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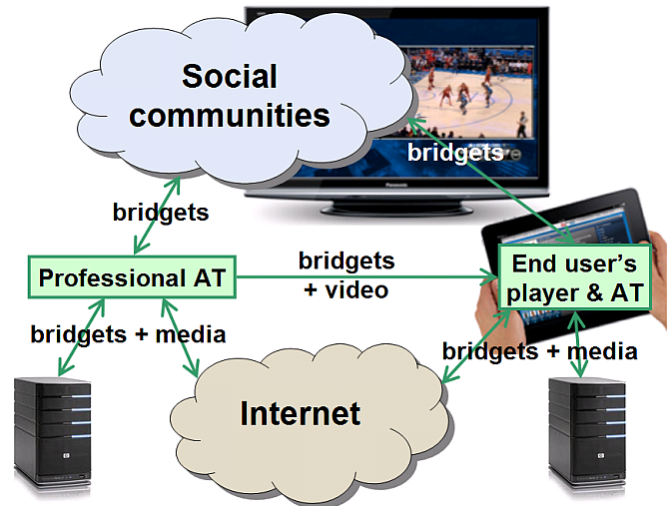
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1 Project Description

BRIDGET opens new dimensions for multimedia content creation and consumption by enhancing broadcast programmes with bridgets: links from the programme you are watching to external interactive media elements such as web pages, images, audio clips, different types of video (2D, multi-view, with depth information, free viewpoint) and synthetic 3D models.

Bridgets can be:

- created automatically or manually by service providers, either from their own content (e.g., archives, Internet and other services) or from wider Internet sources;
- created by end users, either from their local archives or from Internet content;
- transmitted in the broadcast stream or independently;
- independently distributed by users e.g. via social networks;
- filtered by a recommendation engine based on user profile, relevance, quality, etc.;
- enjoyed on the common main screen or a private second screen, in a user-centric and immersive manner, e.g., within 3D models allowing users to place themselves inside an Augmented Reality (AR) scene at the exact location from which the linked content was captured.



To deliver the above, BRIDGET develops:

- a hybrid broadcast/Internet architecture;
- a professional Authoring Tool (AT) to generate bridgets and dynamic AR scenes with spatialised audio;
- an easy-to-use AT for end users;
- a player to select bridgets, and consume and navigate the resulting dynamic AR scenes.

The AT and player use a range of sophisticated and innovative technologies, extending the state-of-the-art in media analysis, visual search, and 3D scene reconstruction. This enables customised and context-adapted hybrid broadcast/Internet services offering enhanced interactive, multi-screen, social and immersive content for new forms of AR experiences. BRIDGET tools are based on and contribute to international standards, thus ensuring the creation of a true horizontal market and ecosystem for connected TV and contributed media applications.

2 Research & Development Areas of Interest

BRIDGET continues to be driven by the change in the way people relate to visual media: digital TV, IPTV, multichannel, user-generated content, interactivity, second screens, etc. There are several elements, which have come together to drive BRIDGET:

- The second screen phenomenon is a powerful complement to existing successful live services, e.g. TV. However, the use of the second screen, while triggered by the service providers' content, often happens independently of them. BRIDGET aims to bring the second screen content closer to that of the service providers, offering a mix of their content and content that is semantically linked.
- Sophisticated signal processing technologies that are nearing readiness for consumer use, such as media analysis and visual search, 3D scene reconstruction, and authoring tools for interactive, multi-screen, social and immersive content. BRIDGET improves these technologies and uses

them to leverage the most valuable service provider's asset, the broadcast content, by enriching it with **links to audio or visual content or time portions** that we call "bridge points" or **bridgets**.

- By developing easy-to-use bridget authoring tools, BRIDGET is stimulating newer forms of creativity for professional- and end-user-generated immersive and interactive digital media content. Our feedback from our colleagues at RAI has been fantastic and we've enjoyed watching how excited they get about the possibilities for second screen content served via *bridgets*.
- BRIDGET is determined to exploit international standards because they lower the threshold of acceptance of such new technologies and create a true horizontal market and ecosystem for connected TV and interactive media applications. With the consortium being established members of MPEG we've already created a draft international standard for Media Linking Application Format (MLAF).

