Vision & SRIA Position Paper

New European Media, *driving the future of digital experience*

October 2014

This document has been drafted by a set of NEM members (see list of contributors below) under the leadership of Pierre-Yves DANET (Orange, NEM Vice Chairman), and being approved by the NEM Steering Board

Content

Executive Summary

The NEM Initiative is one of the recognized European Technology Platform s (ETPs) of Horizon 2020. The NEM ETP aims at building sustainable European leadership in content, media, and the creative industries. With the launch of the Horizon 2020 programme, the renewed NEM platform is pursuing its objective to promote an innovative European approach to convergent Media, Content and Creativity towards a Future Media Internet that will enhance the lives of European citizens through a richer media experience.

The NEM Initiative focuses on an innovative mix of various media forms, delivered ATAWAD (Any Time, Any Where, Any Device) over technologically transparent networks, to improve the quality, enjoyment and value of life for Europe's connected 'digital citizens' and digital content/media professional users. NEM is taking cognizance of existing and new technologies, including broadband, broadcast, mobile and new media across all ICT sectors, to create a new and exciting era of advanced professional and personalised services for various markets. A key focus of the NEM is on innovative services and applications that constitute different media.

The European Technology Platform NEM aims at being a key player in Interactive Content & Media and the Creative Industries, operating within the European innovation ecosystem to help turn Europe into an Innovation Union. NEM is taking a holistic view, identifying the pathway to commercial deployment of research, providing strategic insights into market opportunities and needs, and mobilising and connecting innovation actors across the EU in order to enable European companies and stakeholders to gain competitive advantage in global markets.

In this follow-up to the previous NEM Vision[1] Specific Research Agenda2 we consider the landscapes of future research and economy from the perspective of NEM3, the European Technology Platform on New European Media.

The NEM European Technology platform has recently moved from networking electronic media towards a focus on Content, dealing with Connected, Converging and Interactive Media & Creative Industries . This new version of the Research & Innovation Agenda is taking into account the specific needs of this enlarge NEM community with the concern of developing a complete value chain including innovation and its catalysts (such as education, access to finance, broader Innovation trough cross-sector innovation, start-ups and innovative SMEs), addressing new business opportunities (including experimentation capabilities for new innovative services and involving the users / customers) and linked to the Grand Societal Challenges.

Starting with an analysis of the future societal and business opportunities in the NEM sector, taking into account Europe's cultural diversity, and its awareness of environmental issues and societal challenges, the first part of the document (the **NEM vision**) highlights some key challenges and actions that Europe has ahead in the field of content and creative industries and considered necessary to achieve the goals of the NEM initiative – either to be promoted or to be implemented by NEM and its stakeholders.

A detailed description of all relevant NEM research and innovation areas for Horizon2020 program 2016-2017 can be found in the part 3 of this document (**NEM Foreseen Innovation**). It confirms the list of topics issued from a survey performed among all NEM members. Those topics for which the NEM Community sees a specifically high importance in Horizon 2020 work program 2016-2017 are:

[1] http://nem-initiative.org/wp-content/uploads/2013/11/NEM-V-004.pdf
[2] http://nem-initiative.org/wp-content/uploads/2013/11/NEM-SRA-080.pdf
[3] http://nem-initiative.org/

Media -related applications and business models
- Social Networking and Media Sharing
- User Satisfaction and Quality of Experience

Content Creation
- New Forms of Content
- Representation of Content
- Tools for content creation and manipulation

Networking and delivery infrastructure
- Intelligent Delivery

Content search and media presentation
- User-system interaction
- Authentic, true-to-original media reproduction including Virtual Reality

Technology drivers and enabling technologies
- Data security and personal privacy
- Identity management and AAA (authentication, authorisation and accounting)
- Personalisation/profiling: Smart user profiles across all services & devices
- Power management technologies – energy saving in/by ICT
- Machine-Machine Communication

In its last part, this document suggests also the setting up of a **Private Public Partnership** (PPP) in the field of immersive content that the NEM community expect to be a big business in the next 10 years.

The NEM stakeholders and authors of this Position Paper are firmly convinced that public initiatives, such as the European Commission's ICT Framework Programmes including its PPP approaches, form a powerful and effective instrument to profoundly foster European research, development, and innovation activities while accounting for the bigger picture of sustainable growth and societal challenges.

There are many competencies already available in research organisations, big companies but also in the numerous SMEs that work in that sector. The challenge is to involve all those stakeholders including SMEs in European projects in order to develop new innovative business and to help the development of this strategic sector. The approach taken by NEM as a cluster of clusters should be a facilitator and an accelerators towards this necessity and ambitious target to embed more start-ups and SMEs .

Contributors :

Josephus VAN SAS (Alcatel Lucent), Augustin GRILLET (Barco), Andy BOWER (BBC), Richard J. JACOBS (BT), Chris THOMPSON (Catapult), Frank BOYD (Creative Industries KTN), Silvia BOI (Engineering), Hald HRASNICA (Eurescom), Enrico TURRIN (Federation of European Publishers), Hadmut HOLKEN (Holken Consultants & partners), Gérard LE BIHAN (Images&Réseaux), Paul W. WALLAND (IT Innovation), Verónica BUEY CIESLAK (Madrid ICT-Audiovisual Cluster), Pierre-Yves DANET (Orange Labs), Roger TORRENTI (Sigma-Orionis), Amela KARAHASANOVIC (SINTEF), Michela MAGAS (Stromatolite), Jean-Dominique MEUNIER (Technicolor), Jovanka ADZIC (Telecom Italia), José Manuel MENENDEZ, David JIMENEZ (UPM), Jon ARAMBARRI BASANEZ (Virtual Ware), Rob KOENEN (TNO), Marta Izquierdo Vaquero (Grupo Secuoya)

I- Foreword

In July 2013, The DG CONNECT and DG RTD recognised the NEM European Technology Platform as the official platform covering the Content & Media sectors and requested the NEM initiative to also cover the Creative Industry sector.

Content is clearly in the Horizon 2020 strategy[4] :

- 1.1.3. Broad lines of the activities" (1) identifies, as one of its key activity lines, Content technologies and information management: ICT for digital content and creativity. These activity lines are expected to include industrial leadership in generic ICT-based solutions, products and services needed to tackle major societal challenges as well as application-driven ICT research. The NEM ETP addresses this activity line by … and maintains contact with the key components identified in the other activity lines, that is components and systems, next generation computing, future internet, advanced interfaces and robots, micro- and nano-electronics and photonics, all of which are reliant upon, as well as contributory to, the evolution of innovative content and media.

and among the Media and Content Industry, the Creative Industries is clearly a Horizon 2020 priority sector as highlighted by European Commission Vice President Neelie Kroes on Nov. 16, 2012[5] :

- "[...] The creative industries and cultural content have a very strong role to play. Culture helps our society: supporting inclusion, education, and democratic freedom itself. But it also supports our economy: creative industries represent 5 million jobs and 2.6% of EU GDP.
- [...] More generally, the internet is changing the whole media sector. We won't stop that change from happening; it's inevitable. But, if we don't get it right, we will fall behind our global partners, to the loss of our citizens, our democracy, and the European media sector itself. So we need to seize those opportunities, and rise to that challenge.
- […] The third point today I'd like to make is about the digital agenda more generally. One way to support the creative industries is to look at each subsector — film, books, TV and so on — separately. But for me, that's not enough. In many ways the best way to help the creative sector is to provide digital infrastructure: the networks and frameworks that support a digital society. Provide that infrastructure, and amazing innovation will follow. For this sector just as in others. Imagine, for example, if your favourite films, books and music were stored somewhere in a locker in the cloud. Accessible to you, legally, instantly and on-demand, over a fast network, wherever you are and on whatever device. Imagine what an advantage that would be for our creative industries; and for our citizens."

Considering this recognition and the corresponding evolutions required, NEM became in 2014 the **New European Media** platform addressing the Content sector including Media and the Creative Industries. In this new context and new Horizon 2020 perimeter, there was a need to update the NEM Vision and the Strategic Research and Innovation Agenda. This document represents a high level view for themes that would be relevant for the upcoming Horizon 2020 work program 2016-2017. This document combines the former separate Vision Document and the Strategic Research Agenda. It represents the 2014 version of these documents and should be approved by the NEM General Assembly end of September 2014. A list of research topics resulting from discussion at the NEM workshops conducted in February/April 2014 is added as Annex A.

[4] Brussels, 30.11.2011, COM(2011) 809 final,2011/0401 (COD), page 45, Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing Horizon 2020 - The Framework Programme for Research and Innovation (2014-2020)]

[5] Supporting the Cultural and Creative Sector, SPEECH/12/858

II- NEM Vision

II.1- Sectors

Mediia & Content industries, Creative Industries

New European Media technology platform is addressing Content in large sens, dealing with Connected, Converging and Interactive Media & Creative Industries. It encloses both Media & Content Industries and Creative industries.

The European **Media and Content Industry** (MCI) sector makes an important contribution to the European economy, holds a significant potential for growth and competitiveness, and employs a highly skilled workforce.

- According to JRC [6], the entire MCI sector in Europe produced some 213 billion Euros in 2007. Average annual growth levels of MCI for the EU27 are higher than the overall growth levels and this is a general pattern throughout the EU. In 2007, the entire European economy employed some 226 million people; the MCI employed 10.8 million people across Europe. More than half of these people were employed in the EU6. The average annual growth rate in employment for the MCI between 1995 and 2007 was higher than the growth rate for the economy as a whole in the EU27.

As stated during the Competiveness Week of November 2012 to which NEM contributed, the 'European Competitiveness Report 2010' [7] identified the **Creative Industries** as one of Europe's most dynamic sectors having an important growth potential as the Internet develops.

- It accounts today around 3.5% of the GNP of the EU and some 3.8 % of its workforce (5 million jobs). It is divided into the following main branches: Music, Books, Art, Film, Broadcasting, Performing Arts, Architecture, Designs, Publishing, Advertising, Software and Games[8].

A more recent study (2013) by the OHIM and EPO estimated that copyright industries accounted for 3.2% of employment (more than 7 million people) and 4.2% of total economic activity/GDP (0.5 trillion €) in the EU in 2008-2010. In addition, copyright industries pay significantly more than other industries, with an average wage premium of 69%.[9]

[6] European Commission Joint Research Centre , Institute for Prospective Technological Studies, Statistical, Ecosystems and Competitiveness Analysis of the Media and Content Industries ftp://ftp.jrc.es/pub/EURdoc/JRC69435.pdf

[7] European Competitiveness report 2010, http://bookshop.europa.eu/en/european-competitiveness-report-2010-pbNBAK10001/

[8] Creative Economy Report (2010) UNTAD http://unctad.org/en/Docs/ditctab20103_en.pdf

[9] https://oami.europa.eu/tunnel-web/secure/webdav/guest/document_library/observatory/documents/IPContributionStudy/full_report/joint_report_epo_ohim.pdf

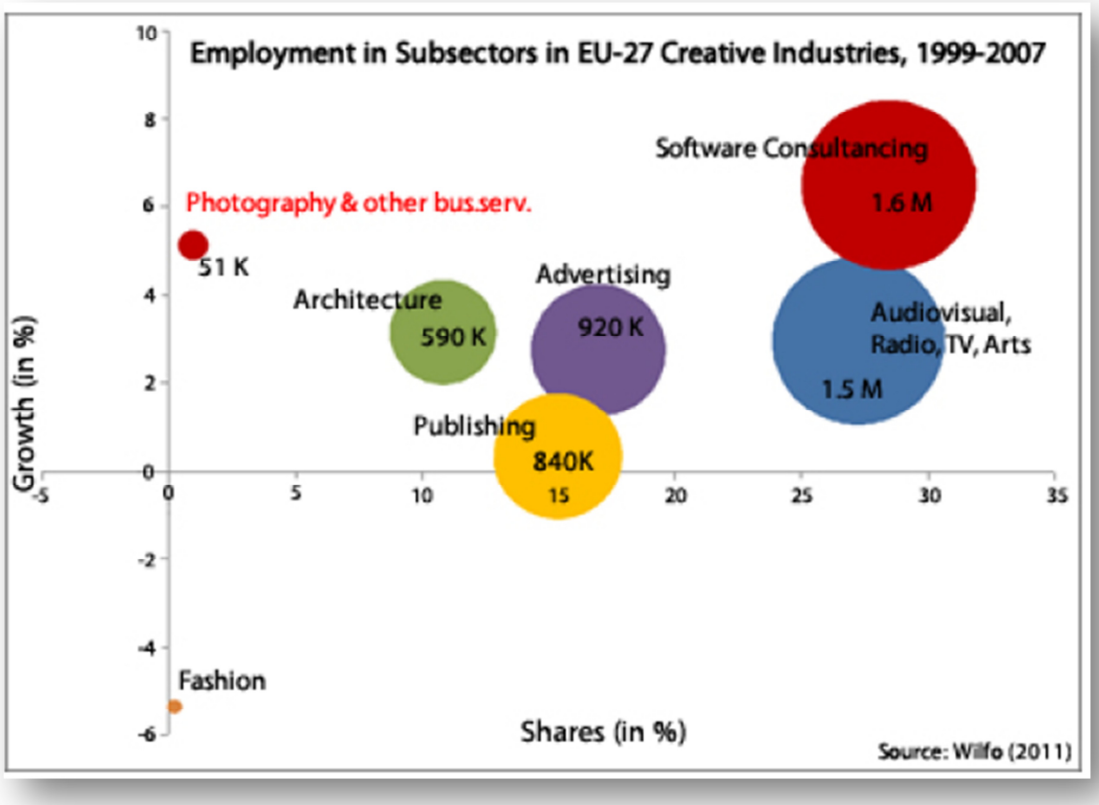

Fig 1: Employment Growth in Creative Industries in the EU-27. European Competitiveness Report 2010, Chapter 5: "Innovation and Competitiveness of the Creative Industries in the EU".

As a sector, the media content sector has moreover a major societal impact, for example :

- European citizens spend on average 1/3 of their waking time consuming media in one form or another
- European Content and particularly Creative industries are dominated by small enterprises. Most of them are even very small; micro-companies and free-lancers represent 85% of companies in creative industries[10].

II.1.1- Creative & content industry : who are the stakeholders ?

There are many…

In a very real sense, we are all potential stakeholders. The consumer is the ultimate stakeholder, since it is the consumers of all types of creativity who provide the direction as creative output develops, and who also pays for the products. At the end of the day it is the commercial viability of a creative enterprise which determines its success or failure, and it is the consumer of that creativity who must be convinced of its value. Nonetheless, we can identify the stakeholders who provide, or seek to provide, the components in the creativity value chain. Whilst not all of them are traditionally classed as creative, they are nevertheless necessary for that chain from creator to consumer to be complete.

[10] "The European Creative Industries Alliance from concept to reality " Speech by Reinhard Büscher on the objectives of the European Creative Industries Alliance http://www.europe-innova.eu/web/guest/home/-/journal_content/56/10136/730173

We think of the originators of any kind of content as the creative individuals:- those whose imagination is harnessed in a new production, whether that is a movie, a TV show, a building, a fashion accessory, a novel, a piece of furniture or anything else in our modern lives that involves an element of original design. They will use whatever technology is available to make their work more effective, as customers of the technology and/or users of the technology. Their primary tools are their talent, skills and training. They look to technology to help them employ those tools, not to substitute for them.

There are many other stakeholders in the delivery chain from creation to consumption. Business and financial facilities are essential, as are brokering services and delivery services. These are components of the chain that benefit directly from developments in technology, which gives the mechanism by which the chain from creator to consumer is connected and managed as a business.

