

INNOVATION REPORT

JEDI brings Blu-ray 3D quality to broadcast



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3DTV sales depend on the preparedness of consumers to buy a product whose possibilities are restricted by a lack of 3D content. The Catch-22, of course, is that producers will only create 3D content if the market is sufficiently sizeable to deliver a profit. So, in this context, standardisation is the key and the JEDI project activities have been very closely aligned to the need to 'broker' this apparent impasse.

The ultimate goal of the JEDI project was to create the conditions that will allow European partners throughout the 3DTV value chain to fully understand market evolution and user expectation, and to technically support them, so they can better prepare the right products in good time. Project consortium members from Belgium, France and Spain collaborated and cooperated closely to ensure broadcasts of Blu-ray 3D quality and a mastery of the complete end-to-end transmission chain.

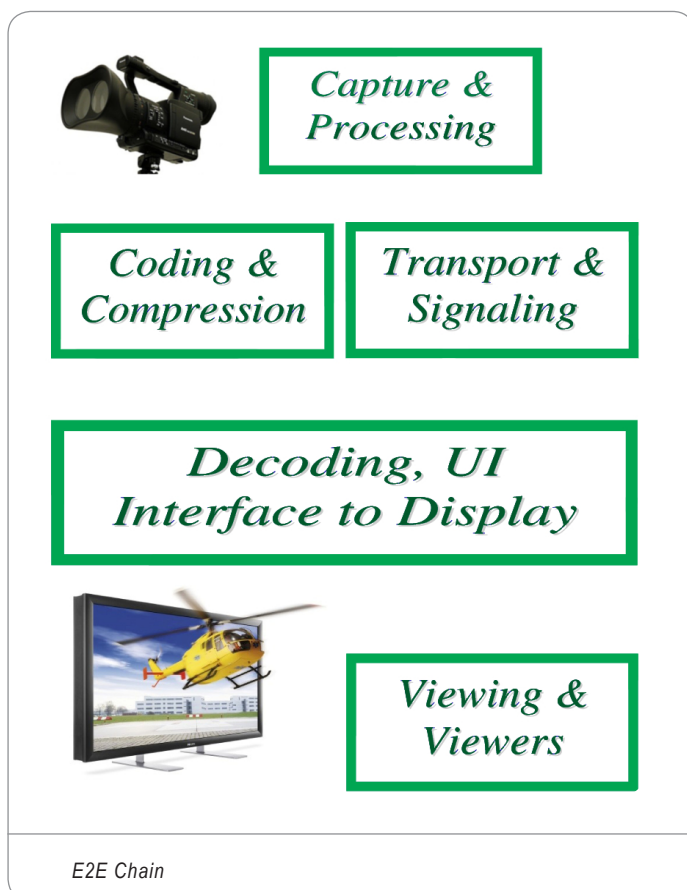
The role of JEDI was to create, and to organise, conditions for partners to understand the evolution and development of 3DTV for consumers, and forecast a corresponding likely time scale. This included building an experimental end-to-end workflow from capture to TV, enabling Blu-ray 3D quality at broadcast and using a user-centric approach to complement the technological and business orientation of the project.

The world's first demonstration of the JEDI television channel in MVC (Multiview Video Coding) format over the HISPASAT 1E satellite, allows the same content to be transmitted in high definition and in 3D Full HD on the same signal.

At the edge of the state of the art

JEDI consortium partners are 'surfing' at the edge of the state of the art and already implementing these technologies ahead of the others. Although the standard for the experimental end-to-end chain in digital video broadcasting Phase 2a was only validated in June 2012, JEDI does have full real-time prototype MVC encoders along with decoding and the appropriate graphics. In terms of advancing the technological innovation, JEDI is probably six months ahead of its competitors. The final evaluation of JEDI in the French town of Caen in June, 2012, was a world first in actually demonstrating the global broadcast of a second-generation, service compatible 3D TV channel. The highly successful and positive test covered the entire value chain: from live recording using 3D cameras, encoding and decoding, for both contribution and distribution, to satellite transmission and TV reception.

The goal of mastering the complete end-to-end transmission chain, which is key to achieving the Blu-ray 3D quality at broadcast, was accomplished through more than 20 new products and solutions over the value chain, a 3D Lab and subjective assessment along with more than 30 exploitation cases. Of course, the process was enhanced by a coherent and proactive consortium supported by open and rich cooperation. The good standardisation and dissemination drove the European consortium partners – Barco, NDS, NXP, Pace, Philips, Technicolor, Trinnav, Thomson Video Networks, TELENET, University of Nantes, UPM, Videohouse, VITEC and VRT– right to the edge of the state of the art in a very



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challenging timeframe. Despite the fast-moving scenarios and market conditions, JEDI kept ahead of the game.