3 Summary of Activities

This year has seen BRIDGET move from strength to strength. We kicked off our first year with a physical workshop to engage with key stakeholders and find out what visions they had for the future of second screen. As part of this we were able to get their feedback on our views for BRIDGET technologies. We took their feedback, integrated it into our use cases and this year we were able to go back to them with our authoring tool to see what they thought. This first full cycle of the development process has been a fantastic chance to demo the work that we've done thus far.

The architecture of the BRIDGET software was laid out in the first year of the project, work in this year has aimed towards improving and integrating the tools. The media structure analysis tools took the base work from last year on temporal video segmentation and have integrated it with the visual search algorithms to allow them to group shots into logical story-boards. It can be used to identify when a video returns to a given scene, e.g. the news desk or a regular set in a drama. Work has also been done to make the face clustering developed in the first year a parallelized application, this means that talk shows can now be clustered in 10x real-time, while more complex programs such as newscasts can be done in near-real-time. Work is also advancing on programme analysis; being able to take a talk show and split it into its component parts, opening credits, closing credits, conversations, segments such as jingles or applause and inset sections from guest performances or reports. The project also developed efficient algorithms for classification of images and video shots, enabling fast search for scenes depicting, for example, mountains, sea-side, or down-town.

Last year's work on image matching and object recognition laid the ground work for further improvements this year. By taking outputs from multiple local image descriptors and combining them in a novel way BRIDGET created a world leading global image descriptor last year, and this year they've extended this further to increase performance again. It has now been validated to scale well to very large databases, containing hundreds of millions images or video sequences, using a very efficient binarisation scheme. The algorithms laid last year for searching in videos have been extended and optimised, and integrated into the Authoring Tool for efficient creation of bridgets. The team have also created an evaluation framework and collected several datasets to enable other techniques to be effectively benchmarked through the MPEG CDVA sub group; so once again BRIDGET is helping to ensure that international standards are able to get the best cutting edge research included. Work on search in video content will continue in year 3, investigating how to derive the most efficient and compact representation for a video segment, so you'll have to wait until next year to find out more about that.

Last but not least from our underlying research areas is the ability to create 3D models from a selection of photos or videos, encode them in a compressed format, transmit them to the user and then allow them to display the results. One of the major problems currently with 3D model creation is the time taken to build the models. BRIDGET researchers have been working to optimise the algorithms using GPUs where available and parallel CPUs elsewhere. The image point matching required for the 3D model construction have been further improved by the introduction of some pre-processing steps to allow more accurate correspondences to be found. In addition, the team have taken their novel 3D representation based on splats and merged it with more traditional mesh based representations. This allows the representation to use meshes where the objects are smooth, represented well by meshes, and it can use splats on areas of more intricate detail where meshes are inefficient. This resulting representation 'SPLASH' is explained in

more detail in the scientific paper published in June 2015.[2] Work has also begun on compression of these 3D models for transmission, using the hybrid nature to their advantage to make the representations efficient; look forward to hearing more about this in Year 3. The 3D modelling team don't stop with images, they have also been working on bringing 3D spatial audio to BRIDGET, now a bridget can contain a number of audio objects which can be rendered to sound as if the user is actually in the scene.

All of these advancements are being integrated into the prototype tools we're developing with help and feedback from professional users and focus group user trials. See the next section for more information about this part of the project.

4 Project Applications & User Involvement

4.1 Project Applications

BRIDGET is combining cutting edge research in several areas and presenting it in three applications for use in the creation and consumption of bridgets. There will be a multi-screen player, an authoring tool for professional use and a mini authoring tool for consumer use. The authoring tools integrate the BRIDGET research, which is focussed on making service providers' and personal archives more manageable. It will enable the authors to access and create 3D models and point clouds for inclusion in their bridgets. The player in turn will allow consumption of bridgets across multiple different environments.

