SALERO

Digital Media Technology, Research and Production Trends Report – Version 2

SALERO Deliverable D10.3.2

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1 Executive Summary

This deliverable follows on from the D10.3.1 survey of digital media technology trends, delivered in December 2006, and maintains the same approach to identifying trends in the development of intelligent media technologies and services. D10.3.2 was written in November 2007 towards the end of the second year of the SALERO project, and while many of the trends have developed as predicted, some unpredicted and potentially disruptive technologies have appeared.

Through both the professional and domestic sectors, we continue to see convergence taking place between digital technologies to create the necessary preconditions for Intelligent Content and the funding of a significant body or research designed to add intelligence or smart functionality to media tools, products and services.

Principal highlights of the findings of this report are

- The importance of the creative content industries and the need for RTD in intelligent content technologies are now widely recognised.
- The content market is expected to continue to grow vigorously, particularly in the area of convergent entertainment and media platforms and formats.
- Domestic technology is now offering more and more of the components that lead to high quality domestic entertainment. This includes significant development of high-speed mobile data connections, wider take-up of Broadband services, 'cheaper than ever' storage, widespread use of HD capable plasmas and LCD monitors, and enormous amounts of programme material available by download from such broker sites as iTunes.
- The formats available to the end user continue to increase with the 'Digital Revolution'.
- The Games sector continues to grow – realism is increasing, and new commercial models involving advertising are emerging. Also of interest is the rise of 'location based' gaming.
- The production of media in the domestic / prosumer sector is still growing, as is recognition by broadcasters of the value of consumer content.
- The cinema is increasingly adopting digital technologies 'from scene to screen' for the capture, postproduction and display of media.
- The industry interest in 3D technologies and movies (predicted in D10.3.1) continues to gather pace.
- Moves in the MPEG community to integrate standards in the MPEG-A family are likely to promote a new level of interoperability in both domestic and professional equipment.
- The Cross Media sector is growing. The announcement that Ubisoft, Europe's second biggest games company is massively diversifying into 3D animated features exemplifies the trend.
- The on-line advertising market continues to grow to the point where it is overtaking the traditional broadcast media market in value.
- Several large-scale research projects have started (such as i3Media in Spain) or are about to start with support from FP7 ICT Call 1, into the creation of intelligent technologies for creating, delivering or using media in domestic and professional contexts. The growing research interest in semantics and 3D technologies supports SALERO's proposition of the value of adding behavioural character. The research due to be carried out in projects such as i3DPost and 2020 3D Media should complement work in SALERO.
- None of the trends discovered or reported on in this report contain any threats to the SALERO. In fact, many of the changes identified here will positively support the SALERO project and the relevance of its goals.

2 Introduction

2.1 Purpose of this Document

To exploit the results of SALERO successfully, it is necessary to understand the present and evolving market place. Gathering information on this is time consuming, currently, while each manufacturer carries out market awareness studies, these are restricted to their individual niche and location within the chain: because of time and cost pressures, each manufacturer tends to look only at his direct competition.

The integration of activities within the consortium provides SALERO with the opportunity to make an economy of scale and carry out this function at a project level to produce a broader picture of Intelligent Media technology and markets as they evolve, to the benefit of all the partners and as the basis for exploitation planning.

This deliverable is the second in a series of reports designed to record and present trends in media production in the sectors that would be interested in SALERO outputs (including the film post production area, broadcast postproduction, games production, 3D animation, on line, streaming, and mobile content production, audio post production) and trends in research that may support the development of intelligent content technologies.

2.2 Scope of this Document

This document concentrates on events and developments occurring in the period from 1 December 2006 to 30 November 2007.

2.3 Status of this Document

This is the final version of D10.3.2.

2.4 Related Documents

Before reading this document it is recommended to be familiar with the following document:

- D10.3.1 Digital Media Technology, Research and Production Trends Report. Version 1

3 Digital Media Technology Today

3.1 The Content Sector and Creative Industries

Digital media technologies and the emerging intelligent content technologies apply primarily to the content sector, which has been the subject of increasing analysis in the recent past as its importance to European economic and social policy is better understood. It is increasingly accepted that the 'Industrial Economy' is giving way to a 'Creative Economy', as more efficient production of food and physical goods has freed the majority of the workforce to concentrate on providing services or producing abstract goods such as data, software, news, entertainment, advertising[1]. The shift to a world in which the ability to create new ideas and new forms of expression is a major resource means that the cultural or creative industries are no longer marginal, but have become the key to success in the Information Economy. The content sector has been defined in many different ways by different agencies according to their agenda. The 2007 ISTAG report on the content sector[2] has usefully summarised the categorisations as follows:

- *Cultural industries* as defined by the European Culture Foundation and encompassing commercial activities: applied arts, culture and media industries (books, film, entertainment and video), related industries and crafts; public activities: public or subsidised arts, media and heritage, public administration and funding and cultural education and informal activities: informal arts, support services (e.g. foundations and associations).
- *Cultural and creative industries* as defined in the 2006 KEA report on the 'Economy of culture': core arts field including visual arts, performing arts, heritage; cultural industries: film and video, TV and radio, music, books and press; creative industries and activities: design, architecture and advertising; related industries: ICT manufacturers, cultural tourism.
- *Copyright industries* as denominated by the World Intellectual Property Organization (WIPO). The copy-right based industries are defined as the firms and professionals who deal with the creation, production, distribution and consumption of products and services resulting from intellectual and artistic creation independently of their specific support and subject to be protected by intellectual property rights, but also by free material that is not copy-right protected.
- *Creative content industries* as defined in the EPIS project: heavily industrialised services including broadcasting, advertising and marketing, films, games, internet and mobile content, music industries, electronic publishing and print, and some of the less industrialised activities namely museums and library services as well as education and learning or knowledge engineering.

The interests of SALERO map most directly onto the definition of the Creative Content Industries. Analysts suggest that the media economies are growing very substantially, but there are many uncertainties as the patterns of production and consumption shift. According to PriceWaterhouseCooper's influential *Global Entertainment and Media Outlook 2006-2010*[3] in the European region alone:

- The online music market which generated €120m in 2005 is expected to grow to €1.1bn by 2010.
- Digital on-demand movie distribution is expected to reach €1.2bn by end 2010.
- Online radio is expected to double its audience by 2010, to 32m or 7% of Europeans.

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[1] Businessweek Online, August 28, 2000 http://www.businessweek.com/2000/00_35/b3696002.htm

[2] *New Business Sectors in Information and Communication Technologies: The Content Sector as a case study*. ISTAG (information Society Technologies Advisory Group), September 2007

[3] New York, June 2006. The following bullets relating specifically to European markets are reproduced from the ISTAG report.

- The digital games market worth €698m in 2005, will reach €2.3bn by 2010.
- Online publishing advertising revenues estimated are expected to reach €2bn in 2010.

The 2007 version of the PWC report is generally even more bullish: The global entertainment & media industry is experiencing sustained growth and will increase at a 6.4 per cent compound annual growth rate to $2trillion in 2011. Rapid growth in Brazil, Russia, India and China is expected to be a major driver but particularly significantly in SALERO's context, in every region, spending on convergent platforms will grow faster than other Entertainment and Media platforms and will account for 72% of the total Entertainment and Media growth during the next five years.

The tantalising challenge for industry is to find cheaper and quicker ways of creating innovative content appealing to a broad international market, with interactive features to enhance the user experience. That means that content has to be visually appealing, with excellent audio support, able to work across language barriers, be deployed cross media and received on multiple devices, and capable of being supported by paid advertising, subscription or pay-per-view. Animation is an excellent example of content that is capable of working across many cultures, is easily dubbed into many languages, and is appealing to audiences. However, the relatively long production time needed, and expense of using animation artists, means that it is difficult to produce long runs of topical, dramatic material for mainstream markets. Finding fast, cheaper ways of creating animations, perhaps by using 3D authoring, would transform the market, as would automating the assembly of routine productions using templates. Another requirement with cross media deployment is the need to create multiple versions. Providing the same content on TV, online and mobile does not make good business sense. What is needed is a means of offering differentiated services that relate to central strong brands, providing added value such as complementary plotlines. Authoring these at moderate costs is a major requirement.

Across all the media industries there is a common challenge – to find and retain audiences. Traditional ways of doing this through TV channels are eroding, while the future lies with the creation of online cross-media communities of interest that, although smaller, have dedication to the aims and intentions of their group. Whether the grouping is local, by interest group, social, political or gender orientation, all research shows that the commitment and involvement of such groups is very high, and that the response to targeted advertising is of a similar level.

All the indicators therefore suggest that there will be a growing requirement for intelligent content technologies (a) in the 'heavily industrialised' creative content sector and (b) in the P2P or user-generated content sector, where consumers are also creators, but lack the skills to author and edit high quality media. Until now, tools for sophisticated audiovisual creation have largely been the preserve of professionals. Although digital still and movie cameras are now consumer items, and basic editing software is supplied free with personal computers, the creation of a meaningful piece of linear audiovisual communication is still a challenge for many amateurs. Today, linear content is only part of the activity, since P2P networks, shared environments and cross media implementation mean that ambitious users aspire to use all the dimensions that technology and the Internet allow. There is a need for usable software to make the authoring of narrative, interactive or intelligent content as pleasurable and easy as using a word processor.

3.2 Domestic Digital Media Technology

During the second year of the SALERO project domestic media technology has continued to develop rapidly, with further convergence between previously separate delivery methods, increasing capacity in devices, and improved broadband delivery.

