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SEA



Deliverable D7.6

D7.6 - Dissemination, standardisation and project liaison results

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Abstract:

This document details the dissemination and standardization activities of the project's two years lifetime. Moreover, the deliverable describes the project liaison activities at Networked Media concertation level and via participation in the Future Internet Assembly (FIA) activities.



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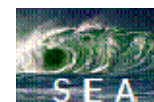


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Abbreviations

AVC	Advanced Video Coding
EC	European Commission
EU	European Union
FDAM	Final Draft Amendment (<i>to ISO/IEC standard</i>)
FPDAM	Final Proposed Draft Amendment (<i>to ISO/IEC standard</i>)
FIA	Future Internet Assembly
FP7	Framework Programme 7
ICT	Information and Communication Technology
IEEE	Institute of Electrical & Electronics Engineers
IETF	Internet Engineering Task Force
IMS	Information Management System
IPTV	Internet Protocol TeleVision
IST	Information Society Technology
MDC	Multi Description Coding
MDP	Media Delivery Platform (cluster)
MVC	Multi-View Coding
P2P	Peer-to-Peer
PDAM	Proposed Draft Amendment (<i>to ISO/IEC standard</i>)
PQoS	Perceived Quality of Service
RTP	Real-time Transport Protocol
STB	Set-Top Box
SVC	Scalable Video Coding
URL	Uniform Resource Locator
WWW	World Wide Web



Executive Summary

The outcome of the project is spread in various ways, including different publication channels such as scientific journals and conferences. An overview on the dissemination strategy of the project results is given in the first section of this document. Details on dissemination activities can be found in section 2. It includes details about the Internet presence as well as a comprehensive list of all journal papers and oral presentations including their abstracts.

Besides, some effort has been put into standardisation of techniques developed within the project. A list of all standardisation activities such as contributions to different standardization bodies and associated working documents is found in section 3.

Further, the project has set up liaisons to other European research projects. For each such activity, topics and form of cooperation are described in section 4 and its subsections.



1. Dissemination Strategy

Since the project proposal phase, SEA had identified channels for the project to disseminate the results. These channels are summarized in the following:

a) Documentation: Both internal and public documents have been issued. The former are circulated inside the project as soon as the involved partners, workpackage leaders and the technical manager have declared their consent. The public documents are made available to the public via the project web site.

b) EC Dissemination Mechanisms: SEA pursued knowledge dissemination and maximum networking with other ongoing relating activities by making maximum use of the EC supported dissemination mechanisms, such as publication of project information on the official sites of EC.

c) EC Conferences & Cluster Meetings: SEA participated to EC Conferences and the clustering meetings organised per thematic area.

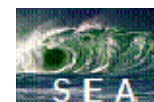
d) Publications: SEA intent has clearly been to enlarge awareness of the technology and applications being experimented to enlarge the potential recipients of the message and increase the number of interested people.

e) Access through WWW: An Internet WWW site has been developed from the very start of the project, which main objective is to diffuse the SEA's objectives and results as wider as possible, throughout the community and over.

f) Brochure: A brochure and a presentation for the project have been updated every six months to reflect the project's progress.

g) Access through events: This includes workshops, conferences, seminars, demonstrations and any other activity, which leads to the involvement of different spectrum of audiences from different backgrounds.

As it is explained in the following sections, SEA has successfully met the above plans.



2. Dissemination Workplan

2.1. SEA Web Site

The SEA web site has been developed and is regularly updated by Synelixis from the very start of the project. The web site main objective is to diffuse the SEA’s objectives and results as wider as possible, throughout the community and over and in parallel to operate as project’s repository. The project website has the following URL:

www.ist-sea.eu

A concise description of the web site structured had been given in Deliverable 7.4.

2.1.1. Web site statistics

Since January 2009, the SEA web site has been visited by 3.868 unique users (robots are not counted). This results in a figure of 5.263 unique visitors (during the project lifetime). Moreover, the unique visitors have almost tripled from the 2008 (1.395 unique visitors in 2008), showing that the project has achieved a good dissemination penetration. The total number of downloaded pages is 11.170, while the number of hits is 36.794. Overall 2.53GBytes of data have been downloaded from the web site.

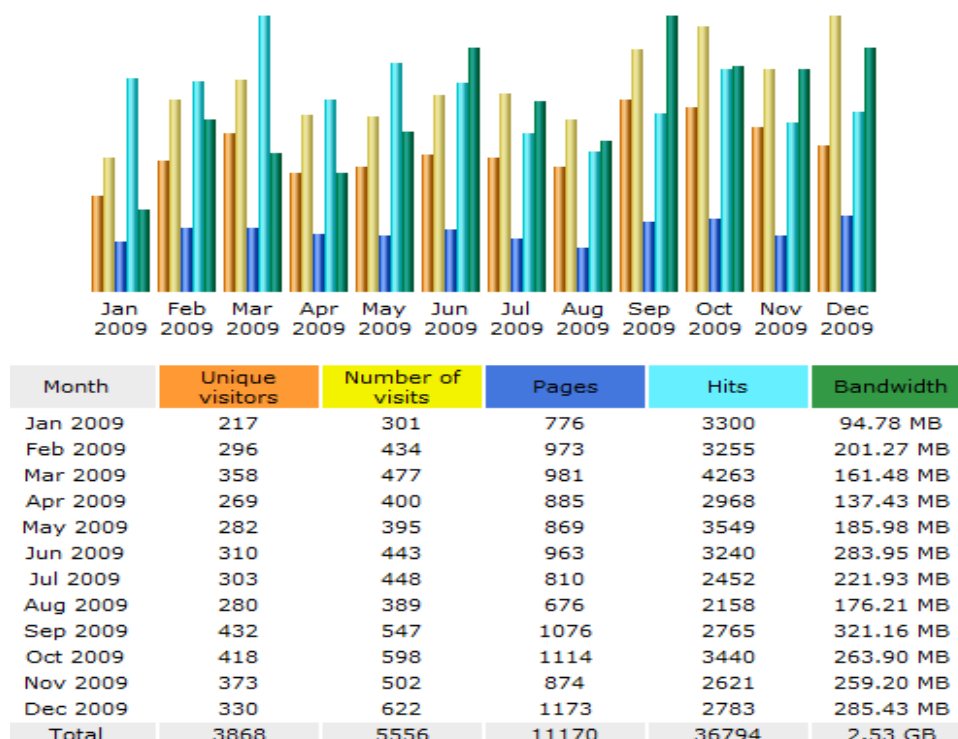


Figure 1: SEA website activity

As per averages values for the two years of the project activity, the SEA web site has been revisited 2.8 times (overall 3.8 visits per user) and visited 2.6 pages per visit.

2.2. ICT Concertation Meetings

The project had a very active role in the Networked Media ICT concertation events. The project has been presented by the project Technical Manager, Dr. Theodore Zahariadis in the following events:



1. Fall 2007 Networked Media Concertation Meeting, 13-14 November 2007, Brussels, Belgium
2. Spring 2008 Networked Media Concertation Meeting, 16-17 April 2008, Algarve, Portugal
3. Fall 2008, Networked Media Concertation Meeting, 15-16 October 2008, St. Malo, France
4. Spring 2009, Network Media Concertation Meeting, 28-29 April 2009, Antwerp, Belgium
5. Fall 2009, Networked Media Concertation Meeting, 28 September 2009, St. Malo, France

In parallel, the project has lead activities in the Media Delivery Platform (MDP) cluster and Future Internet Assembly (FIA) as it is further described in section 4.3 and 4.4.

2.3. Dissemination activities

The following overview tables list the publications by their type (e.g., journal papers, conference papers). Each publication is described in more detail in the related subsections. Audience estimates for conference papers given in the tables include not only the direct audience (conference attendees) but also those persons who can have access to the conference proceedings in research institutes, libraries (or through the internet). Similarly, estimated figures for journal papers and book chapters include not only the direct audience (journal subscribers, book buyers) but all those people who can potentially have access to these journals/books through libraries.