Figure of the NEM stakeholder's taxonomy

And, essentially, made of SMEs…

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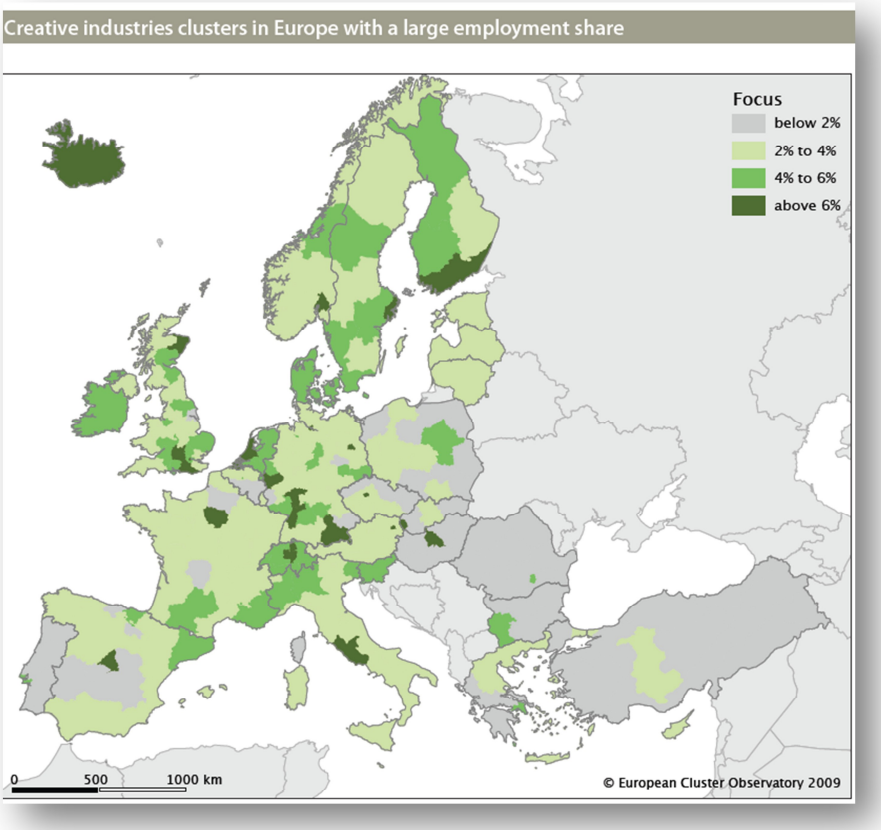
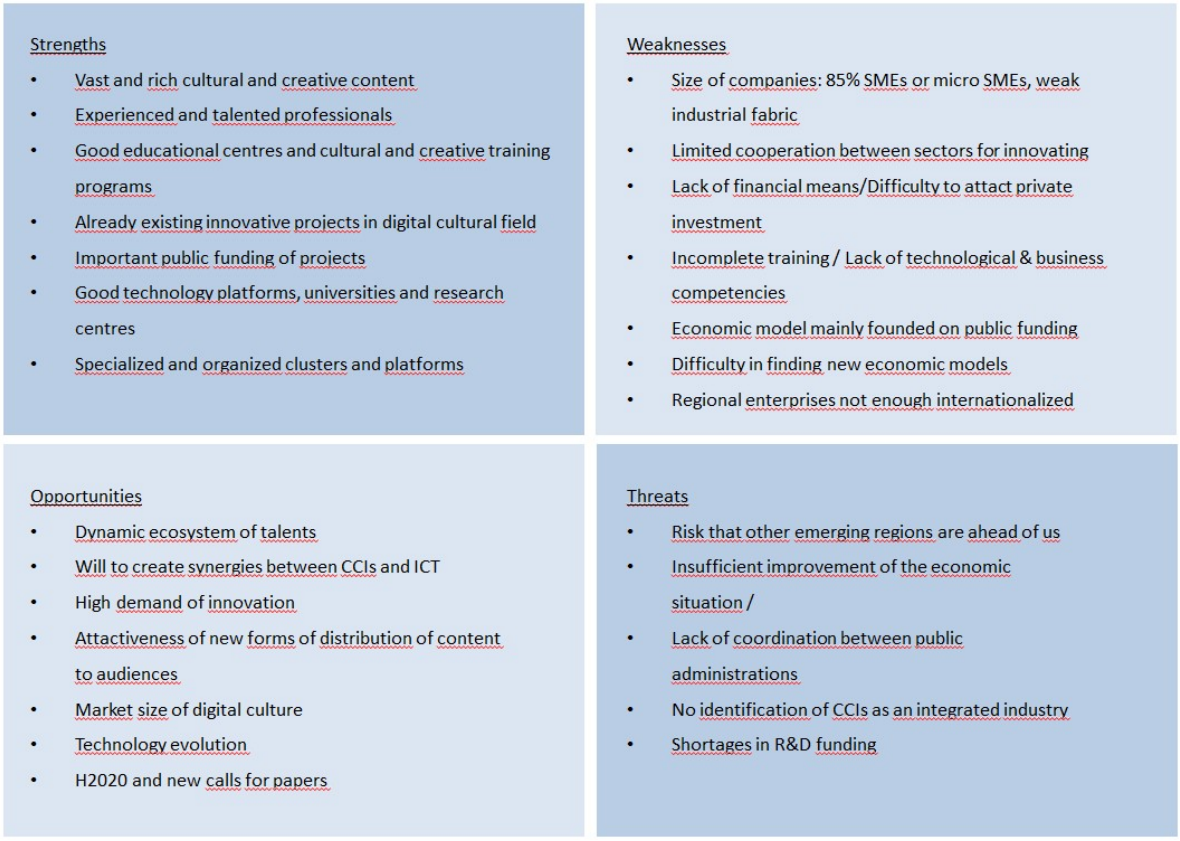
[11] "The European Creative Industries Alliance from concept to reality " Speech by Reinhard Büscher on the objectives of the European Creative Industries Alliance http://www.europe-innova.eu/web/guest/home/-/journal_content/56/10136/730173



The project SmartCulture (www.smartculture.eu) carried out a survey among 657 stakeholders from Cultural and Creative Industries in 8 European regions: Nord Pas de Calais (France), Madrid and Basque Country (Spain), Siena (Italy), Sofia (Bulgaria), Eindhoven (Netherlands), Aarhus (Denmark) and Birmingham (UK). As a result a SWOT analysis was published with the aim to provide a systematic picture of the current state of the creative economy. This SWOT analysis takes place in an interesting moment of structural transition: that from the 'Culture 2.0' paradigm of cultural and creative industry to the new 'Culture 3.0' paradigm of open digital platforms. Such transition is basically determined by the wave of technological innovation that combines new techniques of digital production of cultural and creative contents and social media of second generation.



II.1.2- What is the content ?

It is digital and covers a large spectrum…

Cultural and creative content in the analogue world was fairly easy to identify, consisting traditionally of music, movies, print books, newspapers and magazines, TV and radio broadcasts and the like. Other works of creativity, such as live performances, plastic and visual arts, architecture, etc. were part of the picture but rarely identified as content.

The digital switch has encompassed all creative and cultural sectors and has made it possible for all of their works to become some form of digital content: analogue products have all digital counterparts in some file format (music, movies, books, etc.), broadcasts are done digitally and in addition also other forms of art and culture (paintings, sculptures, buildings, etc.) can now be accessed somehow in digital format, as a consumable file containing a piece of content that is delivered for viewing or listening by an end user.

Moreover there are now other forms of content, created and stored as digital files, often representing some created object which is expressed in physical terms before it is consumed. This might be the CAD plans for an architectural design, a piece of furniture or a 3-D object intended for 3-D printing. Equally it might be the file-set required for production of a physical book or artwork. Any digital rendering or description of a creative product that is consumed in some way, either physically or virtually, and that is transmitted electronically from a creative to a consumer location should therefore be considered to be content.

By Media & Content Industries, including Creative Industries, we mean advertising, architecture, arts, audio visual, cinema, fashion, music, photography, publishing, radio, TV, …so all type of content and media accessible by the citizens.

II.2- Trends

A world of big numbers, a world of big changes…

Microsoft (created in 1975, 78B$ in 2013), Apple (created in 1976, 74B$ in 2013), Amazon (created in 1994, 174B$ in 2013), Yahoo! (created in 1995, 4.7B$ in 2013), Google (created in 1998, 60B$ in 2013), Face book (launched in 2004, 7.9B$ in 2013) have been new comers forcing older companies to reposition themselves to survive in a market which became global - such as Nokia (created in 1865, 23.4B€ in 2013), Technicolor (created in 1883, 3.5B€ in 2013), Philips (created in 1891, 23.3B€ in 2013), IBM (created in 1911, 99.8B$ in 2013), Panasonic (created in 1918, 102B$ in 2012),Samsung (created in 1938, 153B$ in 2013), LG (created in 1940, 128B$ in 2012), Sony (1946, 65B€ in 2012/2013) and Intel (created in 1968, 52.7B$ in 2013) as just some examples.

Since Gutenberg in the 1400s, the Industrial Revolution in the 1800s, the TICs in 2000s, some commentators are estimating that we are entering or even have entered a fourth revolution. What is sure, is that we have entered a world of big numbers: big values, big data, big companies.

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[12] GO-Globe

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Some interesting moves occurred in 2013 and the beginning of 2014, showing maybe some small signals announcing potential new evolution, positioning, challenges and …opportunities. Let's just shortlist some of them:

- the European legislative package adopted in September 2013 for a "Connected Continent: Building a Telecoms Single Market" aimed at building a connected, competitive continent and enabling sustainable digital jobs and industries (roaming and net neutrality) ,
- the net neutrality adopted by the European Parliament in April [14] and supported by the FCC, setting cantilever by a recent U.S. court decision,
- the awaited European positioning on some EC mergers,
- the mega-mergers just announced in the USA (Comcast and Time Warner, AT & T and DirecTV),
- Netflix leading the charge in the VOD market particularly in Europe,
- the all-pervasive market approach of Amazon,
- …

A world of big (European) opportunities…

A world of big numbers, a world of big changes, but a world of opportunities for the European Citizen, for European Industry and for European Research in which the users, the consumers and the content are central. And at an (increasing) speed that we may have never previously have experienced in any fields.

Which make the exercise of writing a vision and a strategic research & innovation agenda even more exciting!

According to Idate[15],

- all the world's top 10 media companies are American (Comcast, DirecTV, Time Warner, Walt Disney Company, News Corp, Cox Enterprises, Dish Network, Viacom, CBS, Time Warner Cable),
- the Asia-Pacific audio-visual market overtook the European market in 2013,

[13] GO-Globe
[14] http://www.europarl.europa.eu/news/en/news-room/content/20140331IPR41232/html/Ensure-open-access-for-internet-service-suppliers-and-ban-roaming-fees-say-MEPs
[15] Digiword Yearbook 2014

- OTT services are forecast to be posting more than an average of 16% growth over the next five years, which is five times more than telecom services
- Content markets' move to the web (rate of dematerialisation in 2013: Music : 36% in Europe, 65% in USA; video games : 54% in Europe, 58% in USA; video : 18% in Europe, 43% in USA; books : 46% in Europe, 25% in USA).

II.2.1- Users trends

More and more connected…

Billions of humans are connected (2.4 Billions[16] of internet users in Q2 2012 ; Europe : 518 million users - 63.2% penetration; USA : 274 million users, 78.6% ; Asia : 1,077 million users, 27.5% penetration). Soon, trillions of devices will be connected (there were more internet-connected mobile devices such as smartphones and 3G tablets than people in the world by the end of 2013), with a huge number of tera bytes of creative/media content as a main driver for adoption of devices and their connection.

It is not just numbers of connected people that matter, but the way in which they are connected, what they are connected to and what they connect with. Over 50% of the world's population or on-line in some fashion – that's around 4 billion people! But more important is the increase of connection bandwidth that they are starting to access, and the number of smart phones, tablets and other portable devices they are using. This is important, because it changes the way that people view their on-line behaviour. Everyone on-line is now a creator as well as a consumer of content. In the past internet connectivity was highly asymmetric, with the up-link being characterized by simple commands and the downlink handling images, movies and other high bit content. This has now changed, and users are uploading their own images and video over mobile networks, with automatic cloud storage of user generated content adding to the load. New digital production techniques allow to digital natives to use sophisticated production suites that would once be financially and technically accessible only to wealthy professionals at a very limited cost and with very quick learning curves. Social media of second generation create the possibility to connect exactly to those people who share the same interest in the same niche of contents by means of highly specialized platforms which become increasingly content specific. As a consequence of this, the distinction between producers and users of contents becomes blurred, and everybody becomes engaged to some extent in producing, remixing, and distributing contents according to a new notion of authorship and intellectual property.

Synchronization of content across devices also increases network traffic, as well as re-sharing between people and across social media. Increasingly, private and public image gathering devices such as cameras have their own internet connection, adding still further to the traffic. And it is still true that image media is the major contributor of Terabytes of content per day to world internet traffic. In comparison, although many more devices are becoming connected, from cars to fridges, the bit density contribution they make to internet traffic is very small and likely to remain so. There is also an increasing trend for user generated images and videos to be at higher and higher resolutions – GoPro cameras are now capturing at 4k – and demand for on-the-move movie and TV consumption, currently at HD will surely develop to UHDTV in the near future. Once people are sharing 3D objects this figure will increase (although how these objects will be 'displayed' is still a moot point). On-line cloud storage demands will increase exponentially as users, and user devices, increasingly expect storage and back-up to be off-device and accessible from anywhere, with these services being offered by network providers, ISPs, device providers and third parties, in what will become a very complex business environment.

[16] http://www.internetworldstats.com/stats.htm

II.2.2- Business & market trends

A (on going) complete change…

When looking more specifically to the Media & Content specific industries (ie publishing, press, cinema, audio visual sectors, TV and movie industries), we note that all the sectors did or do not move at the same speed from the analogue to the digital world, that digital technologies change some value chains (ie postproduction being more global),and that digital technologies allow a larger community of users (including start-ups, web entrepreneurs, SMEs) to climb aboard the new domain previously reserved for professionals (i.e. user generated content, photography, …) and particularly for big Corporations, thus bringing new opportunities to use new services or technologies (e.g. 3D printing) to new users.

Some examples[17], not exhaustive, are highlighted below.

- **Digital publishing :**
  - ICT is embedded at all stages of book production with the exception of the final stage (the consumption) which is, relatively speaking, a more recent integration.
  - The digital publishing market is at an early stage in Europe (6% publishers' turnover in 2013), with the exception of the UK (16%), while more established in the US (25%). The market is driven by the development and generalization of digital reading devices.
  - Publishers had to introduce innovative production processes, products and business models and are facing a Transformation of value chains: fragmentation, multiplication, disintermediation and re-intermediation, with a commensurate pressure on pricing, margins and viability of business models, forcing traditional operators to evolve and seeing the emergence/entrance of new operators, and with the emergence of new global platforms having a strong positioning .
- **Written press :**
  - The written press shows a fragile situation: strong dependency on public funds, under capitalization, low economic profitability hampering investment in production tools, low R&D, low advertising investments.
  - The main technical and professional press companies realize more than half of their turnover in activities other than the printed copy (such as internet, book publishing, fairs, business services, …).
  - At the international level, subscriptions to the digital editions of the Anglo-Saxon newspapers have become substantial (Financial Times, NY Times) and are sometimes more important than advertising income.

- **Cinema & audiovisual technical industries**
  - Cinema & audio visual technical industries is a sector showing a certain amount of stagnation. This is due to the rate at which digital equipment becomes obsolete in the digital era at a time when capital assets are already very high and also to the use of off-shoring (up to 60% of production) at a time of fierce competition between tax regimes, which has led countries to the adopt a system of tax credit.
  - More specifically, the audiovisual sector is facing tension on prices due to the pressure on broadcasters' budgets, cost overruns due to HD requirements, leading to a concentration of actors.
  - The Cinema sector shows a strong heterogeneity between industrial and crafts actors, suffering from insufficient valorization of their services.
  - While dematerialization is still ongoing, the derived automation of broadcasting processes (format management, quality controls,) needs to be completed.

[17] From NEM creative industry workshop organized May 30 2013 in Paris with inputs from Cap Digital, Ficam, Images & Réseaux, Madrid Audio Visual cluster, …

- That overall situation forces that industry to set up a medium/long term vision (R&D, innovation) and to restore investments capacity.

- **TV and movie industry** :
  - The TV and movie industry is close to achieving its switch to digital operation and dematerialization of products, which has a huge impact on the workflows employed[18]. Some example are listed below :
    - In feature films, the 35mm shooting format was used in just 18% of the projects completed in the first quarter of 2013 against 22% in Q1 2012.
    - Digital cameras with big sensors were used on 77% of projects in the first quarter of 2013.
    - The transition from digital video tape to tapeless workflows has led to heavy investments within both the TV and movie industry in training and knowledge management.

    In the same time, the growing off-shoring noticed on big budgets' feature films, on advertising films and on TV series conducted to important loss of profits for technical industries.
- **Games**
  - The European games industry is made up of more than 600 game studios in 12 European countries that employ over 17,000 game industry professionals. More specifically :
    - Only about half of European game developer studios focus solely on game development (48% games developing only, 34% games developing and publishing, 17% other.
    - Almost half of the game development studios have less than 10 employees : 46% less than 10, 44% between 10-50, 8% between 51-250, 3% more than 251
    - European game developers develop games across different platforms: 71% PC/MAC, 67%mobile, 50% web browser, 42% console.
    - CEO's of European game developer studios are still mostly male: only 9% are female.
    - Most CEO's of European game developer studios have graduated from a university: 74% post graduate university, 17% under graduate university, 9% secondary/high school.
  - The European game industry is a digital, cultural and innovation driver.
    - A digital driver: the video games market is the most dynamic entertainment market with a huge growth potential and a natural ability to overcome cultural and linguistic barriers.
    - A cultural driver: video games are played by young and old, male and female alike, and are now recognized as cultural driver
    - An innovation driver: video games engender new business models, create innovative content and germinate unique services that are driving groundbreaking technological discoveries leading the way for many other sectors
  - Traditional and established actors in the video games sector, publishers and developers are facing great difficulties or have simply disappeared. They are forced to adapt, understand and anticipate new uses and engage a wider public in sectors as diverse as B2B, health, transport, female and elderly populations and serious gaming. In 2012 -2013, 50 new companies were created as 'spin off's' of former companies.
  - The majority of games companies are facing the following major challenges and threats :
    - Major challenges: access to financial support (a lot of companies are under financed); access to technologies and possibly to get financial support for R&D projects; identification and consolidation of business models
    - Threats: international competition – the market for the video games industry is global, not European, and European companies are facing aggressive strategies from outside, for example from Canada, stimulated by local tax incentives, or from India and China where the low cost of human resources gives them a significant advantage.
  - Europe needs to find differentiators, such as building on the strong creativity associated with European companies.

[18] Dematerialisation - the increasing trend away from physical media - such as DVDs, CD – to streaming and downloading of digital media content – such as Netflix, Spotify etc…).

- **Production :**
  - The move to digital technologies in the content production industry gives the opportunity for these industries to develop and renew their business models around the new formats and techniques, such as 4k, UHD, previs/postvis, cinema/video game convergence, the development of co-creation techniques (e.g. involvement of spectators and audiences, crowd contribution, interactivity and immersion) and creation of metadata throughout the production workflow to allow new approaches to distribution and presentation and new consumer experiences.

- **Distribution:**
  - Digital technologies allow metadata and usage data to be exploited to diversify consumption models, the rise of big data allows new approaches to recommendation and personalization to be created, leading also to the optimization of advertising models.

II.2.3- Technologies trends

Will the offer drive the demand or will the demand drive the markets?

The success of a technology development depends on what (existing or future) needs or (existing or future) market it is addressing. Having a clear understanding of the needs of the market is fundamental.

Implications for the users and citizens

The success of a technology development will depend more and more on either its acceptance by the users / citizens or its 'transparency' (users want a service that works and do not care about its embedded technologies). Recent technology developments that have not sufficiently put the user in the centre of their development rapidly reach some acceptance limit, which becomes a business limit: the recent 3D developments are a good illustration. The success of such developments will depend also on the clarity of with which the needs it addresses are expressed.