In the area of mobile devices, it is now common to find laptops, phones, smartphones and personal organisers with HSDPA protocol[4] network access (sometimes referred to as 3.5G). HSDPA is part of the evolving family of GSM telephony standards known as HSPA (High Speed Packet Access) and typically provides 3.6 Mbit connectivity on the move, a download data rate comparable to broadband home access. However, HSDPA is symmetric, unlike ADSL, which usually provides only 512Kbit upload bandwidth for an 8Mbit ADSL download connection. Thus the fastest upload device to the Internet in homes and small businesses may be the mobile phone. HSDPA Category 10 allows up to 14 Mbit

[4] http://en.wikipedia.org/wiki/HSDPA

symmetric connections – although we have yet to see this speed available in Europe. The Australian network, Telstra has launched 14 Mbit services across Australia, covering 98% of the population, demonstrating the technical feasibility of HSDPA Cat 10. Typical speeds in Europe remain at 3.6 Mbit, with the exception of parts of Sweden and Spain. The UK network O2 predicts provision of 10 Mbit connections in 2010 and 20Mbit Mobile connections by the year 2011. If this is correct, then 10Mbit services will be available by the end of the SALERO project (31st December 2009). The limiting factor from the customer's point of view may be the pricing policy of service providers. Current charging levels for mobile data services are generally prohibitively expensive for anything other than business use (particularly at the file sizes required for entertainment media).

The Apple iPhone launched in Europe in November 2007 not only closely integrates the iPod and phone but also runs Apple's OSX operating system. The presence of a Unix-based operating system[5], as well as an excellent touch screen, improves the usability of web-based services and offers the theoretical possibility of numerous applications. Although Apple initially launched the iPhone as a closed system (ostensibly on security grounds) a combination of consumer and regulatory pressure will result in the development of third-party applications. While several other mobile phones have the ability to play MP3 music that has been downloaded to the phone, this is the first unit with the well-known iPod interface and functionality. It is also the first mobile phone with 'free' data in the country of subscription. Previously the price of mobile data (typically €1-10 Euros per megabyte) has prevented the devices being used for applications such as listening to the radio, or streaming video entertainment material interestingly, the Apple phone does not utilise 3.5G or even 3G technology, relying instead on the GSM variant technology referred to as EDGE technology.

Display devices in the home have changed radically during the past 10 years. It is now almost impossible to purchase a new large CRT television and the uptake of large-format LCD and plasma screens has increased dramatically as prices have fallen. In the UK, for example, plasma sales are up 36% year on year[6]. Whilst few direct to home broadcasts of HD were available in Europe by November 2007, about 96,000 UK homes had HD service through Sky [7] and it is predicted that 2.6 million homes in Europe will shortly have HD Service.[8] The important factor at present is not whether HD service is received in the home, but that the home is becoming capable of displaying HD service when available. Since nearly all LCD and plasma screens sold are capable of displaying the minimum 'HD' service, HD is being installed in the home by default.

In the past year the cost of 1080p sets has fallen dramatically: many more consumers are now buying them, in an attempt to future-proof their investment in technology. NPD's May 2007 survey found that sales of 1080p sets had increased by 40% in the year, even though there are very few 1080p sources available (in the form of second-generation Blu-Ray and HD DVD players). While it is reasonable to assume that most consumers would like to be able to view native 1080p content, 73% were reported as being satisfied with DVDs (which up-scales reasonably well to 1080p).

The Home Cinema Room and the 'Digital Living Room'

Home Cinema penetration continues to increase. It is now believed that 17.5 million European homes have a Home Cinema[9]. Living rooms are becoming increasingly digital as early adopters use plasma or LCD systems to deliver more than broadcast TV. With the addition of a small computer, an Internet connection (or connection to the home Wi-Fi) this screen can become the heart of the home. Although this has been predicted for some time, we are now seeing the practical introduction of ad hoc Home Gateway media systems, offering facilities for:

- Watching broadcast television
- Watching streamed television programmes from the Internet

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[5] "The iPhone is running an optimised but full version of OS X that weighs in at "considerably less" than half a GB, according to Apple vice president of worldwide iPod marketing Greg Joswiak." Macworld, 12 January 2007http://www.macworld.co.uk/ipod-itunes/news/index.cfm?newsid=16927

[6] http://blog.whathomecinemamag.com/

[7] http://techdigest.tv/2006/11/skyhd_in_96000.html

[8] http://hiddenwires.co.uk/resourcesnews2004/news20040302-10.html

[9] http://www.iptv-news.com/content/view/615/66/

- Receiving non-broadcast internet media services such as *YouTube*
- Internet surfing / email access
- Controlling existing audio material through interfaces such as Apple's iTunes
- Purchasing and consuming Audio, TV, and Music Video material through Internet sites yet again as iTunes
- Listening to digital radio programmes from around the world, distributed by DAB or as Internet radio.
- Streaming material, such as music or TV programmes from other computers in the house onto the living room screen
- Connecting to living room Hi-Fi systems
- Connecting to DVD and HD DVD or Blu-Ray players (which, as was discussed in D10.3.1 have potential for intelligence)
- Displaying of the family's uploaded photographs and videos
- Sharing friends' and relatives' photos and video over the Internet, through sharing systems such as iPhoto or Snapfish

Consumer versus viewer

Domestic media technology has altered the behaviour patterns of viewers. The sea change began with analogue Video Recorders, which for the first time allowed the public to choose to 'time shift' a programme (i.e. to record it when it was shown, and play back at a time the viewer chose). However this trend has steeply increased, with a mass movement away from watching television at the originally scheduled time. There are now many ways of watching media other than at the time of original broadcast. These include

- Watching media that the viewer has chosen to pre-record. This requires foresight and planning. It requires that the viewer knows that he wants to watch this particular program before it is shown – and that he is at home, and remembers to set his video recording device. Recognising the problem, many mainstream broadcasters now offer a '+1' channel, repeating programmes one hour after the original broadcast start time.
- Buying the DVD set of the programme or series. Some viewers wait until a series has been aired, and buy the DVDs if they like the reviews. Many series have had DVD audience figures greater than the original broadcast TV audience.
- Streaming the series after it has been shown. This allows viewers to wait until reviews or press stories appear, and then using Internet facilities to download the programme or series, for consumption at a time of the viewer's choice. An example of this service is the 'iPlayer' (nothing to do with Apple) offered in the UK by the BBC.[10] Commercial channels also offer streaming facilities, sometimes as a pay service. Different levels of service may be offered: a 'rental' service (which allows either only a single viewing of the programme or a time limited period of playing it – typically one week) and a 'purchase' service (which allows multiple plays of the programme in a non-time limited way). Additional premium services may include the ability to watch the next episode of a series *before* it is broadcast. We note a certain backlash against TV station download services that have adopted the Kontiki platform from Verisign. This is a P2P system, so when the user wishes to download a programme, it doesn't necessarily get come from the broadcaster's server, but may come from another user/viewer who has previously downloaded it. The problem is to do with Internet pricing; many broadband subscribers are on a 'capped volume' tariff, which caps the data volume that they can upload and download for the monthly fee. If five – let alone fifty – fifty other viewers download the programme from them, data volumes will increase massively, and penalty fees may apply. Of course, the user has unwittingly agreed to this somewhere in the very long 'service agreement' provided by the broadcaster, but he is unlikely to appreciate what is going on (and certainly not the higher bills).

[10] http://www.bbc.co.uk/iplayer

- Downloading the programme or series to mobile devices such as iPods. The iTunes site now sells downloads of popular TV series. This has led to debate about the ability to watch (or more importantly enjoy) programmes on tiny screens. The experience of downloading the whole of the popular *lost* series from iTunes (20 GB) and watching it all on long distance flights on a video iPod has convinced us, that mobile players can offer a surprisingly acceptable entertainment experience.

Interestingly, downloading short programmes is probably the easiest way for most viewers to get a taste of the quality of HD programming, from the selection of HD clips and shorts available from the iTunes site. These can be replayed either on HDTV or a high-resolution computer monitor, to great effect.

So with the above multiple media availability we believe that the *viewer* – one who watches live – is being replaced by the media *consumer* – one who acquires media and consumes it when, where and how he or she pleases.

This viewer versus consumer argument applies not just to television but also to radio. Let us briefly trace the methods of consuming the world's longest running serial, the BBC's *Archers* programme. For years, listeners had to be in front of a Radio set at the right time to hear the programme with a new episode every evening (except Saturday) and a repeat of the evening's programme the following lunch time. An 'omnibus' edition of all of that week's episodes is broadcast on a Sunday morning, giving a third time to catch the programme – but all of these three times are fixed. New methods of 'consuming' the programme are now available, including:

- The BBC 'Listen Again' service on the Internet, which allows listeners to stream (but not record) episodes of the Archers at any time for up to a week after the initial broadcast. While this generally involves sitting around a computer – which people often keep in their homes in studies or spare bedrooms, there is another way of streaming the Internet at home.
- Streaming through domestic 'internet appliances', which look like portable radios but are Wi-Fi compliant, and run on a home Wi-Fi system. These units cost typically €100, but offer 'freedom from the computer' in small portable devices. One such device is the IMP 'Magic Box'. [11]
- Podcasting allows the consumer to be away for a week, and on return to have the week's episodes of the Archers downloaded onto his computer, and all devices (such as iPods) synchronised to it. So it is possible to take the mobile device to work, to listen to a previous episode of the Archers in one's lunch hour – whatever time that lunch hour is.
- Podcasting direct to a mobile device capable of receiving and playing Podcasts (such as the iPhone or iPod Touch) that can access the source and interpret the feed on the move.

The conclusions here are that the amount of programme material available has never been greater. An Imp 'Magic Box' gives access to over 5,000 radio stations – many with listen again facilities. The BBC iPlayer offers the ability to download many thousands of hours of television, and iTunes offers over 7 million songs – and many tens of thousands of hours of Podcasts and TV programmes. We therefore believe that metadata to help identify media and the properties of media are truly vital. There is no purpose in having this much media available to consume without some way to navigate through it.

