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### **SIGMM Records**

Volume 4, Issue 4, December 2012 (ISSN 1947-4598)

# MPEG Column: 102nd MPEG Meeting

 original post by Multimedia Communication blog, Christian Timmerer, AAU



The **102nd MPEG meeting** was held in Shanghai, China, October 15-19, 2012. The official press release can be found here (not yet available) and I would like to highlight the following topics:

- Augmented Reality Application Format (ARAF) goes DIS
- MPEG-4 has now 30 parts: Let's welcome timed text and other visual overlays
- · Draft call for proposals for 3D audio
- · Green MPEG is progressing
- MPEG starts a new publicity campaign by making more working documents publicly available for free

### Augmented Reality Application Format (ARAF) goes DIS

MPEG's application format dealing with augmented reality reached DIS status and is only one step away from becoming in international standard. In a nutshell, the MPEG ARAF enables to augment 2D/3D regions of scene by combining multiple/existing standards within a specific application format addressing certain industry needs. In particular, ARAF comprises three components referred to as scene, sensor/actuator, and media. The scene component is represented using a subset of MPEG-4 Part 11 (BIFS), the sensor/actuator component is defined within MPEG-V, and the media component

may comprise various type of compressed (multi)media assets using different sorts of modalities and codecs.

A tutorial from Marius Preda, MPEG 3DG chair, at the Web3D conference in August 2012 is provided below.

### MPEG Augmented Reality Tutorial from Marius Preda



### MPEG-4 has now 30 parts

Let's welcome timed text and other visual overlays in the family of MPEG-4 standards. Part 30 of MPEG-4 – in combination with an amendment to the ISO base media file format (ISOBMFF) – addresses the carriage of W3C TTML including its derivative SMPTE Timed Text, as well as WebVTT. The types of overlays include subtitles, captions, and other timed text and graphics. The text-based overlays include basic text and XML-based text. Additionally, the standards provides support for bitmaps, fonts, and other graphics formats such as scalable vector graphics.

#### Draft call for proposals for 3D audio

MPEG 3D audio is concerned about various test items ranging from 9.1 over 12.1 up to 22.1 channel configurations. A public draft call for proposals has been issued at this meeting with the goal to finalize the call and the evaluation guidelines at the next meeting. The evaluation will be conducted in two phases. Phase one for higher bitrates (1.5 Mbps to 265 kbps) is foreseen to conclude in July 2013 with the evaluation of the answers to the call and the selection of the "Reference Model 0 (RM0)" technology which will serve as a basis for the development of an 3D audio standard. The

second phase targets lower bitrates (96 kbps to 48 kbps) and builds on RM0 technology after this has been documented using text and code.



### Green MPEG is progressing

The idea between green MPEG is to define signaling means that enable energy efficient encoding, delivery, decoding, and/or presentation of MPEG formats (and possibly others) without the loss of Quality of Experience. Green MPEG will address this issue from an end-to-end point of view with the focus – as usual – on the decoder. However, a codeccentric design is not desirable as the energy efficiency should not be affected at the expenses of the other components of the media ecosystem. At the moment, first requirements have been defined and everyone is free to join the discussions on the email reflector within the Ad-hoc Group.

#### MPEG starts a new publicity campaign by making more working documents publicly available for free

As a response to national bodies comments, MPEG is starting from now on to make more documents publicly available for free. Here's a selection of these documents which are publicly available here. Note that some may have an editing period and, thus, are not available at the of writing this blog post.