A successful technology development could also be one which does not consist of developing new technology but on the assembly of a set of existing technologies - the smartphone concept is a good illustration of such a development.

It is therefore essential that the Horizon 2020 framework should allow industry to tackle those different aspects of innovation by allowing a system based approach, allowing experimentation, allowing pilots and by allowing the mixing of several scientific disciplines (such as neuroscience, design, …).

These are some of the challenges we face (not an exhaustive list):

- **Standards**
  - Support the widespread application of international standards (e.g. rights, DRM; hbbTV; FIMS, IMF; W3C, ePub3

- **Devices**
  - In mobility
  - New displays

  - Back to consumer

- **TV and movie industry** :
  - 3D Comfort & Acceptance
    - Visual comfort 3Ds : sine qua non of successful future acceptance
  - Development of TV Ultra-HD and 4K movie as the future of broadcasting
    - What are the similarities and differences between S3D and 4K? Is the decline of S3D market linked with the emergence of 4K?
    - Lack of content. How to produce TV content in 4K and be cost effective? In the Cinema market 4K and 2K are more or less at the same price.
    - Higher resolution is not the only challenge for 4K and TV UHD - other developments include wide color gamut, High Dynamic range and HFR…
    - There is a necessity to have ambitious R&D programmes that address these questions in Europe
  - Migration to new methods Making multi-channel sound
    - Stimulate the industry around the technological and economic challenges : accessibility to TV and movie content (Audio Description, subtitles ...)
  - Using and Managing Content and metadata in new file-based systems
    - Promote new tools and solution that facilitate the use of publishing metadata to create more interactivity between viewers and works.
    - Standardize metadata to help share and organize streamlining the exchange of content from production to distribution and archiving
    - Promote connectivity via Very High Speed Hub Media
    - Promote a unique ID for broadcasting content.
    - Promote European players, valuing the metadata associated with the audiovisual and cinema contents in order to maximise the value
    - Create ergonomic applications to help Directors, managers of production and postproduction in manufacturing and distribution of TV programmes and movies in order to increase productivity

II.2.4- Evolution of the business value chain

An incredible set of opportunities towards new services and new business….

The expected technology convergence failed somehow but the abundance of (digital) technologies create s a challenging environment in which to develop new usages and new services, where those new services and usages demand new technology development so as to create a cycle which operates at an accelerating pace.

Moreover, the digitalisation of ICT technologies creates new opportunities to spread them across sectors beyond ICT (e.g. eEnergy, eHealth, eTransport, …), opens new opportunities to make some traditional environments more connected (connected cars, connected home), and opens new ways to embed the citizens / users in these developments.

The phenomenon of users becoming also producers of content is not antithetical to traditional forms of market-mediated cultural and creative production but rather complementary to it, and it creates in particular a new socially embedded field of generation of new creative ideas. Open content platforms are directly linked to the level of active cultural participation and to capability building in the cultural and creative sphere.

Requesting global systems approach and coherencies

This abundance of opportunity and this transversality nevertheless force the development of a coherent system approach to ensure a secured world of billions of connected humans and trillions of connected devices, stressing the work that needs to be conducted on interoperability and standardization.

More specifically when speaking about content, they also force to develop and ensure coherencies between the content and the networks : what will be a network without content and without users and vice versa.

And asking relevant questions :

Will the business be more global ?

- How Amazon and Apple are transforming the value chain to value circles[19]

Will the business be more integrated ?

- The Connected Home : evolution towards more powerful, more open, more technological devices; evolution to IoT approaches
- The Connected Cars

What will be the new paradigms ?

- Will the consumer pay for access ? for the content ? for the good quality of content ?
- Will citizens will create their own content ?
- What will be the impact of crowd-funding ? of crowd-sourcing ?

A first example : the Connected TV

As per the conclusion and recommendation of the NEM connected TV position paper on Connected TV[20], Connected TV will have a great impact on European industry as well as to European citizens. Even though European industry is not a leading TV market, service providers could take advantage of such technology in order to offer advanced innovative services to users.
For that purpose, there is a need to continue investing in innovation with the objective to propose new forms of content and services, but also to influence the next generation of connected TV, to meet societal and commercial requirements.

Most of the future services will be in the cloud and Connected TV will be, as are web tablets and smart phones, one of the key interfaces. If Europe wants to position its industry on cloud-based technologies and architectures, we need to be able to develop services on these devices and as a consequence we need to master all the related technologies. For that purpose, the best way is to develop end-to-end services and test them on real user communities all over Europe.

Another key point is the openness of connected TV in order to allow a real competition between all the device suppliers avoiding reliance on a few vertical actors (Google TV, Apple TV, ..). This implies open standards or even regulation. Connected TV (and its components) are standardised in a number of places such as MPEG and ITU-T but the European Commission should consider enhancing the European profile in Connected TV related standardisation activities that play an instrumental role for the successful deployment of Connected TV services.

[19] http://www.henriverdier.com/2010/04/comment-amazon-et-apple-transforment.html
[20] http://nem-initiative.org/wp-content/uploads/2013/12/NEM-PP-015.pdf

Technical challenges that have to be addressed now

Since most of the Connected TV manufacturers and players are not in Europe, we need to focus our research on services to the end users. As said, we need to use such an environment to develop innovative services.

Connected TV should become a rich open platform, able to bring another wave of economic growth, delivering a multitude of new applications and services, for the young as well as for the ageing population of Europe and globally. The existing Connected TV standards groups and platforms (HbbTV, YouView, etc…) should achieve the goal of allowing content to be created once and then to be delivered to many connected TV platforms having underlying media formats and delivery mechanisms converging.

However, commercial models will continue to differ and a universal path to a single European content market seems a very long way off.

The growing populations of varying 'SMART TV' receivers that implement closed and vendor-specific solutions developed by major CE manufacturers together with rather closed and partly proprietary solutions such as Google TV and Apple TV are aiming at much more vertical markets and have the potential to change the scene in the European market.

To prevent the locking of users into the vertical silos of well-known brands, while fostering the development of a rich ecosystem of services that are independent of any particular brand or device, open platforms running adaptable services, that may require multiple devices to discover each other and cooperate, should be developed on the basis of open, royalty-free technologies and web standards.

So from a technical point of view we have to address the following challenges:

- User interface :
  - Navigation and ergonomics
  - remote controller (what should it be? voice recognition? brain computer interface? smart phone? web tablets?)
  - accessibility for all
- Multi-Cloud secured connectivity
- Immersiveness (3D, holographic ...)
- Interpersonal communication compliance (voice/video over IP – SIP)
- Aggregation of application stores
- Next HbbTV standard including HTML5 support
- Connected TV in any device
- Standardisation consistency

Societal challenges that have to be addressed now

All these innovative services and applications enabled by Connected TV platforms question industry players' strategies, and demand that legislators and regulators find the best way of integration of two worlds organized and regulated separately (Internet and TV). From a societal point of view, at least the following important issues have to be addressed:

- What positioning is needed for national or regional players (broadcaster and service providers, already subject to well defined regulation), facing competition with Internet giants (particularly OTT players) that operate globally, internationally and thus with less regulation?
- What kind of consumer protection is needed, especially for young people?

- How will Connected TV be able to continue to fund European content creation and cultural exception?
- How to guarantee transparency on audience accounting & measurement and recognized protocols for audience measurement verification by independent entities. New reinforced and multi-format audience measurement systems should be developed, able to accurately log not only consumption, but also interactivity through any device and channel.
- Privacy (including audience measurement, personal data management).
- Second screen content regulation.

A second example : big and open data

In its Open and Big data position paper[21], the NEM community is looking at the Technical challenges that have to be addressed now as well as identifying some key societal associated challenges.

Technical challenges that have to be addressed now

Information flows, often generated and collected in real time, are the foundation for new services concerning individual and social-wellbeing, safety, environment, green and integrated transport, resource efficiency and social inclusion. Most of the potential value generation out of big data is at risk without an efficient and trusted flow of heterogeneous data related to particular territories (Data Governance). In order to enable information flows, the "data infrastructure" must be open on the input side (data sources shall be added in a plug-and-play way) as well as on the output side (data shall be accessible through common interfaces).

Some challenges at the Data Management and Analytics Layer are the need for flexible and reliable data management and analytics infrastructure, HW/SW data management and analytics architectures/solutions that present the following characteristics:

- scalable, cost efficient, environmentally friendly and easy to manage multiple autonomous systems that support both structured and unstructured data;
- provide a mix of centralized in memory, distributed/parallel and device based analytics;
- include data bridges to construct common standards;
- data stream reasoning/management/storage;
- data cleaning, provenance and quality assessment and management;
- efficient search and retrieval;
- integrate real-time stream data mining and historical data mining;
- integrate analytics with data storage and data visualization.
- interactive and collaborative modeling and simulation of large and complex phenomena and systems;
- large scale social networks analysis;

Some challenges exist at the Data Access Layer**.** The following are some of the main (technological and non-technical) challenges here:

- Data ecosystem with Data Marketplace and new business models based on Open Data, Data vendors, Data customers;
- Data Visualization - new ways of presenting information - in order to make the knowledge derived from the data valuable and "actionable", new methods to explain and visualize the data, new tools will be required, supporting interactivity, filtering, personalization, …
- User controlled Privacy based on awareness, participation and control and clear policies to help to reduce the threshold for adapting new applications based on data sharing. Particular attention should be put on Accountability and Data Governance.

Analytics-oriented challenges need to be tackled urgently, since only they reward the efforts in collecting and storing the data. The known methods for data analysis require serious and demanding changes for their distributed, parallel and online processing of Big Data. Both batch (using primarily distributed and parallel data analysis) and real-time oriented systems (using primarily online processing on data streams) are needed.

Embedded analytics exploits the streams of data in real time under strict resource restrictions of computing capacity, storage, energy and communication bandwidth. This allows the harvesting of the value of data streams from services on mobile devices for logistics, traffic, medicine, production, and entertainment. The research to be

[21] http://nem-initiative.org/wp-content/uploads/2013/11/NEM-PP-016.pdf

done ranges from the infrastructure to analytics to visualization. Moreover, it should be extended to process control such that natural resources are saved and services are personalized and respect privacy.

This broad subject should be tailored into the application areas: logistics, traffic, medicine, production, and entertainment

Definition of the **European knowledge-based data architecture** between heterogeneous databases in a multiplayers environment.

- What is the place and role of the different actors ?
- How to implement distributed processing in an heterogeneous environment ?
- How to implement distributed calculations dealing with public and private databases ?
- How to ensure security, *End To End Quality of service* ?

Short/medium term :

- Raw data conversion into knowledge data
- Privacy insurance
- Open data APIs
- Distributed calculation in a shared infrastructure with third parties

Medium/long term :

- Semantic characterisation of data
- Qualification, traceability and certification of data
- Knowledge databases interconnection
- Ontology's alignment, semantic graphs

Societal challenges that have to be addressed now

Companies such as IBM, HP, Intel, Google, Netflix, Amazon and Facebook are harnessing online data (online searches, shopping behaviour, posts and messages and general usage patterns and user preferences) to increase their knowledge about their users and preferences (Kolb, 2013). Social science, however, lags behind commercial companies in utilizing Big Data to gain new insights into human behaviour and society (Brandtzæg, 2013), although Big Data tools and technologies for the mapping of behavioural patterns and human preferences across the globe, present opportunities to address grand societal challenges (Lohr, 2012). For example, user created content on Facebook offers social science and media researchers the potential for new forms of analysis, using large amounts of data on demographic patterns, rather than sample-based surveys of what people think they did or might do.

We recommend development of new and more accessible methods to analyze data as well as more open data that aims for high societal impact by providing industry and academics with improved capacities for applying Big Data in the social science domain, supporting scientific renewal.

Regarding privacy aspects, there is a huge need to develop tools suitable for any user (end users or organizations) to withdraw exhaustively any data stored in the cloud (data centers). We need to develop a tool able to analyse all content stored in any data center and to offer to the owner a "suppress" function.

Regarding Open data, several societal studies have to be set up in order to give a consistent environment. Open data should come from several sources such as public data, personal data and corporate data. These 3 sectors have to be studied in order to find commonalities and specificities from a social point of view. In addition these open data should be static data or real-time data, these two types of open data have specificities that have to be addressed. These actions should be :

- Intellectual property rights
- Identify where the value lies
- Use of big and open data as tools to preserve and improve democracy and security
- Raise the awareness of the value of data through education and excellence (privacy charters, best practices, audits, certification)
- Ensure a demonstrable value of cross sector or vertical uses of data based systems (services, operations, decision making)

In addition, it appears that Europe has a lack of data scientists and there is an urgent need to set up a recovery plan in order to help establish masters degrees in this domain.

II.3- Needs

Looking at the specific societal and technology trends that will influence needs and expectations of the European citizens and enterprises regarding NEM technologies we identified the following needs:

- **Innovation through creativity and collaboration**. One of the observable trends that will shape the European landscape is the change in labour force participation and growing vulnerabilities in the workplace. Creating new jobs in Europe is a prerequisite for wellbeing of the European population. Several sectors are forced to reinvent themselves. New technologies, ways of collaboration and business models might accelerate innovation and contribute to the creation of new jobs. Creative and content industries comprise many different types of organisations and enterprises, with a large majority of SMEs (e.g. in the sectors of design and architecture, and also in crafts, fashion, …) and some large businesses (mostly publishers and television companies). Their work is typically strongly localised and fragmented in their regional areas. This results in difficult and extremely costly access to international markets. Thus, it is of fundamental importance to create an opportunity to break down frontiers and encourage access to global markets via technological innovation and the creation of communities and clusters of international action. Technology that fosters efficiency in terms of cost and time saving in the creative production processes is highly necessary. Furthermore, it is essential to create synergies between the best international players in the various sectors, to support small businesses and industrial chain suppliers.

- **Experience driven development.** Several technology trends change our experience and expectations related to new and existing technologies. Access anytime, anywhere on any device remains to be expected from old and new services. Convergence of technologies and functionalities will remain a major trend in the digital landscape. Usage of persuasive technology for changing behaviour in health and wellbeing and motivating in education is expected to grow. Whereas all these trends offer the possibility for new and better businesses they also pose higher requirements on the delivered user experience. Instead of providing products and services that meet business requirements, businesses should provide long-term engaging experience that is better than solutions provided by their competitors. Designing such experience should be aligned with business strategy and values.

  It is worth noticing that the e-book market first took off when a satisfactory digital reading experience was enabled. The increasing sophistication and availability of reading devices and e-books, the growing penetration of the internet and uptake of technological devices by consumers have led to the development of a fast-growing market for digital publications. As readers access books on a plethora of devices (PCs, tablets, dedicated e-readers, smartphones), the supply chain is undergoing big transformations, with traditional players evolving and new players emerging and entering the scene.

- **New approaches to learning experience.** Improved access to education and new technologies that increase connectedness are considered as instruments of individual empowerment. Availability of new technologies in the classroom, Internet and Massive Open Online Courses (MOOC) change the educational practices in directions that are still to be properly assessed. These changes include new ways of interaction among students and teachers, new ways to access educational material, and organise needed resources. These new approaches could potentially enable not only widening access to education but also providing education of better quality – education that could adapt to individuals' needs, preferences and abilities.
  There is a need to assess the effectiveness of ICT learning solutions and provide adequate means to adopt such solutions (from broadband deployment to digitally-equipped classrooms, to high quality digital learning materials) –at the same time paying attention to issues such as interoperability.

- **Universal and inclusive design.** A growing and aging population in Europe on one side, and penetration of NEM technologies in all aspects of our lives from voting at the elections, communicating with our family members, banking, and healthcare, on the other side, means that everybody must have access to technology enabled services. There is an increasing need to enhance inclusion for example through increasing accessibility: people with disabilities should be enabled to enjoy digital content at the best level possible and therefore accessibility should be built

into the supply chain of products and services offered by content and creative industries e.g., digital cultural products.

- **New media and communication professionals.** Changes in the media landscape, new technologies as well as demographic trends such as the foreseen rise of the global middle class give plenty of business opportunities and possibilities for the traditional media business to enter the new era. However, they need media professionals that have both new skills and good understanding of the traditional media business and can help this process. These new competences should be in:
    - New Business/project management
    - Social Media Development and Integration
    - Interactive/Cross Platform Storytelling
    - Crowd-funding and Participatory project development
    - Legal and copyright issues
    - Digital marketing
    - Analytics and consumer support
- **Archive and Preservation.** The emergence of new formats, new applications, new creative processes, user contribution, interactive productions and inclusion of social media into the whole creative content space, including text-based publication, design and art as well as traditional audio-visual productions will demand new approaches to the challenge of archiving and preserving that content and the processes by which it was created. This ongoing challenge needs to be addressed by a new generation of archive professionals familiar with the creative technologies and knowledgeable of the needs and approaches for successful, useable and exploitable archives, supported by the digital tools and techniques that will ensure the preservation of archived digital content over future decades.

The digital revolution has had (and keeps having) a large impact on the cultural and creative industries. Its effects are especially obvious with regard to the ways they reach out to end users, but this is not the only area affected. The switch to digital has also impacted the supply chains, with the emergence of new players and a strong push towards the integration and convergence of media and the transformation of productive processes all along the value chain.

On the other hand, creative and cultural content has been and still is a most powerful driver for the development and adoption of technology and devices in this segment, which explains its attractiveness for many operators from different sectors.

The digital world presents many opportunities for the creative and cultural industries. It does, nonetheless, create also a series of new challenges at the same time as technology can offer solutions to address many of such challenges. When it all comes together, ICT provides opportunities to explore new markets and distribution channels, meet the needs of users in innovative ways, offer innovative products and enhance productive processes; the challenges relate basically to maintaining the viability of business models in a changing environment, as well as to adapting to a series of new circumstances.

Therefore the needs of CCIs in the digital world relate to the possibility to harness the potential of ICT, including via access to R&D, both to take the opportunities and to address the challenges.