3.2.1 HD-DVD and Blu-Ray

While we still believe in the importance of HD DVD and Blu-Ray technologies as a pathway to intelligent content technologies for the consumer, the uncertainties of which format will survive have greatly limited sales of both systems. Toshiba, the main vendor of HD DVD players has twice reduced its US sales forecasts – from 3 million per year to 1million per year[12]. Correspondingly, Blu Ray projections have been reduced to 600,000 units per year in the USA. We pick the USA here for comparison, due to the availability of figures.

[11] http://www.magicboxproducts.co.uk/

[12] http://www.reghardware.co.uk/2007/06/13/tosh_hddvd_forecast_slashed/

Data from Nielsen[13] in February 2007 indicated that sales of Blu-ray media for the first time outpaced those of HD DVD, Blu-Ray selling 100 units for every 98.71 units of HD DVD – although both camps in the high-definition format war have different ways of interpreting the data.

It is probable that purchasing decisions (and ultimately the format war) will be decided by considerations other than media players. The SONY PS-3 gaming console is the principal Blu-Ray route into the home; the X-Box 360 games console is the route for HD DVD, and Toshiba has announced that all of its 2008 Laptops will also come with an HD DVD drive.

3.2.2 Games

Many companies are still striving to make games that look just like films, and realism increases every year. One company making significant steps into 'film realism' is the French company, Quantic Dream (www.quanticdream.com). Quantic Dream has published a trailer entitled 'The Casting' of the 'Heavy Rain' project, which can be downloaded from http://www.fileplanet.com/163443/160000/fileinfo/Heavy-Rain:-The-Casting-E3-2006-Trailer-%5BHigh-Res%5D. It is rumoured (but not confirmed) that Heavy Rain will become a game and a feature film.

Another trend we are seeing is the 'game being used to promote the film'. Spiderman III is a case where the game was launched just before the film premiere. Effectively the 'buzz' created by the game promoted the film. Spiderman III also re-enforced another trend – all of the lead actors (with the exception of Kirsten Dunst) provided voice material for the game. This is, we believe, another example of 'film game convergence' (although the voice data was captured specifically for the film, with the film artist recording given lines in a sound studio).

On 1 January 2007 'Pocket Gamer' Magazine in the UK predicted the ten trends in 2007-8[14]: looking back on the year gives a perspective of the actual development in relation to the predictions, and the possible implications for the technology market. In the following section, text from the original article is reproduced in italics.

1. ***Advertising-supported games****, which may be downloaded free (for example, from mobile advertising firm Greystripe's GameJump portal) but contain advertisements or marketing. Later in the month, Orange announced its first ad-supported commercial trial, offering its French subscribers mobile games from publisher Filao at reduced prices or for free in exchange for accepting advertising during gameplay. In November 2007, ClickZ suggested that 'Web-based game publishers are finding higher revenue potential with an ad-supported model over an e-commerce one. Game developers are beginning to build games with advertising opportunities in mind.'*

   Several companies have emerged primarily to place advertisements in games. One example is IGA Worldwide[15], and another is Double Fusion[16]. Google has created controversy in this area by taking out a US patent on a process for monitoring the habits of players of online games and acquiring the Adscape Media Company, which specialises in game advertisements. Clearly, Google has the potential to become a major force in this area.[17]

   The relevance of this trend is that through additional advertising revenues there could be more games produced. To produce more games, either more games programmers or better tools are needed. It is already difficult to find sufficient programmers, so we believe that the industry will demand better, more productive tools based on intelligent media. The customisation and focusing of on-line advertising is also an obvious application area for intelligent technologies.

2. ***Get set for D2C (Direct to Customer):*** *What it means is mobile games publishers selling games directly to you, rather than just through the mobile operator portals. Why should you care, if the games cost the same? It's a fair question. But as publishers set up D2C sites, it could make for a better experience browsing and buying mobile games. Gameloft's new*

[13] http://www.betanews.com/article/Bluray_Disc_Sales_Surpass_HD_DVD/1172267610

[14] http://www.pocketgamer.co.uk/r/Mobile/feature.asp?c=2075

[15] http://www.igaworldwide.com

[16] http://www.doublefusion.com/

[17] http://www.fiercegamebiz.com/story/google-s-gamer-tracking-patent-sparks-privacy-concerns/2007-05-15

Connect application is a good example, being an iTunes-style application that lets you check out new games, view demos and then easily buy and download them. Expect to see other publishers follow suit next year, while other firms (for example Mpowerplayer in the US) try to bring a number of publishers' games together in one application. And D2C can mean other ways of buying mobile games too. For example, EA Mobile bosses have talked about their desire to sell mobile games in high-street games shops.

This has happened. D2C[18] Games is one of many companies that now do this. The relevance of this to SALERO is that better and more efficient games distribution may result in the opportunities for more titles of games to be commissioned. Yet again this is a 'more programmers or better tools' dilemma, which in turn may be aided by intelligent media tools.

3. ***Next-generation N-Gage** 2007 will see the debut of Nokia's long-awaited next move in mobile gaming, which in short involves putting its N-Gage technology in a host of multimedia handsets, for example its N-Series phones. We got a few hints at what this'll mean when we checked out Nokia's stand at this year's E3 show, and from our recent interview with the company's games boss Jaakko Kaidesoja. The games will be attractively 3D, boast cool connected and community features, and will be purchasable directly from your handset.*

   As of November 2007 N-Gage had still not appeared and the currently announced date for the N-Gage is December 2007[19]. Sixteen titles and eight compatible Nokia phones have been announced, and Nokia certainly has the industrial weight to make a success of a games platform. Programmer intensive 3D games will require more programmers or better tools. We believe that intelligent media tools that can 'adapt' content across media environments and back again will aid productivity in this area.

4. ***More connectivity and multiplayer** Europe was bit rubbish for mobile game connectivity [in 2006]. This will improve in 2007, as operators get their acts together to enable game developers to include community and multiplayer features, and also launch unlimited-data tariffs so that we don't end up paying through the nose if we play online. Our hope is that by the end of 2007, there'll be a healthy bunch of connected games available in Europe, although this doesn't have to be full live multiplayer.*

   We believe that this has come true and Nintendo is launching a collaborative multiplayer version of the Classic 'Supermario'.[20] We believe that multiplayer games will be in demand, as another form of 'social networking'. To meet this expanding area, tools that can facilitate the rapid and cost effective building of multiplayer games, probably based around intelligent media will be in demand

5. ***Tetris will sell millions of downloads:** Some things never change. Amid all the talk of connectivity and swizzy 3D, it's important to remember that there are still millions of mobile gamers who just want a simple, addictive puzzle game to kill time on the bus or train.*

6. ***More crossover with Web and online gaming.** A big buzz-phrase in the mobile industry is 'fixed-mobile convergence'. This could have implications for mobile gaming, like being able to play simple games over the network against people playing on their PCs. It's happened a bit in the past, but will become more common. There are other ways that Web and mobile will crossover. Several publishers are talking about making Web versions of their casual mobile games. And 2007 could be the year when massively multiplayer online role-playing games (MMORPGs for short) get their mobile freak on.*

   This trend was highlighted at the Edinburgh Interactive Festival 2007.[21] 'Crossover' between web and online gaming will be greatly aided by 'repurposing' toolsets, based on intelligent media principles.

7. ***At last, 3D gaming will take off.** In 2006 phones proved they were up to the task of running 3D games. This will continue in 2007, as more people upgrade their phones to find that they've*

[18] http://www.d2cgames.com/

[19] http://www.n-gage.com/get_ngage.html

[20] http://n-europe.com/news.php?nid=10231

[21] http://www.games-digest.com/2007/08/eif-2007-conver.html

actually got a pretty powerful games machine in their pocket, even if they didn't explicitly ask for it. Besides Nokia's next-gen N-Gage, there's been a lot of talk within the mobile games industry about 'native' gaming – games which use the raw power of your mobile's innards rather than running on top of the Java platform. If you've got a Symbian or Windows Mobile handset, for example, there'll be more and better games coming out in glorious 3D for it. However, we'd offer a warning. 3D mobile games will only be as good as their control systems.

The 3D Gamers website in November 2007 alone recorded 27 announcements by (different) 3D games providing companies.[22]

8. ***Flash Lite will make an impact*** *slowly but surely, the Flash technology that powers so many Web games is making its way into phones. Apparently over 115 million handheld devices now have the technology inside. Developers are already creating attractive-looking games that use* [*Flash Lite*] (from Adobe)*, although so far there's been no easy way to get hold of them, unless you're a tech-head or a developer yourself. We expect this to change in 2007, although it remains to be seen whether the mobile operators will start selling Flash Lite games on their portals, and if so, how they'll be priced compared to regular games. Meanwhile, Flash Lite could be the technology that kick-starts viral advertising games on mobile, just as Flash has on the Web.*

   Custom producing media (such as games) for given platforms is expensive and time consuming. Media that can 'adapt' across platforms, for example from games console to mobile Flash Lite powered platforms would be very attractive to games developers.

9. ***Mobile game audio finally gets some props.*** *Does anyone actually play mobile games with the sound turned on? Well, more people than you'd think. While we often quote the train / bus idea, industry research shows that many mobile gamers play at home. As publishers realise this, they may well put more into their audio budgets, to make sure mobile games sound as good as they look. Another trend that'll be important in 2007 is the rise of music phones… music handsets come with earphones, which you're likely to carry around with you. And in that case, why wouldn't you play games with the sound turned on, even in public?*

   We believe that the relevance of this is that mobile phone and PDA platforms, coupled with headphones, can give a desirable experience to games players. This may lead again to a user wanting to play a console game in his home, and carry on playing the game when he leaves his home and catches a train. The more platforms that a player expects to play his game on, the more opportunities there are for the intelligent cross platform media tools.

