Distributed coding for video services

DISCOVER

Deliverable 7

External liaisons
Version 1

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Abstract :	This deliverable reports on the external liaisons of the DISCOVER project. Especial importance is given to liaisons with image and video coding standardization bodies such as ISO/IEC JPEG, ISO/IEC MPEG and ITU-T VCEG. Contributions to these bodies are listed and briefly summarized.
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TABLE OF CONTENTS

Deliverable 7

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1. INTRODUCTION

A liaison standardization activity within the DISCOVER project is a technical or dissemination activity done within the project that has been at least presented (not necessarily proposed) in a standardization forum. On the other hand, activities done in standardization forums related to distributed video coding, which might influence DISCOVER developments are also considered to be informative liaison activities as they have to be carefully followed by DISCOVER partners. It is in this context that one of the main objectives of the DISCOVER project, in addition to research on Distributed Video Coding (DVC), is to keep strong liaisons with international standardisation bodies dealing with image and video coding (i.e. ITU-T SG 16, ISO/IEC MPEG, ISO/IEC JPEG) and to actively contribute with proposals based on DVC developments which might be useful to standardize.

Liaison activities are considered to be of great importance in order to have a strong scientific and technological impact, to open new prospects for IST and to contribute to help solving societal problems in the longer term. Liaisons with relevant EU projects and DVC researchers in Europe and worldwide are also of paramount importance and adequate concertation mechanisms are being developed.

The document is organized as follows: in Section 2, ISO/IEC MPEG activities related to DVC are described and DISCOVER contributions are presented. In Section 3 and Section 4, liaisons of DISCOVER to VCEG and JVT are described respectively. In Section 5, liaisons to JPEG are presented. In Section 6, other liaison activities are presented. Concluding remarks are given in Section 7.

2. MOTION PICTURE EXPERTS GROUP – MPEG

Motion Pictures Experts Group (MPEG) formally known as ISO/IEC JTC1 SC29/WG11 is one of the most active standardization groups in the field of audiovisual representation and coding. DISCOVER partners have been very active in this working group since very long and continue to be active there. Recent contributions of DISCOVER partners in MPEG have been done in the framework of DISCOVER objectives and have concentrated on creating appropriate and adequate links to allow the DISCOVER consortium to become aware of activities of MPEG relevant to the objectives of the project. At the same time, efforts have been made in order to prepare the ground for a possible video compression standard based on technologies and ideas that are taking shape within DISCOVER.

Among various activities done in the MPEG context, three are directly relevant to DISCOVER objectives and activities:

- DVC application scenarios
- Multiview Video Coding (MVC)
- MPEG workshops on future directions in video compression

A description is provided below summarizing the details of efforts made within the context of the DISCOVER project.

2.1 DVC application scenarios

One of the objectives of DISCOVER is to find out which are the most promising scenarios for DVC. The consortium has produced, and submitted to the Commission, Deliverable D4 titled *Application Scenarios and Functionalities for DVC* where the application scenarios for which DVC may bring major benefits have been described after detailed analysis. As this Deliverable may have a strong impact on future developments of DVC, Professor Riccardo Leonardi on behalf of the DISCOVER consortium has presented the following contribution to MPEG in a joint Requirements/Video session:

MPEG 13458, "Distributed Video Coding: Identifying Promising Application Scenarios", Klagenfurt, 17–21 July 2006.

The summary of this document is as follows:

The major objective of this MPEG contribution is to report on the study made by the European project DISCOVER about the application scenarios for which the DVC paradigm may bring major benefits and identify which are these benefits. Note it is not the purpose of this contribution to claim that DVC is the right way to go for any application scenario. Considering the far from mature stage of DVC research, it is too early for final conclusions and claims. The purpose is rather to identify the most promising applications, helping the researchers to focus their work on the most adequate application spots, in order conclusions on the value of DVC for these applications may be taken as soon as possible.

The MPEG Requirements subgroup reacted to this contribution by impressing its appreciation that these reports on new application environments and associated needs are brought to the attention of MPEG. Moreover, it was stated that MPEG would appreciate to be kept informed on further development in the DVC area.

