

TRENDS AND TECHNOLOGIES IN DIGITAL MEDIA



4th Edition

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PREFACE

The ever-increasing media convergence demands new, comprehensive technologies and standards due to the complete digitization of all areas of media. Today, it is important to keep an eye on all media formats to ensure optimized work processes. The result is an expansion of research topics, and also the opportunity for the Fraunhofer alliance to think about its own name. The Fraunhofer institutes IIS, HHI, IDMT, and FOKUS have decided to bundle their expertise in the area of audio and images under the new name Fraunhofer Digital Media Alliance.

With developments and products for 4k/60 fps, HEVC, and MPEG-H for the television of the future, we offer solutions for the implementation of an entirely new picture and sound quality for TV and mobile devices. Second-screen applications in HbbTV applications for home use are just as important as surround sound with CINGO on tablets and smartphones. We will also show this picture and sound quality for virtual glasses systems that allow the viewers to immerse themselves in films

in a way that seems realistic. We demonstrate mobile production and reporting systems for the creation of shots on location and almost in real time.

The focus for production is on recording procedures that offer new potential for post-production. IMF-based work processes that can be used for exchange during production and as an ideal source format for all other distribution formats are becoming more and more important. Light field recording and processing increase the opportunities – well-known in CGI – now also for the recording and alteration of real scenes. Additional views and depth information can be used at any time for changing scenes or for virtual backlots.

The future of media is immersive, flexible, and mobile.



Dr. Siegfried Föbel





LIGHT FIELD OPENS UP NEW WAYS OF PRODUCING FILMS

The number of cameras used on set is growing constantly in order to offer additional views and perspectives for later editing in post-production. Today, there is barely a film that makes it to theaters or TV screens without post-editing or the addition of effects. For filming work, the cameramen, in addition to the main camera, use arrays containing additional cameras in various arrangements. With these multi-camera systems, additional details are recorded right on set. These details can then be added to the main scene in various steps or can be used to adapt or change the scene itself.

Light-field technology, as it is known, can be used to record all light beams within a specific area, i.e. a scene, and use them to reconstruct a view from all possible positions together with the associated depth information. These depth maps are then used as the bases for various effects and post-editing steps in post-production. This means that the focus of a scene can be shifted afterwards, and the perspective can be changed. Virtual panning and the addition or removal of objects and details

is an additional benefit of depth-based post-editing. This makes this type of image data processing particularly useful for applications such as virtual backlots. The clear improvement brought about by the use of light-field technology for this application is represented by the use of objects that have not only been recorded in the distant background, but also the use of people and objects found further to the front of the scene. To this end, views from a virtual camera can be crea-



ted for various positions in the scene. The natural look is a result of the automatic and correct addition of motion parallaxes that comes about when various objects are distributed in a landscape at different distances from one another and the viewer, when looking towards the horizon, moves laterally parallel to these objects. Conventional static recordings cannot achieve that in this form.

Making these new options for real recordings available requires easy-to-handle tools. The Fraunhofer IIS team led by Frederik Zilly has tackled implementation in professional post-production tools, in addition to algorithmic development of processing mechanisms for light-field and multi-camera recordings. By means of a plug-in, the Fraunhofer scientists can now offer for NUCLE by The Foundry, a professional tool for processing this camera data, within the environment of the post-production software. With this Fraunhofer plug-in, various views can be calculated and different camera positions can be selected. A change of the depth of field and

zoom is also possible. Images from multi-camera arrays in a grid-like arrangement can be used as input material.

Data from these arrays is processed via disparity maps, which are used as the basis for producing depth maps, for depth map-based color correction, and for quick »matting«. Converting the images into point clouds also allows a change to the lighting of an object (relighting).

Together with Stuttgart's media university HDM, the scientists at IIS have drawn up a film project to evaluate the possible uses of light-field technology for real recordings and practical conditions. The result of the project is an initial pilot clip »Coming Home« with real scenery and real actors in which the recording for effects and changes to be added later was carried out with a multi-camera system and the algorithm from Fraunhofer IIS. When the clip was presented to a specialist audience at the Technology Summit on Camera, it was received with great interest and a discussion regarding the fu-

ture, changes, and on-set possibilities. At the IBC, the team led by Frederik Zilly will present the light-field tools as a plug-in suite for NUCLE, including as a license model, and will look for professional first adopters who would like to test the tools in their productions together with the Fraunhofer IIS scientists.