10. ***More camera and LBS games.*** *On the latest handsets, mobile games can take advantage of other phone features more easily. For example, the cameras. 2006 saw a few examples of snap-happy games, such as* Brain Genius, 3D Tilt-a-World *and* Foto Fighter*. More developers and publishers will look to include camera features in 2007, for sure. Then there's location-based games – something that's been hyped in the past, with little resulting from it here in Europe. A key trend is that more mobile phones in 2007 will come out with GPS built-in. It'll mainly be used for navigation and mapping applications, but in theory it can be used for gaming too. Is there a future for a GPS-related mobile game involving hundreds of players chasing each other round the streets? Realistically, no. But location data could be used in other ways – bringing the real world around you into games, even if it doesn't involve other players directly. How? That's what we're hoping to find out in 2008…*

    Unlike the article's author, we do believe that there is a future for a GPS-related mobile game involving hundreds of players chasing each other round the streets. We may cite the entry of Hewlett Packard into this area in November 2007[23] and note with interest work carried out at the Mixed Reality Laboratory at Nottingham University[24] in conjunction with Blast Theory.[25] Anything that encourages gamers to play games on a wide range of mobile devices (note that it is

[22] http://www.3dgamers.com/companies/

[23] http://www.pocketgamer.co.uk/r/Mobile/news.asp?c=4474

[24] http://www.mrl.nott.ac.uk/

[25] http://www.blasttheory.co.uk/

unlikely that all users will, for example, have the same make and model of mobile phone, PDA, or mobile console) is likely to increase the market for intelligent cross platform media tools.

The 'top ten' MMORPGs[26] in November 2007 between them had over 35 million subscribers or users:

1. World of Warcraft, released 2004: 8.5 million subscribers.
2. Habbo Hotel, released 2000: 7.5 million active users
3. RuneScape, released 2001: 5 million active users (Over nine million active free accounts, one million paying customers)
4. Club Penguin, released 2006: 4 million active users
5. Webkinz, released 2005: 3.8 million active users
6. Gaia Online, released 2003: 2 million active users
7. Guild Wars, released 2005: 2 million active users
8. Puzzle Pirates, released 2003: 1.5 million active users
9. Lineage I/II, released 1998: 1 million subscribers
10. Second Life, released 2003: 500,000 active users

We believe that the demand for high realism virtual reality experiences is currently limited less by market demand than by the ability to satisfy this market by present day available tools and programmer effort. Tools that can create a diverse set of high realism virtual reality games cost effectively, using intelligent media and automatic cross platform migration are likely to be highly popular, as are tools that allow users to create or modify their own characters and environments.

We believe that the demand for MMORPGs based on films yet again shows a demand for tools based on intelligent media that can cross from film to game' with minimum effort.

The Games market is clearly controlled by three platforms – the Sony PS3, The Microsoft X-Box 360, and the Nintendo Wii. Sony is reported to be well on the way to its global target of 6 million PS-3s[27] and more than 11.6 million Xbox 360 consoles have been sold across the 37 countries where it is currently available[28].

3.2.3 User Generated Content

To quote IUSTAG again[29]: *User Generated Content (UGC) is a very new phenomenon that has rocketed into the headlines in less than twelve months, propelled by the astronomic valuations of sites like YouTube. At one time, the only way to access information was to wait passively for traditional sources like TV, radio, or newspapers. Today, anyone can create news and give opinions through websites, e-mails, and blogs either using text or, if they have the skills, more appealing audio-visual formats.*

At the National Association of Broadcasters Conference Session on the Future of Broadcasting on 16 April 2007, Google CEO Eric Schmidt stressed that the border between professional and user created content will blur: broadcasters should allow for parts of their content to be reused in order to gain revenue from it later. For example, NBA puts some short clips of games on YouTube, which users can remix, add their own comments, insert their own images, video, etc. He felt that media sharing and broadcasting will migrate to mobile devices, and that the provision of some of the media for free can be a way of directing users that watch this content to other sites, which provides further opportunities for commercialisation.

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[26] http://gigaom.com/2007/06/13/top-ten-most-popular-mmos/

[27] http://uk.gamespot.com/news/6169204.html

[28] http://www.gamesindustry.biz/content_page.php?aid=28866

[29] *New Business Sectors…* op cit

Debates continue on whether users should provide User Generated Content to broadcasters such as the BBC for free, or whether it should pay for such media.[30] However, the BBC is committed to expanding its use of User Generated Content. The BBC Director General said "*We need to reinvent BBC Online, fill it with dynamic audio-visual content, personalise it, open it up to user-generated content."*[31] Due to the rise of User Generated content, the BBC now has guidelines for the use of User Generated Content[32]. The BBC encourages users to make and provide media: *"The BBC wishes to take advantage of the full range of user-generated services provided, they fulfil our public purposes and can match the standards our users expect of our presence on the Internet."*

New twists to User Generated Content include the ideas of User Generated Gaming. This seems to be a way of producing high quality extensible games without incurring costs of up to €20 million.[33]

The relevance of this to SALERO is that User Generated Gaming is unlikely to be successful with present professional games engine technology, which can only be used by specialists. Tools that enable the user creation of games, based around intelligent media and cross platform ease, are likely to be in great demand.

3.3 Professional Digital Media Technology

3.3.1 Introduction

During the period of this report, media production technology in the professional sector has continued to change rapidly. The primary driver, we believe, is to bring down production costs.

3.3.2 Acquisition

The Digital Acquisition sector has continued to grow. The 'Red' Camera has become a reality, currently being used in several real productions. The first 100 of the Red One cameras have been shipped. Frustration has been reported on such professional user sites such as CML (the Cinematographers' Mailing List)[34] in using what is essentially a 'beta test' product. The company issues disclaimers to that effect and announced a production hold on October 24th to implement (and retro-fit existing cameras) a new daughter board and lens mount. There have also been problems of software crashes. However, it is being widely tried by cinematographers and Steven Soderbergh is reported to be 'finishing his 2nd feature on two RED cameras'[35]. Several directors of photography have posted very favourable reports about the quality of the camera output and performance.

The predominant Digital Acquisition Camera is still the VIPER camera from Grass Valley Netherlands. Our figures for the number of Digital Acquisition productions over the years is as follows

Year	Number of Digital Acquisition Productions
2004	2
2005	3
2006	27
2007	41
2008 projection	*80*
2009 projection	*144*

30 http://blogs.guardian.co.uk/organgrinder/2006/11/should_the_bbc_pay_for_usergen.html

31 http://networks.silicon.com/webwatch/0,39024667,39158411,00.htm

32 http://www.bbc.co.uk/guidelines/editorialguidelines/onguide/interacting/usergeneratedco.shtml

33 http://news.bbc.co.uk/1/hi/programmes/click_online/4997036.stm

34 http://www.cinematography.net/

35 Posted by Jim Jannard, the oner of RED, on the cml-2k-4k digital cinematography list on 6 November 2007,

2010 projection	*216*
2011 projection	*302*
2012 projection	*363*
2013 projection	*415*

Productions of note in 2007 that are made with Digital Acquisition include Broken English; Chemical Wedding; Highlander: The Source; Honeyz; Killer Pad; Nightwatching; Off the Ledge; One, Two, Many, and Shuttle.

The new Hollywood movie Tempting Hyenas is being shot as a 4K acquisition using the DALSA Digital Cinematography Camera[36]. We note that the post production facility 'Post Logic' was in attendance for this shoot (and announced commencement of the postproduction stage on 26 October 2007). This could mean that Digital Cinematography and postproduction can work together rather than separately

The Arri D20 Digital Cinematography camera appears to be in use more for TV Drama productions or advertisements in HD than for cinema work. One such example is the 'Hogfathers' drama for Sky One[37]. A second example is the shooting of the new LG Mobile phone commercial in HD.[38]

The Sony F23 Digital Cinematography camera started shipping in April 2007. The first units, not surprisingly, went to rental facilities companies. We are not yet aware of any notable productions made with this camera. Even Sony's website cannot provide any.

A good general overview of Digital Cinematography in 2007, debating the strengths and weaknesses of the various cameras and accessories can be seen in the article on the dv.com website.[39]

3.3.3 Storage

Storage continues to become cheaper and cheaper. As a guide figure, the 'domestic' price for a Terabyte is typically €300 Euros. A market leader in provision of professional digital storage is probably Isilon. System sizes range from 4 Terabytes to 1.6 Petabytes (1600 TB). The price of such packaged memory solutions is typically now €1000 per Terabyte.

3.3.4 Special Effects

The demand for special effects has continued to increase during the period of this report. A 'benchmark' is the Spiderman series of Movies. The first movie had 450 special effects scenes. The Spiderman 3 movie by comparison has 970. The overall budgets for Spiderman 3 have not been made public, but analysts believe it to be around $270 million. The director, Sam Raimi is quoted to have said that 'at least 40% of the budget went on special effects' – meaning around $100 million in one movie!

3.3.5 Post Production

Digital Intermediate is now the norm for most movie production, as can be easily demonstrated by looking at the credits at the end of any movie. The main trend of 2007 has been the creation and use of Digital Dailies, which applies digital postproduction technologies to the preceding stage of the movie pipeline. All six major Hollywood studios have released movies in which Digital Dailies have been used.

The term 'dailies' (or 'rushes' as they are usually called in the UK) originated in the film world. Film is usually shot one day, processed in a film laboratory overnight, and the unedited raw footage viewed the next day, to check not just on performances but for correct exposure, focus, scratches, or mistakes.