This list of the needs of the European citizens and businesses is by no means complete. However, we believe that research, innovation and education enabling European businesses should: i) join their innovation forces and access global markets, ii) deliver superior experience aligned with business strategies and values, iii) improve access to education, iv) enhance accessibility of products and services offered by content and creative industries, and v) offer needed competences that would accelerate innovation in the content and creative sectors. Entertainment, education, health and tourism are some of the sectors that might benefit also from this innovation.

III- Foreseen innovations

III.1- Content creation

III.1.1 Overview & Context

The Creative and Cultural Industries have been and will continue to be revolutionised by the impact and application of digital technologies. These have made possible the development and implementation of exciting new forms of digital content and services, enhancing existing ones and bringing new immersive and interactive experiences to consumers; opening up new opportunities for growth and economic benefit along the entire value chain. The pace of change and the increasing demands of digital consumers show no signs of abating.

What really drives innovation (or new behaviour) in creative media? Let's assume that, rather than the Creative Community having new tools and technology that they use to 'invent' new forms of content to push to the consumers, the consumers have new ways of consuming content, and start to demand new content to meet their expectations. Does this change the way we look at the impact of technology on the creative industries? Instead of thinking what can be done to change the art of story-telling using different technology, maybe we should start from the other end, and think about how people want to consume (or get benefit from) the content that is created, find ways to deliver that content and find ways to present the content. We might then think about the technologies getting into the home rather than new production technologies. Ultimately, how users consume and interact with digital media content and services will strongly influence how that content is produced and the development of the appropriate technologies, systems and tools needed for production.

So, what has been happening to the consumption and use of content? Home displays have been getting bigger and bigger, with higher and higher resolutions, driving the visual quality of produced content. Televisions have become 'connected' to the internet, allowing the provision of downloaded additional material (as opposed to 'red button' material), other devices with A/V interfaces have appeared – phones and tablets being the obvious ones (there is a difference between a lap-top and a tablet in the way people are using them, which is interesting in itself). The means for producing images and videos on affordable hand-held mobile devices, with editing features built in have become ubiquitous. These devices often now have the facility to share the resulting videos and content via social media, as a means of communicating and sharing pictures, opinions, links, recommendations, thoughts and feelings.

However, there is strong evidence that ordinary people, consumers of content, still want to have professionally produced, linear storytelling available, alongside new forms of interactive non-linear content. Often they still want, and need, some form of curation of the information and news they have access to, so professional content design and creation is still and will remain very important, as well as the means to deliver the same content to large audiences via broadcast-type media for important cultural and national events.

So, what is happening technically that is impacting the lives of consumers, and how is it changing their expectation of the creative content they have access to? It would appear to be contained within three aspects of life – access to content, communication between peers and immersion & interaction.

- Access to content – this can cover all aspects of content consumption. Very few people use data sources directly, but they use Wikipedia and Google to find edited versions of available data, but on-line sources of information are very important. On-line programme guides are becoming more popular than the guides incorporated into digital receivers. A significant and growing proportion of audio-visual consumption is conducted over the internet. People are becoming selective over what they watch, where and how. The large screen at home may be used for sports and large-scale dramas or documentaries, but portable tablets are used for serial content, news and catch-up. Most content consumption in the bedroom is via tablets rather than television displays. And the same tablets can be used to read a book as to watch A/V content. Increasingly, visual displays of all types are becoming windows onto the world – they differ in size and resolution, but to the consumer they all perform the same function of providing visually delivered content. There is an expectation that the internet is "always on" – it is more common to hear complaints that "there's no internet coverage" than surprise that a network is available. The ubiquity of touch screens has broken the reliance of internet users on keyboard entry, and changed attitudes towards accessing and interacting with content. As such, content and the vital metadata needed to facilitate access and reformatting will need to be produced in a fully integrated way that supports these different modes of consumption.

- Communication between peers – mobile telephony and internet has revolutionised the way that people communicate amongst themselves. It has introduced the "always on, always accessible" concept, whereby users can call and communicate with their friends whenever they have something they want to say or share with them. Emails will give way to texts, Viber, Skype, Facebook, WhatsApp and other 'instant messaging' services. The most convenient communication tool will be used for the occasion, by which is meant the tool that does the job, not the only one available.
- Interaction and Immersion – not just communication or passive observation, but a sense of being engaged with and immersed in an activity or event. Interaction implies some level of control over the process, whether that is by choosing which viewpoint to take in a football match, voting for contestants in a show or interrogating a politician in a televised debate. Of course this works both ways, and viewers can become both participants and targets in the production, which especially applies to advertising, but could also apply to information gathering in the form of crowd statistics.

This digital revolution affects the entire end-to-end value chain, from the creation of the content and media, onwards through its delivery and distribution, finally to consumption by the end-user. To ensure a reliable, robust and compelling experience for the consumer, there needs to be a holistic approach that considers the entire end-to-end chain, with open-standards for the systems and interfaces to guarantee interoperability and compatibility along the chain. This coherent joined up approach needs to cover not just the core media essence, but also the vital supporting metadata that needs to be created and cascaded along the chain so as to fully enable the potential for a personalised, immersive and interactive media experience. All of this presents many new challenges and significant issues that need to be addressed in order to provide coherent and interoperable technology solutions that deliver a truly holistic approach to the entire value chain; and that starts with content creation. Decisions made at the creation stage must be enabling and compatible with the delivery of the content and services along the entire delivery chain through to the user.

III.1.2 Creation of Audio/Visual Content

We live in a world, where there is an increasing range of platforms for the delivery of digital media content and data, as well as growing diversity of target devices and modes of consumption. Digital consumers expect to be able get their content and services, seamlessly, anytime, anywhere, and on any device (ATAWAD) that they choose. This rapidly growing and changing environment includes everything from increasingly large display in the home, with 50 – 60 inch screen size becoming the norm for use in the home and even larger becoming available; all the way to portable small screen personal devices such as tablets and mobile phones, with ever more quality and resolution. Meanwhile we are starting to see the early emergence of wearable technologies such as Google Glass and Oculus Rift, all of which will present exciting new opportunities for the provision and consumption of digital media content, but at the same time will require new types of enhanced, interactive and immersive content to fuel this demand.
Consumers are demanding increasingly immersive and interactive content. They want a more engaging audio-visual experience that is ever more "like being there". With the availability of large display screens, higher quality, ultra-high definition (UHD) video content is becoming more of a reality – *not just more* pixels for greater spatial resolution, but *better* pixels with higher frame rates for better temporal resolution and motion portrayal, more realistic colorimetry and enhanced dynamic range to allow brighter higher contrast images. The recent foray of the content production and consumer electronics industries to promote 3D has, in the domestic environment, largely proved unsuccessful due to the need for users to wear special glasses to see the 3D effect. However, once UHDTV is established, it is likely that demand will grow for UHD 3D. If in the future this is to be successful and adopted by consumers for use in the domestic environment, then it will need to: work without any form of glasses; be viewable simultaneously by a number of viewers; and be accommodated in domestic rooms. It is possible that new display devices will emerge that change the scene completely – the most obvious possibilities are "wave-front" displays that deliver true 3D images in space, and large organic "wallpaper" displays, flexible and large that can be used to cover a wall with an interactive display. The latter may appear within 10 years, but it is very unlikely that the former will arrive any time soon, since it has implications for content production, processing and delivery that will take many years to develop and then introduce as systems that operate at a practical level from content creation through to consumption.
In the short to medium term, the main technical developments will be incremental – higher resolution displays, more complex graphics, higher dynamic range, wider colour gamut, faster networks, higher bandwidth, greater access and connectivity, more robust wireless and mobile services, increasingly

sophisticated apps for tablets and phones, greater penetration of touch-screens in all devices and a move away from keyboard/mouse interaction towards voice, touch and gesture.
One of the big challenges this will present the creative industries with, is how these new forms of content are created, cost-effectively, in ways that that can be delivered simultaneously via a variety of platforms and consumed on a range of user-devices. To fulfil the ATAWAD vision for consumers, this needs to be achievable without costly separate versioning for each different platform / user-device. Research and innovation is required to develop the underlying content formats, systems and tools that will enable this vision. New forms of content based on media objects, for both video and audio, where it is elements of the image or sound field that are coded individually and delivered to the consumers' devices and then combined with other objects in the user device for presentation, are likely to form the solution. Rather than coding the whole image, or sound signal as a whole, by decomposing it to objects, which can be delivered individually and then recombined in the user device, enhanced flexibility should be provided to process and manipulate the objects to provide presentations and renditions that are optimised for different types of user device (large screen, small screen mobile and tablet devices, full multichannel surround sound systems or personalised headphone listening etc…).
Object-based media may already be the key to providing a more personalised experience. Devices and systems that are aware of the context of the user (where they are, the type of device they are using, their individual preferences or personal needs based on accessibility criteria, etc…) can all be used to deliver a more personalised and hence, more engaging and immersive experience to the consumer. Again with the potential to process and manipulate the content at the elemental level new forms of object-based content can help facilitate these personalised experiences.
Whilst linear content will remain important for the foreseeable future, with consumers often still wanting to be entertained or informed in a "more passive" way, there undoubtedly will be growing demand and opportunities for digital media to provide a more interactive and engaging experience for consumers through new forms of non-linear content. New ways of curating and telling stories or providing information that allow users to take their own personalised journey through the content, exploring as they go down different paths. This will be true both for audio-visual media and gaming as well as more textual/graphic forms of content. Producing such non-linear content and story-telling will require significant paradigm shifts in how that content is conceived and produced, so that the end result is a satisfying and coherent experience for the consumer, that makes sense whatever path is taken. This will require innovative new formats and tools that enable the Creative Industries to more easily produce this exciting novel content in ways that are self-consistent.
Clearly the Games Industry has already started to address some aspects of these challenges, producing games which allow players to take multiple paths through the game. Typically, however, games creation requires considerable investment in resources, which would not generally be available or cost effective for other forms of media. If audio-visual and interactive content are to exploit the exciting creative and innovative opportunities of non-linear media formats, then significant investment in research and innovation will be required to develop the creative tools and systems that will allow relatively simple, efficient and cost-effective production of content for personalised non-linear curation and storytelling.
With the obvious pressures to produce increasing volumes of media content that is flexible, immersive and interactive, this has to be balanced against the demand to do so cost-effectively. New forms of content capture technologies could bring clear benefits. For audio visual content, production arrays of IoT IP-networked cameras and microphones would be able capture multiple views (video and audio) of a scene as the basic raw data and with appropriate production processing to code the information as media objects that can be used to re-render new views and perspectives that can be sent as 'atomised' content to users' devices to meet their requirements of personalisation and/or automatic repurposing on different types of device. Object-based media, where content is created from 'atomised' elements of media objects – video and audio - can be combined to:

- Provide different editorial cuts of content and services.
- Deliver content simultaneously to a wide range of end-user devices, optimising the user experience for the particular device they are using.
- Enable richer personalised experiences.

This future production environment represents the vision of the IP Studio at the start of what inevitably will become an IP-based end-to-end chain from content creation to consumption. There is also the opportunity for the Cloud to provide the infrastructure, not only hosting the production capture and post-production processing of the raw media content, but also to serve as the repository from where consumers access their content directly – perhaps with the cloud performing the necessary reformatting needed to deliver to a user's specific target device – as well as forming a scalable archive to meet the growing storage demands of the

Creative Industries. New tools and standards resulting from research and innovation activities, that address the many challenges arising from content creation to consumption, in a holistic and self-consistent way, will be required to fulfil this vision.
Of course, content creation is already no longer and certainly will not be in the future, the preserve of professional creative content producers. With the advent of increasingly low-cost, but high specification consumer equipment (for example, with the introduction of 4K ultra-high definition video services still at a very early stage, it is already possible to buy 4K consumer cameras and displays and 4K capable mobiles are imminent), the rise of the "pro-sumer" and high quality user-generated immersive content is and will be a reality. Couple this with the rise of social media and networks and the ever growing desire of digital citizens to share their experiences and creativity, means that systems and tools that allow them to achieve this will be vital and worthy of further development. Especially so if the boundaries between the "professional" and "consumer" are to blur and dissolve even more in the future, as seems likely.
Meanwhile, thanks to the development of the Internet of Things, more of our devices will become aware of their context and their owners, acting as sensors with the potential to capture new forms of content, that might be shared with others or allow media content and service providers to personalise media services offered to users which reflect their current context (location, current user device / mode of consumption, mood, etc…) and learns about their preferences to provide a "digital concierge" service and media experience. Such opportunities can only be fully exploited if we are able to produce flexible forms of media content and associated metadata that will allow dynamic repurposing and presentation to reflect users' current individual circumstances. Research will be needed to produce the production tools and systems that enable this, as well as tackle the issues of privacy, security and trust to safeguard users against misuse of their personal data generated by their IoT devices.
Social media is already very popular and forms a new way for citizens to express themselves, share experiences and content, or re-purpose (mash-up) media content created by others. With the amount of content available on the internet and within social networks, we need new tools that help people to search and find the richest material that is of interest and of value to them. This is also true for Creative Industries media professionals who will want to explore what is happening within the Internet and relate it to the content and services that they provide. For example, tools and methodologies for argumentation & argument mining in social debates and networks on the Web would help professional journalists to explore and develop different perspectives more efficiently, by automatically sifting through the extensive amount of content and information on the Web when a news event breaks and is trending. Equally, such tools could help ordinary citizens to discover new information and media by mining the vast amount of material, automatically establishing the links between information, data and content and visualising the links, to give a better overall picture of the relationships and interdependencies, as well as facilitating access to that digital content.

In order to achieve this vision for the production of future digital content and services, core research activities in the following areas will be required:

- Immersive Content formats for both video (UHD and 3D) and audio.
- IP-based studios and content capture.
- Object-based media formats, systems and tools so that raw content can be easily captured once and repurposed many to give different versions/perspectives. These will facilitate the production of personalised content that meets the requirements of individual users' preferences, range of user devices and other user contexts.
- Research into the use and relevance of new forms of wearable devices.
- Personalisation - user and device context aware content and supporting metadata
- Systems and tools for new storytelling paradigms.
- IoT – applied to the capture of user-generated content – the prosumer and social networks and in the profession environment of object-based media

III.1.3 Digital Cinema

Cinematography has already widely embraced the adoption of digital media and technologies for the production and distribution of movies. This has enabled great advances in the production of contented aimed at the big-screen cinema experience. We are all familiar with the immersive and engaging experiences of 3D and other visual special effects, only made possible by computer-generated imagery. However, digital content originally produced for the cinema, increasingly is finding itself being delivered and consumed in the home and on mobile devices in a range of contexts, and needs to be produced or

reformatted with these secondary markets in mind. Therefore, many of the challenges facing the audio-visual worlds of television and broadcasting are common and also relevant to digital cinema.
Despite the introduction of innovative digital technologies, devices and processes to cinematography, modern film productions often still use the old-fashioned workflows from the era of film production. This is due to the lack of coherent content management structures and processing of all data generated during media production – handing the content essence and any associated metadata. Different production departments tend to work independently, and are only loosely connected to each other. For example "metadata" may still be captured on set by the crew taking personal notes on papers and pictures in order to have the correct and needed information. Producers need to have clear and transparent data throughout the production process, dailies need to be accessible at the end of the day for the correct view and check, VFX, sound, .etc.... This can lead to inefficiencies in the production process that cost time, effort and ultimately money. What is needed are integrated and interoperable systems, tools and joined up work-flows along the entire production chain – from initial capture to final cut and distribution – that allow those needing to work on the content and metadata to be able to do using modern digital tools and devices along the chain. Better and more extensive use of Cloud infrastructure, as a scalable and flexible production environment, may facilitate this. But with the integrity and security of valuable media assets at stake, there will be a need to investigate and innovate addressing important issues such as security, and ease of access to the content as it progresses along the value chain. Tackling such issues, via IP-based production environments could put Europe at the forefront of D-Cinema and A/V production.

Specific issues that need to be investigated include:

- Production and post-processing in the Cloud looking at infrastructure, accessibility, security and reliability, aimed at gaining the trust of the industry.
- New formats and transcoding for a secure and fast exchange of content and data without degradation of quality.
- New formats that provide novel immersive user experiences.
- Professional tools and applications aimed at the digital cinema and audio-visual production industry sectors.
- Ways of processing and analysing content data at all stages of the value chain - pre-production, production and post-production stages, including systems and tools for searching for, storing and accessing digital audio-visual content.
- Secure and practical IP Rights Management systems and protocols applicable along the entire content/data value chain.

III.1.4 Publishing, Books and Text-based Digital Media

Audio/Visual content, whilst a major form of digital content and media in the connected digital world, is not the only one. Today, books and publishing represent another significant form of electronic digital media. This is a medium for which the digital revolution is opening up a vast array of exciting new and innovative opportunities, but if it is to fully exploit and benefit from these opportunities it must face similar forms of challenges and issues as are faced in the Audio/Visual world. For example being able to supply the same content to a range of e-reader and tablet user devices; new forms of interactive storytelling, embedding audio-visual assets within a largely text based medium, etc…
Digital technologies were introduced very early in the production processes of book publishing and they are now present in every stage of book production, from creation to consumption. The final step was completed relatively recently, driven by technological progress that made it possible to offer a good reading experience in digital, as well as by demand and adoption of digital solutions. With ICT now present all along the book value chain, the stakes are high for publishers to enhance their processes and to meet the requirements of readers, while developing innovative business models.
Innovation in content creation is therefore expected to bring about progress all along the book supply chain, allowing the creation of innovative products but also enabling further improvements in every stage of creation and production. Technology, which is embedded everywhere already, from writing to editing, from typesetting

to printing, will increase efficiency and reduce costs. Semantic technology will become very important in organising, distributing and discovering content.
At the very earliest stage in the digital value chain, content creation will increasingly be performed with digital use-cases in mind. Further along the chain, technology will facilitate handling different formats, producing for different platforms and distribution channels; interoperability will reduce costs in addressing this multiplicity of demands. Accessibility features will be increasingly embedded in digital books and other cultural products. At the end-user, e-book content will be more and more enhanced through the convergence of media (music, video, gaming, etc.) and more and more interactive (a lot of potential will be exploited for example with educational books, children's books, travel guides, etc.). Storytelling will continuously innovate and evolve through technology, providing in particular a more and more immersive experience, but the role of quality will be maintained.