4.1.1 Authoring Tool

By the end of the first year of the project the Professional Authoring tool was already taking shape, with interfaces to many of the tools being developed by the research teams. In this second year that integration has continued and new tools are continually being added as they are developed. In addition, the authoring tool has gained functionalities for managing user-specific content, extended meta-data fields, meta-data based search, a bridget layout editor and bridget reuse for modifying or as bases for new content. During this year we've also had feedback from professional users which has enabled us to improve the interfaces and usability.

4.1.2 BRIDGET Player

This year sees the 3D models come to the BRIDGET player. Already by the end of the first year it was capable of displaying bridgets synchronised with the main screen and had been integrated with WimTV to show how it can work in a real life setting. Now it brings you immersive media rendering allowing the user to explore 3D models on their android device, see Figure 1 for some examples. With the arrival of Android 5.x this year the team have been working hard to ensure it works with the new release and to integrate the feedback from the focus groups ready for the larger scale user trials. They've also added links to facebook and twitter to tie in to the social media-sphere so people can share their favourite bridgets.

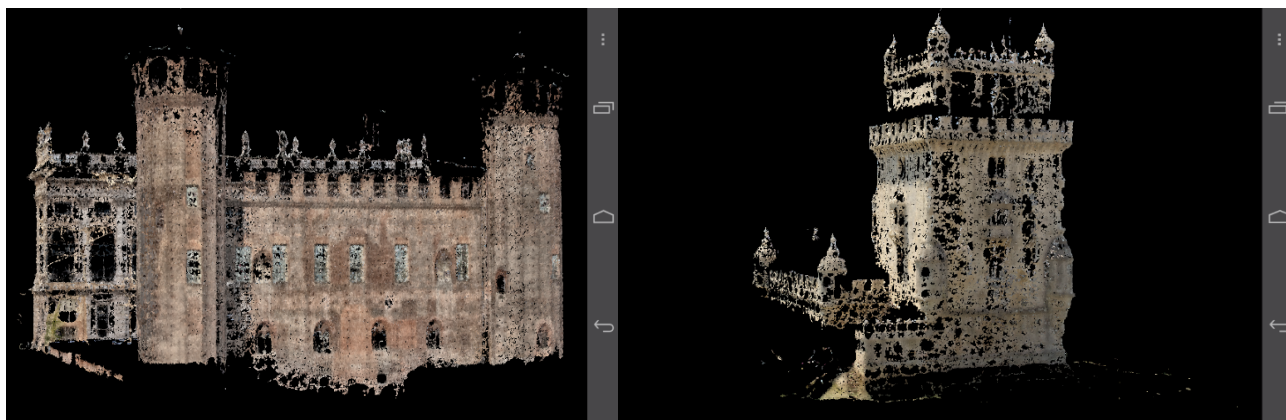


Figure 1 Splats rendering Bridget player on a mobile device running on Android

4.2 User Involvements & Evaluation

This year saw us have 2 full trials, one for each of the prototypes; the authoring tool was trialled in RAI's Turin Production Centre premises between July and August 2015, the player was trialled by end users at Telecom Italia's Joint Open Laboratory in October 2015. The authoring tool trial was well received and many of the users felt they were able to create bridgets with the current provisions. They offered several ideas for future work ranging from content organisation to wysiwyg lay-out editors and integration with existing enterprise services. We'll be looking over the next few months which of these we can feasibly integrate in the final year of the project. One of the main feedbacks received was that extra resources would be required to 'bridgetise' a programme and this should be investigated as part of the project.

The BRIDGET player was positively received during the trials with users finding the prototype easy to interact with and contained interesting content. They were able to navigate the app easily and liked the 2 layouts we'd designed for the trial, see Figure 2 for an example. From an innovation point of view they enjoyed that the bridgets knew when to start so that relevant information was always available. They also saw it as a great way to extend many different types of programmes.