Since the film is almost always shot on negative stock, a print has to be struck to project in a viewing theatre to determine if any of the scenes need re-shooting or the director and crew can go on to shoot new scenes. To make this decision, the relationship between the shot and viewed material must remain constant: the processing and transfer from negative to print must remain fixed, or it is impossible to

[36] http://www.dalsa.com/dc/news/news.asp?itemID=318

[37] http://www.arri.com/prod/cam/d_20/hogfather_in_hd.pdf

[38] http://www.arri.com/news/newsletter/articles/0206/index.php?include=6

[39] http://www.dv.com/features/features_item.php?articleId=196603145

make meaningful decisions 'Dailies' or 'rushes' may also be made by scanning the negative on a Telecine to make VHS tape copies. The term 'Digital Dailies' is now used to refer to a digital copy of the material to be viewed (usually via a digital projector). Digital Dailies also refers to material that has been acquired digitally, such as from a digital cinema camera such as the Grass Valley Viper.

In the world of analogue cinema, dailies help the cameraman and director to estimate (by a combination of experience, rule of thumb and a little bit of measurement) any changes that needed to be made in exposure or filtration. In the digital world, metadata automation can be used not only to make sure that the appearance of the dailies is consistent, but also produce accurate corrections based on metadata, with a high degree of automation.

In the case of a digitally originated film, the raw digital data and its accompanying metadata will be saved to disk, with a colour LUT that applies the 'look' the director and director of photography have agreed. (If the movie is being shot on film, the scanning stage involves the use of a LUT that controls the mapping of film density to digital number, which is included as metadata with the digital data file produced by the Telecine.) When the digital footage is previewed, an output LUT is also used to adapt the colour space to the characteristics of the preview projector or screen. Imagine the director decides that a shot is 'too red' and wants the reds turning down three units. He then looks at this, and says 'hey, it's right now': for the next day's shoot, the camera LUTs can automatically make the desired correction (which on analogue film capture would mean changing the filtration). All the calculations and corrections use the stored metadata: if the director changes his mind again, all the changes can be reversed and a new set applied, since the original camera data is always kept as an unchanged master file.

The Indie Producer's Guide website[40] explains the advantages (and possible disadvantages) of Digital Dailies before concluding that they are a 'great tool to enable further creativity while offering new capabilities for collaboration, security, and access to dailies' which give significant savings in time and can 'save up to $150,000 on larger productions depending on footage shot'.

As always in the movie business, there are a great many procedural variants and alternative workflows, taking into account not only different configurations but also allowing different degrees of manipulation at the 'dailies' stage. The concept of metadata-driven transformation (as used by the Grass Valley Bones Dailies System) is central to them all and the SALERO concept of adding ontologies and semantic data is a logical step change.

3.3.6 Industry Trends

We continue to believe that the trend toward multiviews, stereoscopic and immersive media experiences will not prove to be a fad, but that this kind of media experience (loosely called '3D') will continue to gather pace. The digital cinema revolution is encouraging the successful delivery of 3D entertainment material to cinemas. The latest top-range digital projectors can operate at the frame rates required to project a stereo pair of full resolution image streams through a single projector[41]. In other words, 3D projection comes almost as a free bonus with digital cinema, and the movie industry believes this will be the key economic enabler that propels 3D into the mainstream of entertainment. There is evidence from box office returns that well-produced and presented 3D is attractive to the public, attracting bigger audiences and commanding premium ticket prices. 3D is also attractive to the industry as a means of defeating piracy (since digital camcorders cannot capture off-screen images from 3D projection) and as a way of differentiating 'cinema' from 'home entertainment'. Demand for 3D reciprocally creates a demand for digital installations, and digital technology along the chain. Although the DCI announced a draft specification for 3D distribution in April 2007, movies are likely to be released in versions for different display formats for some time to come.

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[40] http://indieproducing.com/digitaltech.html

[41] In active stereo, a single projector displays alternately the left eye and right eye images. The viewer needs special eyewear consisting of two IR-controlled LCD shutters working in synchronization with the projector. When the projector displays the left eye image, the right eye shutter of the active stereo eyewear is closed, and vice versa. The single projector must be capable of displaying at a high enough refresh rate to prevent the viewer perceiving a flicker between alternate frames. 96 fps (projecting the left eye and right eye view of each frame twice) is a minimum and 'triple flash' (requiring 144 fps) is preferred. In passive stereo systems, we are back to two projectors, emitting orthogonally polarized light, with the viewer wearing polarizing glasses so that the left and right eyes see different images at the same time. Dolby employs a 'spectral vision' technology that encodes left and right images by projecting each with a differently filtered spectrum of light, selected so that each of the different spectra (left-eye, right-eye) is perceived as white light.

Industrial development continues rapidly in the field of 3D (stereoscopic) digital cinema with the rollout of all three currently competing 3D systems (IMAX 3D, Dolby 3D Digital, and Real D). In November 2007 *Beowulf*, the largest release 3D to date, was released across the three technologies on over 1000 screens in 3D.

3.4 Standards including MPEG Implementations

The September 2007 ISTAG report on New Business Sectors in ICT clearly analyses the standards arena and its implications for the content industries:

> Currently, wherever one looks, whether in digital television or mobiles, one sees *a plethora of standards, all of which impede interoperability*. Manufacturers generally support this confusion, seeking to lock consumers into their own proprietary standard. Needless to say, this diversity operates at the cost of producers, distributors and ultimately consumers. For the vision of content anywhere and anytime to work, there must be easy and affordable ways of bridging standards without introducing delays or the de-synching of video and audio elements that are so common today. Work initiated under previous European Framework Programmes for RTD is leading to global metadata standards which support the automated conversion to diverse file formats, simpler language and caption versioning and wide access to media search systems. *The ultimate goal must be common standards that enable true interoperability at no cost.*

As a result, ISTAG makes a substantive recommendation:

> **R1-3. Create a European standardisation initiative on multimedia annotation**.
>
> *A marketplace cannot thrive or be efficient if there is too large a range of options and few common conventions.* Underpinning the entire content enterprise is the need for software systems and devices to work seamlessly together. An important example here is television delivery. Although there were some regional system differences (PAL, SECAM, NTSC), the absolute requirement was that ordinary people without technical skills be able to easily receive programmes, select channels and adjust qualities of picture and sound. This was achieved because public service broadcasters were able to decide and apply standards, and agree them with other national broadcasters through bodies such as the EBU. Also, the more complex conversions between, for example PAL (50 fields/sec in Europe) and NTSC (60 fields/sec in the USA) are done by broadcasters in-house with costly and complex machines. Software and Internet services have developed more independently, as have viewing devices. While it is inevitable that manufacturers seek to lock consumers into using their own products by creating dependencies of content on devices, this undermines the entire concept of convergence. Families of content and devices that do not speak to each other will not, in the long term, encourage the anything, anywhere, anytime concept. Real entrepreneurship in content depends on universal access to devices, and reliability in service provision.
>
> However, achieving standards is easier said than done. The need to 'cover all eventualities' means that standards work can be slow, extend over years, and make heavy demands on contributors. Often only the biggest companies can afford to stay the course. One way of tackling this is to accept that most media forms do actually have similarities. The parameters of sports, news, music and drama programmes impose common requirements, as do those of web pages or music download sites. The result is that although design gives individuality to competing services, the workflow and formats have much in common. In effect, these genres operate using 'templates' into which individual assets (essence) are placed in the process of content creation. By establishing Common Technical Specifications (CTS), these forms should be able to work on multiple devices across multiple service provision.
>
> Standards issues can be confusing firstly because they are in constant flux at this time and secondly because some knowledge of the basic topography of the image capture/creation, editing/processing, distribution and finally the display process, is important in understanding where to put resources to further the convergence in this industry. Compatibility between film, digital cinema and the graphics and IT worlds is now relatively easy to achieve. On the other hand, the overhang of technique of image compression from the analogue era (called interlace

scanning, created in the 1930's) remains a challenge for the easy re-versioning and exchange of material between broadcast television and all the modes of exploitation.

Opportunities now exist to promote progressive (non-interlaced) systems that provide excellent quality and compatibility between IT and audiovisual systems. Being late in taking up digital high-definition television broadcasting when compared to America, Japan and much of Asia, Europe now has a unique chance to bypass this burden from the past and complete the progressive audiovisual chain from capture/creation right through to the cinema and home display.

Common Technical Specifications would of course relate closely to current overarching systems such as MPEG but be put together more quickly and in response to the kind of rapid evolution that is natural in content provision. Since they would be based around the template, or genre concept, the range of requirements would be more limited and therefore achievable.

We believe that we can see the start of a standardisation process that will eventually meet this goal, as MPEG is attempting to achieve true interoperability with its new standards. We hope to see results from these standards that can compare with the interoperability of, say, USB, or HDMI. However, we are currently a long way away from being able to 'drag and drop' audiovisual files from, say, a computer to a television.

Developments in this period in MPEG include the 'integration' or 'packaging' of standards into the new MPEG-A family of standards. The MPEG standards committee white paper explains this in overview as follows.

The MPEG-A Standard

ISO/IEC 23000 (also known as "MPEG-A") is a recent addition to a sequence of standards that have been developed by the Moving Picture Experts Group. This new standard is developed by selecting existing technologies from all published MPEG standards and combining them into so-called "Multimedia Application Formats" or MAFs. MPEG-A aims to serve clearly identified market needs by facilitating the swift development of innovative and standards-based multimedia applications and services. This application driven process results in normative specifications of multimedia formats along with reference software implementation allowing interoperability on an application level.

The Rationale

Since 1992, MPEG has produced a sequence of standards for compressing multimedia data including audio and video compression (MPEG-1, MPEG-2 and MPEG-4). In contrast to media compression, MPEG-7 constitutes a suite of tools for meta-data representation describing the content of multimedia data. More recently, the group has developed MPEG-21, a framework to facilitate creation, distribution and consumption of digital items. Among other things, MPEG-21 includes standardized components that can be used by industry or industry consortia for the development of digital rights management systems facilitating interoperability.