- Text of ISO/IEC 14496-15:2010/DAM 2 Carriage of HEVC (2012/11/02)
- Text of ISO/IEC CD 14496-30 Timed Text and Other Visual Overlays in ISO Base Media File Format (2012/11/02)
- DIS of ISO/IEC 23000-13, Augmented Reality Application Format (2012/11/07)
- DTR of ISO/IEC 23000-14, Augmented reality reference model (2012/11/21)
- Study of ISO/IEC CD 23008-1 MPEG Media Transport (2012/11/12)
- High Efficiency Video Coding (HEVC) Test Model
   9 (HM 9) Encoder Description (2012/11/30)
- Study Text of ISO/IEC DIS 23008-2 High Efficiency Video Coding (2012/11/30)

- Working Draft of HEVC Full Range Extensions (2012/11/02)
- Working Draft of HEVC Conformance (2012/11/02)
- Report of Results of the Joint Call for Proposals on Scalable High Efficiency Video Coding (SHVC) (2012/11/09)
- Draft Call for Proposals on 3D Audio (2012/10/19)
- Text of ISO/IEC 23009-1:2012 DAM 1 Support for Event Messages and Extended Audio Channel Configuration (2012/10/31)
- Internet Video Coding Test Model (ITM) v 3.0 (2012/11/02)
- Draft Requirements on MPEG User Descriptions (2012/10/19)
- Draft Use Cases for MPEG User Description (Ver. 4.0) (2012/10/19)
- Requirements on Green MPEG (2012/10/19)
- White Paper on State of the Art in compression and transmission of 3D Video (Draft) (2012/10/19)
- White Paper on Compact Descriptors for Visual Search (2012/11/09)

# Open Source Column: GPAC

### GPAC, Toolbox for Interactive Multimedia Packaging, Delivery and Playback



#### Introduction

GPAC was born 10 years ago from the need of a lighter and more robust implementation of the MPEG-4

Systems standard [1], compared to the official reference software. It has since then evolved into a much wider project, covering many tools required when exploring new research topics in multimedia, while keeping a strong focus on international standard coming from organization such as W3C, ISO, ETSI or IETF. The goal of the project is to provide the tools needed to setup test beds and experiments for interactive multimedia applications, in any of the various environments used to deliver content in modern systems: broadcast, multicast, unicast unreliable streaming, HTTP-based streaming and file-based delivery.

The project is used in many contexts, from commercial video services production chains to academic research projects, teaching and lab sessions; it allows fast designing of multimedia prototypes, from content production (creation and delivery) to interactive playback (such as augmented reality, video streaming, 2D or 3D scalable drawing) – more details are available in our paper [6].

#### **Architecture and tools**

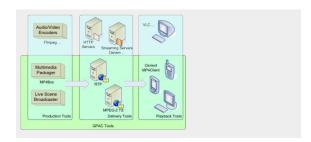


Figure 1: GPAC tools and related OSS multimedia projects

Most of GPAC functionalities are gathered in a core library called libgpac, allowing building a wide range of applications on top of GPAC without depending on the media player or on the media packagers. Figure 1 shows various GPAC tools and their relationships with other OSS multimedia softwares. All multimedia capabilities needed by the player (access to video display, cameras, sensors such as accelerometers) are abstracted into platform-specific modules.



Figure 2: MP4Box, a swiss-army knife for content packaging

The core library is written in extremely portable C code, and all modules required by the player have been ported to a wide variety of platforms, from desktop OS (Windows, Linux, OSX) to mobile devices (iOS, Android, Windows CE) or embedded systems (various SH4 and ARM boards, set-top boxes ...), as shown in Figure 6. Under constant construction, GPAC is build and bugchecked on a daily basis, thanks to the Buildbot project.

## Packaging of Interactive Multimedia Content

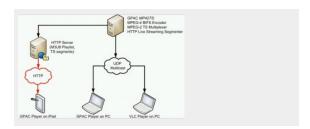


Figure 3: Sample usage of GPAC tools

The first set of tools present in GPAC deal with multimedia content packaging. These tools are unique in the open-source world, both in terms of supported features and of compliance to industry standards. The most known and used tool is called MP4Box, and has a variety of applicative usages (as illustrated in Figure 2): it can be used to package raw media data such as video or audio streams or subtitles into files conforming to the ISO base media file specification [2], as used by most smartphone and tablet devices. MP4Box can work on ISOBMF files on a variety of ways, adding or removing tracks, extracting media data, analyzing files, splitting in smaller files, concatenating files, adding meta data and tags, embedding extra files (such as HTML/ CSS/JavaScript) into the file to simplify the distribution process. MP4Box also features tools for encoding and decoding MPEG scene description streams (MPEG-4 BIFS and LASeR), encryption and decryption of media streams, and is capable of preparing the content for various kind of delivery:

- Altering the data layout to enable progressive download and play of the file,
- · Streaming a file over RTP [3] unicast or multicast,
- Creating hint tracks, thereby allowing streaming servers such as the open-source Darwin Streaming Serverto stream the file over RTP without knowledge of the media format.
- Creating and optionally streaming an MPEG-2 Transport Stream [4] from a set of ISOBMF files.