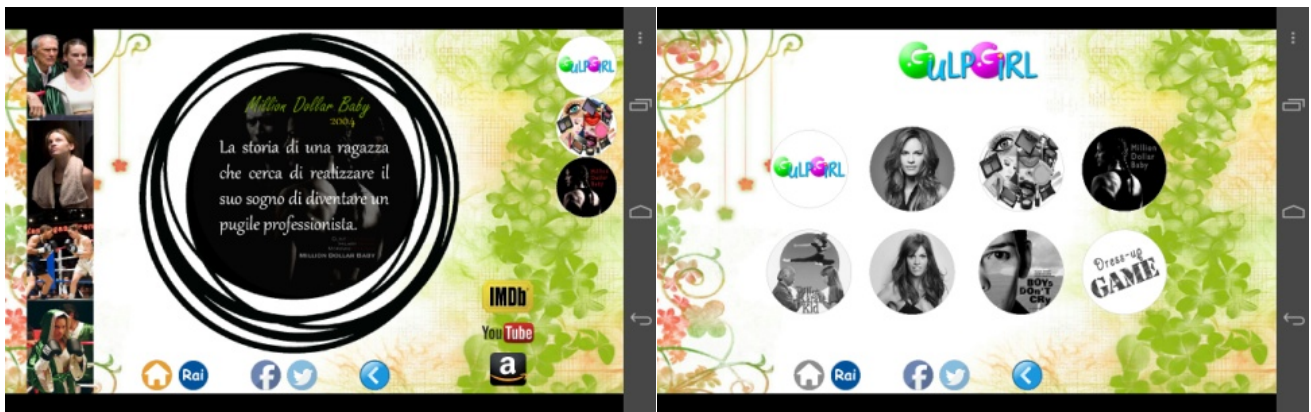


Figure 2 Example of a BRIDGET player layout for the programme GulpGirl

5 Dissemination and Future Exploitation Prospects

5.1 Dissemination Strategy

5.1.1 BRIDGET Web Site

The BRIDGET website (<http://ict-bridget.eu>) is the project's main public communication tool. It reflects the project's aims, research progress and scientific impact. This is the place where all information related to BRIDGET is stored and made accessible to interested parties.

As the project progresses please use the website to keep up to date with scientific publications of project research groups, Project applications, future workshops, news and events

5.1.2 Dissemination to the Scientific Community and Industry

Dissemination to scientific community is based on bilateral exchange of information with major scientific institutions as well as communication of project achievements in conferences and through publications. Dissemination of knowledge within the scientific community is done via presentation of research methodologies, strategies and outcomes at conferences pertinent to the key BRIDGET technologies. Ongoing dissemination to the wider academic community has already taken place in several peer reviewed international publications. As part of this BRIDGET project partners have attended the following scientific dissemination venues to present research papers:

- International Conference on 3D web technology.
- International Conference on Interactive Experiences for TV and online Video.
- International Broadcasting Convention.
- International Conference on Image Processing.

5.1.3 Dissemination in View of Future Exploitation

One of the main strengths of the BRIDGET consortium is their strong ties to industry. This has resulted in BRIDGET attending industry workshops and events, to better disseminate the technologies being developed as part of the project. With the development of the prototypes this year BRIDGET has been able to take engaging demonstrators to key venues this year:

- IBC 2015: BRIDGET had a successful exhibition at [IBC](#), where we shared a CC Mini-Cluster stand with 3 companion EU projects (MediaScape, SAM and LinkTV). BRIDGET presented demos including the full delivery chain with bridgets being served from a remote server, with the main TV channel and two 2nd screen devices. We received very positive feedback from the many broadcasters and content providers who visited our stand. We also showed off the Authoring tool to create Bridgets with the underlying 3D reconstruction and the Visual Search Engine for Images and Videos. BRIDGET received the prestigious IBC award “*What Caught my Eye – Blue Sky Thinking*”, together with our colleagues at the CC Mini-Cluster stand.
- The consortium also presented a paper at IBC conference, detailing the forthcoming MLAF MPEG standard, which helped to publicise the work we were doing and send a steady stream of visitors to our booth.
- 67th Prix Italia: BRIDGET partner RAI demonstrated the project’s player application at 67th edition of Prix Italia, held in Torino between 19th and 24th September 2015. Prix Italia is an international competition for television, radio and online media which attracts hundreds of visitors from around the world. The event helped the project increase its visibility inside RAI’s production department and among the widest audience of international producers and programme makers with an overall good feedback.
- EBU Metadata Developer Network Workshop: During the first day of EBU’s Metadata Developer Network Seminar (MDN 2015) BRIDGET presented a contribution about applications of CDVS in media and broadcasting. MDN is an annual workshop presenting technological innovations and new applications in the area of metadata and its audience includes EBU members’ technology experts as well as external experts coming from industry and academia.

