



# Vision, Insights and Trends for Awareness and Leadership in Media

## D 3.3 Final report on strategy development for Convergence and Social Media

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# Abstract

This document is the final report addressing the vision of NEM, led by VITAL MEDIA, concerning the foreseen future within the new European media ecosystem.

The report includes detailed project activities on establishing the strategy for the European Media community and the creation of the related documents. Vision, strategic research and innovation agenda (SRIA), roadmaps, position papers, European and national policies analysis on convergence and social media are considered, and several contributions to NEM working groups on key aspects has been developed. Vision, position and white papers and contributions to working groups created by the convergence and social media community with the project support are included as annexes to the deliverable.

## Executive Summary

This report gathers all the outputs from the working groups VITAL MEDIA partners have contributed throughout the life of the project. These works are included in the different sections of the deliverable directly related to the contributions from the project: the building of the media and convergence strategic research agenda, Vital media white and position papers, policy related activities and contributions to several working groups.

Thus, VITAL MEDIA has been able to provide a set of documents gathering the media and convergence strategic research agenda, including research lines and the definition of a roadmap; establishing the vision and position of the sector for several topics through white and position papers in different technical (immersivity, data for media, content distribution, AI for creative industries, hyper-personalization, social media) and regulatory (European policies) issues; and collecting contributions to different impacting working groups as new generation internet, digitalising European Industry, industrial hub innovation,

The report is concluded with the conclusions that bring together the aims on creative content and media and technology enablers, which are key for the management and visibility of the sector.

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# Abbreviations

Abbreviation	Explanation
3D	Three Dimension/al
AR	Augmented Reality
ATAWAD	AnyTime, AnyWhere, Any Device
BCI	Brain Computer Interface
CCI	Cultural Creative Industries
DEI	Digitalising European Industry
DIH	Digital Innovation Hub
DRM	Digital Right Management
DSM	Digital Single Market
EC	European Comission
ETP	European Technology Platform
ESP	Enhanced Sense of Presence
EU	European Union
FP	Framework Programme
GA	General Assembly
H2020	Horizon 2020
HMI	Human Machine Interaction
ICT	Information and Communication Technology

KPI	Key Performance Indicators
NEM	New European Media
NGI	New Generation Internet
QoE	Quality of Experience
R&D	Research and Development
SB	Steering Board
SoA	State of Art
SME	Small Medium Enterprise
SRIA	Strategic Research and Innovation Agenda
VM	VITAL MEDIA
VR	Virtual Reality
WG	Working Group



# 1. INTRODUCTION

Media and content is rooted in European culture, forms an indivisible part of the cultural and democratic values of the European Union (EU), and at the economic level it constitutes a dynamic, innovative multisectorial market capable of incorporating essential disruptive elements to achieve substantial competitive advantages and promote new business models to through services with a high added value.

VITAL MEDIA (VM) aims at reflecting on the future of the media industries from a global perspective, covering the whole value chain of the media business and through work groups joining knowledge, experience and proven track record. From this task it is expected to build a convergence and social media strategy for the European Media community.

The NEM Initiative – New European Media Initiative – is a European Technology Platform, fostering the convergence among Media, Content, Creative industries, Social Media, Broadcasting and Telecom sectors, as well as Consumer electronics to develop a common innovation environment for the new European media landscape.

NEM is becoming 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. The NEM Initiative therefore takes 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. NEM has actively participated under the direction of VITAL MEDIA in the creation of strategy and position for the whole community.

This activity leaded, by VITAL MEDIA, has served to identify the opportunities and challenges linked to the major changes in the media sector as a result of the most critical challenges media is facing on, as the development of new communication networks, the digitization of the industry, the birth of a new generation internet, the global impact of social media as an integral part of citizens' information, education and entertainment and their associated risks. Additionally, it has assessed how current EU policies help or hinder the development of the sector, and which new policies, specially regarding the way research and innovation is supported, promoted and funded through European frameworks and programmes, might be needed, and finally, to join forces within the main stakeholders and all actors of the European media community, even the most atomized in order to attract attention - at the appropriate level - of public authorities, consumers, creators and the rest of the industry on

the urgency to act and make the NEM community stand clear. As to reap the benefits of these challenges fully, the challenge for the European media content sector is to adjust to new ways of doing things and for policymakers to create the right conditions for turning disruptive trends into opportunities and exploit the huge potential of the innovation revolution.