Table 1 — Website and project brochure

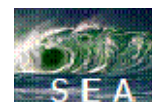
Type	Type of audience	Countries addressed	Size of audience	Partner responsible / involved
Website	General public, Research, Industry	Worldwide	<i>cf. section 2.1</i>	Synelixis / all
Brochure	General public, Research, Industry	Worldwide		Synelixis

Table 2 — Journal papers

Ref	Title/Journal	Type of audience	Countries addressed	Size of audience	Partner responsible / involved
(1)	"Content Adaptation Issues in the Future Internet," EU Prague Book	Research, Industry	EU - Worldwide	~1000	Synelixis, HHI, STM
(2)	"A Survey on P2P Overlay Streaming Clients," EU Prague Book	Research, Industry	EU - Worldwide	~1000	STM, UCLA, Synelixis
(3)	"Slice Sorting for Unequal Loss Protection of Video Streams," IEEE Signal Processing Letters	Research	Worldwide	~2000	POLITO



Ref	Title/Journal	Type of audience	Countries addressed	Size of audience	Partner responsible / involved
(4)	"Multiple descriptions based on multi-rate coding for JPEG 2000 and H.264/AVC," IEEE Transactions on image processing	Research, Industry	Worldwide	~2000	POLITO
(5)	"Unequal loss protection and slice skipping for resilient H.264/AVC video transmission," IEEE Transactions on image processing	Research, Industry	Worldwide	~2000	POLITO
(6)	"A comparison between unequal loss protection and multiple description coding for image transmission over lossy packet networks," IEEE Signal processing letters	Research, Industry	Worldwide	~2000	POLITO
(7)	"A Future Perspective on the 3D Media Internet", Towards the Future Internet - A European Research Perspective, IOS Press, May 2009.	Research, Industry	EU - Worldwide	~1000	UPM
(8)	"Seamless Content Delivery in the Future Mobile Internet," Guest Editorial, IEEE Wireless Communications Magazine, October 2009	Research, Industry	Worldwide	~2000	Synelixis, UCLA, STM
(9)	"Scalable Video Coding (SVC) over RTP and MPEG-2 Transport Stream in Broadcast and IPTV channels," IEEE Wireless Communications Magazine, October 2009	Research, Industry	Worldwide	~2000	HHI
(10)	"Protected Seamless Content Delivery in P2P Wireless and Wired Networks," IEEE Wireless Communications Magazine, October 2009	Research, Industry	Worldwide	~2000	UPM, HHI



Ref	Title/Journal	Type of audience	Countries addressed	Size of audience	Partner responsible / involved
(11)	"An Interoperable Delivery Framework For Scalable Media Resources," IEEE Wireless Communications Magazine, October 2009	Research, Industry	Worldwide	~2000	STM (coauthored with Klagenfurt University)
(12)	"Efficient Streaming in Future Internet" submitted for publication at the EU Valencia Book	Research, Industry	Worldwide	~2000	Synelixis, UPM (coauthored by projects nextMedia, COAST, P2PNext, Optimix, Adamantium)
(13)	"Towards a Content-Centric Internet" submitted for publication at the EU Valencia Book	Research, Industry	Worldwide	~2000	Synelixis, UPM (coauthored by projects nextMedia, COAST, 4WAND, MDP & UCM clusters)

Table 3 — Conference presentations

Ref	Title/Journal	Type of audience	Countries addressed	Size of audience	Partner responsible / involved
(14)	"SEA Project Presentation", Networked Media Concertation, Brussels, 13-14 November 2007	Research, Industry	EU	~60	Synelixis
(15)	"SEA Project Poster", Bled, Slovenia, 31 March - 2 April 2008	Research, Industry	EU - Worldwide	~400	Synelixis
(16)	"Seamless Content Delivery" Media Delivery Platforms Cluster, Vilamoura, Portugal, 16 April 2008	Research, Industry	EU	~100	Synelixis
(17)	"Considerations on Content Delivery over Future Internet", Networked Media and 3D Internet Task Force, EC, 5-6 June 2008	Research, Industry	EU	~25	Synelixis
(18)	"Towards Future Media Internet," Adamantium Information Day, Athens, Greece, 19 September 2008	Research, Industry	EU	~30	Synelixis



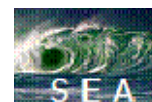
Ref	Title/Journal	Type of audience	Countries addressed	Size of audience	Partner responsible / involved
(19)	“Future Content Networks”, NEM Summit, St. Malo, France, 14 Oct. 08	Research, Industry	EU - Worldwide	~350	Synelixis
(20)	“Media Delivery Platforms Cluster”, St. Malo, France, 15 October 2008	Research, Industry	EU	~25	Synelixis
(21)	“Future Content Networks: Position Paper”, FIA Future Content Networks, Madrid, 9 Dec. 2008	Research, Industry	EU- Worldwide	~250	Synelixis
(22)	“The SEA use case in the FIRE testbed”, FIA Future Content Networks, Madrid, 9 Dec. 2008	Research, Industry	EU- Worldwide	~150	Synelixis
(23)	“Content Protection Issues,” FIA Identity and Trust Session, Madrid, 9 December 2008	Research, Industry	EU- Worldwide	~100	Synelixis
(24)	“Seamless Content Delivery over the FIRE,” FIA, FIRE Session, Madrid, 10 December 2008	Research, Industry	EU- Worldwide	~100	Synelixis

Table 4 — Conference and workshop papers

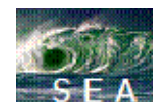
Ref	Title/Journal	Type of audience	Countries addressed	Size of audience	Partner responsible / involved
(25)	“Scalable Content Delivery over P2P convergent networks,” IEEE Intern. Symposium on Consumer Electronics, Portugal, 14-16 April 2008	Research, Industry	EU- Worldwide	~150	Synelixis, Thomson, UPM
(26)	“Concealment driven smart slice reordering for robust video transmission,” IEEE International Conference on Multimedia and Expo (ICME08), Germany, June 23-26, 2008	Research, Industry	EU- Worldwide	~120	POLITO
(27)	“Seamless Content Delivery over the Future Internet” TEMU 2008, 16-18 July 2008	Research, Industry	EU- Worldwide	~120	Synelixis, Thomson, STM, UPM



Ref	Title/Journal	Type of audience	Countries addressed	Size of audience	Partner responsible / involved
(28)	“A complexity scalable H.264/AVC encoder for mobile terminals,” EUSIPCO, Switzerland, August 2008	Research, Industry	EU-Worldwide	~80	POLITO, STM
(29)	“Robust video communication for peer-to-peer streaming using slice reordering and error protection codes,” ST Microelectronics STreaming Day 2008, Parma (PR), September 2, 2008	Research, Industry	EU-Worldwide	~50	POLITO, STM
(30)	“Decoder driven adaptive distributed arithmetic coding,” IEEE International Conference on Image Processing, San Diego, USA, Oct. 2008	Research, Industry	EU-Worldwide	~120	POLITO
(31)	“Error Resilient JPEG2000 Decoding For Wireless Applications,” IEEE International Conference on Image Processing, San Diego, Oct. 2008	Research, Industry	EU-Worldwide	~120	POLITO
(32)	“Towards Future 3D Media Internet,” NEM Summit 2008, St. Malo, 13-15 October 2008	Research, Industry	EU-Worldwide	~350	Synelixis
(33)	“Seamless Content Delivery”, ACM WICON 2008, USA, 17-19 Nov. 2008	Research, Industry	EU-Worldwide	~50	Synelixis, HHI
(34)	“A Survey on P2P Streaming Clients: Looking at the End-User,” ACM WICON 2008, USA, 17-19 Nov. 2008	Research, Industry (STB Manufacturers)	EU-Worldwide	~50	STM, UCLA
(35)	“Lightweight management of scalable and personalised media in mobile IPTV networks,” ACM WICON, USA, 17-19 Nov. 2008	Research, Industry	EU-Worldwide	~50	UPM



Ref	Title/Journal	Type of audience	Countries addressed	Size of audience	Partner responsible / involved
(36)	“SVC/MVC Content Protection over P2P Delivery Networks,” ICCE2009 January 2009	Research, Industry	EU-Worldwide	~150	UPM, Synelaxis
(37)	Spring Networked Media Concertation Meeting, Antwerp, 27-28 April 2009	Research, Industry	EU-Worldwide	~40	Synelaxis
(38)	EU Future Internet Assembly, Prague, Czech Republic, 12-14 May 2009	Research, Industry	EU-Worldwide	~150	Synelaxis
(39)	“A Survey on P2P Overlay Streaming Clients,” Future of the Internet, Prague, May 2009	Research, Industry	Worldwide	~150	Synelaxis, STM, UCLA
(40)	International Workshop on Systems, Signal and Image Processing 2009, Chalkida, Greece, 18-20 June 2009	Research, Industry	EU-Worldwide	~150	STM, UCLA
(41)	"Adaptive Video Streaming over Mobile Networks with TCP-Friendly Rate Control," WCMC, Leipzig, Germany, June 2009	Research, Industry	Worldwide	~80	Nomor
(42)	"SEAcast: Seamless video streaming using P2P overlay networks," ICME 2009	Research, Industry	Worldwide	~150	POLITO, STM
(43)	Fall Networked Media Concertation Meeting, Antwerp, Belgium, 28-29 Sept. 2009	Research, Industry	EU-Worldwide	~100	Synelaxis
(44)	"Priority-based Transmission Scheduling for Delivery of Scalable Video Coding over Mobile Channels", ICST Mobimedia workshop EUMOB 2009, London, UK, September 2009	Research, Industry	EU-Worldwide	~100	HHI
(45)	STreaming Day, Genova, 21 September 2009.	Research, Industry	EU-Worldwide	~50	Polito



Ref	Title/Journal	Type of audience	Countries addressed	Size of audience	Partner responsible / involved
(46)	STreaming Day, Genova, 21 September 2009.	Research, Industry	EU-Worldwide	~50	HHI
(47)	“Personalization of Media Delivery in Seamless Content Delivery Networks” International ICST Conference on User Centric Media, Italy, Decembre 2009	Research, Industry	EU-Worldwide	~100	Synelixis, UPM
(48)	“Efficient Streaming in Future Internet” poster presentation in FIA Stockholm	Research, Industry	Worldwide	~200	Synelixis, UPM
(49)	““Towards a Content-Centric Internet” poster presentation in FIA Stockholm	Research, Industry	Worldwide	~200	Synelixis, UPM

2.3.1. Publications in journals and magazines

The SEA project, represented by Th. Zahariadis, L. Celetto and G. Pau, has organized the special session entitled “Seamless Content Delivery in the Future Mobile Internet” published in October 2009 in the IEEE Wireless Communications magazine.