2.2 DVC multiview video coding

Multiview video coding in MPEG goes back to the period when the MPEG-2 standard was enhanced with a profile on multiview coding in order to cope with stereo and other multiview content. Later on, and with the increasing availability of sensors, displays and content capable of multiview features, MPEG started an exploration activity under the label '3DAV' in order to assess the needs, requirements and technologies for a potential new standard in this field.

Since October 2003, several efforts were made and various calls for evidence, requirements, and technologies were issued with many feedbacks received. The last call for technologies in MVC (Multiview Video Coding) was issued at the 74th MPEG meeting in Nice, France, in October 2005, and responses were evaluated at 75th MPEG meeting in Bangkok, Thailand, in January 2006. As a result, several Core Experiments in MVC were set up in order to improve various

components of multiview video compression, a reference software was created, and the first multiview verification model describing a complete multiview codec was designed.

The core of the multiview coding algorithm retained for standardization in MPEG is an extension of the well-known AVC algorithm (MPEG-4 Part 10 also known as H.264 by ITU-T) where appropriate tools have been added to cope with predictions between different views and their corresponding modes, illumination compensation, etc. As of the 77th MPEG meeting in Klagenfurt, Austria, in July 2006, MPEG decided to appoint the Joint Video Team (JVT) to be responsible for standardization of MVC. The resulting standard will therefore become not only an ISO standard, but also an ITU-T recommendation.

The major difference between MVC dealt with in MPEG (now JVT) and DISCOVER resides in the fact that DISCOVER Distributed Video Coding does not require that all the cameras communicate with each other when compressing the video data, which is the case with the current MPEG-MVC. The DISCOVER project can therefore play an important role by showing to the MPEG delegates and researchers a multiview DVC approach which brings a clear and tangible added value to what is being pursued there.

Beside the input from DISCOVER to MPEG, it is important to mention that MPEG activities in MVC have also played an important role in the way DISCOVER project has and continues to plan its research activities. A large portion of the multiview test material used today within DISCOVER has been gathered thanks to contacts established inside MPEG with experts active in this field. In addition, the Core Experiments and some of the ideas used in MPEG MVC influenced the coding approach used in DISCOVER by bringing in ideas that seemed efficient for MVC coding. Among such ideas one can mention the illumination compensation between various views.

No specific contributions have been made yet to MPEG on the topic of multiview video coding. However, DISCOVER hopes to submit some contributions during the life of the project.

2.3 MPEG workshops on future directions in video compression

MPEG is among the standardization groups that can be qualified as pro-active. In fact, during its history, MPEG has not only responded to a need expressed by the industry or a market to establish a standard, but more than often, has predicted and initiated standardization activities in view of a possible need which would soon arise. Establishment of exploration activities such as those mentioned on 3DAV in the previous section is such an example. MPEG also constantly assesses the performance of its standardized specifications against the state of the art.

MPEG workshops on future directions in video compression were established to contribute to the two objectives mentioned above. One can easily assert that DISCOVER partners have played a successful role in the organization and success of the MPEG workshops, even when one can see that the scope of such workshops go beyond that of DISCOVER objectives alone.

Professor Touradj Ebrahimi, and Professor Joern Ostermann, two of the partners of the project are among the organizers of these workshops, together with Dr. T.K. Tan and Dr. Andy Tescher. In a way it can be said that the DISCOVER partners represent Europe's view, whereas the two others each Asia and North America, respectively.

The Second MPEG Workshop on Future Directions in Video Compression was organized in Nice, France, prior to the 74th MPEG meeting in October 2005. Thanks to DISCOVER consortium which could meet well before the official start of the project in September 2005, a presentation could be planned on distributed video coding, as a potential technology to be considered as a future MPEG specification. The task of presenting such a topic was given to

Professor Fernando Pereira another partner of the DISCOVER project, who kindly accepted the invitation and performed a very successful presentation at the workshop. It is important to mention that the presentation was also a first occasion, already in October 2005 and only two months after the start of the project, to mention to MPEG community made of international experts in video compression, of the existence of the DISCOVER consortium, and hence to be irrevocably associate the project with advanced research in distributed video coding.

