measures are the equipping of all important system components with dual, redundant power supply units and the aforementioned master-slave arrangement of both streaming servers. If a server fails, its tasks are taken over by the other server.

In addition to the stated measures and the redundant system design there is a second, smaller backup system which is installed directly in the central equipment room in the same rack as the encoder. Both of these servers work on principle like the large productive servers but only have five TB internal memories each, where they once again hold the last 14 days of all legally relevant broadcast recordings. If considerable disturbances occur in the organisational environment or maintenance windows in the network, in the central memory or with the HSM system, this system will continue to operate safely in its enclosed form. Material which is missing in the productive system can be subsequently restored and completed from the backup system via an administration control panel.

Concluding comments

With the digital broadcast recording system for all playout signals in combination with a combined NAS/HSM memory solution, an automated solution is available to the employees of ProSiebenSat.1 Media AG for the long term archiving of all the channels that they operate and manage. Differing tools enable rapid and straightforward access to the recorded contents with adjustable video quality, as well as its monitoring and management. A redundant system architecture with multi-step access and authorisation levels provides security. Due to its modular configuration, the system solution can be upgraded, which means it can therefore be adapted to changing operational conditions in the future at any time.