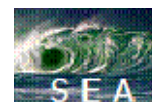
The following papers have been published:

- (1) Theodore Zahariadis, Catherine Lamy-Bergot, Thomas Schierl, Karsten Grüneberg, Luca Celetto, Christian Timmerer, “Content Adaptation Issues in the Future Internet,” published in: Future Internet Assembly book 2009, Towards the Future Internet - A European Research Perspective, ISBN 978-1-60750-007-0

Abstract: Future Media Internet is envisaged to provide the means to share and distribute (new) multimedia content and services with superior quality and striking flexibility, in a trusted and personalized way, improving citizens’ quality of life, working conditions, edutainment and safety. Based on work that has taken place in project SEA and the Medial Delivery Platforms Cluster of projects, we try to provide the challenges and the way ahead in the area of Content Adaptation.

- (2) Alexandro Sentinelli, Luca Celetto, Damien Lefol, Claudio Palazzi, Giovanni Pau, Theodore Zahariadis, Ahola Jari, “Survey on P2P Overlay Streaming Clients,” published in: Future Internet Assembly book 2009, Towards the Future Internet - A European Research Perspective, ISBN 978-1-60750-007-0

Abstract: Peer-to-peer (P2P) streaming systems grow in numbers and potential and several commercial products are already competing. Internet home users — through the diffusion of xDSL connections — represent the potential market of IPTV channels that Content Generators may distribute at reduced costs. This work describes the state of the art of P2P streaming clients and poses some questions about the end-user perspective which is still a non-trivial problem: expectations, content popularity, system’s responsiveness and requirements. To this aim, a representative set of experiments has been performed on a popular P2P system. The client offers live streaming content from some European broadcasters, the start-up delay is just



a few seconds and the user satisfaction rank is pretty good (resolution choice, good responsiveness, some popular channel). The new trend is to investigate flexible solutions in order to get closer to the user's needs and requirements. Unexpected cross-layer optimisations may overcome, like the synergic effect integrating video encoding techniques in a P2P environment. This work is aimed at helping the research community in getting a better comprehension of the issues and metrics that have to be considered in the design of P2P streaming applications.

- (3) E. Baccaglini, T. Tillo, Member, G. Olmo “Slice Sorting for Unequal Loss Protection of Video Streams,” IEEE Signal Processing Letters, Vol. 15, 2008

Abstract: In this letter we propose a novel unequal loss protection scheme, which allocates FEC codes to video slices according to their impact on the GOP distortion. This is evaluated taking the concealment procedure and the drift effect into account. Simulation results show that the proposed algorithm outperforms state-of-the-art approaches, reducing the gap with the error-free performance curve. Moreover, the complexity of the additional stage required to pilot the protection allocation stage is negligible with respect to traditional ULP schemes.

- (4) T. Tillo, E. Baccaglini, G. Olmo, “Multiple descriptions based on multi-rate coding for JPEG 2000 and H.264/AVC,” IEEE Transactions on image processing, Nov. 2008.

Abstract: Multiple description coding makes use of redundant representations of the multimedia data to face link failures. Descriptions should be generated so that the quality obtained when decoding a subset of them only depends on their number and not on the particular received subset. In this paper, we propose a method based on the principle of encoding the source at several rates, and properly blending data encoded at different rates to generate the descriptions. The aim of this strategy is to achieve efficient redundancy exploitation, and easy adaptation to different network scenarios, by means of fine tuning of the encoder parameters. We apply the algorithm to both JPEG 2000 images and H.264/AVC video data. The experimental results reveal that our method favorably compares with state-of-art MDC techniques.

- (5) T. Tillo, E. Baccaglini, G. Olmo, “Unequal loss protection and slice skipping for resilient H.264/AVC video transmission,” IEEE Transactions on image processing, Dec. 2008.

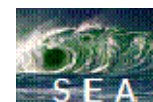
Abstract: In this paper, we devise a procedure that mimics the behavior of a progressive video stream starting from a non progressive one such as H.264/AVC encoded video. This allows one to unequally protect the video data in an efficient way, according to their importance and to the network state. The reported results demonstrate the superior performance of the proposed approach with respect to state of the art methods for resilient transmission of H.264 data. Moreover, the flexibility of the proposed scheme, in terms of redundancy insertion and achieved quality levels, permits to span different applications, including P2P video streaming.

- (6) E. Baccaglini, G. Olmo, “A comparison between unequal loss protection and multiple description coding for image transmission over lossy packet networks, IEEE Signal processing letters, Volume 17, Issue 1, Jan. , pp 75-78.

Abstract: We propose a performance comparison between rate-distortion-based multiple description (MD) coding and state of- the-art layered coding/unequal loss protection algorithms based on Reed Solomon FEC allocation. We point out that both schemes allocate the same total redundancy, but the MD algorithm, besides being usually computationally less intensive, may achieve a smoother performance degradation as the packet loss rate increases. The comparison is performed using JPEG 2000 as test-bed and complexity issues are also addressed.

- (7) P. Daras and F. Alvarez, "A Future Perspective on the 3D Media Internet", Towards the Future Internet - A European Research Perspective, IOS Press, May 2009.

Abstract: The Internet is a living, dynamic “wizard” who is constantly and rapidly evolving, reshaping and transforming and consequently it is changing our social and economic world.



However, Internet was designed and primarily used by scientists for networking research and for exchanging information. The current form of Internet cannot efficiently serve future needs raised by the exponential increase of the available cross-modal content and ensure consistency and correctness in terms of media storage, distribution and consumption, along with options to navigate, interact, search and retrieve this content. In this paper we make an attempt to identify the main barriers posed by the Current Internet and analyse major issues and challenges which is expected to be the pillars of the Future 3D Media Internet.

- (8) Theodore Zahariadis, Giovanni Pau, Luca Celetto, Petros Daras, "Seamless Content Delivery In The Future Mobile Internet," Guest Editorial, IEEE Wireless Communications Magazine, October 2009, Special Issue.

Abstract: The Internet is incontrovertibly a great success that has changed our social and economic world. Today, over one billion users access the Internet on regular basis, more than 100 million users have downloaded at least one (multi) media file, and over 47 million of them do so regularly, searching in more than 160 exabytes of content. The content is expected to rise to more than 990 exabytes before 2012, fueled mainly by the users themselves. However, the Internet was designed 40 years ago for purposes that bear little resemblance to today's usage scenarios and related traffic patterns. The future mobile Internet should be designed to overcome current limitations and address emerging trends, including network architecture, content and service mobility, diffusion of heterogeneous nodes and devices, mass digitization, new forms of (3D) user-centric/-generated content provisioning, emergence of software as a service, and interaction with improved security, trustworthiness, and privacy.

- (9) Thomas Schierl, Karsten Grüneberg, and Thomas Wiegand, "Scalable Video Coding over RTP and MPEG-2 Transport Stream in Broadcast and IPTV Channels", IEEE Wireless Communications Magazine, vol. 16, Special Issue no. 5, October 2009, pp. 64-71.

Abstract: The ITU-T and ISO/IEC standard for scalable video coding was recently finalized. SVC allows for scalability of the video bitstream in the temporal, spatial, or fidelity domain, or any combination of those. Video scalability may be used for different purposes, such as saving bandwidth when the same media content is required to be sent simultaneously on a broadcast medium at different resolutions to support heterogeneous devices, when unequal error protection shall be used for coverage extension in wireless broadcasting, as well as for rate shaping in IPTV environments. Furthermore, it may also be useful in layered multicast transmission over the Internet or peer-to-peer networks, or in any transmission scenario where prioritized transmission for network flows is meaningful. In order to make usage of SVC in the aforementioned use cases, standards for defining the transport format and procedure are required. Therefore, we give a detailed overview of the recently finished SVC standards on transport over IP/RTP and the MPEG-2 transport stream. Both standards are important for IPTV and video on demand, where the first is important for SVC transport over mobile broadcast/multicast channels, and the latter is also important for SVC transport over traditional digital broadcast channels.

- (10) Lara Garcia, Laura Arnaiz, Federico Álvarez, José Manuel Menéndez, Karsten Grüneberg, "Protected seamless content delivery in P2P wireless and wired networks", IEEE Wireless Communications Magazine, vol 16, Special Issue no. 5, October 2009, pp. 50-57.