5.1.4 Dissemination to Key Stakeholders

Following feedback after the first workshop we decided to change the format for our second workshop and instead we had a ‘Distributed Workshop’ that allowed us to communicate with more Key Stakeholders from industry. We interviewed 28 individuals from Broadcasting, Cable, Commercial, Consulting, Cultural, Education, OTT, Publishing, Research, Technology and Telco companies from 13 countries in Europe, Asia and America. From this we have garnered extremely valuable feedback on our current prototypes and we will be using this to help direct the research during the final year of the project and beyond.

5.2 Publications by the Project Team in the Period November 2014 to October 2015

5.2.1 Papers

- [1] S. García, R. Pagés, D. Berjón, F. Morán, “Textured Splat-Based Point Clouds for Rendering in Handheld Devices”, Proc. ACM Web3D (Intl. Conf. on 3D Web Technology) 2015, p. 227-230, Heraklion, GR, June 2015 (DOI: 10.1145/2775292.2782779).
- [2] R. Pagés, S. García, D. Berjón, F. Morán, “SPLASH: A Hybrid 3D Modeling/Rendering Approach Mixing Splats and Meshes”, Proc. ACM Web3D (Intl. Conf. on 3D Web Technology) 2015, p. 231-234, Heraklion, GR, June 2015 (DOI: 10.1145/2775292.2775320).

- [3] A. Messina, F. Morán, M. Preda, S. Lepsøy, M. Bober, D. Bertola, S. Paschalakis, “Making Second Screen Sustainable in Media Production: the BRIDGET Approach”, Proc. ACM TVX (Intl. Conf. on Interactive Experiences for TV and Online Video) 2015, p. 155-160, Bruxelles, BE, June 2015 (DOI: 10.1145/2745197.2755517).
- [4] M. Bober, I. Feldmann, S. García, A. Messina, S. Paschalakis, “BRIDGET: an approach at sustainable and efficient production of second screen media applications”, Proc. IBC (Intl. Broadcasting Convention) 2015, Amsterdam, NL, September 2015.
- [5] E. Vidal, N. Piatto, G. Cordara, F. Morán, “Automatic Video to Point Cloud Registration in a Structure-from-Motion Framework”, Proc. IEEE ICIP (Intl. Conf. on Image Processing), in print (5 p.), Québec City, CA, September 2015.
- [6] D. Berjón, G. Gallego, C. Cuevas, F. Morán, N. García, “Optimal Piecewise Linear Function Approximation for GPU-based Applications”, IEEE Tr. on Cybernetics, in print (12 p.), available on-line since October 2015 (DOI: 10.1109/TCYB.2015.2482365).

5.2.2 MPEG Standardisation Documents

Nineteen proposals and technical contributions have been submitted to MPEG and discussed at its meetings, at the end of which **twelve output documents** (fifteen counting successively refined versions) have been agreed upon and approved.