Figure 3 shows one usage of GPAC tools to generate an MPEG-2 Transport Stream containing interactive BIFS scenes generated live, compatible with the T-DMB standard; the resulting multiplex is streamed over RTP or using HTTP Live Streaming format, and is compatible with traditional MPEG-2 TS player without T-DMB support such as VLC.

Recent additions to MP4Box concern the packaging of media content for Adaptive HTTP Streaming, such as HLS, Smooth Streaming or HDS, with a special focus on the new MPEG-DASH standard: different bitrate/resolution versions of the content can be processed together by MP4Box to generate a set of "segmented" files used by these streaming protocols, as explained in [5]. The generated files have been successfully tested with existing MPEG-DASH and other HTTP adaptive streaming players, as well as with the experimental implementation of Media Source Extension (Chrome browser). The segment generation process can be automated in MP4Box to simulate an adaptive streaming live session.

### Playback and Rendering of Interactive Multimedia Content

The second set of tools in GPAC deal with content playback and interactive application rendering. The software includes a player, referred to as Osmo4 or MP4Client (command-line version), whose main design is to present media data together with rasterizing vector-based media descriptions, in a synchronized and interactive way. The player may use hardware acceleration such as OpenGL whenever possible (for video composition, 2D or 3D image synthesis).



Figure 4: Image output for 5 views 3D display

The player supports many audio and video formats, mainly relying on third party open source software such as ffmpeg, OpenSVC, XVID. It also supports native processing and rendering of scene description formats such as X3D/VRML, SVG and BIFS, thereby enabling a wide range of applications: cartoons, interactive video portals, immersive 3D worlds, augmented reality, "follow-me" applications, etc ... It can also perform multi-

stereoscopic rendering for many 3D displays types, from old-style anaglyphs to side-by-side or interlaced multiview (as illustrated in Figure 4, and can easily be configured for new displays using OpenGL shaders.



Figure 5: Illustration of a possible application played with GPAC, mixing 2D and 3D content, natural and synthetic.

The player can be extended easily through flexible plugin architecture. These plugins can either implement new video decoder, new protocol parsers, new JavaScript support, and new rendering methods. For instance, the UPnP plugin allow fast prototyping of networked multimedia applications through UPnP / DLNA (GPAC can act as a media server, media renderer and media controller). This plugin has been used to demonstrate application discovery and cross-browser communications using UPnP based on the MPEG-U standard, enabling secondary screen applications by relocating part of the content, whether synthetic (game, UI) or natural (video or audio streams).



Figure 6: GPAC on a custom ARM platform

The player has also been used to showcase adaptive video playback through scalable video decoding, highly immersive worlds on 3D displays, augmented reality using embedded camera, streaming media portals (RTP/RTSP, web radios, progressive download, MPEG-2 TS over IP or DVB4Linux, HTTP Adaptive Streaming). Client-side scripting is possible in ECMAScript through Mozilla SpiderMonkey engine, and some usual bindings are provided (DOM subset, XMLHttpRequest support). Plugins can also expose their functionalities through scripting (for example UPnP/DLNA stack can be completely controlled from script).

### **Future work**

Our future works will focus on more flexibility in the various tools present in GPAC to simplify creation of streaming media applications by third-party developers, as well as new tools to help the research community in areas such as hybrid networking, ultra-high definition displays and immersive environments.