Shaping and demonstrating the innovation

The innovation was shaped through five work packages:

WP1: Roadmap and plans for 3DTV

WP2: 3D content delivery

WP3: 3D user experience

WP4: Demonstrations & user assessment

WP5: Project management, dissemination, exploitation

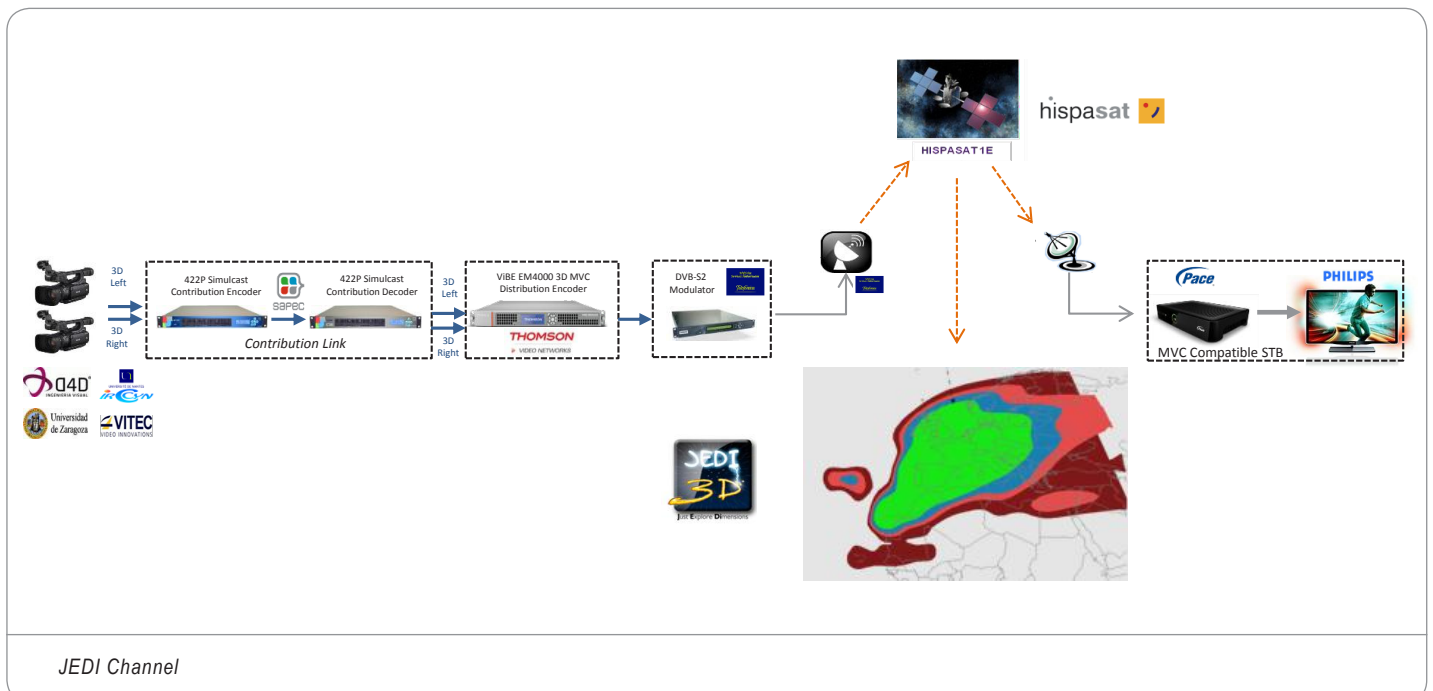
The insights gained in the first three work packages provided the basis for an “end-to-end” chain concept demonstrator to enable user acceptance and quality of experience to be studied in WP4. Finally, the establishment of a dedicated management and organisation structure ensured that the development of relevant external technologies and standardisation activities could be actively monitored and a clear route to exploitation and project result dissemination defined.

Until now, transmitting a channel in 3D requires the use of a format called “Frame Compatible” which makes use of the existing HD infrastructure. To do so, the resolution of the left and right views is reduced and they are placed side by side (or top and bottom) in order to simulate a normal HD image. The specification of this transmission mode was approved by the DVB (Digital Video Broadcasting global standardization forum) in February 2011 (DVB-3DTV Phase1). The JEDI consortium made the first transmission fully compatible with

this specification in May of that year and, since then, keeps the channel free-to-air available across Europe via Hispasat 1E satellite (frequency 10810 MHz, Pol H) now used for the JEDI DVB-Phase 2a signal, as mentioned in above.

Three demonstrators selected to physically demonstrate the end-to-end chain (satellite channel demo), graphics (insertion) and quality (metadata management) were complemented by four other demonstrators focused on content shaping and pre-processing with conversion to specific 3D screen, video quality assessment to evaluate the JEDI technology, and audio supervision geared to correct localisation and an enlarged listening area.