Specific research topics required, include:

- Development of new non-linear story telling tools.
- Interaction and convergence – the integration of text and A/V media.
- Accessible forms of media.
- eLearning services : including MOOC and serious gaming

III.2- Content personalization & recommendation

This section identifies key areas in which technological development is shaping the main challenges and opportunities for the domain of personalization and recommendation, covering in particular the areas of convergence and the Internet of Everything:

Convergence: new platforms and services need to deliver content across a range of devices and environments providing *"access to content on any device, anywhere, anytime"*. Convergence of technologies and functionalities, developments in wiring and materials carrying digital information will remain one of the major trends. Similar to this is hybridization of two or more technologies or media, such as Internet TV, portable video, or mobile messaging, creating new possibilities to modify and extend media in new ways. Managing interoperability, ensuring security and privacy while engaging consumers actively, allowing them to move their data and profiles across platforms (for instance, moving profile between Netflix and LOVEFiLM) will be some of main challenges.

Internet of Everything (billions of end points) and **Big Data** technologies are quite mature and able to manage and transport, analyze and exploit huge amounts of data for personalization, including security and privacy in all situations. Big Data is all about capturing the value out of big and raw data for personalization while preserving privacy.

European innovation actions should foster content personalization through exploitation of location, interest, contextualization and social interaction while

- being in advance on user acceptability
- being in advance on security, privacy and personal data protection
- ensuring that digital innovation preserves our way of life and our environment (greener, safer)
- ensuring new, fair and respectful business models.

III.2.1- Personal data, privacy

The growth in volume and type of personal data, the growth in devices producing them (mobiles, cameras, bio-sensors) and the growth in user generated content are some of the main challenges and opportunities in the digital media marketplace.
Big Data technologies provide enablers for storing and managing enormous volume of data but they also provide the means to improve search & discovery, data mining, audience targeting and consumer profiling.
Privacy is a big issue and may become an even bigger issue as time passes. There is strong need to address privacy concerns while still gaining value from analysing data coming from industrial, private and

open data sources. Definition of “data usage licenses”, not only for “open data”, but also for other types of data could provide a way to better user acceptance. It is important to find the right balance between personal privacy and exploitation of personal data, by allowing people to have an active role in the life-cycle of data produced or delivered by them or about them, as suggested by World Economic Forum’ project “Rethinking Personal Data”. Individuals should have an active role both in data production (e.g., personal data voluntarily provided), data control (e.g., privacy, conditions in data usage and sharing), and in the usage of data-enabled applications. It is also important to enable any actors (including individuals or other entities acting on behalf of them) to develop data-driven applications, according to their wills and needs. The active involvement of individuals in the ecosystem could be a basis for a new approach to the management and exploitation of personal data. Enabling such involvement requires simple and user friendly private data management systems. Such systems should be designed under user terms and extensively validated with different user groups across Europe.
Understanding how to mash-up data assets coming from different domains is very important because this could require the moving of personal data assets across different administrative domains.
A *Globally Competitive Framework* for data privacy and data ownership should be a framework where individuals are actors in the personal data ecosystem, where they play an active role in the control and in the exploitation of their data. This kind of framework could offer new business opportunities and approaches to personal data exploitation. It is important to analyze the business models also from the point of view of individuals in order to achieve better user acceptance. In order to foster data-driven innovation the regulatory framework should enable a balance between personal data protection and personal data exploitation.
Personal cloud and privacy-preserving mechanisms (e.g., data anonymisation, pseudonymisation, privacy-by-design) are some of the research topic and innovation challenges to be addressed.

III.2.2- Emotional monitoring, user behaviour

New ways of ***user engagement*** are emerging thanks to ***emotional monitoring***, targeting content based on emotional metrics using also facial imaging software analysing human non-verbal signals in order to catch emotional responses.

New ways of interacting with technology such as ‘texting by thinking’ can also be considered, that can be achieved by a combination of eye-tracking technology and a sensor-mounted headset worn by the user. Similarly, there are new interfaces and interaction types emerging, such as 3D interfaces, holographic, and line of sight cameras; including virtual and augmented reality.

Intelligent, interactive, natural user interfaces for accessing content include the following key technologies and research topics:

- AudioVisual search - new ways for crowd sourcing, social network contribution, etc;
- Natural interaction including brain computer Interface, gesture, dialog;
- Natural Human Machine interaction & Value added contents - Augmented reality experience on advanced devices (glasses, windscreen, TV, mobile, 3D/holographic content and displays);
- Intelligent interface “concierge” services incorporating social awareness, geography, social media, personal preference and user behaviour and knowledge;
- Real-time translation - Multilinguality, language agnostic systems and interfaces
- Tele-Immersive digital environments providing new ways to access and combine content;
- Immersive technologies - Immersive communication
- Shared (collaborative) media experiences and integration with social media.

Innovative creative experience tools to accelerate the creative design process and to stimulate human creativity in different design domains using content for inspiration in the creative phase.

- Dissemination of augmented reality in various sectors such as Industry, Tourism, Health could be a way to foster innovative and creative experiences.
- Gamification and crowdsourcing could be a way to foster creativity processes and culture as a game;
- Adaptive and personalised storytelling - collective memory and heritage built on-the-fly combining different content formats;
- Learning to Culture and Creativity- fostering culture and learning as fundamental assets of the user experience.

III.2.3- Big & Open Data

Data management and data analysis technologies (Big Data) provide technical enablers for new personalized ways to retrieve and suggest "the right" content, analyse and target audiences, describe and even predict consumer behaviour and expectations. Big data technologies are also used in the creative industry space and domains such as entertainment, game, education, book publishing. There is a particular need for solutions to efficiently collect, analyse and manage huge amounts of data in order to build contextual user data profiles (**User Data Challenge**).

Data governance, inter-sectorial data, data brokering, access to data for anyone according to authorization, accountability and tools for accessing and summarizing large and heterogeneous data collections are going to be a fundamental User Data Challenge. The following are some of the topics in the huge domain of Big & Open Data (see NEM Positon Paper for the complete NEM position) that need to be particularly studied:

- Semantic Web technology, semantic data analysis (learning, data analytics, data mining) making big data smart; usage of metadata to track the movement of content;
- Data storage and transfer infrastructures e.g. cloud computing and its application to data analysis;
- Data architecture for semantic search in large data bases and crowd sourcing solutions for search.

III.2.4- User personalisation and individual experience

Delivering service and content recommendations for customer segments is no longer enough. What we need is targeting a single user. Developing solutions for offering accurately targeted recommendation and increased personal data privacy requirements (**Personalization Challenge**) are well known research and innovation topics that still need to be studied. Users - used to interactive experiences – demand real-time relevancy that is tailored to their device of choice and individual situation/context. Contextualization should take personalization a step further by adding situational, predictive, and real-time elements to existing personalization.

New models of predictive applications analysing big data in near real-time and optimization of advertising models (personalized advertising recommendations - eg Netflix) are necessary in order to provide the right functionality and right content for the right person at the right moment adapted to their device.

Personalization of multi-screen services and content should be provided without compromising privacy. Delivering content simultaneously to a wide range of end-user devices, optimising the user experience for the particular device they are using, and enabling richer personalised and individual experiences are going to be the main challenges here. A world of ***individual experience, intensified personal control and social media innovation,*** harnessing and standardizing the social media as the new pathway to personalized content, will be strongly ***required and present in the new digital media value chain.***

Research topics necessary to be studied (SRIA)

Personal data, privacy

- The growth in volume and type of personal data and user generated content

- Private personal data and choice of consumer protection including visualization of 'who is using my data and why'
- Growth in volume and types of personal data and devices producing them (mobiles, cameras, bio-sensors)

Emotional monitoring, user behaviour

- New interfaces and interaction, such as 3D interfaces, holographic, and line of sight cameras.
- Natural interactions - Natural interaction including Brain Computer Interface, gesture, dialog
- New ways of engaging the consumer (emotional monitoring) and targeting content based on emotional metrics.
- User interaction and engagement
- Content on the move
- Shared (collaborative) media experiences
- Integration with social media
- Natural and interactive interfaces
- Immersive technologies - Immersive communication
- New ways of interacting with technology such as 'Texting by thinking'
- Increased use of decision making systems (smart systems)
- Persuasive technologies. Playfulness and competition added to social-web, social-TV applications are expected to have larger roles in driving behaviours, connections and discovery
- Intelligent user (natural) interface for accessing content - Audiovisual search (new ways for crowd sourcing, social network contribution, etc)
- Natural Human Machine interaction & Value added contents - Augmented reality experience on advanced devices (glasses, windscreen, TV, mobile, 3D/holographic content and displays)
- Gamification - Gamification and crowdsourcing (Creativity process and Culture as a game)
- Innovative creative experience tools to accelerate the creative design process and to stimulate human creativity in different design domains (Using content for inspiration in the creative phase)
- Longitudinal studies of user experience and technology acceptance as a source for innovation
- Social data crawling and analysis: analyse user behaviour to discover market trends
- Learning to Culture and creativity (Culture and Learning as fundamental assets of the user experience)
- Deliver content simultaneously to a wide range of end-user devices, optimising the user experience for the particular device they are using.
- Enabling richer personalised experiences.
- Facial imaging software to analyze human non-verbal signals (emotional responses)
- Augmented reality experience and advanced devices (google glass, wind screen, TV, mobile, …) for dissemination of augmented reality in industries such as Tourism and Health
- Real-time translation - Multilinguality, language agnostic systems and interfaces
- Intelligent interface "concierge" services incorporating social awareness, geography, social media, personal preference and knowledge
- Tele-Immersive digital environment (New ways to access and combine content)
- New interactive interfaces (including virtual and augmented reality)

Open&Big Data

Technologies to enhance the opportunities provided by data management and data analysis technologies in order to retrieve and suggest "the right" content, and to analyses and understand audience and consumers:

- Semantic web technology, especially around learning and data analytics, modelling user behaviour, experiences and processes
- Data transfer infrastructures e.g. Cloud computing and its application to data analysis.

- Modelling user behaviour, experience and processes.
- Standardisation and automation for shunting high volume data for the film industry.
- Using metadata to track the movement of content.
- Storage, analytics, security/privacy
- User profile modelling and Recommendations
- data anonymisation, data storage/personal cloud, security/privacy/access control, data brokering, semantic data analysis, data architecture for semantic search in large data bases, accountability, data governance and inter-sectorial data
- Access to data for anyone
- Innovative business models for big and open data
- making data smart and personal
- Obtaining information out of big data
- Technologies that enables 'me' private, secure, personal opting out in Big Data explosion
- improve search & discovery, information mining, audience/consumer experience, privacy and security
- Big data and its use in the creative space (knowledge/education/entertainment/game)
- Fast processing of big raw data for business analytics
- Crowd sourcing solutions for search
- Develop solutions for offering accurately targeted recommendation and increased personal data privacy (personalization challenge)
- Means of editing and summarizing large & heterogeneous data collections (imaging science)
- Conceive solutions to efficiently collect, analyse and manage huge amounts of data to build contextual user data profiles (user data challenge)
- Open data brokering tool

User personalisation and individual experience

- Ad hoc themes : "here" and "now", authoring
- Social innovation : accessibility from the ? within the content + service production process -> personalization (cross devices)
- harnessing and standardizing the power of social media as the new pathway to content
- Towards a digital life (adapted content – terminal, location, situation; privacy)
- optimization of advertising models leading to personalized advertising recommendations (eg Netflix)
- Personalization of content without compromising privacy
- Multi-screen service, individualization/personalization of services
- Adaptive and personalised Storytelling (memory and collective heritage built on the fly combining different content format)
- Contextualization to take personalization a step further by adding situation, predictive, and real-time elements to existing tenets of personalization..
- Delivering service and content recommendations for customer segments is no longer enough. Users --used to interactive experiences -- demand real-time relevancy that is tailored to their device of choice and individual situation / context.
- Right functionality, content for the right persona at the right moment adapted to device
- No longer targeting a niche, or segment
- New model of predictive applications analyzing big data in near real-time
- Digital disruption taken to the extreme : a world of individual experience and intensified personal control.

TO DO - European action

- Being in advance on user acceptability
- Ensure Security/privacy

- Ensure digital innovation preserving our way of life and our environment (greener, safer) and respectful business model

III.3- Content processing

This chapter describes the vision expressed by NEM members regarding the future of content processing. Content processing covers all techniques which are used to adapt, to manipulate, to aggregate, to enrich, any content having the objective to be forwarded to the end users.

III.3.1- Storage, cloud

It is expected that images and video will account for more than 75% of traffic over the internet, entailing an ever growing and enabling role for cloud based visualization systems. The development of new technologies and business models allowing remote processing, consumption, storage and sharing of high quality (e.g. UHD) visual content in real time remain high on the priority list, including e.g. the exploration of novel cloud distribution architectures or GPU-based video processing pipelines enabling ultra-low latency remote processing.

One of the key functions is the storage of the content in end devices, but also more and more in the cloud. Looking at what has happened in computing devices, it is remarkable to observe how fast tablets have become the most popular computing devices, displacing desktops and then laptops in record time. But this is more than just an interesting factoid, it is a key portent of the future. Why? Well, tablets are inherently wireless devices – no Ethernet port here, and as such require high capacity wireless connectivity, and also require continuous, 'ubiquitous' access to the Cloud because they have limited processing and storage power due their size, weight and cost constraints. And lastly, tablets are both consumer and now increasingly Enterprise devices with the BYOD phenomenon. So, tablets almost single-handedly drive the need for UBB wireless networks, to connect to the Cloud, anywhere, anytime, at home, at work, or anywhere in between.

Behind cloud storage, we can find obviously the big data paradigm which is key to optimizing huge data management. NEM has already developed a position paper on this topic as a contribution to the big data PPP definition.

It is highly strategic for the European industry and for European citizens that a strong European cloud storage solution is set up in order to keep control of content produced in Europe. That is true for user generated content as well as for professional content.

For that purpose, there is still a need to define standardised APIs in order to help development of apps by third parties.

Research topics necessary to be studied (SRIA)

- Data transfer infrastructure (e.g. cloud computing and its application to data analysis)
- Archiving and preservation
- Cloud storage solving the European infrastructure versus personal solution question
- A European Asset Repository, creating a central repository of global assets, with metadata standards

III.3.2- Brokering, aggregation

The internet of things will become more and more ubiquitous in the future and all these devices will be able to provide content. This content will not be a huge amount in terms of Mbits but there will be a lot of

single information sources. In order to be useful, there will be a need to aggregate this single information into relevant/understandable information. This will be the job of brokering functions which will have to aggregate information coming from several devices into usable information.
This function will be the corner stone of future business and there is a need for Europe to keep/get the leadership of such a domain.
Behind that domain, we have open data which has similar requirements as far as there will be a need collect information from different sources and to aggregate them into usable content.
In order to achieve that goal and to get efficient brokering and aggregation services, there will be a need to define standard formats facilitating information collection. We also need standards and tools to allow end users to create "over content" over bought content (notes, evaluation, bookmarks, ...) which could then be shared without the original content.
In the sector of the press and journalism, there is also a need to standardize article formats in order to help people to define their own press book aggregating press articles from different sources.

Research topics necessary to be studied (SRIA)

- Aggregation tools
- Data format definition and standardisation
- IoT data APIs
- Open data brokering tool

III.3.3- New formats (UHD, 3D video & sound, holographic), virtual & augmented reality

During the last decade we have seen new formats appearing due to device capabilities (smart phones, Connected TV, tablets) but also due to the telecommunication networks capabilities. These two domains will continue to innovate, so there is good reason to think that new formats will appear in the near future such as :

- Stereoscopic 3D
- 3D Augmented reality
- Immersive technologies including holographic
- Hyper realistic 3D modelization (automatic digitization, human & environment)
- Multimedia formats (UHD, stereoscopic 3D…)

Europe has to keep the lead in the definition of these future formats, but also needs to lead in the ability/capacity to manage heterogeneous formats in order to be able to provide to end users content that aggregates different types of information.

For the professional markets, the following topics are at the top of the priority list:

- Development and demonstration of a complete e-2-e chain for High Dynamic Range (HDR) content, in particular for cinema
- On a longer term, the development and demonstration of a complete e-2-e chain for auto-stereoscopic (i.e. glasses-free) multi-view 3D visualization, with high resolution, high frame rate and high number of views, suitable for professional applications such as remote collaboration, telemedicine, cooperative design, etc.

Research topics necessary to be studied (SRIA)

- 3D/holographic capture, manipulation and consumption for content and person to person communication (immersive communication)
- 3D Virtual/augmented reality using new devices (glasses, 3D Screen, windscreen display, ..)
- 3D Printing

III.3.4- Metadata

Metadata is one of the key aspects of personalisation, in so far as this information is used to search specific content on behalf of the end user according to several criteria. Metadata is already an old concept but we still need to work on it in order to solve existing issues such as :

- Using metadata to track the movement of content.
- Richer metadata with intelligent automated generation, both in terms of professional content and services and metadata about you as a user, to drive the richer immersive experience and personalisation and un-lock vast cultural and heritage archives of digital media

There is also still a need to define a standard format for metadata in order to make use of them easier and to ensure interoperability during content aggregation.