In this suite of standards, MPEG-1 and MPEG-2 are two very successful examples; these technologies are used around the world in a number of large-scale consumer products (DTV, DVD, MP3, etc.). These two MPEG standards are somewhat vertically integrated standards serving the needs of clearly identified markets and industries. Therefore, most people – industry representatives as well as consumers –have a clear picture of how these standards can be used to create products.

During the work on MPEG-4, MPEG-7 and MPEG-21, experts have developed an incredible wealth of technologies, with technical quality and merit second to none. However, it has become increasingly difficult for the industry to master all the technical options and to evaluate their relative benefits.

In order for the industry to fully leverage the existing body of MPEG technologies, it is necessary for MPEG to deliver normative specifications to achieve interoperability on the application level and to offer guidance on how to use these MPEG standards in new and innovative ways. Multimedia Application Formats provide this guidance by offering combinations of various MPEG technologies to address specific application scenarios. In the past, MPEG has addressed the problem of providing solutions with scoped complexity by defining profiles. A profile in MPEG represents a subset of tools from a part of an MPEG standard (subset of the syntax) in order to carve out a part of the standard to arrive at an appropriate trade-off in terms of functionality and complexity for relevant classes of applications.

For example, in MPEG-2 Video there exists the “Main Profile”, which represents a subset of the complete MPEG-2 Video specification and which is tailored to digital television services. Other examples for widely known profiles in MPEG are the “Simple Profile” or the “Advanced Simple Profile” in the MPEG-4 Visual standard or the widespread MP3 audio coding format, which is actually a subset of MPEG-1 audio coding. However, these profiles have always been defined within a specific standard, e.g. within MPEG-2 Audio or MPEG-4 Visual.

The concept of picking components from different standards and combining them with other technologies to arrive at industry specific specifications is not new at all. So far, industry consortia like the DVD-Forum, DVB, ISMA and ATSC have done this successfully. Consider the example of the ubiquitous DVD, which employs MPEG-2 Video while using non-MPEG technology for coding of multi-channel audio. The DVD is a commercially successful technology and has had a major impact on consumer electronics as well as on the content industry.

The Concept of MPEG-A

MPEG-A supports a fast track to standardization by selecting readily tested and verified tools taken form the MPEG body of standards and combining them to form a MAF. This approach builds on the toolbox approach of existing MPEG standards. This means there is no need for time-consuming research, development and testing of new technologies. If MPEG cannot provide a needed piece of technology, then additional technologies originating from other organizations can be included by reference in order to facilitate the envisioned MAF. Hence, a MAF is created by cutting horizontally through all MPEG standards, selecting existing parts and profiles as appropriate for the envisioned application.

Consider Figure 1, which provides an illustration of this concept. MPEG standards are represented by the vertical bars on the right, and profiles are represented by the bold boxes. Non-MPEG standards or technologies are represented as vertical bars on the left. A particular MAF uses profiles from each technology (the various coloured boxes) and combines them in a single standard.

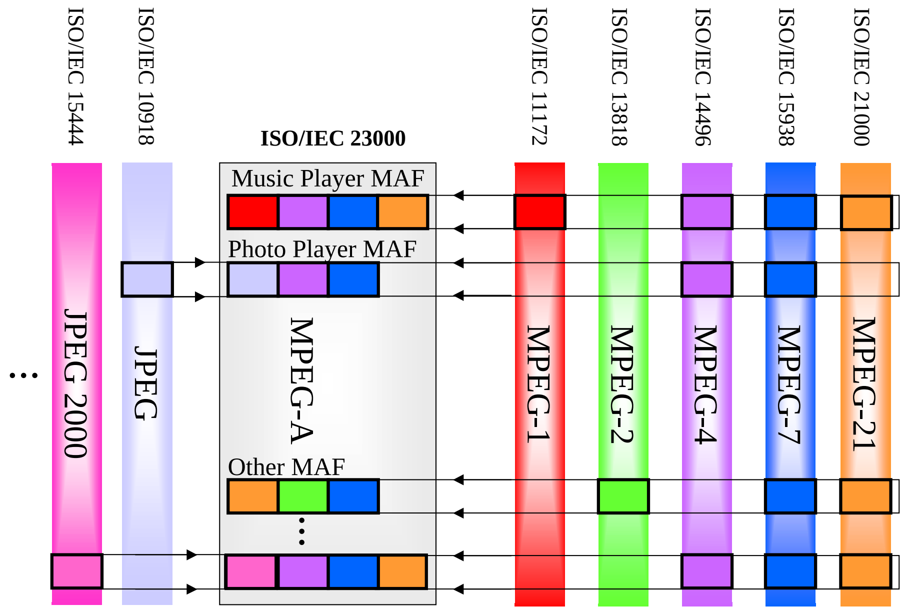

Figure 1: Conceptual Overview of MPEG-A

Ideally, a MAF specification consists of references to existing profiles within MPEG standards. However, if the appropriate profiles do not exist, then the experts can select and quantify the tools and profiles they believe are necessary to develop the MAF, which in turn provides feedback to the ongoing profiling activities within MPEG. It is also conceivable that the MAF process will help to identify gaps in the technology landscape of MPEG standards, gaps that may be mended subsequently by a new standardization campaign.

4 Production Trends

4.1 Cross Media Production Trends

The ISTAG report on New Business Sectors in ICT states

> *New network ICTs have transformed the devices* used to access and consume content and services. From WebTV in the 90s we have reached Personal Video Recorders (PVR), Media Gateways and other devices that combine computer performances with TV components. Telephones have also converged with computers as Internet Protocol (IP) and Wi-Fi telephony blossoms, but in the mobile field, changes are both more radical and rapid. Mobile phones have PDA capabilities (or vice versa) with 'qwerty' keyboards, camera, mp3 transceiver and video game console capabilities, with the possibility to watch Terrestrial Digital TV, plus GPS, etc.
>
> The most radical consequence of this change is that *devices are now independent of the format* in which the content is stored. Consumption of content is no longer strictly connected to the device itself but to the preferences of users, based either on contextual needs (fixed/mobile, audio/visual) desired level of immersion (size of screen/quality of sound) or depth of experience (cinema/home video/iPod)
>
> ***Changes in operation and exploitation models***
>
> The traditional Broadcast Model in which content was exploited through time windows (cinema, premium channels, TV) maximising audience numbers, is being transformed towards a narrower, multi-platform and multi format environment. This new scenario leads to new exploitation models selling TV episodes through Internet (without advertisements), buying songs, movies, building hot spots into video, as Blinkx have done with James Bond's sunglasses (click them as they take you straight to the manufacturer's website). Personalisation can affect device, viewing time, context, the nature of the content itself and tailoring of advertisements.

The most exciting example we have seen in Cross Media Production Trends is French video game publisher Ubisoft. Ubisoft is entering the CGI entertainment business in a big way, with plans to invest almost $400 million in an expansion of its production centre in Montreal with a goal to make movies. The Hollywood Reporter[42] reports that Ubisoft, the Number 2 independent games producer in Europe, with revenues of €680 million, is planning to become a 'Major player' in the 3D animated movie sector. To do this, they plan to recruit 500 new employees.'

The broadcast community is starting to realise the importance of cross media production. They are also starting to get concerned about how cross media production will be carried out. Reproduced here are extracts from 'Broadcast Magazine' dated the 9th November 2007 issue. The interviewee, Carole Dunlop, is a content producer, employed by BBC Scotland.

> *The pressure is ramping up for independent production companies to embrace the new technologies that are in many cases alien and may even be perceived as threatening. Companies are faced with a choice between exploring the new opportunities afforded to them and being squeezed out of an increasingly crowded and confusing world of platforms and programmes. The landscape of multimedia broadcasting has never been more riddled with potholes and mountains.*
>
> *It's a tough challenge to work out exactly how to finance an additional development bod with new media skills in your small team when no one yet quite has a grasp of how they're going to make money from the resulting concepts.*
>
> *Many forward-thinking companies are taking steps now to build their knowledge of available platforms and to enable themselves to talk knowledgeably about issues such as digital rights, podcasting, web-TV and cross-platform storytelling - especially in relation to their current core business aims.*

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[42] Hollywood Reporter, November 24th, Page 10

Linking up with the right new media companies with complementary skills will be a key route for indies, which don't necessarily want to develop the skills in-house. But that too is not without its pitfalls.

I was amazed at the Edinburgh TV Festival by the tension in the room at the end of one of the sessions as the Q&A degenerated into a heated debate between TV producers and the so-called "geeks". It was intimated that the creativity in collaborative projects lay solely with the development of the initial idea, a concept which was not well received by the more technically minded in the room. From personal experience, I would say that there can be some real chasms in producer/techie interaction, and these must be bridged if we are to move forward together and find the interactive Promised Land.

Multimedia elements of a proposal need to be integrated from the conception of the idea and developed in tandem using the correct technology and most effective platforms. Regardless of its source, compelling storytelling always lies at the heart of truly successful projects. "Build it and they will come" may no longer apply, but tell a good story, promote it effectively and they'll flock in - as will advertisers.

The promise of a truly effective economy for cross-platform production may still be around the corner but these early days of multimedia evolution offer unprecedented opportunities for the most creative leaders in television to experiment and move to new levels of inter-action with their audiences.

Indies have an agility not always afforded to in-house broadcaster teams and armed with the appropriate technical knowledge and the right business partners they have the power to work better and get to the heart of their audiences.

As well as understanding how business models have to adapt to the changes in the broadcasting sector as commissioning is defined, it will be increasingly important to think outside the box.

The focus of cross-platform creation has to continue the shift towards completely new art forms and fully immersive user experiences.