Benjamin Bross
Fraunhofer HHI

HEVC ALLOWS SHARPER IMAGES

The future of television lies in crystal-clear, ultra-high-definition images. At the moment, however, home televisions have barely been able to provide this pleasure. This is because higher definition also means that a much higher volume of data must be transmitted. Data masses for which the conventional compression standard H.264 is not designed. This is where the new HEVC standard comes in, a standard that has been developed by renowned electronics manufacturers hand in hand with researchers at the Fraunhofer Heinrich-Hertz-Institut HHI. HEVC stands for „High Efficiency Video Coding“. But what exactly is behind these four letters? Benjamin Bross, project manager at Fraunhofer HHI, is able to answer our questions.

What are the benefits of HEVC?

With this compression standard only half as much data need to be transmitted on a channel compared to its predecessor H.264 – while retaining the same picture quality. That is how the standard allows for the transmission of ultra-high-definition 4K television, i.e. images with four times as many pixels as HD.

Is HEVC already being used?

Large events such as the soccer World Cup and the Olympics have made use of HEVC – meaning that these events could

be shown in 4K definition. Sky has also transmitted Germany's DFB Cup and the Champions League final in high definition to selected sports bars using the HEVC encoder which was developed at Fraunhofer HHI. Netflix, too, is already using HEVC for its 4K videos.

When will people get to benefit from HEVC when watching day-to-day TV programs?

From the beginning of 2017, the digital terrestrial TV standard DVB-T will be replaced with DVB-T2, which is based on

HEVC. For TV viewers, this means that they will be able to see programs in high definition (HD) instead of merely standard definition. The process ought to be faster in the area of video-on-demand.

The latest smartphones already have a chip that can decode and play HEVC videos; older smartphones will receive HEVC support with Android Lollipop. Internet telephony on the iPhone 6 is also already based on HEVC.

Will HEVC smooth the way for new technologies?

Definitely. One good example is video with a wider contrast scope, known as „High Dynamic Range“ or HDR. The latest TV sets support HDR and can show, for example, stars very brightly while the rest of night sky is shown in pitch black. This higher contrast is usually combined with higher definition, following the maxim of „Not only more, but better pixels.“ HEVC and HDR therefore complement each other perfectly. Hollywood has already remastered a number of films with

HDR, such as Life of Pi. Furthermore, the Blu-ray Disc Association has defined precisely this combination of 4K, HDR, and HEVC for the successor to the Blu-ray disc.

Are there any new developments that are based directly on the HEVC standard?

Yes, there are. At the IBC, for example, we will show how fade-in commercials and overlays – such as the user interface – can be added directly to the compressed HEVC video material. This saves the effort of decoding the material before the information is added, and then encoding it again. One good application example is the set-top box: it shows an overlay over the video containing a selection menu that can be used, for example, to select the TV channel. The overlay can now be added to the cloud; the set-top box only needs to decode the processed bit stream and forward the menu control entries made by the user to the cloud. Interviewed by Janine van Ackeren



MPEG-H AUDIO – THE NEXT GENERATION OF AUDIO TRANSMISSION

The next leap in technology for the world of television is just around the corner. The magic word is ultra high-definition television (UHDTV). As far as images are concerned, this means higher resolution, a larger dynamic range of colors, and a higher image repetition rate. For audio, meanwhile, there is a small revolution going on in the processing and transmission of audio signals. The keywords here are personalization and a three-dimensional sound experience. While for the three-dimensional sound experience loudspeakers are added at various levels to veritably envelop the viewer, personalization allows viewers to adapt individual audio elements, such as the dialogue, to their own requirements. To achieve this, individual audio elements are not mixed at the broadcaster's end, but are rather merged to form the final audio mix in the receiving device based on the viewer's settings. This technology is known as object-based audio transmission.

The foundations for the next generation of audio transmission were laid in MPEG with the MPEG-H 3D Audio standard. The Fraunhofer Institute for Integrated

In the future, MPEG-H audio will allow TV audiences to adapt the audio signal individually. As an example, viewers can adjust the volume of their TV program's dialogue independently of the background noise.