Research topics necessary to be studied (SRIA)

- Interoperable metadata if it is not possible to get standardized Metadata
- Automatic generation of metadata (open data, IoT data, ….)
- Use of metadata to track the movement of content

III.3.5- Post production

This domain addresses mainly professional content creation which will experience big evolutions in the near future such as :

- Real time postproduction : Technologies for true mashup of video & CGI (same for audio) to be rendered at end users (personalized)
- Semantic language analysis for semantic indexation and automatic production of formal knowledge (link with semantic web and automatic language analysis)
- Novel production techniques
- Mixed media production
- 3-D production and presentation
- The use of multiple sensors to collect a multitude of raw content essence and metadata and new forms of production tools to allow this to be repurposed off-line or in real-time to produce a range of content,
- Semantic media production for new types of content

Europe has big content provider players and is in competition with worldwide actors. It is key for Europe to keep a leadership in this field in order to be able to provide professional content to European citizens that has been created locally.

Research topics necessary to be studied (SRIA)

- Interoperability (platforms, APIs, standards, etc, …)
- Arrays of video sensors that capture multiple perspectives of a scene which can then be manipulated by the production team to allow any virtual perspective to be generated
- Ultra HD TV, 4K, end to end production tools

III.3.6- Data analytics

Data analytics is very close to big data and there is still a lot of research to be done in order to be able to give useful information to end users. In the future we will be faced with more and more information, so there is a need to develop tools able to analyse this information to provide useful output to end users. We need further research on:

- Semantic web technology, especially around learning and data analytics, modeling user behavior and experiences and processes
- Fast processing of big raw data for business analytics

This domain needs specific competencies that need to be taught at university level (technologists) because it will be key for Europe to be able to find the relevant information in the huge amount of data provided by users, machines and sensors.

Research topics necessary to be studied (SRIA)

- Semantic data analytic techniques
- Semantic language analysis for semantic indexation and automatic production of formal knowledge (link with semantic web and automatic language analysis)
- Data mining
- Semantic web technology, especially around learning and data analytics, modelling user behaviour and experiences and processes

III.3.7- Content search

Content search is a key domain and unfortunately Europe is behind big US players for actual content. As far as we are moving to new forms of content, there is a new chance for Europe to take the lead for specific formats such as 3D or voice, etc. Big data is another opportunity for new search engines. There is a need to make research on topics such as :

- Search mechanisms that allow full discoverability of e-Books online (availability, terms & conditions, etc …)
- Multimodal Multimedia Search Engine that supports and enhances the exploration phase of the design process
- Big&Open data : data anonymisation, data storage/personal cloud, security/privacy/access control, data brokering, semantic data analysis, data architecture for semantic search in large data bases, accountability, data governance and inter-sectorial data by providing intuitive cross media querying capabilities
- Intelligent search and recommendation that offers content and services based on:
  - Your known preferences and habits – exploiting **Big Data**.
  - Your current circumstances, location and environment – where, what and how you are consuming media, your current device. Context aware personalisation, exploiting the opportunities of ubiquitous Internet-of-Things sensors, but subject to suitable privacy, security and trust safeguards.
  - Mood based preferences – again using IoT sensors monitoring behaviour.
- Audiovisual search (new ways for crowd sourcing, social network contribution, etc)

Research topics necessary to be studied (SRIA)

- Data architecture for semantic search in large data bases
- Content search and discovery
- Multimedia search in big data infrastructure and in Cloud environment
- Discoverability of e-books

III.3.8- Compression performance

As far as content will become more and more huge and that the content formats will become ever more complex, there will be a need to define new compression mechanisms in order to avoid network congestion and bad user experience.

In particular, highly performing codecs for UHD graphics content with 4:4:4 colour mode, and codecs supporting the realization of complete e-2-e new imaging chains (e.g. UHD, HDR, HFR, auto-stereoscopic 3D)

Research topics necessary to be studied (SRIA)

- New compression tools and standards

III.3.9- Secure Content

Content has a clear value for professional content providers but also for end users. For that reason, there is a need to propose secured environments using efficient and flexible solutions to ensure an end to end security and privacy of content and media.
Today there are several solutions but none of them has become a standard so there is no interoperability which is an issue for flexible consumption of content.

Research topics necessary to be studied (SRIA)

- DRM interoperability (or standard solution)
- On demand exhaustive withdrawal of content from the internet
- Multimedia content homomorphic encryption
- Voice signature

III.4- Content distribution

The digital revolution is affecting also the area of content distribution, with a series of challenges and opportunities as well as many current and potential technological developments and transformations in business models.
From a technological point of view, a large part of the future developments will hinge on the evolution of networks. In fact, for the first time ever, we have the technologies in hand to transform the way networks are built and services are delivered, to create a global, high performance, scalable, intelligent, integrated IP-IT network.
There are essentially 5 coupled dimensions that need to be addressed to enable this true digital revolution:

- First, there is the end user 'device factor', wherein we need to enable 10x as many devices, but with economics that will be up to 10x lower per device.
- Second, there is the end user 'demand factor', which will require 100x more bytes delivered, which at today's economics means 100x lower cost per byte.
- Third, there is the network 'scalability factor', which requires a unification of tens of different network domains and the unification of hundreds of disparate operator networks into a federated global and open network.
- Fourth, there is the 'elasticity factor', which requires that the dedicated systems that were used to reliably deliver a fixed set of services be replaced by IT systems that deliver an infinite set of services with a completely different reliability model.
- Fifth, there is the 'velocity factor', which mandates a 100x increase in the rate of service onboarding, and an attendant 100x decrease in service management complexity.

Spanning across all these challenges are the great 'transversal' challenges of massively improved energy consumption and massively scalable security, which are also essential to solve. Future technological developments will work towards addressing this 100x device-demand-scalability-elasticity-velocity-energy-security issue.

Looking at what has happened in computing devices, it is remarkable to observe how fast tablets have become the most popular computing devices, displacing desktops and then laptops in record time. This may

well be the key to the future of content distribution. Tablets are inherently wireless devices, and as such require high capacity wireless connectivity, and also continuous, 'ubiquitous' access to the Cloud because they have limited processing and storage power due their size, weight and cost constraints.[22] And last, tablets are both consumer and now increasingly enterprise devices (see the BYOD phenomenon). So, tablets almost single-handedly drive the need for UBB wireless networks, to connect to the Cloud, anywhere, anytime, at home, at work, or anywhere in between. This resonates with a clear trend towards content in motion, everywhere.
Looking beyond tablets, we see that there are many other such future features with similar exponential scaling apparent or predicted, that will also dictate the path to the future: wearable devices and M2M in general show exponential growth, as do Cloud servers and the networking of those servers and VMs using SDN. And if we look at the growth in Wifi Apps as a proxy for the need for UBB wireless access, this connects the two. In short, the future is about tablets and machines connecting to the Cloud over UBB wireless networks, and it is starting now. But the challenge is to achieve this with 10-100x change in the scale and at sustainable economics.
This will have to be looked at within the broader picture of the development of CCIs, ICT and content production and consumption models, making the necessary connections between content, services and networks. CCI SMEs will have to be involved in technology development and uptake and links among them will have to be strengthened. The scale and diversity of EU CCIs shall be leveraged by clusters and clusters of clusters (rather than one Silicon Valley, many interconnected communities).

Moreover, the experience of the media/digital media industry will be used to cut across sectors (health, education, transport, energy) to unlock new interactive services and the links between CCIs and 'traditional' industry will be explored in both directions. Another challenge will be to create a pan-European cultural heritage digital public space, also raising awareness in the market about how creativity is a fundamental added value in the context of "Made in Europe". Efforts should focus on keeping delivery platforms in Europe, aiming at establishing European OTTs dealing with platforms, content, rights management, etc. Europe should master the end-to-end value chain and recover a leadership in embedded execution environments (LINUX of things, European cloud, etc.).

This of course is in part about technological maturity, and some of these technologies are more mature than others, but it is much more about the economics these networks will enable, and the sustainability of those economics. Supply chains in the creative sectors are undergoing big transformations, with traditional players evolving and new players emerging and entering the scene (including technology providers, pure internet players, telecoms, etc.). Some tensions are developing between current and emerging models, in areas such as distribution, licensing, legislation, privacy, new consumption of content, new sources of production, etc.; technology will be put to the test to try and address some of these as well.

And clearly the specificities of content distribution will go hand in hand with the broader issues related to e-commerce (including marketing/discoverability, licensing, big data/metadata, micropayments, etc.) and its technological developments and solutions – with special emphasis on boosting cross-border transactions in order to contribute to the realisation of the Digital Single Market.

Technology will have to support the viability of some current business models as well as enable a number of new experimentations. The big picture will be based on proving how it is possible to foster economic growth through the adoption of technology and the exploitation of the European cultural digital heritage by CCIs.

Solutions will be needed to find new ways to capture value with the disintermediation and fragmentation of markets as well as new measures of assessing return on investment (e.g. for pan-platform devices). Intelligent ICT will support micropayments, context-aware ad-insertion, personalisation and recommendation to enable broader monetisation of content (including user-generated content) and sustain future business models. The optimisation of advertising models will improve personalised advertising recommendations (e.g. Netflix).

A particularly relevant field of application for digital content will be the management of rights and rights information. Technology will provide machine-readable solutions for the automated expression of rights, for their protection, for the handling of negotiations and transactions involving rights clearance, concerning use

[22] We are assuming that efforts will tend towards potentiating the networks and Cloud infrastructure more than towards the expansion of the capabilities of devices, even though this will happen too.

and reuse of content. Digital rights management systems will need to be interoperable and user-friendly and be able to cater for the management of sales / licensing for multimedia content containers ('micro rights').

Another important field will be enabling businesses to adapt to the new VAT rules that will apply as of 2015 to the supply of electronic services (which include digital cultural and creative content), as content distributors will need to geolocalise their customers and adopt dynamic price display systems.

A key feature of future scenarios – that is already visible now – will be convergence, particularly in the domain of distribution. Convergence will involve internet, phone, TV, mobile and content (in music, video, gaming, etc.); it will rely on very high speed networks and will be inextricably linked to seamless access to content: the idea of ATAWAD (anytime, anywhere, on any device – including 'heavy' content, transmedia). Service quality will need to be adequate to user needs and network and device capabilities; new platforms and services will emerge to deliver content across a range of devices and environments. The underlying motive will be 'smart content on smart devices'.
Technology will have to further drive this convergence: content will be delivered on future 5G networks (including home networks), simultaneously, to a range of devices from whole wall UHDTV displays to mobile handheld devices. Furthermore, it will be a world of IP interconnected devices, the age of the Internet of Things, which will span a spectrum of use cases. Everything from TV and telephony to home lightning can be integrated into one product. Similar to this is the hybridisation of two or more technologies or media, such as Internet TV, portable video, or mobile messaging, which expands the possibilities to modify and extend media in new ways. Also pure media convergence will continue in many fields; for example, book publishing will be more and more interlinked with audio-visual, gaming, etc. Developments in wiring and materials carrying digital information and in the cost and availability of bandwidth will be essential.

Closely related to networks and convergence is the issue of interoperability and standardisation in digital content distribution. These will be very important building blocks in creating seamless access to content across formats, platforms, APIs and devices, allowing consumers to move their data across different environments. This will be essential in the e-book market, for example, but also in the audio-visual domain (moving your profile between Netflix and Lovefilm, etc.).

In a world of content everywhere and at any time, content search and discovery will be increasingly important. Search mechanisms will have to allow full discoverability of content online (availability, terms and conditions, etc.). They will have to offer better ways for (content) exploration at interface level (visualisation) and backend level (cross channel), possibly via multimodal multimedia search engines that provide intuitive cross media querying capabilities (including audio-visual search). Such mechanisms will enhance participation, competition and growth in the digital market place (for example in the e-book sector).

Huge challenges and opportunities for content distribution (and not only) will come from the area of Big Data, as the amount of data created and circulated escalates exponentially. Big Data will create opportunities to find and retrieve content, and to analyse and understand audiences and consumers. The use of better and bigger datasets of content, media and user information will allow producing richer, more engaging and personalised metadata, tailored to user behaviours, preferences and context. Collecting data about users, what their preferences are and what services they need and are consuming, where and how they are consuming content and media will allow these to be optimised for the environment of the end users and their devices. New possibilities will be opened for new ways of engaging the consumer via emotional monitoring and targeting content based on emotional metrics. The use of Big Data will span across the creative space: knowledge, education, entertainment, etc. It will also improve the search and discovery of content.

Technology will need to allow modelling user behaviour and experience and processes to identify market trends and more, using metadata to track the movement of content, fast processing big raw data for business analytics, efficiently collecting, analysing and managing huge amounts of data to build contextual user data profiles. Solutions will include semantic web technology and data analysis, data architecture for semantic search in large data bases, data storage and transfer infrastructures (especially cloud computing), standardisation and automation for shunting high volume data (for example for the film industry), intelligent automated generation of rich metadata (for professional content and services and about users). A desirable scenario would see the establishment of a European platform for Big Data, a European data infrastructure (Cloud). The main challenge – also to be solved at least partly through technology – will be that of the security and privacy of data (anonymisation).

More broadly, in a world of interconnected devices, omnipresent social networks and converging media, the networks that will carry all the content and data and the clouds that will store it will need to provide for security, integrity and privacy, through strong systems and protocols, thanks to advances in areas like electronic identification.

Progress is expected as well in the area of content accessibility for people with disabilities. For example, accessibility for the visually impaired should be achieved for most (or all) text- and image-based content; technology is already available to produce accessible formats of e-books, but the mechanisms by which an e-book is made accessible involve all the actors in the supply chain from author to reader and cooperation and further efforts will need to be made in this area.

Other specific domains of application for content distribution include, for example, social networks. Social network content is predominantly text-, image- and video clip-based. This could expand to include long-form and near-synchronous media consumption, with implications for network architectures. Understanding the psychology of social network usage and the interplay with content will provide a powerful roadmap towards new services as communication and content services become increasingly intertwined and interrelated. These 'Conversational Content' applications are providing a form of convergence and underpin the rich and creative, and often subtle, ways in which people express themselves and communicate with others through the use of content. ICT will possibly support and facilitate new communication modalities and enable new business models that may emerge as a result.

The digitisation of education will also drive and shape content distribution in this very specific domain. New technologies in the (digital) classroom, and the dynamics of the Web, are transforming the ways in which students and teachers interact with educational media and practices, opening the learning experience up to many new approaches. E-learning services (including MOOCs and serious gaming) will keep expanding and ICT solutions will be needed to search and discover educational materials, express and clear rights, etc.

Research topics necessary to be studied (SRIA)

A number of individual technological areas have been identified for development in the near future that will have an impact on content distribution across various platforms, content sectors and application domains:

- Tools for search and discovery of digital content
- Tools to enhance e-commerce and distribution solutions
- Real time speech transcription and (real-time) translation (ultra-large vocabulary, adaptation to the diversity of languages, reduction of model learning cost, convergence with text language analysis)
- Augmented reality experience on advanced devices (glasses, windscreen, TV, mobile, ...)
- 3D/holographic content and displays, 3D/holographic capture (including gestures and natural interaction), manipulation and consumption for content and person to person communication (immersive communication), line of sight cameras
- Accessibility features all along the supply chain (file formats, software, devices, e-commerce platforms, payment services, etc.)
- Open source solutions and open ontologies (APIs)
- Voice signature, including authentication
- Next-generation manufacturing, such as 3D printing or ad hoc manufacturing
- 3D technological blends of virtual and physical content
- Smart connected digital TV and second screen technology.
- Multi-screen and OTT TV
- SVoD (windowing is key)
- Real-time rendering
- Multimedia formats, mixed media production
- Multi-platform viewing and use
- Ultra-high definition presentation (TV and beyond)
- 'Smart' network interaction and management

- Persuasive technologies (playfulness and competition added to social-web, social-TV applications are expected to have larger roles in driving behaviors, connections and discovery in health, education and similar)
- Decision-making systems (smart systems)
- Wearable displays
- Interaction tools and interactive entertainment (including for mobile devices)
- Broadcast standard A/V over IP, mass distribution and usage, IP end-to-end (planning for the phasing out of traditional broadcast)
- One standard for mobile internet and broadcast TV/Radio (DVB/LTE)
- 4K, 8K?
- Glass-free 3D
- Advanced IoT (advanced IP protocols, communications channels, new devices)
- Communication by brain reading
- Large area colour reflective displays for signage and advertising
- HDR for wide colour game and entertainment at home (imaging science)
- Personal device synchronisation and auto discovery
- B2B streaming technologies based on consumer equipment's
- Quality of experience placement of content in the network, graceful degradation, complexity hiding
- Virtualisation of networks (NFV/SDN, seamless connection via tablets to content)
- Networking and computing technologies enabling "Visualisation as a Service" business models
- Very high speed transmission for media (optical and wireless infrastructure), ubiquitous access to it for producers and consumers, strong networks geographically widespread, ultra-broadband
- LTE/DVB convergence
- New low power wireless protocols
- Object-based media, where content is created from "atomised" elements of media objects – video and audio - that can be combined to: provide different editorial cuts of content and services; and deliver content simultaneously to a wide range of end-user devices, optimising the user experience for the particular device they are using.
- Standardisation and standards deployment (formats, metadata, classification schemes, identifiers)
- Semantic technologies, big market data analysis
- User-friendly and interoperable rights management systems
- Automated rights information management
- Automated rights management (negotiations, transactions, protection)

In particular, standards able to support bandwidth reservation, guaranteed throughput, low or at least consistent latency, real-time monitoring and clock synchronization are needed, also as a way to enable large interoperability between different platforms and markets.

Security & privacy aspects are very much an inextricable aspect of content distribution, and will play an enabling role in the deployment of networked visualization systems, in particular for professional markets. For example, challenges such as privacy, remote participant identification, secure content sharing, in remote collaboration/video conferencing are yet to be resolved.