### Acknowledgements

Being an open-source project, GPAC would not be GPAC without its user community, which we would like to thank for their support, suggestions, bug spotting and fixing, and positive feedback during these years! Especially, many thanks to all software developers who joined our team at Telecom ParisTech and all our students.

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### **PhD Thesis Summaries**

### **Dominik Strohmeier**

# Open Profiling of Quality: A Mixed Methods Research Approach for Audiovisual Quality Evaluations

Supervisor(s) and Committee member(s): Prof. Dr.-Ing. Karlheinz Brandenburg, Prof. Dr. Søren Bech, Prof. Dr. Patrick Le Callet

URL: http://d-nb.info/101865268X/34



To meet the requirements of consumers and to provide them with a greater quality of experience than existing systems do is a key issue for the success of modern multimedia systems. However, the question about an optimized quality of experience becomes more and more complex as technological systems are evolving and several systems are merged into new ones, e.g. systems for mobile 3D television and video. To be able to optimize critical components of a system under development with as little perceptual errors as possible, user studies are conducted throughout the whole process. A variety of research methods for different purposes have been provided by standardization bodies since the 1970s. These methods allow researchers to evaluate the hedonic excellence of a set of test stimuli. However, a broader view to quality has been taken recently to be able to evaluate quality beyond its hedonic excellence to obtain a greater knowledge about perceived quality and its subjective quality factors that impact on the user.

The goal of this thesis is twofold. The primary goal is the development of a validated mixed- methods research approach for audiovisual quality evaluations. The method shall allow collecting quantitative and descriptive data during the experiment to combine evaluation of hedonic excellence and the elicitation of underlying subjective quality factors. The second goal is the application of the developed method within a series of studies in the domain of mobile 3D video and television to show its applicability.

Open Profiling of Quality (OPQ) is a mixedmethods research approach which combines a quan- titative, psychoperceptual evaluation of hedonic excellence and a descriptive sensory analysis of underlying quality factors based on naïve participants' individual vocabulary. This combination allows defining the excellence of overall quality, understanding the characteristics of quality per- ception, and, eventually, constructing a link between preferences and quality attributes. The method was developed under constructive research with respect to validity and reliability of test results. A series of quality evaluation studies with more than 300 test participants was conducted along dif- ferent critical components of a system for optimized mobile 3DTV content delivery over DVB-H. The results complemented each other, and, even more importantly, quantitative quality preferences were explained by sensory descriptions in all studies.

Beyond the development of OPQ, the thesis proposes further research approaches, e.g. a con- ventional profiling in which OPQ's individual vacobulary is substituted by a fixed set of Quality of Experience components or Descriptive Sorted Napping which combines a sorting task and a short post-task interview. All approaches are compared to Open Profiling of Quality at the end of the thesis. To be able to holistically contrast strengths and weaknesses of each method, a comparison model for audiovisual evaluation methods was developed and a first conceptual operationalization of the model was applied in the comparison.

### Stefan Wieser

### Flocks: A Dynamic, Self-Organizing Overlay Network for Multimedia Distribution

Supervisor(s) and Committee member(s): Laszlo Böszörmenyi, supervisor Pier Luca Montessoro, advisor



This thesis investigates flexible self-organizing overlay networks for multimedia delivery – networks that are

dynamically built on existing infrastructure to support the preferences of applications using them. For example, consider a large sports event with several concurrent competitions, in which hundreds of thousands visitors produce and consume videos with their mobile devices. These devices connect to each other to exchange videos. However, as the interests of their owners change, the overlay must adapt as well: existing connections must be replaced with connections to other relevant devices, such as devices of other visitors with similar interests. Deciding which devices should connect to each other, while also optimizing network performance is not trivial.