Circuits IIS in Erlangen was a main contributor to the development of the standard which offers various options for transmitting audio signals. In addition to the tried-and-tested method of transmitting the individual audio channels of the loudspeaker signal directly, the MPEG-H 3D Audio standard allows the use of a scene-based representation of the audio signal (Higher Order Ambisonics). In addition, the individual elements of the audio signal can be transmitted as audio objects, as they are known. The MPEG-H 3D Audio standard also allows the transmission of a mix of various forms of representation. In practice, it is to be expected that the audio signal is comprised of a channel- or scene-based description of music and effects, known as the sound bed, and certain audio objects that largely contain speech elements.

This offers the following benefits to the viewer and the producers:

- A three-dimensional sound pattern creates an entirely new sound

experience and involves the viewer much more in the action.

- The ability to change audio objects in conjunction with the overall sound experience offers new personalization options to both the viewer and the producers.
- One typical example of personalization is »Dialogue Enhancement«. This offers the viewer the ability to change the volume of the dialogue relative to music and sound effects. This means that playback can be adapted to the viewer's own hearing and the current environment.
- Another example is the issue of audio description. If the audio description track is transmitted as an audio object, the viewer can select it when required and, depending on which device is being used, play the mix through the loudspeakers or the headphone output.
- Transmissions of sporting events allow a whole range of innovations: In addition to the option of selecting from various commentators (e.g.

home/away team), the entire experience can be changed by increasing the volume of the stadium atmosphere and replacing the TV commentary with the stadium announcer.

The examples listed are only an excerpt of the personalization options offered by audio objects.

At the Fraunhofer booth at the IBC, Fraunhofer IIS will showcase the possibilities offered by MPEG-H Audio and will also show the necessary adjustments to be made by broadcasters.

HBBTV APPLICATION TOOLKIT

The HbbTV market is growing rapidly in Europe and across the world. This growth generates a huge demand for HbbTV applications. Often, HbbTV applications are developed to be available for a short period only to accompany a certain TV event or breaking news. Those apps do not justify long and costly implementation processes.

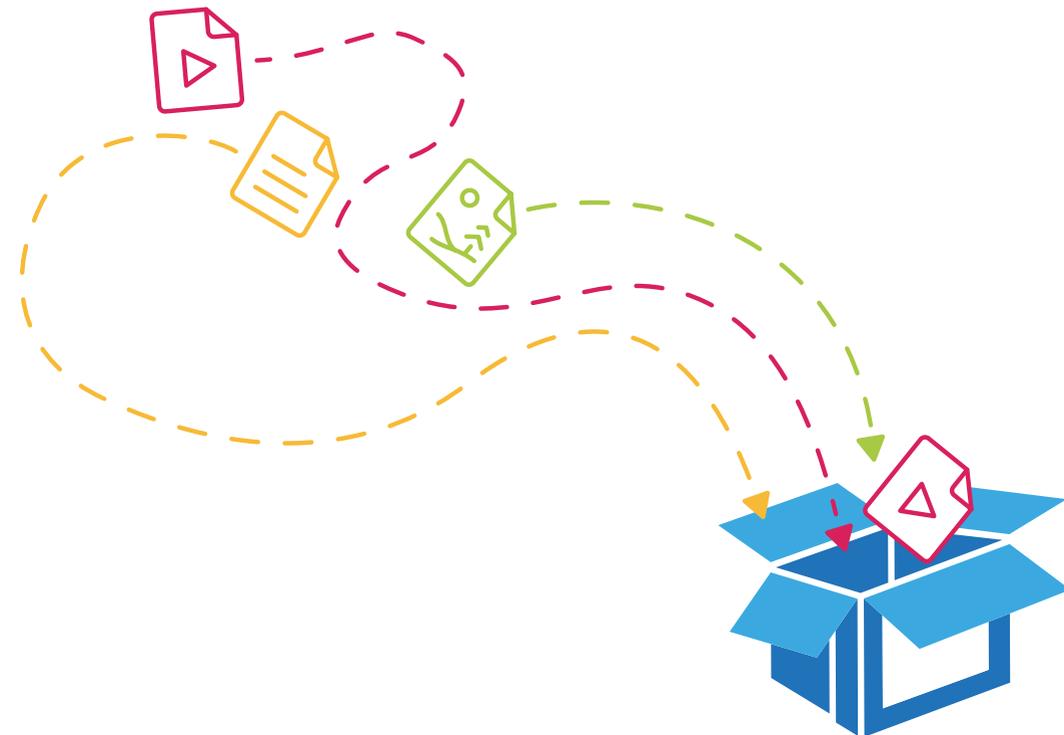
One of the biggest barriers getting TV applications on connected devices is device fragmentation with regard to HbbTV compliance and interpretation of the HbbTV standard by the different CE manufacturers and browser vendors.