One of the main goals of the VITAL MEDIA project was to enlarge the community in the social media area at the European level, at level of the national and regional clusters, through collaboration among the NEM Initiative and the clusters, and to link those communities with the policy makers and stakeholders (i.e. standardization organizations) to increase the awareness of topics of interest from both side, for the benefit of the European CCI and ICT economy. Furthermore, this enlarged community had to be animated through a number of discussions at workshops organised at all mentioned levels and through cooperation within an innovative online collaboration tool (OPPENESS) with the aim to widely discuss and establish research and innovations roadmaps for the area, in a strong cooperation with industry (start-ups, SMEs, big corporations), research and academic institutions active in the area, covering the identified gaps between the technology providers, their users/adopters, and policy makers.

Accordingly, based on the community discussions and results of work of the community WGs, VITAL MEDIA has supported the creation of several documents, identifying strategic targets of the European Media sector. The main documents gathers the vision of the sector for the main topics that will be addressed in a close future, and the Convergence and Social Media Strategic Innovation and Research Agenda in order to align a common strategic vision and roadmap shared by all relevant players from the industry, academia, research and policy spheres. VM has taken care of the structure definition, major contributions and editing, including the related community discussions and gathering the community feedbacks and inputs.

Besides the SRIA, VM supported the creation of position papers, whose topics have been identified by the community itself in accordance with the community needs and requirements from EC and Public Authorities.

This deliverable includes detailed project activities on establishing the strategy and creation of the documents. It also includes all documents created by VM and the convergence and social media community (specially NEM Steering Board (SB) members) as Vision, SRIA, roadmaps, contributions to the most relevant work groups, position and white papers. All these documents, including well established procedures and open consultations for their creation, represent significant community inputs for creation of future strategies for the convergence and social media sector.

## 2. BUILDING CONVERGENCE AND SOCIAL MEDIA STRATEGY

### Strategic Research and Innovation Agenda and roadmap

The media content sector has a major societal impact in Europe. It has to face problems, like the accelerating speed of technological change that creates a macro-level risk for most businesses, but also can find opportunities for innovation in product offerings, brands, and business models that revolve around the user experience. At the same time, the European media content sector makes an important contribution to the European economy, holds a significant potential for growth and competitiveness, and employs a highly skilled workforce.

VITAL MEDIA has worked on the definition of the overall goals, main technical and non-technical priorities, and a research and innovation roadmap for the new European media environment. The main task achieved has been the publication of the Strategic Research and Innovation Agenda (SRIA 2018), that gathers the strategic importance of Convergence and Social Media, and provides a detailed vision for this ecosystem in Europe, analysing the associated strengths, weaknesses, opportunities and threats. The SRIA sets out the objectives and goals to be accomplished next years (up to 2025) by the stakeholders, policymakers and all the relevant actors of this sector.

The SRIA aims to provide keys for the evolution of technology and anticipating radical changes or 'technology shocks', making visible the next wave of technologies and services to be brought to market on a short term. Technology evolution as a driver of economic growth, adds substantially to economic activity, helps to create jobs, strengthens competitiveness and offers unprecedented opportunities for growth among small businesses and medium sized enterprises, the most in the sector.

The SRIA is the output of a process encompassing the collection of inputs coming from a wide range of sources, analysis, workshops, stakeholder events involving experts and multiple stakeholders. From the SRIA it clearly emerges that it aims at promoting excellent research, defining solutions supporting the creative communities, consumers and enterprises able to deal with the most intriguing challenges, and to build cooperation among researchers and innovators. VITAL MEDIA supported and contributed to the creation of bridges between creatives and technology-based companies fostering cooperation and the creation of a new enriched environment for the sector.

SRIA is fed from the gathering of various media ecosystems and actors (from large industry players, to SMEs and researchers) from all over Europe and contributes to bringing new ideas, priorities, timing into the European arena; including ways to leverage private and public R&D investment.

This latest version of the NEM Strategic Research Agenda (SRIA) has the objective to contribute to the next Framework Programme (beyond H2020) in order to help the Commission to define the content of the related Objectives.

The NEM SRIA 2018 document is planned to be presented and approved by all current NEM members following the usual procedure. A final version will be presented and discussed within NEM Steering Board meeting (26 members) and finally, including potential corrections and amendments, approved during the next NEM General Assembly.

### **SRIA structure and main goals**

The Strategic Research and Innovation Agenda is the new strategic roadmap for the media technology research, development and innovation developed by VITAL MEDIA and the New European Media technology platform. It takes into account both the evolution of technology as well as radical changes or 'technology shocks', including how this new paradigms will interact with human users in a broad sense, and the business and other non-technical implications.

It aims to provide a guide to future actions in public and private funding programmes to ensure that research is adequately supported and funded, and media, as a vertical representing a big European sector, and related technology are promoted in the most important on-going innovative initiatives within EU. Thereby, the position of creative and media community regarding the main European technology trends, aiming at ensuring that all the main innovation initiatives may take into account the media sector needs, will be well established.