All in all, JEDI successes are evidenced by a whole range of deliverables, including the availability of Pace STB with MVC decoding capabilities, DVB engine integration and NDS’s 3D graphics while the NXP HDMI 1.4a silicon is up and running and the NXP DisplayPort 1.2 silicon is now very successfully in production. Furthermore, the Trinnov QoE and rendering has been completed and the Planet Media user interface interactivity (Unity) has been integrated with NDS’s 3D EPG. The University of Zaragoza has developed real-time software to evaluate the quality of 3D streams and the University of Nantes and UPM have specified and designed a 3D user lab to run the subjective quality assessment. Benefits for the professional markets were also not overlooked, as is evident from Barco which is now using some of the JEDI results in its product range for professional visualisation markets.



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Industry and consumer benefits

The JEDI project innovations have led to an improved 3DTV roadmap rollout. Additional financing for 3D movies and 3D live broadcasting will give TV manufacturers new opportunities to sell TVs with added value and renew existing stocks. JEDI partners have gained considerably from the experiences shared during the project and, in terms of exploitation, they have introduced DVB Phase 1 in their commercial products throughout the value chain and are experimenting with prototypes prepared for DVB Phase 2. For example, Sapec & Thomson VN for their encoders, Vitec for their 2D to 3D conversion, NDS for User Interface, Pace for STB, NXP for HDMI and Display Port ICs and Philips which won the Eisa Award for the European 3DTV 2011-2012 in August 2011.

In this highly competitive market, European partners can benefit from leveraging on existing technologies and infrastructures. Industrial partners are able to propose identified and evaluated solutions to their consumers, with further research and investigations by JEDI's academic partners. In turn, this will boost market growth, consumers will benefit from the interoperability and better quality of experience, and DVB improvements and implementation will put Europe at the edge of the state of the art worldwide. The results of the project will also serve as a basis for further R&D in the domain: improved user viewing comfort, assessment of 3D exposure over longer periods of time, 3D techniques in more use cases (e.g. 2D to 3D conversion).

The next challenges

The costs of 3DTV production, movies, documentaries or live broadcasts are still expensive and no real business models have been identified to regulate this issue. However, production models have been optimised iteratively, with an emerging format codenamed "5D" judiciously combining 2D+3D with common cameras for wide-angle filming and dedicated near-field vision for 3D.

The viewing issue perpetuates. Glasses are still a problem area and 10% of people, both colour-sighted and colour-blind, are not able to enjoy 3D. Active technology has been preferred for industrial purposes but these 'goggles' are restrictive in terms of the mechanics, battery, interoperability and cost, as well as lighting environment and viewers position that are much more suitable with Home Cinema dedicated TV UX. The polarised technology that has become more affordable removes most of these constraints but systematically divides the vertical resolution by two since lines are used per pair: one is polarised for the left view and one for the right. This means that we cannot get full HD per eye and in the case of frame compatible

transmission, the final resolution is divided by 4 when the left and right views are reduced horizontally and placed side by side (for frame compatibility, the top-bottom scheme is a better match with the polarised technology). These problems, however, should be solved by the emerging Ultra HD formats. As for decoding and interfacing, all the required technologies are already present and deployed but a lack of compatibility means that they are not being used as such. In addition, DVB-3D specifications that allow the transport and signalling of most 3D metadata are not being fully used in decoding and display.

The JEDI consortium made the first transmission fully compatible with the DVB Phase 1 specification in May of 2011 year and, since then, has kept the free-to-air channel available across Europe via the HISPASAT 1E satellite (frequency 10810 MHz, Pol H). As mentioned, this JEDI channel is now delivering a DVB Phase 2a (Service Compatible) signal given a world-premiere in June 2012.

A promising future

For more than a century 3D has fluctuated every 20 to 30 years, but this time, digital TV & display technologies provide the basis for on-going improvement, making 3D a given aspect of the TV, as happened for stereo sound and colour in the past. In the coming years there will be certainly several generations of 3DTV workflow. A higher frame rate and higher resolution, even in 2D, generate excellent 3D impression and comfort, where glassless viewing technology remains certainly one of the key factors for definite acceptance of 3DTV.

The next step for both the 2D and the 3D experience will be HEVC and UltraHD. The impact of this will be much more widespread acceptance, viewing comfort and augmented reality.

As for the Catch-22 referred to earlier: producers will only create 3D content if the market is sufficiently sizeable to deliver a profit but consumers will only be willing to buy a product if it enhances their viewing experience, comfortably, affordably and with extensive choice of content. The innovations developed in the JEDI project do indeed help to 'broker' this impasse by enabling the conditions that allow European partners throughout the 3DTV value chain to fully understand market evolution and user expectation so that the right products are available for the discerning consumer. And, in the process, give European industry a competitive boost in a fierce global market.

More information:

www.jedi-itea2.org