Abstract: Delivering protected seamless content services over heterogeneous networks should be solidly sustained on top of architectures that can offer support for guaranteed quality delivery according to network or consumer requirements. The delivery of personalized, scalable, seamless, and trusted multimedia content delivery, while adequately protecting the content, is a key factor to provide seamless content services to the final user and provide a framework for user participation. This article describes novel forms of delivering seamless content services over P2P networks using multilayered/multiviewed content coding techniques, such as SVC/MVC, multisource/ multinetwork streaming, and adaptation, with special focus on enabling content protection and lightweight asset management for a secure and privacy



keeping content delivery. The implementation has been validated in the framework of the European Project SEA (IST-214063).

- (11) Michael Eberhard, Christian Timmerer, Hermann Hellwagner, Emanuele Quacchio, "An interoperable delivery framework for scalable media resources", IEEE Wireless Communications Magazine, October 2009, Special Issue, vol 16, issue 5, pp 58-63.

Abstract: In this article an interoperable framework for the delivery of scalable media resources (e.g., in the standardized scalable video coding format) is presented. The framework provides support for video on demand as well as multicast streaming, and performs efficient, generic, and interoperable adaptation of streamed content based on MPEG-21 Digital Item Adaptation. The server as well as the clients of the streaming framework implement the MPEG Extensible Middleware and utilize the MPEG Query Format for querying the available media resources. The framework has been fully integrated into the VLC media player. The architecture for both VoD and multicast is presented in detail. Finally, a comparison in terms of performance of the generic MPEG-21 metadata-based adaptation approach to an SVC-specific adaptation approach is provided.

- (12) Theodore Zahariadis, , Ahola Jari, Roberta Fracchia, Federico Alvarez, Thierry Filoche, Harilaos Koumaras, "Efficient Streaming in Future Internet," submitted for publication to the EC FIA Valencia book (co-authored by projects SEA, nextMedia, COAST, P2PNext, Optimix, Adamantium and MDP cluster of projects)

Abstract. The Future Internet is not envisaged to be simply a faster way to go online. What is expected to fundamentally change the way that people use the Internet is the ability to produce, and seamlessly deliver and share their own multimedia content. In this paper, we introduce and analyse innovative architecture components to offer media scalable content delivery, increasing the robustness, enriching the PQoS and protecting the content from unauthorized access over heterogeneous physical architecture and P2P logical overlay network topologies. Technology pillars in which the system is based are described: i.e. Multi-layered/Multi-viewed content coding, Multi-source/multi-network streaming & adaptation, content protection and lightweight asset management.

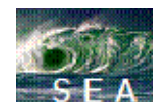
- (13) Theodore Zahariadis, Petros Daras, Jan Bouwen, Norbert Niebert, David Griffin, Federico Alvarez, Emilio Corchado, Gonzalo Camarillo, "Towards a Content-Centric Internet," submitted for publication to the EC FIA Valencia book (by projects SEA, nextMedia, COAST, 4WAND and MDP and UCM clusters of projects)

Abstract. In most cases, current Internet architecture treats content and services simply as bits of data transported between end-systems. While this relatively simple model of operation had clear benefits when users interacted with well-known servers, the recent evolution of the way the Internet is used makes it necessary to create a new model of interaction between entities representing content. In this paper we study the limitations of current Internet and propose a new model, where the smallest addressable unit is a content object, regardless of its location.

2.3.2. Presentations/Posters

Within the life time of the project, the following presentations have been taken place:

- (14) Th. Zahariadis, "SEA Project Presentation", Networked Media Concertation Meeting, Brussels, 13-14 November 2007
- (15) Th. Zahariadis, "SEA Project Poster", Bled, Slovenia, 31 March -2 April 2008
- (16) Th. Zahariadis, "Seamless Content Delivery" Media Delivery Platforms Cluster, Vilamoura, Portugal, 16 April 2008
- (17) Th. Zahariadis, "Considerations on Content Delivery over Future Internet", Networked Media and 3D Internet Task Force, EC, 5-6 June 2008



- (18) Th. Zahariadis, "Towards Future Media Internet," Adamantium Information Day, Athens, Greece, 19 September 2008
- (19) Th. Zahariadis, "Future Content Networks", NEM Summit ,St. Malo, France, 14 October 2008.
- (20) Th. Zahariadis, "Media Delivery Platforms Cluster", St. Malo, France, 15 October 2008
- (21) Th. Zahariadis, "Future Content Networks: Position Paper", Future Internet Assembly (FIA), Future Content Networks (FCN) Session, Madrid, 9 December 2008
- (22) Th. Zahariadis, "The SEA use case in the FIRE testbed," Future Internet Assembly (FIA), Future Content Networks (FCN) Session, Madrid, 9 December 2008
- (23) Th. Zahariadis, "Content Protection Issues," Future Internet Assembly (FIA), Identity and Trust Session, Madrid, 9 December 2008
- (24) Th. Zahariadis, "Seamless Content Delivery over the FIRE," Future Internet Assembly (FIA), FIRE Session, Madrid, 10 December 2008

2.3.3. Conference Papers

The following conference papers have been published and presented during the life time the project:

- (25) Th. Zahariadis, O. Negru, F. Álvarez, "Scalable Content Delivery over P2P convergent networks," 12th IEEE International Symposium on Consumer Electronics, (ISCE 2008), Vilamoura, Portugal, 14-16 April 2008
- (26) Enrico Baccaglini, Tammam Tillo, Gabriella Olmo, "Concealment driven smart slice reordering for robust video transmission," 2008 IEEE International Conference on Multimedia and Expo (ICME08), Hanover, Germany, 23-26 June 2008

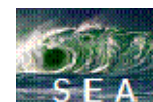
Abstract: In this paper we address a novel scheme to protect video sequences according to slice importance based on slice reordering, ULP and error-concealment techniques. The approach does not require the modification to the video decoder although an application-layer channel coding is required. Simulation results show that the proposed algorithm outperforms state-of-the-art approaches, reducing the gap with the upper-bound error-free performance curve. Moreover, the complexity of the additional stage required to pilot the protection allocation stage is negligible with respect to traditional ULP schemes.

- (27) Th. Zahariadis, O. Negru, F. Rovati, F. Álvarez, "Seamless Content Delivery over the Future Internet", International Conference on Telecommunications and Multimedia (TEMU 2008), 16-18 July 2008
- (28) Amit Kumar, Daniele Alfonso, Luca Pezzoni and Gabriella Olmo, "A complexity scalable H.264/AVC encoder for mobile terminals," 16th European Signal Processing Conference (EUSIPCO 2008), Lausanne, Switzerland, 25-29 August 2008

Abstract: Video encoding is one of the most appealing features of modern mobile terminals, but also one of the most demanding for what concerns power consumption. We propose an H.264/AVC encoder able to adaptively self-adjust the accuracy of the motion-compensated prediction on the basis of the available power resources to achieve a progressive reduction of the computational requirements with graceful degradation of the rate-distortion performance.

- (29) Enrico Baccaglini, Tammam Tillo, Gabriella Olmo, "Robust video communication for peer-to-peer streaming using slice reordering and error protection codes," ST Microelectronics STStreaming Day 2008, Parma (PR), September 2, 2008

Abstract: In this paper we address a novel scheme to protect video sequences according to slice importance based on slice reordering, ULP and error-concealment techniques. The approach does not require the modification to the video decoder although an application-layer channel coding is required. Simulation results show that the proposed algorithm outperforms state-of-the-art approaches, reducing the gap with the upper-bound error-free performance



curve. Moreover, the complexity of the additional stage required to pilot the protection allocation stage is negligible with respect to traditional ULP schemes.

- (30) Marco Grangetto, Enrico Magli, Gabriella Olmo, “Decoder driven adaptive distributed arithmetic coding,” IEEE International Conference on Image Processing 2008 (ICIP 2008), San Diego, USA, 12-15 Oct. 2008

Abstract: We propose a distributed source coding system for data collected by sensor networks. It uses a feedback channel between the sensors and the gateway node (i.e., the joint decoder) but, unlike previous systems, the encoding process is driven by the decoder. Compression is performed using distributed arithmetic coding, which is extended to adaptively estimate the source probabilities. Specifically, the decoder estimates marginal and conditional probabilities, and sends them back to the sensors to drive the distributed arithmetic coding process. This reduces the decoding delay, and potentially eliminates the need of rate-compatible Slepian-Wolf codes.

- (31) Simone Zezza, Maurizio Martina, Guido Masera, Saeid Nooshabadi, "Error Resilient JPEG2000 Decoding For Wireless Applications," IEEE International Conference on Image Processing 2008 (ICIP 2008), San Diego, USA, 12-15 Oct. 2008

Abstract: To improve the JPEG2000 compression standard error resiliency in the wireless environment, the use of ternary MQ arithmetic coders/decoders that are based on the concept of forbidden symbol has been proposed. This paper presents two ternary MQ based techniques to reduce both the computational complexity and the memory requirement during the decoding process, with no or little degradation in the PSNR.