Future delivery networks should :

1. Be ATAWAD (any device and multiscreen), seamless access to any content
2. Support more and more devices (high end but also low end devices)
3. Support higher quality (4K, 8K, 3D, …)
4. Support better latency (games)
5. Could be configured according to the content requirements
6. Support LTE/DVB convergence
7. Support Personal device synchronisation and auto discovery

8. Include Home networking
9. Support B2B streaming technologies based on consumer equipments
10. Support Quality of experience placement of content in the network, graceful degradation, complexity hiding
11. Support Virtualisation of networks (NFV/SDN, seamless connection via tablets to content)
12. Support Networking and computing technologies enabling “Visualisation as a Service” business models
13. Support Very high speed transmission for media (optical and wireless infrastructure), ubiquitous access to it for producers and consumers, strong networks geographically widespread, ultra-broadband
14. Offer New low power wireless protocols
15. Be interoperable
16. Allow rights management and rights information management
17. Improve accessibility for the disabled
18. Allow for handling big data
19. Convergence ;: Internet, phone, TV, mobile and content (music, video, games, book, …)

III.5- Content consumption

New technologies and business models in the area of content consumption will require innovation in the following areas:

III.5.1- Rights management.

The content rights management defines and controls the rights of content users to access, copy, modify, delete, print, or transmit content. Related to this are content protection and security and Digital Rights Management (DRM). Content consumption practices and end users’ needs and professional content providers' needs and practices, sometimes not fully aligned, should be reconciled. User Generated Content poses additional challenges. In addition to new technologies facilitating rights management, content and creative industries are exploring new business models and need a clear legislative framework.

Research topics necessary to be studied (SRIA)

With users interested in simplifying access to such, and producers (the CCIs) needing to ensure the protection of their IPR on the content, research and innovation is envisaged in the following areas:

- digital rights management and content protection, in particular with the development of user-friendly systems that offer protection without hampering the user experience while at the same time communicating clearly all the relevant information
- automated expression of rights (digital rights information management), machine-readable, in order to facilitate identification, negotiations and transactions concerning protected digital works

III.5.2- User interaction

During the next decade there will be radical changes in ways we interact with the Internet and devices around us, from phones to cars and shopping trolleys. Advances in sensors that plug into the brain, prosthetic limbs that are controlled from the brain, and even implants that directly interface with the brain are expected. Future research and innovation activities should target the extension of natural and intuitive user interfaces beyond the consumer space. Ambient computing, social media, BYOD, etc. are a few examples of consumer technologies and trends that have yet to be fully adopted by professional environments. User interaction should be defined in the context of the users’ workflows, and fully

integrated into these. This requires contextual, application driven approaches. Particularly, research on new ways of interaction in complex working environments is needed. Additionally, the reliability of advanced HMIs needs to be improved for reaching a qualified usability in professional, safety critical environments. New interaction forms including several senses will be increasingly embedded in digital books and other cultural products. Storytelling has to be innovated to fully benefit from these new forms of interaction and convergence of media while providing better user experience. Research is needed on user experience of such new cultural products.

Research topics necessary to be studied (SRIA)

- Natural and intuitive user interfaces
- New ways of interaction in complex working environments
- Embedding new ways of interaction in storytelling
- User Experience of new products
- Natural interaction including brain-computer interface, gesture, dialog, …

III.5.3- Visualization end points.

Visualization end points will play a key role in supporting the advent of new media experiences. In particular, increasing the immersiveness of the viewers for e.g. entertainment or new media experiences or for professional duties – such as collaborative design, remote surgery, training, is targeted.

Research topics necessary to be studied (SRIA)

- High quality displays, able to reliably and faithfully render more immersive 2D visual content such as UHD, HFR, HDR, large colour gamut content, etc.. Not only new display technology but also connectivity & interfaces should be addressed. For the future of Cinema, especially high dynamic range (HDR) projection systems with higher contrast ratio and especially peak brightness somewhere between 10x and 15x the maximum brightness of current projectors are sought, providing cinema gurus and audiences with much brighter and more natural images
- Regarding 3D displays, technological advances are required to reach high resolution, full parallax and multi-view (>100views of eye limiting resolution) auto-stereoscopic 3D displays, yet cost-effective.
- Immersive devices (connected TV, glasses, windscreen) will be increasingly used and need to be advanced.

III.5.4- Media convergence

Henry Jenkins argues, “old media[s] never die”. Despite the fluctuation in the genre and technologies of media, essentially “media persists as layers within an ever more complicated information and entertainment system ... A medium’s content may shift, its audience may change and its social status may rise or fall, but once a medium establishes itself it continues to be part of the media ecosystem”.

That is why the media industry needs to be part of this change, not just waiting to see what the audience asks for, but offering new ways, new experiences. Media industries are diversifying so they produce and distribute across several media (VOD, Cinema, App stores, Steam, Broadcast, Live events, printed publications...). However, this is not enough. Convergence is much more than just offering content through different channels - it is a cultural change that has to be understood as a new way of communicating where the audience is both viewer and creator, where a lot of information is put together and interconnected. Collaboration between industry and academia is needed to investigate new and innovative ways of interacting with the audience and distributing the content.

Media convergence is not only a matter of technology (new devices, internet access, broadband networks,...), it is also a matter of adapting the current policy framework, reaching and protecting public interests and market needs: access, data privacy, advertising, IP, market structure, business models and similar. It is also a matter of what the audience will use, (probably the more attractive and complete user friendly content service) or produce. This convergence also enables new ways to approach the audience, to be more immersive, more interactive, attractive, diverse, creative and innovative.

Furthermore, we will also need new media and communications professionals that have new skills and can understand the traditional media business in order to help them in the transition to a new media and communications era. Examples of such competences are social media development and crowd-funding.

For the media industry, convergence represents opportunities to reach wider audiences, but it also presents large challenges:

Research topics necessary to be studied (SRIA)

- Immersive devices and technologies
- Internet of things
- Big data management
- Digital Design and creativity
- Mobile Technology
- Geo localization
- 3D: Stereoscopic and CGI
- Motion Capture
- Augmented Reality
- Educating new media professionals...
- Interactivity/user engagement
- Privacy Issues
- Content Security and DRM (Digital Rights Management) issues
- Standards and formats
- Business models
- Data management
- Legal issues

III.5.5- Transaction (payment)

Technology will facilitate transactions and payments by making them both easier and more secure. This will include repeated transactions involving small amounts of money – i.e. micropayments. One of the challenges for the developers of such systems is to keep the costs for individual transactions very low. The challenge for creative and content industries is to develop and validate sustainable business models based on micropayment. Furthermore, good business models are needed that allow commercial exploitation of the end-users' non-identifying personal data (including their needs and interests) by content providers and advertisers. These business models should be beneficial to all the end-users giving away their data. The intended usage of the users' data should be clearly presented to the users.

Research topics necessary to be studied (SRIA)

- Market and Business models
- Different financing models (crowd funding, venture capital, advertising, brand content, product placement, public support or privet invest, ...)
- Legal issues

III.5.6- Translation

European culture is very strong and is mainly national and one of the key aspects is the language which is still national and even regional. In this context, there is a need to be able to provide content to consumers in their own language. Today, most of the content (films, books, games, MOOC, ...) is translated by hand and it is very costly and time consuming.
The challenge for the creative and content industries is to develop a real time solution able to translate any type of content (written, vocal) from any language to any language. Such a service should be used in any sector and could become a real business strength for European Industry as many other worldwide regions have similar needs and could take advantage of such a technology.

Research topics necessary to be studied (SRIA)

- Real time solutions for speech and text transcription and translation : Ultra large vocabulary, adaptation to the diversity of languages, reduction of learning model cost, convergence with text language analysis.
- Business models for such solutions

III.5.6- Accessibility

Accessibility is a transversal topic and addresses societal challenges and social innovation as much as technological innovation.

As outlined above, accessibility features should be addressed all along the supply chain (file formats, software, devices, e-commerce platforms, payment services, etc.), but not only them. Since NEM's Connected TV position paper published in December 2012, an important project concerning Connected TV and accessibility, HBB4ALL[23], was initiated and started in December 2013 for a three year period. This CIP project aims at setting up user tests and pilots, namely to bring innovation into use. We take over here the writings of NEM's Connected TV position paper, which designs guidance to research projects including accessibility and personalization for all. Future research topics should be envisaged as having multi-device and multi-accessible features, and there is a need for awareness creation in the content industries to integrate accessibility features directly into the content production process. The idea is to bring Europe to excellence in the field of universal accessibility.

Opportunities and challenges in the context of connected TV are described below.[24]

III-5.6.1 Strong Mass Market Opportunities

According to ITU's focus group on audio-visual media accessibility, an estimated 15 % of the world's population lives with a disability. If family members or care-givers are included, one quarter of the global population is directly affected by disability. Adding the ageing population means that more people than ever will be living with a disability in the future. According to the ITU; "information and communication technologies (ICTs), embedded in apparatus, are already transforming the lives of many disabled people, through aids to mobility, speech and hearing, and the performance of everyday tasks. For its part, ITU strives to ensure that ICTs as a means of communication – and the myriad and multiplying benefits and opportunities they bring are accessible to all, including those with disabilities".

EDF (the European Disability Forum) counts 80 million people with disabilities throughout Europe[25]. Age Platform Europe[26] refers to 100 million ageing people throughout Europe. As a mix, this represents an estimated 40%+ of the European population. These indicators will increase with the European ageing

[23] www.hbb4all.eu
[24] From Danet, P.Y. et al, Connected TV, Position paper, NEM, 2012
[25] Nadège Riche, Media4D presentation, Paris, 30/03/2012
[26] **AGE Platform Europe** describe themselves as "European network of around 167 organisations of and for people aged 50+ which aims to voice and promote the interests of the 30 million senior citizens in the European Union and to raise awareness on the issues that concern them most."

population. Ageing people represent market segments towards 60, 70 or 80 year-old people[27] possibly interested in or in need of personalized services. At the same time, different impairments require different personalized services.

These given figures alone represent already mass market potential, just within the field of concerned users. Beyond the fact of producing "personalized services for all", originally invented for specific populations, it is all about moving from classic accessibility mechanisms to personalised media systems that allow to make life and access easier for all users. Tablets or touchscreen devices expressly show new ways for innovative interactive TV content handling.

Legislative constraints[28] may even be perceived as a strong lever, creating added value for users and stakeholder communities by moving from obligation to opportunity and real market visions. Altogether, accessibility is expected to bring new opportunities for the value chain and especially end-users benefits, whether they have impairments or not.

In the above mentioned ITU text, the organisation encourages development of products and services aimed at increasing accessibility, such as the "Total Conversation Service", a flexible interface that merges voice, video and text telephony. Like user representatives, ITU also promotes the principle of "universal design"[29].

As they underline, *"the need for "accessibility" is not confined to people with physical or mental disabilities. Anyone can be permanently or temporarily "disabled", for example, if they try to receive a phone call in a noisy environment or speak a language for which there are few internet resources. Rather than treating accessibility as important solely for addressing the needs of people with disabilities, elderly people or those with temporary impairments, we should regard accessibility as a universal requirement that aims to ensure that ICTs of all kinds can be used with ease by people with the widest range of capabilities. In this way, all the world's people, whatever their individual abilities or disabilities, stand to benefit from an "accessible ICT world".*

III-5.6.2 Individualization and Personalization of Connected TV Products and Services

With respect to the consumption of Television, connected TV represents a prime means to help the elderly and people with disabilities (but also minorities) to improve their access to TV content. Access services such as sign language, subtitles, audio description, clean audio, etc. can be made available via IP link and can be displayed on either the prime screen (or prime loudspeakers, respectively) or can be consumed via a second screen. The beauty is that these services can be made adjustable to the individual needs of the users. The technical challenge (not yet standardised) is to time-synchronize the broadcast and the IP delivered content.

The following depict such solutions for a show case of HbbTV:

In principle, HbbTV can be used to provide any access service required: Signer video, audio description, spoken subtitles, multi-lingual text subtitles, multi-language sound tracks or additional sound tracks with clear(er) audio dialogues, etc. Today, HbbTV is already of help to people with viewing difficulties as the new text-services provided by HbbTV are much better to read than the conventional videotext service and, in some instances, already offer personalisation options for further improving readability through extended font sizes and various colour options (adapting colour contrast to individual needs). Further access services like, for example, an application which allows for individual configuring of subtitles in terms of their size, position or background are in experimental or pre-operational stage.

[27] Michel Riquer, Introduction discourse, Media4D conference, Paris, 30 March 2012

[28] The Commission set up a legal framework in 2007 with the *"European i2010 initiative on e-Inclusion - to be part of the information society"*; this called on the ICT industry to work to help disabled people access digital TV and electronic communications products. It adopted the Audiovisual Media Services Directive in 2010

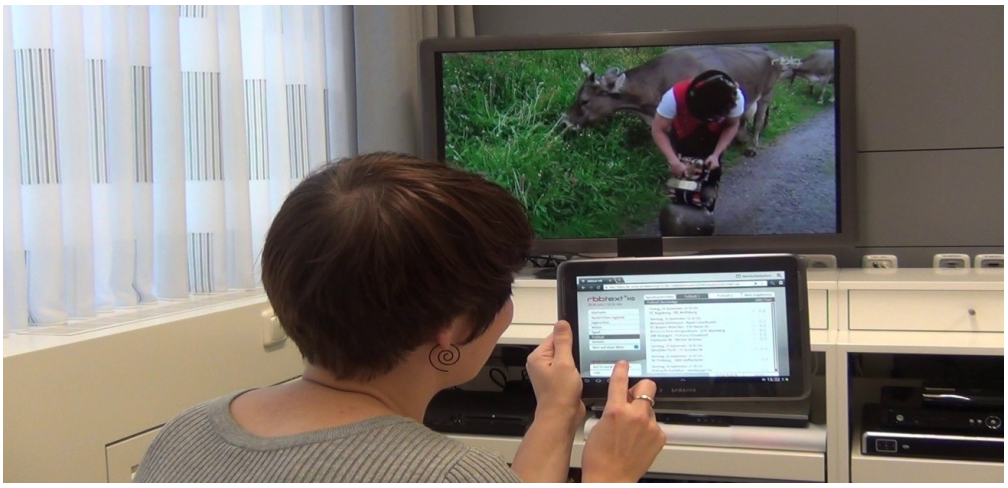
[29] This is defined by the UN Convention as the design of products and services to be usable by everyone to the greatest extent possible, minimizing the need for special adaptations or different devices for people with disabilities.

The inscription says: Via Internet, a signer video is available for this programme – switch it on now?

Selection of personally adjustable subtitles from the start page (launcher application) of HbbTV

Example of a signer video (delivered via the Internet) superimposed with the main broadcast video

Menu to select size, appearance and position of subtitles



Example of 2nd screen usage (IRT demo in cooperation with rbb – shown at IFA-12)

The HbbTV application can be switched from the main screen to the second screen (in this case a tablet PC) – The broadcast TV signal remains on the main screen, also an ideal solution for additional audio services such as audio description, clean audio or spoken subtitles (with or without the mixed original sound)

III-5.6.3 Future Research Activities on Connected TV to improve accessibility – for all

Especially from the user perspective, it seems to be interesting to develop the research on accessibility to connected TV in the following ways:

1. Automatic translator to sign language

The translation into sign language for TV broadcasting and also for telecommunication purposes is very costly. There are not enough translators to meet the needs of hearing impaired users. It would be useful to make research on this matter. It is even more difficult to turn text or speech into sign language than turning text into speech. It requires a kind of robot on the screen speaking the sign language. Being able to reproduce gestures and signs on the screen automatically requires long research on linguistic and expression by signs. It could be interesting also for other purposes.

2. Accessible universal remote control

Currently blind users cannot get access to the menu of their TV. It would be costly to equip each receiver with text to speech menus. The user idea is to set a universal remote control with text to speech menu. This remote control should be able to be connected to all receivers and DVD players meeting some common standards to be defined allowing the users to go through the menu and use all the functionalities available on their device. Users can have their own personal remote control to use when they are moving for example in a hotel.

3. Screen reader enabling visually impaired viewers to read subtitles

None of the existing screen readers that we use on a computer are able to read the subtitles on TV, on a DVD or on videos available on the Internet. So the idea is to develop software allowing to turn the subtitles on the speech or in braille when the user has a braille displayer as it is possible on the computer.

In other words, although there are already some mature technologies that at the moment need only be taken up by broadcasters, there remain still a number of topics which require further attention from the research community:

- Need to develop synthetic speech modules for spoken subtitles in less spoken European countries (text to speech technology).
- Development of robust language transcription modules for less widely spoken European languages to ease live subtitling and use of automatic transcription tools.
- Promote technical development of Computer Generated Sign Language.
- Standardisation of delivery mechanism of closed access services on connected TV to allow devices to be able to render access services from different Content providers.

- Research of a mechanism to allow creation of content with access services so that they can be delivered on multiple platforms without being reformatted (COPE - Create once publish everywhere).
- Development of transmission and synchronization technology in connected TV for access services (e.g. Closed signing).
- Tools for cost effective creation of second screen applications for providing personalised accessibility services. When watching television together with a group accessibility services, e.g. audio descriptions, are sometimes turned off even if available because they are perceived to negatively influence the viewing experience of those who would not benefit from these services. Companion devices could provide personalised services alongside the communal activity of the broadcast media.
- Interfaces and systems for accessible control of the “domestic” connected TV ecosystem (especially relevant for visually impaired people).
- Accessible broadcast services for asynchronous viewing.
- Exploring business models (through pilots) for the provision of accessible Connected TV in order to facilitate buy-in by key stakeholders.
- Protection of the personal end-user data that can be collected by the portal owners and by linked applications.
- Investigate new scenarios (multi-screen, multi-modal, networked home) in studies with disabled and elderly users, to better understand requirements.
- Study the opportunities of novel interaction paradigms (multi-modal - speech, gestures, remote control, etc.) for providing improved TV accessibility.
- Going from guided manual system configuration to automatic user profile-based configuration.
- Achieve adaptive service front ends that enable individual configuration and dynamic (contextual) adjustments, without confusing the users.
- Better education of ICT developers in terms of user-centred design and accessibility.
- Tools for creating adaptive/personalisable TV services, and/or to better consider user requirements at design time (the growing importance of HTML5 may be a good chance).
- Consolidate available TV design guidelines, simplifying and improving access to design knowledge for developers.
- Develop more relevant services for disabled/elderly users (e.g. eHealth etc.) or in general for non-technically savvy people, while exploiting the available technical TV platforms.
- Develop ways to escape the arbitrary and crippling limitations introduced by big brands to protect their business silos at the expense of the users, especially the non technically savvy users: any service should be accessible on any device or sets of devices. Good tools for this include fostering the development of open and secure service platforms, based on royalty-free web technologies, allowing the creation of services that will run on any combination of TVs, phones, tablets, PCs of any brand. And this requires supporting the development of more free and open web standards.
- Accessibility evaluation tools / schemes for TV-based/-centred services.