The HbbTV Application Toolkit (HAT) solves this problem by providing an efficient, easy to use and fast way to create and maintain applications for HbbTV.

We see a great potential in the uptake of program-related HbbTV apps creating new markets for broadcasters, content providers and 3rd party service providers.

Especially considering the recently released HbbTV 2.0 Standard, HAT will be the perfect tool for designers and developers to build their own designs, templates, modules or plugins and integrate them with the existing core features of HAT.

The HbbTV Application Toolkit is open source and will be available on GitHub soon.





POCKET-SIZED PRODUCTION TRUCK

The current trend is for online videos. However, telling captivating stories usually requires a setup with multiple cameras. The mobile HIGGS production system enables everyone to become a professional producer. Smart miniature cameras, an easy-to-use tablet app and live streaming technology make it possible. Tell your story live on the Internet.

A fantastic live show and a great atmosphere – the up-and-coming young band thrills its audience – worldwide. International fans from around the world can follow the concert's live stream online using the latest technology achievement developed by researchers at the Fraunhofer Institute for Integrated Circuits IIS.

The mobile video production system HIGGS is portable and easy-to-use while being powerful and flexible at the same time. Up to five smart cameras and a tablet-based app are the two key components for amazing live productions. The battery-powered plug-and-play cameras

come with Wifi, a professional image sensor and a set of features integrated in a pocket-sized case. These miniature cameras stream wirelessly to the tablet PC on which is running the HIGGS software. Managing cameras, previewing video streams, recording full HD, creating video footage, and broadcasting live video to Content Distribution Networks (CDNs) are possible with this mobile, cost-efficient system that is suitable for both amateur directors and smaller production companies.

With their development, the engineers have captured the spirit of the age, as

more and more video content is being put on the net – there is barely a large company left that does not use online videos. Until now, it was a cumbersome procedure to create videos with a professional look. When all cameras are set up and adjusted manually, the real work starts with the post-production.

Reviewing hours of redundant video footage, selecting the relevant shots and encoding the final video are expensive and time-consuming procedures.

All these post-production steps are things of the past – HIGGS allows for remote camera management as well as for real-time video-editing.

The integrated live-streaming capabilities put the viewers right in the middle of the event. Support for all major CDNs is already included and ready-to-use in the software.

HIGGS has already been used to produce various events, such as »Your New Favorite Band« in Erlangen's E-Werk concert hall or for an interview session of Start-up Grind, Berlin.



MEDIA MANAGEMENT – EFFICIENT HANDLING AND PROCESSING OF DIGITAL CONTENT

In this age of digital media, larger and larger amounts of digital content is being produced and processed in shorter and shorter times. In complex production processes, many variants and versions of content and metadata are produced. As a result, errors and quality problems can arise on the one hand and, on the other, it becomes more and more difficult to trace the origin and copyright attached to the material used. Efficient management of this content is a big challenge to production, management, and distribution systems. Fraunhofer IDMT supports this effort with technology for automatic A/V analysis.

Content identification and content tracking

Using the IDMT technologies for content identification, content can be reliably detected and cataloged at any time during the production and distribution process, independently of the data format or the metadata – even if the content has already been edited or transcoded. This helps when it comes to detecting unnecessary duplicates, prevents unintentional

duplicate issue of IDs, and allows content to be recognized across different systems and distribution channels.

„We access the content directly when performing the analysis. This means that we are not dependent on manually created, textual metadata,“ says Dr. Uwe Kühhirt, head of department at Fraunhofer IDMT.

Furthermore, the A/V analysis can be used to determine automatically which image, audio, or video content or parts of it has been used in the production process. Once metadata on the origin, rights, or transcription of image and film material has been captured, it can be tracked from the original material right to the end product. This saves time and allows quick and easy reuse of the material, such as in online media libraries. Combined with processes for automatic metadata clean up, this allows existing metadata from various sources to be merged, to be checked for consistency and plausibility, and to be purged of errors.