- (32) Theodore Zahariadis, Petros Daras, Isidro Laso-Ballesteros, “Towards Future 3D Media Internet,” NEM Summit 2008, St. Malo, 13-15 October 2008

- (33) Theodore Zahariadis, George Leoleis, Thomas Schierl, Karsten Grüneberg, “Seamless Content Delivery”, ACM WICON 2008, Maui, USA, 17-19 November 2008

- (34) Alexandro Sentinelli, Luca Celetto, Damien Lefol, Claudio Palazzi, Giovanni Pau, “A Survey on P2P Streaming Clients: Looking at the End-User,” ACM WICON 2008, Maui, USA, 17-19 November 2008

Abstract: Peer-to-peer (P2P) streaming systems grow in numbers and potential and several commercial products are already competing. Internet home users – through the diffusion of xDSL connections – represent the potential market of IPTV channels that Content Generators may distribute at reduced costs. This work describes the state of the art of P2P streaming clients and poses some questions about the end-user perspective which is still a non-trivial problem: expectations, content popularity, system’s responsiveness and requirements. To this aim, a representative set of experiments has been performed on a popular p2p system. The client offers live streaming content from some European broadcasters, the start-up delay is just a few seconds and the user satisfaction rank is pretty good (resolution choice, good responsiveness, some popular channel). In general, the new trend is a flexible system getting closer to the user’s needs and requirements. A promising approach is to look for cross-layer optimisation integrating particular video encoding techniques and, sometimes, unexpected synergy may overcome, like the use of Scalable Video Coding in heterogeneous P2P environments. This work is aimed at helping the research community in getting a better comprehension of the issues and metrics that have to be considered in the design of p2p streaming applications.

- (35) Laura Arnaiz, José Menéndez, Lara García, Guillermo Cisneros, Federico Álvarez, “Lightweight management of scalable and personalised media in mobile IPTV networks,” ACM WICON 2008, Maui, USA, 17-19 November 2008

Abstract: In the present paper a novel system for scalable and personalised media management and its architecture is presented. The proposed solution is based on the creation of a secure and adaptable content delivery architecture and the underlying mechanisms to



ensure the correct content management which, along with the content protection mechanisms, can be useful for, on one hand, ensuring user privacy and, on the other hand, enabling the possibility of offering commercial IPTV services over a mobile environment. The aim of the system is to enable personalised view, scalable, seamless and trusted multimedia content delivery, while protecting content from unauthorized access.

- (36) Lara García, Laura Arnaiz, Federico Álvarez, Theodore Zahariadis, "SVC/MVC Content Protection over P2P Delivery Networks," International Conference on Consumer electronics (ICCE 2009) 12-14 January 2009

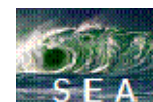
Abstract: In the present paper a novel system and its architecture is presented. The aim of this system is to enable personalized view, scalable, seamless and trusted multimedia content delivery, while protecting content from unauthorized access. Moreover, the system aims to keep bandwidth requirements low and increase the Perceived Quality of Service (PQoS). This content delivery is done through multiple kinds of networks. Special attention to content protection and license management and the possibilities of the system to provide adaptable content to the user thanks to the scalable and multi view video coding is made.

- (37) Theodore Zahariadis, "SEA project status," Spring Networked Media Concertation Meeting, Antwerp, 27-28 April 2009
- (38) Theodore Zahariadis (as caretaker of the FCN session) "Why do we need a Content-Centric Future Internet? Proposals towards Content-Centric Internet Architectures," EU Future Internet Assembly, Prague, Czech Republic, 12-14 May 2009
- (39) Alexandro Sentinelli, Luca Celetto, Damien Lefol, Claudio Palazzi, Giovanni Pau, Theodore, Zahariadis, Ahola Jari, "A Survey on P2P Overlay Streaming Clients", Future of the Internet, Prague, May 2009

Abstract: Peer-to-peer (P2P) streaming systems grow in numbers and potential and several commercial products are already competing. Internet home users — through the diffusion of xDSL connections — represent the potential market of IPTV channels that Content Generators may distribute at reduced costs. This work describes the state of the art of P2P streaming clients and poses some questions about the end-user perspective which is still a non-trivial problem: expectations, content popularity, system's responsiveness and requirements. To this aim, a representative set of experiments has been performed on a popular P2P system. The client offers live streaming content from some European broadcasters, the start-up delay is just a few seconds and the user satisfaction rank is pretty good (resolution choice, good responsiveness, some popular channel). The new trend is to investigate flexible solutions in order to get closer to the user's needs and requirements. Unexpected cross-layer optimisations may overcome, like the synergic effect integrating video encoding techniques in a P2P environment. This work is aimed at helping the research community in getting a better comprehension of the issues and metrics that have to be considered in the design of P2P streaming applications.

- (40) A. Sentinelli, G. Marfia, G. Pau, L. Celetto, "IPTV-P2P clients at home," IWSSIP2009, Chalkida, Greece, 18-20 June 2009
- (41) Ktawut T.Pijarn, "Adaptive Video Streaming over Mobile Networks with TCP-Friendly Rate Control," The International Wireless Communications and Mobile Computing Conference, Leipzig, Germany, 21-24 June 2009

Abstract: This paper investigates and analyses the performances of using the TCP-Friendly Rate Control (TFRC) to control the transmission rate of an adaptive video stream in a mobile network. The stream is encoded based on the Scalable Video Coding (SVC) extension of the H.264/AVC standard comprising of several video layers. Adding and removing the layers is controlled during streaming from the TFRC based on varying channel conditions of the mobile network in real time. We conducted simulations on various realistic use cases in a mobile



network, evaluated and compared the performances with and without adaptation from the TFRC. The results show significant improvements in all areas.

- (42) S. Zezza, E. Magli, G. Olmo, M. Grangetto, "Seacast: A protocol for peer-to-peer video streaming supporting multiple description coding", IEEE International Conference on Multimedia and Expo (ICME), 28 June – 3 July 2009, pp 1586-1587.

Abstract: SEACAST is a peer-to-peer live streaming protocol developed at Politecnico di Torino, which aims at improving current systems in two key areas. The first is the use of fullfledged flow control using RTP/UDP and session signaling. The second is the use of multiple description coding to handle error resilience and user heterogeneity. In this paper we overview SEACAST, highlighting its main innovations, and providing a short summary of performance evaluation over a local testbed at Politecnico di Torino. The results show a definite performance improvement with respect to existing systems, and point out the usefulness of multiple description coding in the peer-to-peer context.

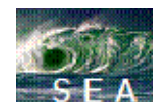
- (43) Theodore Zahariadis, "SEA project status," Fall Networked Media Concertation Meeting, St. Malo, 2-29 September 2009
- (44) Thomas Schierl, Y. Sanchez de la Fuente, Cornelius Hellge, and Thomas Wiegand: "Priority-based Transmission Scheduling for Delivery of Scalable Video Coding over Mobile Channels", Proceedings of ICST Mobimedia workshop EUMOB 2009, London, UK, September 2009.

Abstract: The media, especially the video delivery over mobile channels may be affected by link outages and transmission bit rate variations due to the actual channel condition and the used wireless interface. In this paper we present the use of Priority-based Transmission Scheduling of SVC media data to overcome link outages and reduction in channel bit rate in mobile networks. The Priority-based Transmission Scheduling framework aims to use the same transmission bit rate and the same overall buffer size as a traditionally streaming approach would require. In order to overcome outages and phases with reduced bit rate, a priority scheduling is used to pre-buffer larger amounts of more important data for longer playout than data with less importance for the resulting video playout quality. We compare the use of SVC with Priority-based Transmission Scheduling against H.264/AVC using temporal scalability with Priority-based Transmission Scheduling and H.264/AVC without Priority-based Transmission Scheduling. We show the benefits of using SVC in terms of received quality during outage and re-buffering time. We present a quality optimization approach for the Priority-based Transmission Scheduling and show results for different outage times.

- (45) Simone Zezza, Enrico Magli, Gabriella Olmo, Marco Grangetto, "SEACAST: A Protocol for Peer-To-Peer Video Streaming Supporting Multiple Description Coding", STreaming Day 2009, Genoa, Italy, Sept. 2009.

Abstract: SEACAST is a peer-to-peer live streaming protocol developed in the framework of the European Project "SEA - seamless content delivery". SEACAST represents an evolution of the VidTorrent multiple-tree protocol developed by Viral Communication. Similarly to other P2P streaming protocols, VidTorrent's design is still largely based on file-sharing systems. The objective of SEACAST is to overcome this limitation, adopting techniques and protocols optimized for H.264/AVC video streaming. In particular, SEACAST introduces two main innovations, namely flow control using a proper protocol stack, and application-layer error control by means of state-of-the-art Multiple Description Coding (MDC) techniques. We have evaluated the performance of SEACAST on a local test bed, consisting of several personal computers running Linux or Linux virtual machines.

- (46) Yago Sanchez de la Fuente, Cornelius Hellge, Karsten Grüneberg and Thomas Schierl, "Priority-based Transmission of Scalable Video Coding (SVC)", STreaming Day, Genova, 21 September 2009.