3. VIDEO CODING EXPERTS GROUP - VCEG

VCEG is looking into future video coding algorithms under an activity referred to as H.265. Currently there is no coordinated effort towards developing H.265. However, the group is looking at different technologies which is evaluated in a common software platform (KTA) based on H.264. The KTA software includes improvements by University of Hannover and France Telecom. At this point, encoder complexity or error resilience are not yet part of the issues being investigated.

Although the DISCOVER consortium has not yet established any activities within VCEG, efforts will be made to keep aware of current developments within the group and to contribute, if possible, to the development of distributed video coding activities.

4. JOINT VIDEO TEAM - JVT

JVT is currently working on amendments to H.264. One is related to multiview video coding. As a result of a call for proposals by MPEG, H.264 based technology was choosen as a basis for Multiview Video Coding (MVC). Another work item is the extension of H.264 to Scalable Video Coding (SVC). Both work items are not related to DVC, but in the case of MVC many tools developped in that framework are relevant and can be adapted to a multiview DVC algorithm. DISCOVER partners involved in multiview coding and standardization Hill continue to monitor MVC within JVT and as in the past continue to adapt some of the comcepts Duch as multiview prediction and illumination compensation to DISCOVER multiview codec. Also, the MVC codec will be used as an anchor to compare with DISCOVER multiview codec in terms of performance.

A presentation from Stanford University to JVT was based on DVC ideas. They are used in the context of error resilience in case of packet loss of H.264 packets. The results indicate slightly superior performance over classical error correction codes due to the graceful degradation in case of increasing errors. Conventional coding does not support graceful degradation. The proposal needs further refinement before being competitive.

At the 77th MPEG meeting held in Klagenfurt, July 2006, it was decided that error resilience including the development of appropriate payload formats for streaming is now part of the task of VCEG. This decision will open the door for DISCOVER to contribute to the error resilience performance of video coding. A timeline for the development has not yet been set.

5. JOINT PHOTOGRAPHIC EXPERTS GROUP – JPEG

The Joint Photographic Experts Group (JPEG) is a joint committee of experts from ISO and ITU-T responsible for standardization of picture coding systems. Within ISO, it is formally

known as ISO/IEC JTC1 SC29/WG1. DISCOVER partners have been active in this working group since a few years and continue to be active there. As in the case of MPEG, recent activities of the consortium within JPEG have been done in the framework of DISCOVER objectives and aim at creating appropriate and adequate links to allow DISCOVER members to become aware of activities of JPEG relevant to the objectives of this project. At the same time, efforts have been made in order to bring an impact of DISCOVER research activities to the JPEG community.

Among different JPEG activities done in the DVC context, two are directly relevant to DISCOVER objectives and activities:

- Advanced Image Coding (AIC)
- JPEG 2000 as a technology for non-DVC portion of DISCOVER codec

Below, a report is provided summarizing the details of efforts made in JPEG within the context of the DISCOVER project.

5.1 Advanced image coding

JPEG group has been behind a number of successful standards. The most popular, JPEG is widely used in digital cameras, and the Internet. The more recent JPEG 2000 standard has been successful in other applications such as archival, video surveillance and especially digital cinema. An interesting observation is to note that JPEG 2000 has not been very successful in replacing JPEG standard in applications where it has been used, but rather has become successful in those applications where JPEG has not been deployed.

Based on this observation, and taking into account the cycles of technology innovations in compression, JPEG committee has started new explorations in order to find if there is a need and if there are technologies reaching maturity in order to define the next generation of image compression systems beyond JPEG 2000. This activity is referred to as Advanced Image Coding (AIC). If successful, AIC is foreseen to be ready for deployment in applications around the middle of the next decade. It is therefore important that the evaluation methodologies used in order to choose the best technologies for AIC, make use of the same content and assess features that will be used by then.