4.2 Online Advertising

Historically, entertainment and advertising are co-dependent: media deliver audiences to advertisers who, in return, finance the making of programmes. The symbiosis between media and advertising has been disrupted by the fragmentation of channels by the digital revolution, and the rise of the Internet as an entertainment and advertising space. The traditional media industries are converging with the telecommunications space, where the growth of content-based applications for VoIP (Voice over Internet Protocol) and the introduction of IPTV (Internet Protocol TV) are transforming user services and economic models. Changing media consumption patterns are changing the forms and placement of advertising. We have already mentioned the emergence of advertising in games: to quote ISTAG again *the importance of online advertising lies in its direct connection with the consumer. The actual number of viewers can be assessed more accurately than with television, consumer preferences can be better measured, advertising more precisely targeted, and consumer interest turned into direct sales. There are many forms of direct online advertising, ranging from banner headlines on websites to intelligent product placement. Indirect advertising takes the form of sponsored programming or underwriting of services.*

In the UK figures from IMRG show that in the last six years, e-commerce sales have grown by 3,500% to a total of £42 billion. These figures show the very high valuations now placed on Internet advertising and commercial activity, and the kind of potential market that exists to support relevant content. In the USA, announced a community-generated content initiative for its network of local Web site to let audiences participate in local broadcasting with full integration into its content publishing workflow. "Broadcasting is no longer a one-way directional medium," said Jonathan Leess, President of CBS TV Stations Digital Media Group. "Audiences and advertisers are looking for compelling local content that speaks to them, to their families, to their neighbours."

With domestic demand driving the European economy, advertising and sponsor-driven marketing will be a major factor in many Internet and mobile businesses. However, the strength of the web lies in its global reach. Many minority interests aggregate to sizeable audience numbers when seen in a

European or international perspective, and monetizing these and understanding the value chain though what might be a complex route of interactions, requires a thorough investigation. Though automated, metadata-based systems for knowing and trading in rights is promised with MPEG-21, there is a widespread recognition that existing copyright procedures and the practice of basing rights on territories and numbers of showings, will need to be rethought under the onslaught of businesses that view content as “rights-free”. The development of the Venice Project – now Joost – shows how flexibly these arrangements must be viewed.

The impact of on-line advertising and its growing economic dominance in the media market can be illustrated by the case of Google, which in April 2007 was estimated to serve 55% of all web searches. In the same month, Google paid $3.1 billion to buy DoubleClick, the world’s largest advertising network whose technology is used to place display advertisements (banners, pop-ups, and video ads) on websites. In May 2007 Google agreed to pay $680 million for RealMedia, an exchange where advertisers buy space on thousands of niche websites, using an open auction system to bring buyers and sellers together. On October 31 2007, it was reported that in the UK market ‘Google’s advertising revenues have now exceeded those collected by ITV1, according to newly released figures. UK third quarter results for the leading search engine showed it brought in £327 million in advertising between July and September, while ITV's main channel only reaped £317 million over the same period. With Google's funds coming mainly from sponsored links, it managed to outstrip the ad revenues of ITV1 for the first time, despite the channel being boosted by showing the Rugby World Cup.’[43]

[43] http://www.directtraffic.org/OnlineNews/Google_overtakes_ITV1_on_UK_ad_revenue_18336871.html

5 Digital Media Research

5.1 Introduction: Research Trends and Directions

Last year, in D10.3.1, we remarked that 'intelligent media content technologies represent a very new field for research, whose parameters are comparatively undefined, although it builds on a very large body of well-established component disciplines'. We then gave a quite extended review of the state of the art in the main contributory fields of digital media technologies, as well in as the limited number of projects that specifically address the core topic of intelligent content technologies. The review provided in D10.3.1 remains current: rather than provide a section by section update, we will here concentrate on some of the more significant high-level changes.

It is increasingly obvious that convergence creates additional complexity, whether at the domestic or professional level, in the creation and consumption of media. The addition of intelligent behaviour to media objects, data streams, networks and delivery methods is essential as a means of managing complexity, controlling costs, and providing more attractive (and commercially viable) audience experience. Intelligent media content technologies are consequently recognised as a strategically important research field. As a result, we are seeing the establishment of major new research projects at European and national research levels, and initiatives that will lead to more dedicated research activities in future, as well as the appearance of the first practical results from existing projects.

5.2 Emerging Results from Current Research

We have already remarked on some of the trends in industry that point to future opportunities for intelligent content technologies. In the field of semantic understanding of audio-visual content, using a multimedia ontology infrastructure is regarded to be the first step for closing the Semantic Gap between low-level signal processing results and explicit semantic descriptions of the concepts depicted in multimedia content. Multimedia ontologies have the potential to increase the interoperability of applications producing and consuming multimedia annotations. As a solution to the drawbacks of MPEG-7, various multimedia ontologies based on the standard have been proposed in the past five years, at a research level. Garcia and Celma[44] produced the first complete MPEG-7 ontology in 2005 by automatically generating a generic mapping from XSD to OWL. The definitions of the XML schema types and elements of MPEG-7 are converted into OWL full axioms. A non-translational approach has been taken in the K-Space[45] project, where a multimedia ontology[46] was proposed in January 2007. It is encouraging to see early signs of media applications for semantic technologies, and practical collaborations between software and hardware manufacturers, the computer vision and audio research communities, and the research community specialising in semantics and ontologies.

In the domain of video analysis, considerable attention is being paid to problems of increasingly automated media segmentation and semantic annotation as the basis not only for audiovisual information retrieval but to allow the eventual manipulation of characters through the modification of semantic metadata. Historically, most approaches devised for the semantic description of video have made little or no use of information regarding the state and activities of people depicted in the video, and most rely on single rather than multiple viewpoints or 3D approaches.

Full body human detection is a difficult problem due to its highly articulated structure, self-occlusion, appearance variation due to clothing, etc. The most recent trend is to use bottom-up approaches that

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[44] Roberto Garcia and Oscar Celma. Semantic Integration and Retrieval of Multimedia Metadata. In 5th International Workshop on Knowledge Markup and Semantic Annotation (SemAnnot'05), Galway, Ireland, 2005.

[45] EU project NoE: Knowledge Space of semantic inference for automatic annotation and retrieval of multimedia content, http://kspace.qmul.net/

[46] Richard Arndt, Raphaël Troncy, Steffen Staab, and Lynda Hardman. Adding Formal Semantics to MPEG7: Designing a Well-Founded Multimedia Ontology for the Web. (KU and CWI technical report KU-N0407), January 2007.

detect body parts and assemble them into a human figure[47]. Detection from multiple views is closely related to the problem of initialization of a humanoid kinematic structure or a 3D shape model from multiple views. Model-based 3D pose estimation from multiple views also implies human body detection. Approaches usually involve fitting a skeletal structure to a suitable abstract representation (e.g. medial axis[48]) of volumetric human data.

The aim@shape Network of Excellence supports the development of methodologies for modelling and processing knowledge related to the geometry, structure, attributes and semantics of digital shapes. The project's Digital Shape Workbench (DSW)[49] contains repositories of ontologies, shapes, tools and publications. By November 2007, this had grown to include over 70 tools, the most recent of which address problems relating to shape retrieval, surface mesh generation and point cloud visibility. The ontologies collection contains three domain ontologies and two common ontologies. The virtual humans ontology "aims at organizing the knowledge and data of the Virtual Humans (VH) ontology. The ontology aims at organizing the knowledge and data of three main research topics and applications involving the virtual representations of humans: a) Human body modelling and analysis morphological analysis, measuring similarity, model editing and reconstruction; b) Animation of virtual humans: autonomous or pre-set animation of VH; c) Interaction of virtual humans with virtual objects: virtual –smart– objects that contain the semantic information indicating how interactions between virtual humans and objects are to be carried out."

AKT is a six-year, £7.5 million (€10.65 million) UK national research collaboration between research groups at the Universities of Aberdeen, Edinburgh, Sheffield, Southampton and the Open University, designed to ease fundamental bottlenecks in the engineering and management of knowledge. The significant outcome, in our context, is AKTive Media as an ontology based cross-media annotation (images and text) system. Its goal is to automate the process of annotation by suggesting knowledge to the user in an interactive way while the user is annotating. The system works in the background, interacting with web services and queries a central annotational store to look for context specific knowledge. The tool is now being offered under Open Source terms; version 1.9 can import multiple ontologies and support all types of still image formats: 3D annotation modalities are under development.

The two-year UK 'DREAM' project[50] started in 2007, developing efficient storage, management, indexing, search, use and re-use of digital media assets for the postproduction industry. The R&D focuses on the creation and use of metadata generated from low-level content analysis and high-level semantic awareness, and the incorporation of semantic metadata into the workflow process. The semantic labelling approach is designed to take account of the particular context of objects and characters[51].

5.3 Research Projects into Intelligent Content Technologies

Possibly the largest single research project yet to be undertaken into intelligent content technologies started its work in March 2007. i3media is a Spanish national project involving leading media companies who have formed a consortium, largely inspired by Barcelona Media, with a budget of €35 million (50% funded by the government Cénit programme) and the collaboration of 150 researchers. Over a period of 4 years, the project will research technologies for the automated creation and management of intelligent media content. The Consortium comprises 12 companies (including Mediapro as leader, Telefónica I+D, Alcatel-Lucent, Havas Media, Corporación Catalana de Radio y Televisión, Activa Multimedia, STT, Infospeech, Brainstorm, Televisión de Cataluña and Noufer) together with 19 research groups from 12 Universities and research centres.

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[47] A. Micilotta, E.-J. Ong, and R. Bowden, "Real-time Upper Body Detection and 3D Pose Estimation in Monoscopic Images", Proceedings of ECCV, 2006

[48] C. Menier, E. Boyer, B. Raffin, "3D skeleton-based body pose recovery", Proc. International Symposium on 3D Data Processing, Visualisation and Transmission, 2006.