Automatic annotation and quality control

The analysis processes developed by Fraunhofer IDMT can also be used for automated annotation and enrichment of metadata. For example, individual shots or movements in video files, the devices used to record, transcoding, or music

genres in audio files can be detected and added as information.

Automatic quality control (QC) can also automatically detect errors and quality issues in the A/V material at each stage of the production process.

The examples show that automated analyses technologies are already making efficient management of digital media content easier.

For the optimization of processes, a close link between A/V analysis and metadata management will play a central role in the future



OPTIMIZED MEDIA MONITORING

What's the name of the song on the radio right now? Every smartphone nowadays can use an app to identify a piece of music within a few seconds. Something that now works reliably for personal use can also be used to greatly simplify and optimize station monitoring by TV broadcasters.

Fair remuneration for musicians and rights holders

Music is to be found everywhere on television – not only on shows, during the intro sequences, or in TV spots, but also as a background for spoken-word pieces. This use is often not consistently documented, but is just as important when it comes to remunerating the rights holders as any other use.

„Until now, we have not had a fast and simple solution that covers the entire musical portion of a daily or weekly TV schedule while including all variants of music use,“ says Steffen Holly, head of business

unit Media Management & Delivery at Fraunhofer IDMT. „This is where our system that can automatically measure the musical portion of a broadcast TV program comes in. It is based on a universal algorithm for classifying audio signals, which has been trained using machine learning algorithms. It can be used to divide files and broadcast streams reliably and statistically accurately into components „with music“ and „without music.“ German broadcasters ARD and ZDF are already using the technology successfully. Since summer of 2015, Fraunhofer IDMT has been under contract from ARD and ZDF to analyze all public TV channels at

the German Broadcasting Archive (Deutsches Rundfunkarchiv).

The result supplied to the TV companies contains more than just the proportion of music in percentage terms. The licensing department can also use the results of the analysis to determine those parts of the programming „with music“ for which the precise track reports are missing, so that the editorial department can request them. This is an important step towards fairer remuneration for the musicians and rights holders involved.

Recording of ratings accurate to the nearest second

The Arbeitsgemeinschaft Fernsehforschung (Working Group for Television Research (AGF)) has also been using audio analysis technology from Fraunhofer IDMT for ratings recording for several years.

„In close cooperation with GfK/Telecontrol, we have developed an individual version of our audio identification system

that is tailored for monitoring of TV stations for the AGF,“ explains Holly. In a consumer panel that is evaluated to measure daily German TV ratings, the algorithm only uses the audio signal received to log which channel of almost 200 is currently being watched, accurate to the nearest second.

The project partners are now working on a mobile application that can also count usage figures for programs viewed in online media centers, which might be up to 14 days old. In this case, the audio signal is recorded via the microphone of a mobile device.

The particular challenges involved are that interfering ambient noise is also recorded and that the viewer can decide independently when to watch a program and when or whether to pause playback. This places high standards of robustness on the process.