Abstract: The media, especially the video delivery over mobile channels may be affected by link outages and transmission bit rate variations due to the actual channel condition and the used wireless interface. In this paper we present the use of Priority-based Transmission Scheduling of SVC media data to overcome link outages and reduction in channel bit rate in mobile networks. The Priority-based Transmission Scheduling framework aims to use the same transmission bit rate and the same overall buffer size as a traditionally streaming approach would require. In order to overcome outages and phases with reduced bit rate, a priority scheduling is used to pre-buffer larger amounts of more important data for longer playout than data with less importance for the resulting video playout quality. We compare the use of SVC with Priority-based Transmission Scheduling against H.264/AVC using temporal scalability with Priority-based Transmission Scheduling and H.264/AVC without Priority-based Transmission Scheduling. We show the benefits of using SVC in terms of received quality during outage and re-buffering time. We present a quality optimization approach for the Priority-based Transmission Scheduling and show results for different outage times.

- (47) Marta Alvargonzález, Laura Arnaiz, Lara García, Faustino Sanchez, Theodore Zahariadis, Federico Álvarez, “Personalization of Media Delivery in Seamless Content Delivery Networks”, International ICST Conference on User Centric Media, Italy, December 2009.

Abstract: In this paper, we propose an innovative system that aims to adapt to the user needs and preferences the media content transmissions within IP and P2P environments. To personalize the manner the content is displayed to the final user, this proposed network allows the transmission of multiple views and different layers for each media content piece. In addition, we suggest an approach on how to deal with the problem of contents transmission over P2P networks while preserving the author’s rights. In this document, the system architecture is presented, especially the structure concerning the different streams sent over it and the security involved. This research path is being investigated within “SEAmless Content delivery” (SEA) project.

- (48) Theodore Zahariadis, , Ahola Jari, Roberta Fracchia, Federico Alvarez, Thierry Filoche, Harilaos Koumaras, “Efficient Streaming in Future Internet,” submitted for publication to the EC FIA Valencia book (co-authored by projects SEA, nextMedia, COAST, P2PNext, Optimix, Adamantium and MDP cluster of projects)
- (49) Theodore Zahariadis, Petros Daras, Jan Bouwen, Norbert Niebert, David Griffin, Federico Alvarez, Emilio Corchado, Gonzalo Camarillo, “Towards a Content-Centric Internet,” submitted for publication to the EC FIA Valencia book (by projects SEA, nextMedia, COAST, 4WAND and MDP and UCM clusters of projects)

2.3.4. White Paper

SEA has actively contributed in the Media Delivery Platforms Cluster white paper entitled: "[Multimedia Delivery in the Future Internet — A Converged Network Perspective](#)", October 2008.

SEA has also actively contributed in the Future Internet Assembly Activities. Theodore Zahariadis is one of the Future Content Networks (FCN) breakout sessions and the editor of the white paper entitled: “*Why do we need a Content-Centric Future Internet? Proposals towards Content-Centric Internet Architectures,*” Prague May 2009. Moreover has contributed to the sessions “*Different architectures for different business models?*” and “*Orchestration across things, services and content,*” Stockholm, November 2009.

Moreover SEA has contributed to the Future Media and 3D Internet Task Force.



2.3.5. Web Site

The web site content has been updated regularly with events, project related and general interest news, deliverables, papers and presentations.

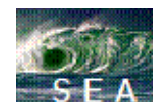
2.3.6. Workshop

In parallel to the **International Workshop of Systems, Signal and Image Processing (IWSSIP 2009)**, in Chalkida, Greece, which is co-sponsored by IEEE, ACM and EURASIP communities, Synelixis organized a special session on “Media Streaming over Content Aware Networks”. The SEA Special Session took place on 20 June 2009.

2.3.7. Trade fairs and exhibitions

Nomor had an exhibit at the GSMA Mobile World Congress from 6 - 19 February 2009 in Barcelona and spread the project brochure to the interested audience.

STM has presented the developments performed in the SEA project as part of a real-time SVC/MVC streaming demonstrator at the Consumer Electronic Show (CES) held in Las Vegas in January 2009. The demonstrator was based on current System-on-Chips (SoC) and related reference boards including SoC targeted as digital TV-HD decoders and portable multimedia players.



3. Contribution to Standardisation

A significant number of contributions to different standardisation bodies have been issued by SEA consortium members. In the following subsections, these contributions are listed sorted by the targeted standardisation body.

3.1. Contributions to MPEG

As already foreseen in the proposal, there has been a need for standardisation regarding MVC storage. Clearly, MPEG has been regarded as the standardisation body responsible for such a file format as this would extend the already existing specification for AVC storage. More details on the MVC storage within MP4 files can be found in [2].

The following proposals have been sent to MPEG:

- (1) K. Grüneberg, T. Schierl, "On MVC File Format", 84th MPEG Meeting - ISO/IEC JTC1/SC29/WG11, Archamps, France, MPEG84/M15356, April 2008
- (2) K. Grüneberg, T. Schierl, "On MVC File Format", 85th MPEG Meeting - ISO/IEC JTC1/SC29/WG11, Hanover, Germany, MPEG85/M15600, July 2008
- (3) K. Grüneberg, T. Schierl, "On MVC File Format", 86th MPEG Meeting - ISO/IEC JTC1/SC29/WG11, Busan, Korea, MPEG86/M15874, October 2008

With slight modifications, the first proposal had been adopted by MPEG as Working Draft 1.0 for the Amendment 3 (MVC File Format) to the MPEG-4 Part 15 — AVC File Format.

- (4) K. Grüneberg, T. Schierl, D. Singer, "Working Draft 1.0 for the Amendment 3 (MVC File Format) to 14496-15 (2004) (AVC File Format)", MPEG Meeting - ISO/IEC JTC1/SC29/WG11, Archamps, France, MPEG85/N9827, April 2008.

Including the second proposal amongst others, MPEG has issued Working Draft 2.0 for the Amendment 3 (MVC File Format) to the MPEG-4 Part 15 — AVC File Format.

- (5) K. Grüneberg, T. Schierl, M. Hannuksela, Y.-K. Wang, Y. Chen, D. Singer, "Working Draft 2.0 for the Amendment 3 (MVC File Format) to 14496-15 (2004) (AVC File Format)", MPEG Meeting - ISO/IEC JTC1/SC29/WG11, Hanover, Germany, MPEG85/N10062, July 2008.

At the 86th MPEG meeting, 2008-10-13/17, Busan, Rep. of Korea, Working Draft 2.0, amongst others extended by the SEA proposal, had been adopted by MPEG as Proposed Draft Amendment (PDAM) to the MPEG-4 Part 15 — AVC File Format and put up for ballot until 2009-01-19.

After comments by the National Bodies of Germany, Sweden and the US, the PDAM was revised at the 87th SC 29/WG 11 meeting, 2009-02-02/06, Lausanne, Switzerland (ref. SC 29 N 10063), and the SC 29 Secretariat issued FPDAM ballot on 2009-02-24 (closing date: 2009-06-23).

Further editing took place at the 89th SC 29/WG 11 meeting, 2009-06-29/07-03, London, UK (ref. SC 29 N 10533), in response to comments by the National Bodies of Finland, Japan, Sweden and the US. The SC 29 Secretariat submitted the FDAM text for ballot on 2009-09-03 [1].

Additionally, MVC transport over MPEG-2 systems has been targeted because there seems to be an industrial interest for the transport of MVC of existing broadcast channels. This proposal has directly been adopted by MPEG as Proposed Draft Amendment (PDAM) to the MPEG-2 Systems standard and put up for ballot (closing date: 2009-01-19).

- (6) T. Schierl, K. Grüneberg, "Proposal for the Amendment to ISO/IEC 13818-1:2007 - Transport of MVC in MPEG-2 Systems", MPEG Meeting - ISO/IEC JTC1/SC29/WG11, Busan, Korea, MPEG86/M15869, October 2008.



- (7) In response to comments by the US National Body, the PDAM text has been revised at the 87th SC 29/WG 11 meeting, 2009-02-02/06, Lausanne, and issued as Final Proposed Draft Amendment (FPDAM). The FPDAM ballot was issued by ISO/IEC JTC1/SC29 on 2009-02-18 (closing date: 2009-06-17).
- (8) At the 89th SC 29/WG 11 meeting, 2009-06-29/07-03, London, UK (ref. SC 29 N 10533), the text was revised according to further comments by the US National Body and the Japanese National body. ISO/IEC JTC1/SC 29 sent the resulting text to the ITTF for FDAM ballot on 2009-07-31.

3.2. Contributions to IETF

As anticipated, some effort has been put into standardisation of SVC and MVC transport through the Internet using the Real-time Transport Protocol (RTP). Clearly, the IETF is the responsible standardisation body for this as it owns the specification of RTP payload formats for all kinds of contents.