The SRIA proposes a mission oriented R&D development that will meet the societal and market needs, will maintain and extend the industrial leadership, will be aligned with the environment protection and the energy savings, and will ensure safety and security, while prioritising research, through innovation and education.

The new document reflects the common view of the NEM community on a higher strategic level taking into account the constantly changing R&D and policy landscapes. At the same time this document represents an important instrument towards public bodies such as the European Commission.

A major challenge in this work was to further increase the constructive involvement of a larger number of NEM members into the SRIA building process. Consequently, NEM members were encouraged to participate actively at various occasions and, in addition, a

new online and paper survey was performed to identify the updated portfolio of research challenges in NEM.

The proposed SRIA document consists of six sections: Introduction, Vision, Business&Market impact, User vision & requirements, Policy, regulatory and standardization issues and Enabling technologies. It has focused in providing a wide vision of the European media and content sector, gathering not only the technological point of view through collecting the enabling technologies (viewed as essential by the experts) but also the market and business implications, and highlighting how the user-centric approach needs new approaches in terms of human factors and skills developments.

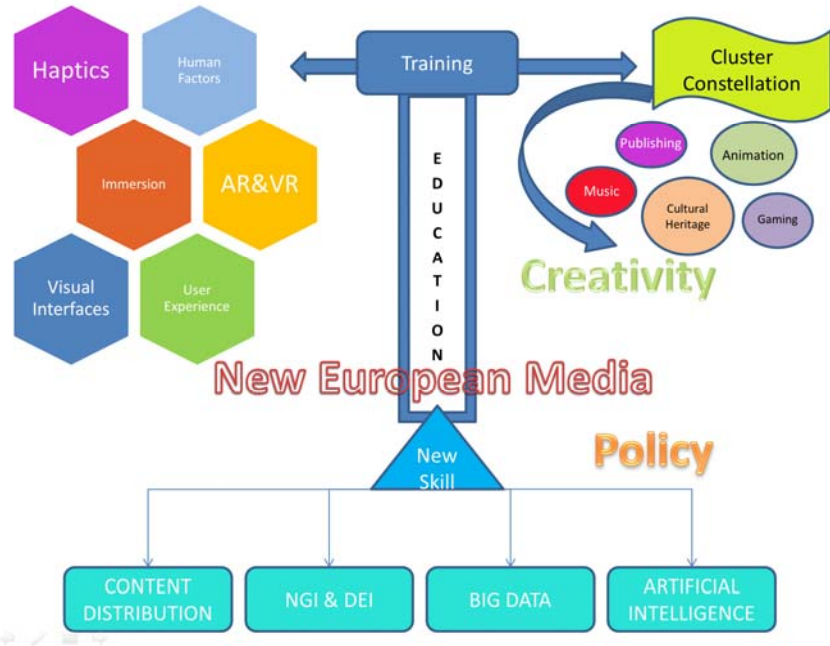
Additionally, an statement on the position with regards to Digitalising European Industry (DEI) & New Generation Internet (NGI) initiatives has been collected, a detailed roadmap has been defined for Europe until 2025, and the main issues regarding international cooperation have been analysed.

## **Working methodology**

The NEM SRIA is based on the previous editions, (last published version is SRIA 2016) on several previous white and position papers, integrating creative industries inputs through the clusters' involvement. The SRIA summarizes the overall NEM community position, from both Creative and Media players, regarding market and business, key technologies forecasting and research priorities.

The document is the result of extensive discussions and brainstorming with more than 50 experts from Europe's industry (large, medium and small) and academia on strategically important research, development, innovation on Creative content and Media. The topics are based on a range of talks that were given in selected workshops and conferences, by several key speakers, representatives of all ICT ecosystems consisting of; network operators, creative industry, service providers, SME's, regulators and academia. The identified applications and technologies are those that experts believe Europe should invest and carry collaborative research.

The final document consists of a compilation of all the inputs into a homogeneous document and an integrated technology roadmap fostered by VITAL MEDIA project. A global view of the approach is shown in Figure 1.



**Figure 1 NEM SRIA sources**

### Summary of achievements

The media sector current business models are being reshaped by challenging technology and market trends. Media sector is moving to even more personalized services, conceding more power to users, aiming at having users more engaged by powering emotional and social connectivity with the content and people.

Technological innovation will be able to break down many of the functional barriers opening a wide scenario of convergence of broadcasting, internet, and communication services.