The first concrete results in terms of scopes and requirements of AIC were reported in a document at the 37th JPEG meeting in Singapore, on November 2005, and produced by the Requirements subgroup of JPEG under the leadership of Professor Touradj Ebrahimi, a partner in the DISCOVER project. Already in this document, Distributed Source Coding and Distributed Video Coding were identified as potential technologies which could eventually respond to the needs of AIC.

Another important milestone took place during the 38th JPEG meeting in Cupertino, in March 2006, where in addition to further studies in scope and requirements, a process was identified for the possible establishment of AIC. According to this process, it is important to first define evaluation methodologies reflecting the desired features of the applications under the scope of AIC, before considering a call and assessment of technologies. A preliminary call for evaluation methodologies was therefore issued and interested parties were invited to respond to it not only with evaluation methodologies, but also with suggestions on how to finalize the call.

The 39th JPEG meeting in Perugia received two responses to this preliminary call of which one was from Professor Riccardo Leonardi another partner of the DISCOVER project. As a result of these responses, it became evident that a call for only evaluation methodologies in an abstract

way is not efficient and that a number of technology examples should also be called for in order to make sure that the evaluation methodologies are not biased to a limited set of technologies such as those in current JPEG standards. The version 2 of the preliminary call produced at the 39th JPEG meeting now asks for both evaluation methodologies and AIC technology examples. DISCOVER project partners will therefore intend to contribute to this call with distributed video coding as a potential technology to be considered when defining the evaluation methodologies of AIC.

5.2 JPEG 2000 as a technology for the non-DVC portion of DISCOVER codec

In most DVC codecs, part of the coding strategy relies on non-DVC techniques. As an example, in the DISCOVER codec, some of the video frames are coded in Intra AVC, and transmitted to the decoder. The DISCOVER general architecture proposes other alternatives such as JPEG 2000. A natural question concerns which of the two alternatives, among Intra AVC and JPEG 2000 is more suitable. Although a few attempts were made since summer 2005 by various researchers to answer to this question, no in-depth, extensive, and rigorous study was performed. In addition, some of the conclusions in the most recent reports on this topic seemed contradictory. EPFL, a partner of the DISCOVER project undertook a rigorous and extensive test to evaluate these two alternatives in terms of compression efficiency each provides. Several test video with various resolutions from small (QCIF) to medium (CIF) and high resolutions (4CIF) were compressed with appropriate parameters giving the best possible rate distortion characteristics for both Intra AVC, and JPEG 2000. For Intra AVC, both Main Profile and High Profile were employed. As a conclusion, it turns out that in general one can say that for medium and low resolution video, the performance of both AVC Intra Main and High profiles surpass that of JPEG 2000. The result becomes similar and even goes in favour of JPEG 2000 in higher resolution video, when compared to AVC Intra Main profile, and High profile, respectively.

The results of these investigations are planned to be contributed to JPEG at its 40th meeting in November 2006.

6. OTHER LIAISON ACTIVITIES

DISCOVER puts a strong emphasis at IST related projects in order to optimize resources and to establish common synergies for the benefit of the European Union research strategy. During the project life of DISCOVER, the following IST projects have been identified whose video coding activities may have a relationship to DISCOVER activities. For each of the related projects, objectives, results where available and demonstrations have been followed and taken into account. However, it is worthwhile mentioning that only another European project has been clearly identified with activities in distributed video coding.

Dynamic and Distributed Adaptation of scalable multimedia conteNt in a context-Aware Environment (DANAE) http://danae.rd.francetelecom.com/. January 2004-June 2006.

DANAE proposes to address the dynamic and distributed adaptation of scalable multimedia content in a context-aware environment. Its objectives are to specify, develop, integrate and validate in a testbed a complete framework able to provide end-to-end quality of (multimedia) service at a minimal cost to the end-user. Error resilient and efficient (in terms of bitrate and required processing power in the player) coding schemes will be studied to cater for the specific constraints introduced by the existing multiplicity of networks and terminals. An application will

be specifically developed and implemented on a demonstrator, to illustrate the new service concepts pioneered by the Project.