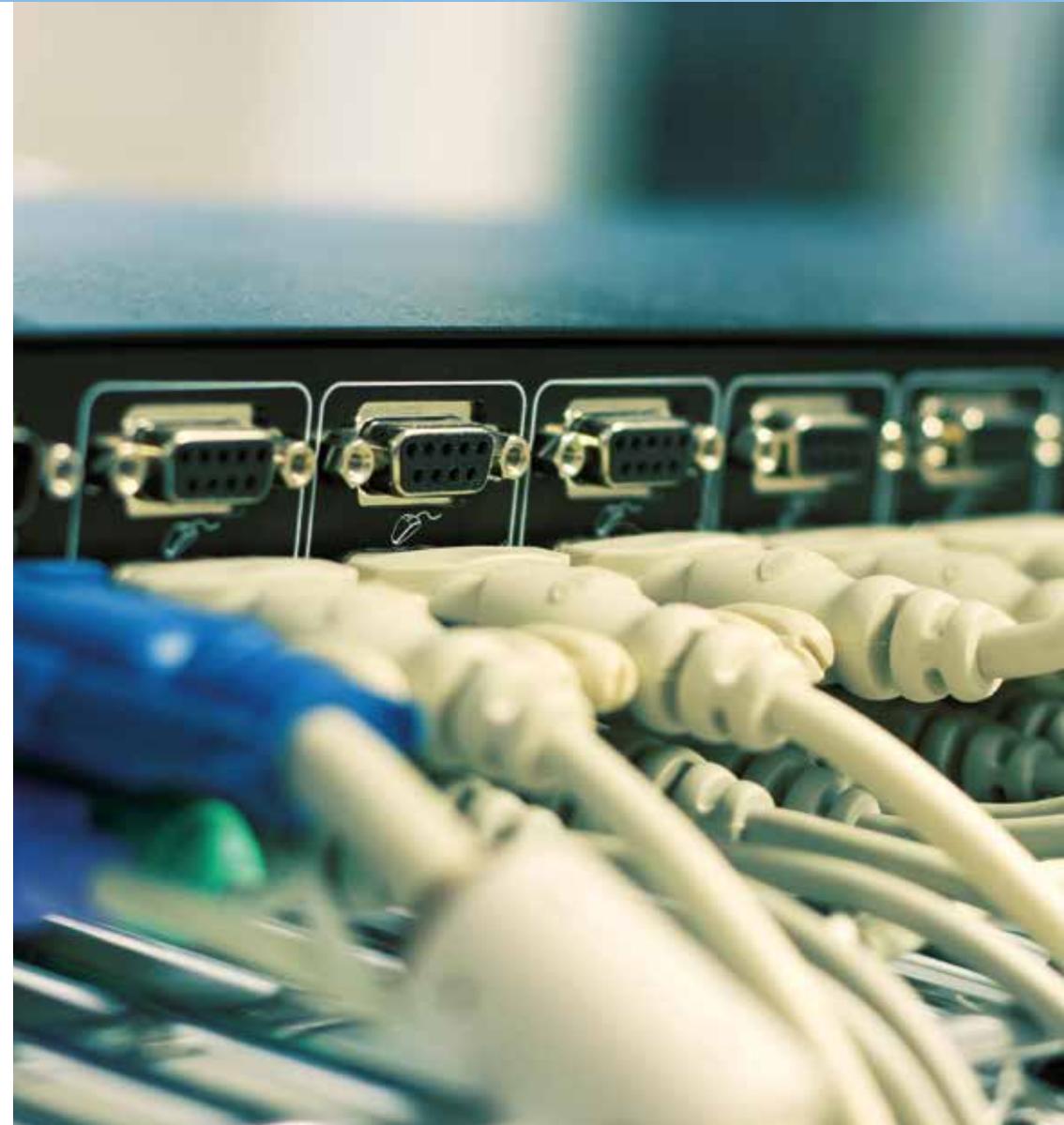
FLEXIBLE, COMPACT, AND SMART

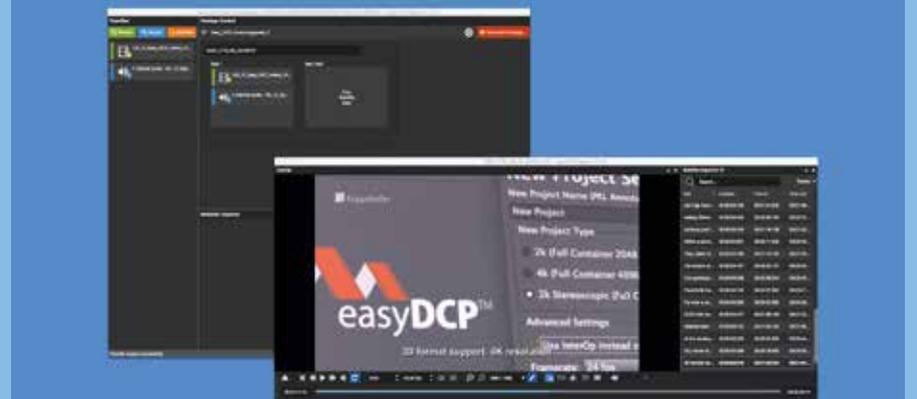
When it comes to data transmission of high-definition images, the available infrastructure and assignable bandwidths are often the bottleneck, and not just in the consumer sector. Even with professional applications used in production, with remote desktop applications, and the transmission of high-definition camera data up to 120 Hz and with a color depth of up to 12 bits for display on HDR monitors, one quickly comes up against the limitations of conventional transmission cables such as Ethernet or HD SDI. In order to be able to transmit this data with as little loss as possible and with low compression rates of 1:2 to 1:6, the Lici® codec was developed by Fraunhofer IIS. Lici® offers extremely low latency times with high data throughput as it adapts flexibly to the available transmission rate. This is because nobody would accept noticeable display delays or changes to the original material when data is being transmitted to a monitor.