1. *Proposals submitted to MPEG for their consideration at the 111th MPEG meeting held in Genève, CH, during 16-20 February 2015*

- [7] D. Bertola, T. Lavric, C. Tulvan, A. Gabrielli, A. Messina, M. Preda, G. Vavalà, “An initial demonstration of MLAF technologies”, MPEG contrib. M35667, 111th MPEG mtg., Genève, CH, February 2015.
- [8] L. Chiariglione, A. Messina, M. Preda, “Proposal for update of MLAF requirements”, MPEG contrib. M35668, 111th MPEG mtg., Genève, CH, February 2015.
- [9] T. Lavric, A. Gabrielli, V. Scurtu, M. Preda, G. Vavalà, “High level presentation layer for MLAF”, MPEG contrib. M35767, 111th MPEG mtg., Genève, CH, February 2015.
- [10] M. Balestri, G. Francini, S. Lepsoy, A. Bay, A. Fiandrotti, M. Mattelliano, “CDVS test model code optimizations and enhancements”, MPEG contrib. M35824, 111th MPEG mtg., Genève, CH, February 2015.

2. *Proposals submitted to MPEG for their consideration at the 112th MPEG meeting held in Warszawa, PL, during 22-26 June 2015*

- [11] D. Buzzi, A. M. De Cristofaro, G. De Santis, A. Messina, G. Perrozzi, S. Proscia, “RAI dataset for CDVA: monuments of Italy”, MPEG contrib. M36246, 112th MPEG mtg., Warszawa, PL, June 2015.
- [12] A. Messina, “A possible implementation of MLAF in MPEG-21 DIDL”, MPEG contrib. M36247, 112th MPEG mtg., Warszawa, PL, June 2015.
- [13] A. Fiandrotti, M. Mattelliano, M. Balestri, G. Francini, S. Lepsoy, A. Bay, P. Porto Buarque de Gusmão, “CDVS test model code maintenance”, MPEG contrib. M36391, 112th MPEG mtg., Warszawa, PL, June 2015.
- [14] S. Lepsoy, M. Balestri, G. Francini, “Turin buildings: a dataset for CDVA”, MPEG contrib. M36393, 112th MPEG mtg., Warszawa, PL, June 2015.
- [15] T. Lavric, M. Preda, “Presentation layer for MLAF”, MPEG contrib. M36418, 112th MPEG mtg., Warszawa, PL, June 2015.
- [16] S. Paschalakis, K. Jouneau, “Visual Atoms Contribution to CDVA Datasets”, MPEG contrib. M36765, 112th MPEG mtg., Warszawa, PL, June 2015.

3. *Proposals submitted to MPEG for their consideration at the 113th MPEG meeting held in Genève, CH, during 19-23 October 2015*

- [17] M. Balestri, S. Lepsoy, G. Francini, "Proposal of a CDVA evaluation framework implementation", MPEG contrib. M36908, 113th MPEG mtg., Genève, CH, October 2015.
- [18] S. García, A. Meyer, P. Carballeira, F. Morán, "Scene reconstruction with hybrid SPLASH 3D models", MPEG contrib. M37411, 113th MPEG mtg., Genève, CH, October 2015.
- [19] S. García, F. Morán, P. Carballeira, "Proposal for efficient coding of hybrid SPLASH 3D models", MPEG contrib. M37415, 113th MPEG mtg., Genève, CH, October 2015.
- [20] T. Lavric, M. Preda, "A proposal for MLAF reference SW", MPEG contrib. M37433, 113th MPEG mtg., Genève, CH, October 2015.
- [21] M. Bober, S. Paschalakis, A. Freestone, "Evaluation of MPEG-7 descriptors in scene classification tasks", MPEG contrib. M37466, 113th MPEG mtg., Genève, CH, October 2015.

4. *Output documents agreed upon at the end of the 111th MPEG meeting held in Genève, CH, during 16-20 February 2015*