Future research and development activities should also explore how the features of Connected TV can be used to improve multimedia accessibility. Two main challenges are highlighted:

1. How to take advantage of the broadband channel to provide new accessible content and services, overcoming current problems such as latency or synchronization. The personalization of Connected TV, which is one of the main characteristics of this technology, can be used to provide access services in a closed way (i.e., available just for the users that select them). This is an old aspiration of TV operators to provide a signing service. A wide variety of new services for the elderly or people with disabilities can be implemented taking into account the mentioned characteristics of Connected TV: personalization, multimedia, and interactivity.

2. How to achieve that the new connected services (such as video on demand applications or integration of social networks on the TV screen) are accessible and available for as many users as possible. If, as mentioned, accessibility must be seen as a universal requirement, Connected TV should be deployed according to the design-for-all principle from the concept phase.

Therefore social reasons and social innovation stand at the beginning to promote overall multimedia accessibility. As mentioned in this section, accessibility users represent a huge market that also demands and should be offered every kind of services and products enhancing access to content and services. Providing more accessible media is an opportunity that should be considered as an investment.

Research topics necessary to be studied (SRIA)

- Automatic translator to sign language
- Accessible universal remote control
- Screen reader enabling visually impaired viewers to read subtitles
- Improving multimedia accessibility by design-for-all

IV- International cooperation

In the following we develop arguments to set the international communication strategy with regard to expressed interests and expectations from the NEM community. Building on this background information and some first actions, it appears important to develop a European international cooperation strategy.

Background information

The NEM EG-group recently conducted a short survey among NEM members questioning their interest with regard to international cooperation. The results have been presented during the NEM GA on 1st of April 2014[30].

The following highlights three outcomes:

1. Surprisingly all types of members (40 responses in total) are interested, among which 25% of SMEs:

Type of NEM members interested in International Cooperation
SME (10)
Research Institutes (7)
Academia (6)
Big Companies (5)
Non-profit organisations (4)
Clusters (3)
Consulting (1)
Non identified (3)

2. The most important reason for their interest lies in *business development, market take-up and diversification,* but also in knowledge sharing, networking and partnership building:

[30] The results are available on the NEM website: http://nem-initiative.org/wp-content/uploads/2014/04/5_17GA__NEM_Survey_int.pdf

Interest in int'l cooperation	# responses (multiple answers)	% of total responses
1/ Business development / Market diversification & Global take-up of products and services	**20**	**47,6 %**
2/ Knowledge transfer / Knowledge sharing	13	30,6%
3/ Networking and partnership building	7	16,6%
4/ Cooperation for Trustworthy ITC	2	4,7 %

3. Respondents declared to be interested in all regions of the world. The list of citations by order of importance is as follows:

Country/region (multiple responses)
Pacific/Asia (34) China, South Korea, Japan, Singapore, Taiwan, Hong Kong, Australia
North America (21) US, Canada, Silicon Valley, NY, Boston, Montréal
Latin & South America (15) Brazil, Mexico, Columbia, Panama, Argentina, Chile, Peru, Venezuela
EU & associated countries (Israel & Turkey, Nordics) **(11)** **Inl. Euro Asia** (Russia, Uzbekistan, Kazakhstan, Belarus, former SU)
India (7)
South Africa, wider Africa, and North Africa (5)
All countries are considered as interesting (4)

USA and China for example are considered as "biggest economies" in the world and shaping the universal arena. Stakeholders want to get informed about best practices and technological roadmaps. Furthermore, respondents insist that the USA with their top universities, big companies and investors are leading in e-Health, embedded systems, and immersive visualisation for example. They are advanced in high-tech ICs and integrated technologies, and dominating science *without* cooperation with Europeans.
Asia/Pacific, Latin and South Americas are potentially big emerging markets where to be.

Member expectations

First of all, stakeholders see NEM as **strategic mobilizer and information provider** through knowledge and experience sharing. They are seeking for needs and societal challenges in third regions and countries, would like to get informed of the selection of each country best capabilities and share experiences from other organizations working on a similar technological domain, possibly with key organizations on targeted domains. They declare also to be interested in liaison with key players, markets and reciprocal NEM organisations from outside of Europe. The idea is to foster international collaboration and business opportunities.

Stakeholders see **NEM here as potential facilitator, operator and networker** for their interests, helping to identify opportunities and potential partners. This expression of interest came from all types of respondents, including from clusters interested in obtaining information for and showing information on SMEs (for example on the NEM website). Interestingly, it has been expressed to make the international strategy part of European rather than a single company or single EU country strategy. Special attention concerns to make benefit small companies of the network of NEM representatives, but also facilitate and organize bilateral networking (physical and/or virtual sessions). Wishes range from the launch of specific initiatives related to gather scientists interested in media, support projects with regions, support "twinning" agreements between SMEs, become the operator of a European booth at international events (like Siggraph for example), and others[31].

Actions and involvements to set the strategy

With regard to the above-mentioned interests of stakeholders, first steps are to:

1. set-up a NEM internal INCO WG (international cooperation working Group),
2. develop contacts through international cooperation projects, possibly with the involvement of complementary ETPs (NEM-NESSI for example),
3. encourage INCO in bilateral working groups (WG) with other ETPs interested in the international approach (NM-Networld2020 for example), become more transversal in inviting several ETPs to work around int'l cooperation, among other topics NEM-NESSI-Networld 2020) for example.

(1) NEM stakeholders like Engineering (Italy), Holken Consultants & Partners (France), KoçSistem Information Communication Services (Turkey) KTN (TheKnowledge Transfer Network) (UK), MediaDeals (Germany), Orange (France), Sigma Orionis (France), TSSG/Waterford Institute of Technology (Ireland) declared their interest to set-up and contribute to a WG. Respondents of the evoked survey who declared to be willing to get involved actively, will be invited to particpate. The group is open for further NEM members who want to join. Together the stakeholders will identify priority actions and design tasks leading to actions an operational INCO strategy.

(2) A natural way to develop INCO comes through exchanges with existing European projects. The recent MOSAIC project[32], which aims at building technology platforms (TP) in North Africa and the Middle East. Thus MOSAIC organises a public debate at the NEM Summit 2014[33] about international partnership building with the participation of coordinators and partners from other INCO projects like BIC (Building International Cooperation for Trustworthy ICT)[34], EECA-2-HORIZON and EAST-HORIZON[35], Med-Dialogue, and Conecta 2020[36]. Since within the MOSAIC project active NEM and NESSI representatives, NEM is invited to expose its vision and strategy at the coming 1st NESSI INCO days[37]. NEM contributes inviting its members to join the NESSI INCO event and to propose project proposals with view to H2020 projects (call closing in April 2015). This is a first peer

[31] Specific wishes, topics and initiatives are listed in the Survey Feedback on the NEM website: http://nem-initiative.org/wp-content/uploads/2014/04/5_17GA__NEM_Survey_int.pdf

[32] Cooperation with Mediterranean Partners to build Opportunities around ICT and Societal and Industrial Challenges of Horizon 2020: http://www.mosaic-med.eu/index.php/en/
MOSAIC is partner of EU-MED ICT http://www.eumed-ict.eu/

[33] NEM Summit 29-30/9/2014 in Brussels http://nem-initiative.org/show-case-mosaic/

[34] http://www.bic-trust.eu/

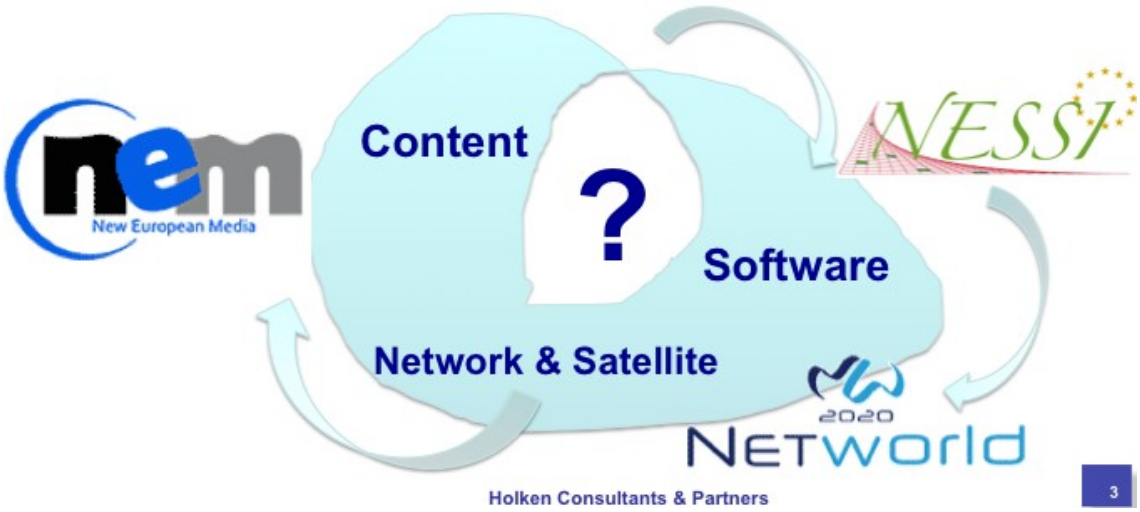
[35] http://www.eeca-ict.eu/

[36] http://www.conecta2020.eu/latestnews.html

[37] NESSI Member's and International Cooperation Day 20-21/11/2014 in Barcelona http://www.nessi-europe.eu/?page=eventsdetails&listID=9&rowID=495

partnership for international cooperation activities between NEM and NESSI technology platforms.

(3) NEM aims at opening this kind of partnership towards further concerned ETPs. For example, NEM and Networld 2020 set-up recently a joint working group with the idea to share and to align their respective strategic research agendas. Participants welcomed the idea to open the WG also to NESSI experts.



Starting from the international cooperation topic, it will also concern other identified common themes. Concerning INCO, NEM intends to set further contacts and the relationship with peers (also extra-European TP, be there in place or under construction).

Vision of International Cooperation Strategy

With regard to the survey feedback and the evolution of the initiated actions, it appears to be important to develop an international cooperation strategy for including the following scope:

Treat transversal aspects and needs,

- consider different research areas with regard to H2020,
- identify bottlenecks,
- look at different regions in the world,
- facilitate the input for coming strategic and research agendas,
- create the basic pillars for the promotion of cooperation between Europe and third countries/regions in the field of ICT
- create contributions of ICT to identified societal challenges.

Even more importantly, an international cooperation strategy allows identifying potential areas of cooperation between Europe and third countries/regions around the thematic areas of ICT and ICT applied to societal challenges.

Through the liaison with extra-European counterparts (TPs), it will be possible to contribute to the update of the European International Cooperation strategy.

It allows to increase awareness on the potentialities for cooperation between Europe and other countries on common R&D priorities in the fields of ICT and ICT applied to Societal Challenges.

And last but not least, the strategy should be build on market take-up of innovations, and therefore new business opportunities and (diversified) market approaches for European stakeholders.

V- Potential PPP

With the exponentially increasing rate of technological developments, it is very hard to predict the exact shape of the Future Media for the Internet and even more difficult to predict future services. After extended analysis of the different efforts and activities towards envisioning the Future Internet (both in Europe and world-wide), after participating in a number of activities and task forces, after analysing numerous market studies, market trends, different proposals to reinforce the European competitiveness, the NEM ETP has concluded that Future Media Internet needs really visionary, innovative, challenging and ambitious service offerings; something really break-though; the NEM has concluded that the Immersive content environment has such a potential.

Therefore, the program should have the objective to create and integrate several new tools, interfaces and technologies enabling the creation of an augmented immersive environment where people interact with each other through virtual or real representations and environments. Communication between these people will thus be the most natural as possible thanks to the large panel of possibilities offered by the environment.

There are potential use cases in many vertical markets such as health, transport, energy, ... taking advantage of such technologies. The use cases proposed will be in between AR and AV such as those explained in the following figure that shows the possible mixed reality states:

- Virtual Environment or Virtual Reality (VR) has virtual objects placed in a virtual world offering Immersive Virtual Worlds (IVW)
- Augmented Virtuality (AV) has real objects added to virtual ones in a virtual world
- Augmented Reality (AR) or Augmented World (AW) has real objects combined with virtual objects, but the surrounding environment is real instead of using a virtual world.

The objective is to create a global open environment able to capture any Immersive objects, to create Immersive content, to aggregate them together according to specific rules and to display the result on Immersive devices. With such an environment, third party developers should be able to use these enablers for any type of vertical applications.

The solution should take advantage of Future Internet PPP vertical use cases and also from the 5G PPP network capabilities

That PPP should have the objective to be forward-looking and to be multidisciplinary in order to achieve this human dream of being able to move in a virtual world in the same way as they are able to move today in the real world

V.1- Technology locks

- A need to address/study/develop
- Networked cameras able to capture Immersive images and sounds
- Immersive content creation tools

- Real time Immersive images cropping solutions
- Real time Immersive images reconstruction engine with open APIs to third parties developers
- Real time Immersive sound aggregation
- Immersive Augmented reality solutions
- Immersive images and sound restitution (screen, glasses, holographic, …)
- End User natural interaction (motion, voice, brain, …)
- Setup a pan European open secured Immersive environment offering to third party developers the possibility to develop a wide range of innovative applications

V.2- Potential stakeholders

- Immersive Camera manufacturers
- Immersive sound micro manufacturers
- Immersive content creators
- Immersive content providers
- 5G telecom operators
- Software developers
- Third party developers
- End user device manufacturers
- Some representative use case owners

V.3- Expected impact

- Widespread adoption of new digital media consumption and production patterns.
- Significantly higher performances in terms of built-in intelligence, scalability, flexibility, speed, capacity and ease of use.
- Quick response to new and sustainable market opportunities based on converged business models between content, telecom, broadcast and consumer electronics industries.
- New opportunities for content creation, production and exploitation
- New approaches to applications such as remote elderly care and monitoring, education, science, business, entertainment, future music active fruition, culture, etc.
- Novel theories on empathy, entrainment, synchronisation which are crucial to boost the outputs from such multimodal/context aware data and sensors.
- Boost the effectiveness of the communication and interaction.
- Enhanced quality of life through new usage forms contributing to social, intellectual and leisure well-being.

V.4- Potential business areas

- Such a service could be used for many sectors such as :
- Health : telemedecine, telediagnostic
- Manufacturing : maintenance, hot line
- Business : teleconference
- Entertainments : gaming, serious gaming
- Sport : training
- Education : online learning & course
- Tourism : site visit
- Fashion : Fitting garment
- Real estate : apartment visit
- Culture : museum visit, cinema, theatres, digital performance

V.5- Expecting deliverables

- Tools for Immersive content creation
- Tools for Immersive content manipulation (augmented reality, cropping, ...)
- Immersive content capturing devices
- Immersive content display devices
- Immersive real time reconstruction platform
- Scalable pan-European solution offering open APIs to any third party developer

- Efficient standardised Immersive coding/decoding standards
- Use case scenarios
- Testbeds (Living Labs) for technology evaluation across Europe
- Business scenarios

V.6- Program phases

- Phase 0 (ignition) : existing projects cooperate for demos
- Phase 1 (exploration) : Proof-of-concept demonstrators +roadmap of needs and requirements for experimentation, validation, demonstration
- Phase 2 : Experimental requirements from phase 1 + leveraging existing infrastructures for experiments
- Phase 3 : Large-scale trials, prototypes, pilots, scalable tests

V- Conclusion

As a starting point, the key drivers for the compilation of this NEM Position Paper on Future Research Directions were:

Working to the benefit and well-being of European citizens.

- Helping our society to reduce and eliminate the digital divide in Europe as far as possible.
- Assisting in realising the key themes of the European Union's Digital Agenda and of the Innovation Union communications.
- Enabling the EU Media Industry to play a leading role in the creation of a smarter and more sustainable planet.

Starting with an analysis of the future societal and business opportunities in the wider IT sector, and taking into account Europe's cultural diversity as an asset that we inherited from our ancestors, this document describes the NEM vision and the NEM foreseen needed innovations necessary in regards with these illustrious goals. Clearly, new ecosystems and progressive educational strategies have to go hand in hand with research and large, medium and small companies in the NEM field.

As stated by the NEM Community in the different projects and market analysis conducted in Europe, there is a large number of companies, creative employees, research institutions, creative hubs, researchers and practitioners involved in the Digital Creative field. This shows a vast growth potential, that will only be capitalized if we have the capacity to collaborate, exchange best practices and stimulate knowledge transfer for the benefit of the Creative Industries. Clusters, business networks and regional development agencies, have proven to be key drivers in this sense. NEM, as a cluster of clusters, will continue to work for the benefit of its community members and of the industry as a whole, also connecting the industry stakeholders with policy makers to stress the importance of Media and Creative Industries as main drivers for innovation and economic growth in the knowledge economy and, consequently, help reduce existing disparity among European regions.

The NEM stakeholders and authors of this Position Paper are firmly convinced that public initiatives, such as the European Commission's ICT Framework Programmes, form a powerful and effective instrument to profoundly foster European research, development, and innovation activities while addressing the bigger picture of sustainable growth and societal challenges. Consequently, this document represents a high-level view for themes which NEM considers to be relevant for the EU Framework Programme "Horizon 2020, and particularly towards the 2016-2017 program and towards the establishment of a public private partnership dedicated to Immersive Content (including Immersive printing) ".