Lici® stands for »Lightweight Image Codec«, and due to its low requirements on logic circuitry, it can be integrated into various applications in professional production equipment, KVM (keyboard, video, mouse) extenders, and camera and multimedia applications. What's special about the Lici® code is its low technical outlay required, as well as its use of low-cost logic. It can, for example, be integrated into existing programmable modules that are generally intended for various other functions within the system.

Together with German KVM extender supplier IHSE GmbH Oberteuringen, the codec is being integrated into professional KVMs for the market in order to satisfy requirements for ever higher resolutions up to 4K and higher frame rates for professional purposes, too.

The codec is also available for other suppliers and applications on a license basis.





NEW FORMAT FOR EXCHANGING FILM DATA

There is increasing talk in the film and TV industries about IMF-based work processes. The Interoperable Master Format (IMF), which is currently being standardized by the Society of Motion Pictures and Television Engineers (SMPTE), is intended to be a new, uniform exchange format for production data in professional contexts. IMF, also known as IMP (for IMF package), is a flexible format for data exchange of the master copy, as it is known, between post-production stages or between post-production and the content supplier. Based on the IMF, the content can be converted into any distribution formats required, such as H.264 or HEVC.

The easyDCP software, which has been successful on the market for quite a long time, supports both the Digital Cinema Package (DCP) and the creation and playback of IMPs in their familiar functionality – both as individual software and in various plug-in integrations. The scientists at

Fraunhofer IIS are working closely with Hollywood studios and various VoD (video on demand) providers. That is one good reason why IMPs that are created with easyDCP are equipped to satisfy the requirements for supplying Netflix, for example.

Furthermore, the current version of easyDCP now comes with a redesigned user interface. The developers have placed even more emphasis on ensuring that frequently used functions are found more quickly by the user. Another new function is the support of the latest object-oriented audio formats. Optimization of the software algorithms has allowed a significant increase in decoding power for the easyDCP player. This allows not only real-time-enabled display of DCPs, but also playback of IMPs with a data rate of up to 800 Mbit per second (2k) without any frame drops. Furthermore, the easyDCP Creator can now use a powerful graphics card to encode source images, which al-

lows a significant increase in performance during package generation.

In addition to the easyDCP software, which is now being used by around 1,500 license holders, the IIS scientists also showcase a tool to manage and archive DCPs at IBC in Amsterdam.

easyDCP – New functions at a glance

- The purely software-based easyDCP Suite is simple and convenient to operate that the creation of DCPs for small and medium-sized production companies does not present any problems.
- The software has been optimized to ensure that standard hardware can be used
- easyDCP conforms to the standards laid down by international specifications for digital cinema and SMPTE.
- easyDCP is platform independent and can be used in stand-alone form or as a plug-in for post-production tools from various suppliers.
- easyDCP offers the same functionality and handling for IMP (Interoperable Master Packages).
- The latest generation of object-oriented audio formats is supported
- Worldwide distribution via our distribution partner easyDCP GmbH

FRAUNHOFER DIGITAL MEDIA ALLIANCE

Fraunhofer Institutes in the Digital Media Alliance jointly offer innovative solutions and products for the transition to the digital movie and media world of tomorrow. The Institutes in the Alliance are available as renowned contacts and partners for all of the digital topics connected to digital media, digital movies, and standardization, as well as new cinematography, audio, and projection technologies, post-production, distribution, and archiving.

The goal of the Fraunhofer Digital Media Alliance is to quickly and easily help find the right contacts, partners, and suitable technology.

The Fraunhofer Institute members are

- Digital Media Technologie IDMT, Ilmenau
- Integrated Circuits IIS, Erlangen
- Telecommunications, Heinrich-Hertz-Institut HHI, Berlin
- Open Communication Systems FOKUS, Berlin

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