- [22] L. Chiariglione, D. Bertola, A. Messina, M. Preda, T. Lavric, "Requirements for MLAF", MPEG output doc. N15096, 111th MPEG mtg., Genève, CH, February 2015.
- [23] S. Paschalakis, K. Wnukowicz, "Text of ISO/IEC CD 15938-6:201X Reference software (2nd edition)", MPEG output doc. N15127, 111th MPEG mtg., Genève, CH, February 2015. The following version of this document, co-edited by the same experts, has also been produced during this reporting period: N15368, 112th MPEG mtg., Warszawa, PL, June 2015.
- [24] A. Messina, T. Lavric, M. Preda, L. Chiariglione "Technology under consideration for MLAF", MPEG output doc. N15203, 111th MPEG mtg., Genève, CH, February 2015.
- [25] C. Tulvan, F. Morán, S. W. Lee, M.-L. Champel, I. Bivolarski, R. Mekuria, T. Lavric (eds.), "Description of 3DG core experiments", MPEG output doc. N15290, 111th MPEG mtg., Genève, CH, February 2015. The following two successive versions of this document, co-edited by the same experts, have also been produced during this reporting period: N15356, 112th MPEG mtg., Warszawa, PL, June 2015; N15868, 113th MPEG mtg., Genève, CH, October 2015.
- [26] S. Paschalakis, G. Francini, G. Cordara, M. Bober, et al. (eds.), "Test model 13.0: CDVS", MPEG output doc. N15129, 111th MPEG mtg., Genève, CH, February 2015. The following version of this document, co-edited by the same experts, has also been produced during this reporting period: N15372, 112th MPEG mtg., Warszawa, PL, June 2015.

5. *Output documents agreed upon at the end of the 112th MPEG meeting held in Warszawa, PL, during 22-26 June 2015*

- [27] MPEG's Video subgroup, "Presentations of CDVS awareness event", MPEG output doc. N15370, 112th MPEG mtg., Warszawa, PL, June 2015.
- [28] A. Messina, M. Preda, "Request for subdivision of ISO/IEC 23000-18 Media Linking Application Format", MPEG output doc. N15497, 112th MPEG mtg., Warszawa, PL, June 2015.
- [29] A. Messina, T. Lavric, M. Preda, "CD of multimedia application format (MPEG-A) – Part 18: Media Linking Application Format (MLAF)", MPEG output doc. N15498, 112th MPEG mtg., Warszawa, PL, June 2015.

6. *Output documents agreed upon at the end of the 113th MPEG meeting held in Genève, CH, during 19-23 October 2015*

- [30] A. Messina, "DoC on CD of MLAF", MPEG output doc. N15655, 113th MPEG mtg., Genève, CH, October 2015.
- [31] A. Messina, T. Lavric, M. Preda, "DIS of MLAF", MPEG output doc. N15656, 113th MPEG mtg., Genève, CH, October 2015.
- [32] T. Lavric, M. Preda, "Workplan for reference SW of MLAF", MPEG output doc. N15657, 113th MPEG mtg., Genève, CH, October 2015.

- [33] MPEG's Requirements subgroup, "Evaluation framework for CDVA – Search and retrieval – version 2.0", MPEG output doc. N15729, 113th MPEG mtg., Genève, CH, October 2015.

6 Collaboration

6.1 Collaboration between Consortium Members

The members of the partners have known each other for a long time, they have cooperated for many years in common standardisation bodies, such as MPEG. In addition they have variously teamed up with some of these and other partners in successful European projects, and effected experts' exchanges.

Currently members of the BRIDGET consortium are collaborating within the following projects and standardisation groups: MPEG-CVDS, MPEG-CDVA, MPEG-Requirements, EBU-Automated Metadata Extraction (SCAIE).

6.2 Clustering Activities

BRIDGET is involved in several activities, which encourage knowledge sharing within their domains of expertise:

- The project established direct links with 3 related EU projects: LinkedTV, MediaScape and SAM, creating the so-called 2nd Screen CC (Content Convergence) mini-cluster. It is a collaborative initiative focused on developing innovative solutions for production, delivery, consumption and ecosystems for monetisation of 2nd Screen content. We held joint meetings, presentations, and exchanges.
- The project co-organised the MPEG CVDS Awareness Event in June 2015. We contributed presentations on "CDVS vision, applications and opportunities" and "CDVS standard, technologies and resources" and demos including "Authoring for second screen applications using CDVS", "CDVS in media postproduction applications", and "CDVS on mobile GPUs".

7 Useful Links



BRIDGET Project main site: <http://ict-bridget.eu>



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University of Surrey
www.surrey.ac.uk/CVSSP



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