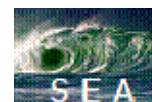
The RTP Payload Format for SVC Video is now in the last stage before being published as an RFC. Many draft versions on the SVC payload format have been contributed to the IETF (see list below), and finally a Working Group Last Call until 19 January 2009 has been issued for this item.

Two drafts have been issued on the MVC payload format which is still in the state of an individual internet draft. More details on the RTP payload format for SVC and MVC are found in the project Deliverable D3.3.1 — Integrated SVC/MVC/MDC transport [3].

In addition to the RTP payload format, specific signalling has been specified for layered and multi-description codecs in order to enable a Media Aware Network Element (MANE) to do adaptation such as "thinning" on media streams which contain SVC, MVC or MDC contents. This specification, published as **RFC 5583** by the IETF (cf. section 4.5 below), is now a Proposed Standard Protocol produced by the Multiparty Multimedia Session Control Working Group of the IETF. It defines semantics that allow for signaling the decoding dependency of different media descriptions with the same media type in the Session Description Protocol (SDP). This is required, for example, if media data is separated and transported in different network streams as a result of the use of a layered or multiple descriptive media coding process. A new grouping type "DDP" — decoding dependency — is defined, to be used in conjunction with RFC 3388 entitled "Grouping of Media Lines in the Session Description Protocol". In addition, an attribute is specified describing the relationship of the media streams in a "DDP" group indicated by media identification attribute(s) and media format description(s).

In detail, the following IETF drafts have been co-authored:

- (9) Y.-K. Wang, T. Schierl, "RTP Payload Format for MVC Video", 25 Feb 2008, Internet Engineering Task Force (IETF), Audio Video Transport Group (avt), 25 February 2008, <http://tools.ietf.org/html/draft-wang-avt-rtp-mvc-01.txt> .
- (10) Y.-K. Wang, T. Schierl, "RTP Payload Format for MVC Video", 21 Aug 2008, Internet Engineering Task Force (IETF), Audio Video Transport Group (avt), 21 August 2008, <http://tools.ietf.org/html/draft-wang-avt-rtp-mvc-02.txt>.
- (11) S. Wenger, Y.-K. Wang, T. Schierl, "RTP Payload Format for SVC Video", Internet Engineering Task Force (IETF), Audio Video Transport Group (avt), 2 January 2008 <http://tools.ietf.org/html/draft-ietf-avt-rtp-svc-05>
- (12) S. Wenger, Y.-K. Wang, T. Schierl, "RTP Payload Format for SVC Video", Internet Engineering Task Force (IETF), Audio Video Transport Group (avt), 21 January 2008 <http://tools.ietf.org/html/draft-ietf-avt-rtp-svc-06>



- (13) S. Wenger, Y.-K. Wang, T. Schierl, "RTP Payload Format for SVC Video", Internet Engineering Task Force (IETF), Audio Video Transport Group (avt), 1 February 2008 <http://tools.ietf.org/html/draft-ietf-avt-rtp-svc-07>
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- (19) S. Wenger, Y.-K. Wang, T. Schierl, A. Eleftheriadis, "RTP Payload Format for SVC Video", Internet Engineering Task Force (IETF), Audio Video Transport Group (avt), 14 July 2008 <http://tools.ietf.org/html/draft-ietf-avt-rtp-svc-13>
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- (28) T. Schierl, S. Wenger, "Signaling media decoding dependency in Session Description Protocol (SDP)", Internet Engineering Task Force (IETF), Multiparty Multimedia Session Control (mmusic), 25 May 2008, <http://tools.ietf.org/html/draft-ietf-mmusic-decoding-dependency-02>
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- (31) T. Schierl, S. Wenger, "Signaling media decoding dependency in Session Description Protocol (SDP)", Internet Engineering Task Force (IETF), Multiparty Multimedia Session Control (mmusic), 20 Nov 2008, <http://tools.ietf.org/html/draft-ietf-mmusic-decoding-dependency-05>
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- (33) T. Schierl, S. Wenger, "Signaling media decoding dependency in Session Description Protocol (SDP)", Internet Engineering Task Force (IETF), Multiparty Multimedia Session Control (mmusic), 2 April 2009, <http://tools.ietf.org/html/draft-ietf-mmusic-decoding-dependency-07>
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- (35) T. Schierl, S. Wenger, "Signaling media decoding dependency in Session Description Protocol (SDP)", Internet Engineering Task Force (IETF), **RFC 5583**, July 2009, <http://tools.ietf.org/html/rfc5583>

Last but not least, synchronisation becomes an issue if layered media are transported through different RTP sessions. In general, this issue had been regarded as solved, but during implementation some obstacles have been found which make the re-assembly of the original bitstream from different RTP sessions rather difficult. Consequently, the following draft has been issued which discusses problems related to multi-session and multi-source transmission using the Real-Time Transport Protocol.

- (36) T. Schierl, J. Lennox, "Multi-Session and Multi-Source Transmission in the Real-Time Transport Protocol (RTP)", Internet Engineering Task Force (IETF), Audio Video Transport Group (avt), 27 October 2008, <http://tools.ietf.org/html/draft-schierl-avt-rtp-multi-session-transmission-00>



4. Project liaisons

Though SEA is a rather small STREP project, the project consortium has managed to gain high visibility within the EC, the NEM platform and the industrial and academic worlds. This has been achieved via a targeted list of activities where SEA has played a key role. In more details:

4.1. Bilateral project liaisons

The SEA project has set up liaison activities with a number of projects. We may highlight some of them:

4.1.1. P2PNext

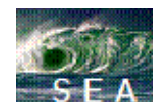
The main objective of P2PNext is to work on the P2P scenarios, trying to identify the limitation of current software systems. The project has started from the BitTorrent software and aims to extend it in order to support decoding of video stream before the whole chunk has been received. Moreover, porting on a STB is underway. As the P2P software system has increased processing power requirements, a new version of the STB was implemented in 2009.

SEA (Synelixis, STM) has been discussing with P2PNext (VTT, STM) in order to find common ways of optimizing P2P streaming. A number of phone call and physical meetings (in parallel to other events e.g. concentration and cluster meetings, FIA meetings, normal project meetings) have taken place. As a conclusion:

- a) ***The P2P approach that the two projects are following is very different.*** P2PNext is following a P2P mesh topology, while SEA has followed a multiple-tree P2P topology. As a consequence, the results can be hardly compared as the tree-based P2P architectures show a better suitability for managed systems, while the mesh-based architectures are able to cope with totally random peer churn and fully unorganized networks. As a collaboration step, SEA will make available to P2PNext the results of the SEA P2P tests, so that comparison with the P2PNext results could take place and further results may be extracted.
- b) ***The SEA project has worked towards video adaptation techniques.*** Some of these techniques reside in the network (in the sHMG and sNMG MANEs), while others reside in the VLC client side. P2PNext is mainly focusing on efficient distribution of video scalable content through the P2P network. Redistribution and adaptation of the retrieved scalable content within a local network via RTP protocols is beyond the main target of the project. However SEA will provide to P2PNext a VLC library (as object code), which will enable RTP streaming and adaptation in the local network in order to keep the P2PNext architecture more flexible and extendible in future.

Moreover, a team from SEA consisting of Alexandro Sentinelli (STM), Luca Celetto (STM), Claudio Palazzi (UCLA), Giovanni Pau (UCLA) and Theodore Zahariadis (Synelixis) has co-authored with P2PNext project coordinator Ahola Jari (VTT) a paper titled “Survey on P2P Overlay Streaming Clients”, published in: Future Internet Assembly book 2009, Towards the Future Internet - A European Research Perspective, ISBN 978-1-60750-007-0

SEA (Theodore Zahariadis, Synelixis and Federico Alvarez, UPM) and P2PNext (Ahola Jari, VTT) issued a second common paper entitled: “Efficient Streaming in Future Internet,” which was successfully presented in FIA Stockholm as poster. The final version will be published in the FIA Valencia Book (April 2010) – approval is still pending.



4.1.2. Adamantium

The key objective of ADAMANTIUM (Adaptive Management of media distribution based on satisfaction oriented User Modelling) is the implementation of PQoS-aware management mechanisms that enable for maximised user satisfaction during multimedia services access. This is also a key objective of SEA. Yet, SEA follows a lightweight approach based on distributed Adaptation Engines, while ADAMANTIUM is based on a more centralized IMS Multimedia Content Management System (MCMS).

SEA (Synelixis) has been discussing with Adamantium (Demokritos) in order to find common approaches for content optimization measurements. Moreover, SEA represented by Th.Zahariadis participated at the Adamantium Information Day, in Athens, Greece, on 19 September 2008 and discussed the approaches towards a Future Media Internet.

SEA (Synelixis) and Adamantium (Demokritos, Thales) issued a common paper to the FIA Valencia Book.

4.1.3. OPTIMIX

The main objective of OPTIMIX is to enable enhanced video streaming, based on cross layer adaptation of the whole transmission chain. OPTIMIX target goal is to increase the PQoS for the end user in a point to multi-point multimedia transmission context.

SEA (Synelixis) has been discussing with OPTIMIX (Thales Communications) in order to find common ways for content adaptation over wireless media/networks.