This thesis attempts to solve that issue by using a flexible and scalable self-organizing overlay located between an application and its underlying network, which optimizes itself based the application's interest in content and network quality. A special focus is placed on including metrics relevant to multimedia delivery, such as jitter and bottleneck bandwidth, in the optimization. As these metrics cannot be predicted by a third node, established approaches such as matchmaking cannot be used. Therefore, a new approach based on a novel interest-property concept is introduced, which provides the flexibility of traditional matchmaking approaches, but also supports optimization based on parameters that can only be determined once two potential neighbours connect. In addition, a distributed way for nodes to estimate the level of service they are likely to receive to another node is introduced. A "Flocks" prototype overlay that implements the concepts and techniques described

n this thesis is developed and evaluated. Results show that Flocks optimize even large overlays based on content and network metrics quickly and with modest overhead.

### **Zixia Huang**

### Synchronized Distribution Framework for High-Quality Multimodal Interactive Teleimmersion

Supervisor(s) and Committee member(s): Klara Nahrstedt (PhD research supervisor), Thomas Huang (PhD committee member), Marco Caccamo (PhD committee member), Thomas Woo (PhD committee member)



This dissertation investigates issues of performing synchronized distribution of time-correlated multi-modal continuous media data in the distributed interactive teleimmersion, and proposes approaches to solve these problems. The current best-effort shared Internet is unreliable in supporting bandwidth-savvy multimedia streaming, and frequent network jitter can contribute to the heterogeneity of distribution latencies (a.k.a., synchronization skews) within and across the multisource sensory streams over time. The system limitations and computation constraints at the end devices can also prohibit the multimedia data in preserving the synchronization dependencies. Existing studies usually control synchronization skews by inserting buffering latencies at the media receivers. But due to the real-time nature of interactive multimedia in both two-site and multi-site applications, these approaches can impact the communication interactivity and media signal intelligibility, and affect the subjective satisfactions of end users.

To address these issues, we propose a novel and systematic synchronization framework for teleimmersion, and more generally, distributed interactive multimedia systems. We first discuss a new multi-dimensional synchronization specification model that captures the scalability of multi-modal devices, the heterogeneity of multimedia, and the diversity of the end user activities in the next-generation multimedia applications. An adaptive decision policy is also included for identifying the time correlations of multimedia frames captured from distributed media sensors. Based on the new model, we then develop collaborative multi-tier synchronization controls that consistently minimize the multimedia skews during media processing and distribution. Specifically, at the sender capturing tier, we present a dynamic computation resource provisioning algorithm to bound the skews arising during multimedia computation. At the distribution tier, we

design a synchronized multi-stream distribution overlay with cooperative bandwidth management according to the diverse end user interests. At the receiver presentation tier, we perform presentation scheduling scheme to realize the multimedia synchronization at the output devices. To evaluate the tradeoff of the synchronization quality, media signal intelligibility and interactive quality, and their interactions with end user perception, we further conduct extensive subjective evaluations, and utilize the real perceptual feedback to drive the media presentation adaptation. We elaborate on the implementation of the synchronization service component in our Illinois TEEVE (Teleimmersive Environment for EVErybody) testbed. Repeatable experimental results from both the teleimmersive emulator and the real TEEVE system confirm the effectiveness of our framework.

Multimedia Operating System and Networking Group URL: http://cairo.cs.uiuc.edu/

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### ACM International Conference on Multimodal Interaction

Submission deadline: 24. May 2013

Location: Sydney, Australia

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#### **IH & MMSEC**

#### **ACM**

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Location: Montpellier, France Dates: 17. June 2013 -19. June 2013 More information: http://www.ihmmsec.org/

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#### **EuroITV**

#### **European Interactive TV Conference**

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Location: Como, Italy

Dates: 24. June 2013 -26. June 2013 More information: http://www.euro-itv.org/ In cooperation with ACM SIGMM

#### **ICEC**

### International Conference on Entertainment Computing

Submission deadline: 28. April 2013

Location: Sao Paulo, Brazil

Dates: 16. October 2013 -18. October 2013 More information: http://lia.dc.ufscar.br/ICEC2013/

#### **ICSC**

#### IEEE International Conference on Semantic Computing

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Location: Irvine, CA, USA

Dates: 16. September 2013 -18. September 2013 More information: http://ieee-icsc.org/icsc2013/

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### IEEE IVMSP Workshop: 3D Image/Video Technologies and Applications

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