[49] http://dsw.aimatshape.net/

[50] see http://www.imss.reading.ac.uk/dream.html

[51] Zhu, M, Badii, A., "Semantic-associative visual content labelling and retrieval: A multimodal approach", Signal processing: Image communication, Vol 22(6), July 2007, pp. 569-582.

The projects resulting from Call 1 of the ICT programme in FP7 will be starting work from early 2008. Although the Commission is still in negotiation at the time of writing and has not yet released the full details of selected projects in the area of Objective 4.2 Intelligent Content and Semantics, it has publicly identified several themes and project groupings in the intelligent media content and technologies area. According to the summary report released on October 24 (from which we extract the areas related to SALERO's domain)[52]:

> Top-ranked proposals focus on advancing the current state of the art by considering multiple content types, novel authoring techniques, advanced knowledge management and semantic foundations…
>
> Several proposals addressed various aspects of *multimedia content creation and management.* One addresses the area of semantic coding of 3D media content and the sharing of 3D models. It will actively disseminate state-of-the-art techniques in the modelling, manipulation, search and reuse of 3D data - a content modality of growing importance for medicine and bioinformatics, computer assisted design, game development, etc. Another one will support the development of film and game productions by developing a system of notation similar in concept to those that have been developed for music and choreography, together with authoring tools for producing, sharing and modifying 'scores' written using the notation. This will allow authors to concentrate on their creative vision and communicate it formally to those that will execute it in various media.
>
> A third focuses on the management of existing multimedia materials by means of semantic annotation. In contrast to ongoing research efforts, this will be done by automated mechanisms that will perform the annotation whenever possible and request human intervention where necessary, requiring less and less human intervention as more and more materials are annotated. A fourth one in turn plans to take advantage of richly annotated cultural heritage materials to optimise personalised experiences.
>
> Two proposals address problems concerning the physical setup of video capturing systems and the analysis of their output: one will perform a sophisticated analysis of sensor outputs to decide when to capture video and how to transfer control from one camera to the next in multi-camera environments; the other one will integrate production and post-production activities (e.g. addition of special effects) by capturing video through choreographies of multiple cameras and enriching them with the output of advanced analyses over the synchronised video streams[53].
>
> The *knowledge management* needs of various types of organisations and communities are addressed by a number of proposals with complementary goals and perspectives: one of them is designed to observe the activities that take place within enterprises and identify patterns that could result in better decision support or more efficient collaboration patterns….
>
> Similarly another proposal proposes the integration of different systems designed to add successive levels of intelligence to multimedia content aggregated from large user communities: the key insight is to fuse information obtained from different sources (for example in the event of a civil emergency) and re-circulate it within the community to improve a collective and evolving understanding of the situation….
>
> Finally, another proposal will ease and speed up the uptake of semantic technologies for the enterprise, by performing market research and promoting forums, seminars and other initiatives designed to match business needs with emerging solutions and mutually educate leading customers and technology developers. It will thus help to move semantic technology to the mainstream.

[52] At which time it was stated that a full list of proposals retained for negotiations would be made public between mid-November and mid-December 2007

[53] We believe this refers to the i3DPost project, whose public summary reads: i3DPost will develop new methods and intelligent technologies for the extraction of structured 3D content models from video, at a level of quality suitable for use in digital cinema and interactive games. The research will enable the increasingly automatic manipulation and re-use of characters, with changes of viewpoint and lighting. i3DPost will combine advances in 3D data capture, 3D motion estimation, post-production tools and media semantics. The result will be film quality 3D content in a structured form, with semantic tagging, which can be manipulated in a graphic production pipeline and reused across different media platforms.

A cluster of its own is formed by two proposals that address fundamental problems that stand in the way of the takeoff of the *semantic web.* The first one plans to build a distributed infrastructure for entity identification. This will allow applications built by different actors to unambiguously publish and refer to the same set of entities much in the way GPS signals allow different applications to refer to the same location on earth. The other one will provide a modular and scaleable architecture for real-time inference engines of extremely large scale. This exploits insights from various disciplines in the form of programmable heuristics that can be plugged in the inference engine to optimise its behaviour under various conditions.

The other objective in ICT Work Programme 2007-8, Challenge 1.5 Networked Media, reported a good coverage with selected proposals grouping into three main themes:

- Multimedia services and applications (shared interactive media experiences, IPTV)
- New forms of media (3D, end-to-end immersive media experiences); and
- Media systems and platform management (IPTV via P2P networks)

It is clear that all of these domains require what SALERO would classify as intelligent content technologies. Unpacking the themes, the commission has identified several highly relevant areas covered by the projects:

- Changing the paradigm of TV broadcasting toward personalized TV-on-demand
- P2P architectures to deliver scalable solutions that are not controlled by a single operator, with a trial platform based on Open Source
- 3D digital cinema technologies for the acquisition, coding, editing, networked distribution of stereoscopic and immersive content
- 3D digital TV systems for high quality media, to prove the viability of the format in the production for delivery over IP and traditional channels, with multi-view and depth capture techniques and a 3D broadcast format
- 3D mobile (stereoscopic) telephony, with 3D content capture/creation, coding, transport rendering and display, which will also enable future mobile broadcasting to 3D handhelds
- Immersive media experiences based on end-to-end systems delivering novel, creative experiences to individuals as well as groups, with an open reference architecture for immersive and shared experiences
- Coding for multi-layered, multi-view content; multi-source and multi-network streaming and adaptation; content protection and management; QoS

5.4 Future Directions for Research

The 2007 ISTAG report clearly identified research into underlying content technologies as essential to future success, and suggests concentrating efforts on ten lines of action that would:

- R2-1 Support social scientific research for early-stage innovative technologies
- R2-2 Support creativity and technical expertise in content and product creation
- R2-3 Support the development of content-rich communication products
- R2-4 Support high-quality visual and sound content
- R2-5 Support the development of intelligent content
- R2-6 Support the understanding of interactive contents, use and impact
- R2-7 Support multi-channel technologies
- R2-8 Support community models for creating and sharing content
- R2-9 Support anywhere and anytime access to personalised content
- R2-10 Support the deployment of digital cinema

The report goes on to amplify the recommendations as follows:

Research into audiovisual content technologies covers a wide variety of activities, from basic research with no specific aims or limits ("Blue sky" research) to research into advanced applications. The field also includes disciplines that ensure the technological viability of advanced applications as well as applied industrial research, which comprises aspects such as multimodal semantics, advanced interfaces and creation of, and experimentation with new media contents and formats.

Research in the media field necessitates guiding technologists toward the creation of intelligent content (including collaboration and creation of metadata), as well as toward (i), the organization of content using automated work flows, (ii) rendering for different users and platforms, and (iii) secure, efficient exchange and marketing of contents. The creation of content technologies will also involve researching people's response and modelling their behaviour − not only to discover how best to develop the technology, but also how to exploit it in business terms.

Technology for content treatment, oriented toward the automation of laborious tasks for the audiovisual content creation industry, as well as significant improvements in the usability and accessibility of content, represent san enormous challenge. In order to address it successfully, great strides need to be made in the following research areas: computational image and graphic processing, linguistic computation and speech treatment, acoustic and physical acoustic modelling, information recovery, cognitive and perception sciences, data mining, information systems, experimental creation, the sociology and ethnography of communications.

Following the ICT FP7 Call 1, the Commission has identified several future gaps or trends to be filled by EU research:

- Novel content *consumption experiences* of the kind made possible by recent advances in sensors and display hardware technology as exemplified by Nintendo's Wii platform and the touch-screen capabilities pursued by Apple (iPhone) and others
- Further research into context-aware media search
- Digital media production technologies and intelligent content packaging from creation to distribution
- More work related to user-generated content
- Applications in (mobile) MMPORGs and digital cinema
- A 3D Internet

6 SWOT Analysis of SALERO, in the Light of Current Trends

We are clearly seeing wider ways of 'consuming' media, whereby a large amount of cross media is produced with manual intervention. It is reasonably obvious that the trend we will see next is the automatic cross purposing of media productions.

Whereas a year ago 'intelligent content' was a little-understood concept (and impossible to illustrate with examples), the trend toward and requirement for intelligent content technologies, which the SALERO consortium was among the first groups to identify, is increasingly recognised in the research, technology, business and decision-making communities. This represents a major opportunity for the project and its partners, but also increases the competitive threats.

Strengths	**Weaknesses**
RTD in intelligent media (in audio, visual and language domains) capable of leading to advances in media production and cross-media repurposing at reduced costs Involvement of creative professionals and users as well as technologists Testing of technologies in experimental productions	It is difficult for intelligent technologies to meet both the quality standards required by high-end media professionals *and* the speed and simplicity required for UGC and mobile content Lack of suitable multimedia standards platforms Interoperability may be reduced by lack of appropriate standards Experimental productions need to integrate different formats in cross-media contexts
Opportunities	**Threats**
Use of intelligent content technology tools to enable low-cost production by a wide range of content creators Niche content creation by SME producers New business based on cross-media development and user-generated content	ICT solutions from other providers and research groups in a fast-moving area Low-cost content from outside Europe Lack of interoperability due to stop-down standardisation process

7 Glossary

Partner Acronyms

AM	Activa Multimedia, ES
BLITZ	Blitz Games, UK
DIT	Dublin Institute of Technology, IE
DTS	Digital Theatre Systems, UK
FBM-UPF	Fundació Universitat Pompeu Fabra, ES
GVG	Grass Valley Germany, DE
JRS	JOANNEUM RESEARCH Forschungsgesellschaft mbH, AT
LFUI	Leopold-Franzenzs Universtät Innsbruck, AT
PGP	Pepper's Ghost Productions Ltd., UK
TAIK	Taideteollinen Korkeakoulu, FI
UG	University of Glasgow, UK
UPF	Universitat Pompeu Fabra, ES
URL	Universitat Ramon Llull, ES