Moreover, a team from SEA consisting of Theodore Zahariadis (Synelixis), Thomas Schierl (Fraunhofer HHI), Karsten Grüneberg (Fraunhofer HHI), Luca Celetto (STM) has co-authored with OPTIMIX project manager Catherine Lamy-Bergot (Thales Communications) and Christian Timmerer (Klagenfurt University) a paper on “Content Adaptation Issues in the Future Internet,” published in: Future Internet Assembly book 2009, Towards the Future Internet - A European Research Perspective, ISBN 978-1-60750-007-0.

SEA (Synelixis) and Optimix (Thales) issued a common paper to the FIA Valencia Book.

4.1.4. ENTHRONE

The ENTHRONE project proposes an integrated MPEG-21-based management solution that covers the entire audio-visual service distribution chain, including protected content handling, distribution across networks and reception at user terminals. The main project goal is to provide a dynamic QoS based MPEG-21 cross-layer media adaptation in a policy based management for end-to-end heterogeneous delivery chain.

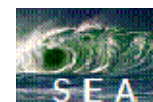
SEA (Synelixis, STM) discussing with ENTHRONE (Thomson, Demokritos, Labri, Thales) in order to find common approaches for cross-layer media adaptation and management of the heterogeneous network configurations. Also, the protected content handling solutions (SVC, MVC, IPMP, OMA) provided by the two projects were compared and checked for interoperability.

4.2. The FIRE initiative

The FIRE initiative aims to offer facilities for testing and evaluation by building a pan-European testbed, integrating a number of LAN, GRID and mobile testbeds (PanLab, One Lab, G-Lab) and interfacing PlanetLab.

SEA has even from the proposal phase foreseen a complete testing environment with:

- a) a real-time simulated, controlled lab testbed in Nomor, Germany,
- b) a world-wide P2P network via access to PlanetLab via UCLA and STM and



c) a real mobile network via Vodafone, Greece.

Yet, in order to evaluate the new opportunity of FIRE and liaison with FIRE infrastructure, it has submitted to FIRE a complete use case and has extensively explained the project testing requirements. So far, the technical manager of SEA, Theodore Zahariadis (Synelixis) and the technical manager of FIRE, Anastasius Gavra (Eurescom) have a very good co-operation and SEA was presented by FIRE in both ICT 2008, Lyon 2008 and FIA, Madrid 2008 as the model project, where FIRE may build his first real use-case.

4.3. Clusters and Task Force

SEA has actively participated in the Media Delivery Platforms Cluster and the Future Media and 3D Internet Task Force.

4.3.1. Media Delivery Platforms Cluster

Since the fall 2007 concertation meeting, the SEA project has successfully led the Media Delivery Platforms (MDP) Cluster. The MDP cluster consists of 12 projects in Networked Media and has been active the last 2 years. The interaction with the MDP cluster and the Concertation meetings have given the opportunity to SEA, to exchange useful information and views with other Networked Media projects and formulate the issue of Content Aware Network.

Led by Theodore Zahariadis, who is the MDP cluster co-ordinator, MDP has produced a white paper entitled: "[Multimedia Delivery in the Future Internet A Converged Network Perspective](#)", which was published in October 2008 and presented in NEM Summit in St. Malo.

4.3.2. User Centric Media Cluster

SEA has also actively participated in the User Centric Media cluster. Federico Alvarez (UPM) has always followed the Concertation meeting (Fall 2007, Spring 2008, Fall 2008) and contributed actively in User Centric Media Cluster white papers.

4.3.3. FM3DI Task Force

SEA has actively contributed to the Future Media and 3D Internet Task Force. Th. Zahariadis has participated in the activities of the FM3DI task force in a meeting in Brussels, 5-6 June 2008. Moreover, Th. Zahariadis and F. Alvarez have actively contributed to the FM3DI white paper "Research on Future Media and 3D Internet"

4.4. Future Internet Assembly

SEA has been one of the first projects that have supported the **Future Internet Assembly (FIA) initiative**, formed and signed the **Future Internet Bled declaration**. Th. Zahariadis and F. Alvarez have participated in a number of preparation events in Brussels and a number of phone conferences, which have been organized by EC.

SEA had a dedicated poster stand in the FIA event in Bled, Slovenia. Moreover, **UPM has organized and sponsored the complete FIA event in Madrid, Spain in 9-10 December 2008.**

For his contribution to the FIA preparation, Th. Zahariadis was assigned by EC as the "Media Internet" breakout session caretaker in Bled, Slovenia on 31/3-2/4/2008. Moreover, Th. Zahariadis co-chaired the "Future Content Networks" breakout session in Madrid, Spain.

SEA made presentations in the following FIA events:

- 1) Th. Zahariadis, "SEA Project Poster", Bled, Slovenia, 31 March -2 April 2008



- 2) Th. Zahariadis, F. Alvarez, "Content Issues in the Future Internet," Brussels, 24 July 2008
- 3) F. Alvarez, "Preparation for the FIA event," Brussels, 15 September 2008
- 4) Th. Zahariadis, "Future Content Networks: Position Paper", Future Internet Assembly (FIA), Future Content Networks (FCN) Session, Madrid, 9 December 2008
- 5) Th. Zahariadis, "The SEA use case in the FIRE testbed," Future Internet Assembly (FIA), Future Content Networks (FCN) Session, Madrid, 9 December 2008
- 6) Th. Zahariadis, "Content Protection Issues," Future Internet Assembly (FIA), Identity and Trust Session, Madrid, 9 December 2008
- 7) Th. Zahariadis, "Seamless Content Delivery over the FIRE," Future Internet Assembly (FIA), FIRE Session, Madrid, 10 December 2008
- 8) Th. Zahariadis, F. Alvarez, "Content Centric Internet," Future Internet Assembly (FIA), FCN Session, Prague, 11-13 May 2009
- 9) Th. Zahariadis, F. Alvarez, "Architectures targeting Content Centric Internet," Future Internet Assembly (FIA), FCN Session, Stockholm, 23-24 November 2009

SEA has also contributed to the **FIA Future Content Networks position paper**, having Th. Zahariadis (Synelixis) as the paper editor and F. Alvarez (UPM) and Guillermo Cisneros (UPM) among the main contributors.

SEA has also been present in the preparation of the FIA event in Prague. Th. Zahariadis and F. Alvarez are members of the EC scientific committee, which has been peer-reviewing the papers submitted for the FIA book. Moreover, Th. Zahariadis (Synelixis), Norbert Niebert (Ericsson) and Jean-Dominique Meunier (Thomson) have authored an **introductory chapter on Future Content Networks for the Prague book**. Finally, as detailed earlier, SEA has co-authored with other projects (OPTIMIX, P2PNext) two papers, which have been published in the FIA Prague book and two papers that have been co-authored with other projects (OPTIMIX, ADAMANTIUM, P2PNext, nextMedia) presented as posters in the Stockholm FIA event and submitted to FIA Valencia book..

4.5. SEA in Networked Media Unit Newsletter

SEA is acknowledged in the Networked Media Unit Newsletter (Issue 24, September 2009). The following text is copied from the newsletter:

"SEA Signalling Media Decoding solution has entered the status of IETF RFC.

The SEA consortium announces that the SEA signalling solution has been awarded the approval from the Internet Engineering Task Force (IETF) and entered the status of an IETF RFC in the "standards track" category. Supported by the SEA project (FP7-ICT- 214063) Thomas Schierl (HHI) has co-authored the RFC 5583 "Signaling Media Decoding Dependency in the Session Description Protocol (SDP)". It is worth to mention that RFCs (Request for Comments) are memorandums which after extended peer review of the Internet Society, are published by the IETF. RFCs describe methods, behaviors, research, or innovations applicable to the working of the Internet and Internet-connected systems. By getting the RFC status together with the unique RFC number, the SEA Signalling Media Decoding Dependency achieves the maximum dissemination Level in the Internet Community. Companies and researchers all over the world are expected to comply and use the proposed signalling solution or comment on the RFC.

For more info: www.ist-sea.eu

<http://www.rfc-editor.org/rfc/rfc5583.txt>



5. Conclusion

During the two years of the project's lifetime, the SEA project has spread its scientific results actively on different fields of publications, i.e., a number of articles have been submitted to journals and scientific conferences.

Liaisons have been established with other European research projects. Furthermore, it has made significant contributions to different standardisation bodies.

SEA partners will continue contributing to the Future Internet Assembly (FIA) initiative, even after the project end.



6. References

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- [2] SEA Deliverable D3.2 — MVC/SVC storage format, issued 29 January 2009, http://www.ist-sea.eu/Public/SEA_D3.2_HHI_FF_20090129.pdf.
- [3] SEA Deliverable D3.3.1 — Integrated SVC/MVC/MDC transport, issued 15 May 2009, http://www.ist-sea.eu/Confidential/SEA_D3.3.1_HHI_FF_20090515.pdf.
- [4] Networked Media News Letter, Issue 24, September 2009