Main interest to DISCOVER:

Scalable coding systems

Error resilience and efficient coding schemes

Networked audiovisual media technologies (VISNET) http://www.visnet-noe.org/. December 2003-November 2005.

VISNET aims to create a sustainable world force of leading research groups in the field of networked audiovisual (AV) media technologies applied to home platforms. The member institutions have grouped together to set up a network of excellence with a clear vision for integration, research and dissemination plans. The research activities within VISNET will cover several disciplines related to networked AV systems and home platforms. These are: creation/coding of AV content for immersive home platforms, storage and transport of AV information over heterogeneous networks, audiovisual analysis techniques for immersive communications and audiovisual analysis techniques for immersive communications.

VISNET is the only identified IST founded European effort with activities in distributed video coding. Three partners of DISCOVER (IST, EPFL and UPC) are also members of VISNET what has contributed to strong synergies with other VISNET partners, mainly Politecnico di Milano. These synergies have resulted in common cooperation and shared publications between VISNET and DISCOVER partners. VISNET has ended in November 2005 but a follow-up with the name of VISNET-2 has started in July 2006. Strong cooperation in distributed video coding is expected among the two consortiums.

Main interest to DISCOVER:

Distributed video coding activities done by DISCOVER partners and liaisons with Politecnico di Milano.

Wireless Cameras and audio-visual seamless networking (WCAM) http://www.ist-wcam.org/. December 2003-March 2006.

The WCAM project studied, developed and validated a wireless, seamless and secured end-to-end networked audio-visual system. WCAM also focused on the technology convergence between video surveillance and multimedia distribution over the Internet. WCAM took into account real time aspects as well as security and scalability issues. The project aimed at improving state of the art technologies in each of the technological components involved in the system and combineed them. The WCAM system was installed and tested with users of both multimedia distribution and videosurveillance communities. The objectives of DISCOVER project were presented to WCAM partners and interest was expressed by Univeryity of Bristol in following the future activities of DISCOVER as this institution has an activity on Distributed Video Coding.

Main interest to DISCOVER:

Low complexity video cameras

Video surveillance applications and underlying requirements

Multimedia networking (MEDIANET) http://www.ist-ipmedianet.org/. December 2003-November 2005.

Targeting multimedia communications and audio-visual content distribution services for residential markets, MediaNet addresses new & more open possible supply chain architectures and co-operation schemes between content owners, service providers, network service providers, and personal computer and consumer electronics equipment manufacturers.

Main interest to DISCOVER:

Wireless audio-visual distribution

Except for the VISNET network excellence whose cooperation and liaison activities have been explained above, no strong synergies have been developed with the other projects. This is due to several reasons. The main one because no distributed video coding activities have been described in any of these projects (neither, to the best of our knowledge, in any of IST existing projects) and because of the small time overlap between DISCOVER and the other projects. However project results and corresponding project publications have been followed to detect any input worthwhile for DISCOVER activities.

7. CONCLUSIONS

Liaison activities are being very important for the DISCOVER project. Particular attention has been paid to liaison activities with standardization bodies such as MPEG, JVT and JPEG and many DISCOVER partners play a key role in these standardization bodies. Presentations have been made into the MPEG forum to introduce DISCOVER technical activities. In addition as JVT has been appointed to develop multiview coding techniques, special emphasis is being put in following JVT developments which might influence DISCOVER research activities. Liaisons have been also very important with JPEG particularly in the AIC group and JPEG 2000 as a technology for non-DVC portion of the DISCOVER codec. Results and publications from other IST projects related to video coding have been followed, although no relevant activity has been found in distributed video coding.

DISCOVER intends to continue contributing to standardization bodies. The research activities done so far in the project and the very important liaisons established by DISCOVER partners with MPEG, JVT and JPEG assure that distributed video coding may have an important impact on future standardization activities. The just starting work of JVT on error resilience will be the first topic where concepts of distributed video coding may find their way into standards.