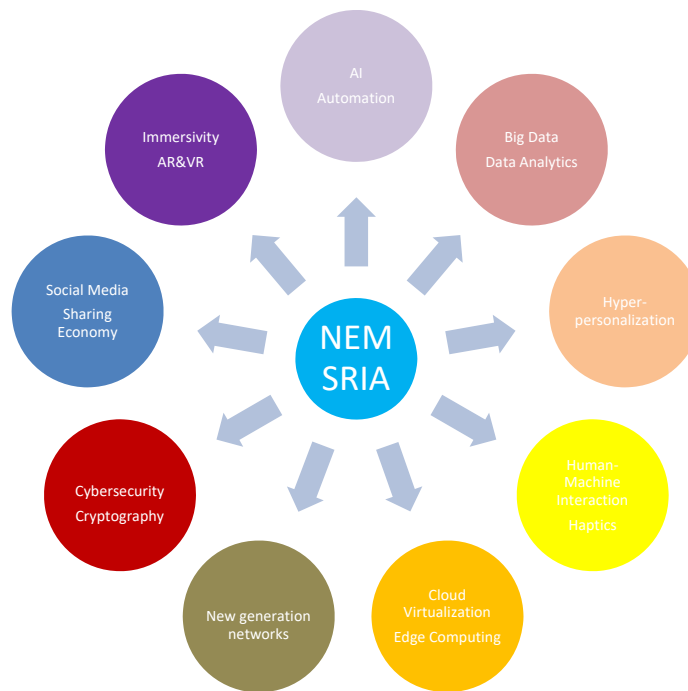
NEM focuses on an innovative mix of various media and creative content forms, delivered seamlessly over technologically transparent networks, to improve the quality, enjoyment and value of life. NEM represents the convergence of existing and new technologies, including broadband, mobile and new media, including creativity, across all sectors, to create a new and exciting era of advanced personalised services.



**Figure 2 NEM SRIA key research domains**

The most relevant technologies co-existing for the envisioned scenario are shown in Figure 3. The topics have been identified as main NEM research and innovation drivers. In the scope of its enlargement towards the creative industries, the NEM Initiative also includes review of the listed innovation areas of application below.

**Book publishing, broadcasting, music, multimedia, advertising and digital signage, gaming, fashion, cultural heritage, design, education & training, user and social engagement and collaboration, storytelling, smart environment, digital society and the impact of new media in lifestyle** has been selected as the most promised sectors in NEM community.



**Figure 3 NEM SRIA most relevant technologies**

The SRIA is presenting the main market and users, and technology trends and their expected impact on the sector. A global view of the principal sectors and topics involved in the transformation, both from business and societal points of views, and all the related non-technical issues involved as well. All the contributions has been gathered from active working groups in the community, each of them led by a partner of Vital Media.

Convergence is mainstream in the new generation networks. It will ultimately involve seamless access to content, achieving the idea of ATAWAD (anytime, anywhere and on any device). All the potential combinations of content, networks and devices will provide very different service scenarios, providing adequate quality of experience. These paradigms are going to be further addressed by consolidating new networks capabilities (such as 5G networks) with an improved management (such as SDN - Software Defined Networks). User-generated-content and the media shared by social networks are completely changing the media flows through the network, leading to a need for a higher uplink bandwidth. Since currently the majority of Internet exchanged data is media and content, it is of utmost importance to include and promote content technologies in the new developments for both, research and business development purposes.

Next Generation Internet will take content and media experience to a new era, going beyond improving technical capabilities such as bandwidth, intelligence, scalability and performance. It will include immersive technologies, multimodal interaction and hyper-personalized media services, including social media and social networking.

Immersive technologies are going to enable even more natural experiences and natural interactions with objects and/or remote people very similar as real-time face-to-face



experiences and interactions. Immersive content will offer novel experiences aiming to improve connection, information, control, cooperation and interaction. Virtual reality (VR) and augmented reality (AR) transform the way individuals interact with each other and with software systems creating an immersive environment. Immersive experiences with AR and VR are expanding beyond visual immersion to include all human senses.

Immersive, interactive, emotional, aesthetic, entertaining experiences have become the key elements of human existence, having users, even those with no skills or technical knowledge, more active and involved in advanced and interactive experiences. Immersion encompasses sensorial and interactive environments to experiment a "sense of presence" in artificial, interactive, virtual created scene or 'world' within which users can immerse themselves. Immersivity tackles with a lot of related technologies: visual rendering and capturing, gaze and gesture tracking, auditory and immersive auditory rendering and capturing, human computer interaction, visual design/user interface (UI), psychophysics and 3D modelling. A strong interdisciplinary approach is going to offer a great opportunity to improve people's lives and jobs by transforming their experiences through immersive technologies, with technology itself tending to disappear, becoming invisible while becoming substantial.

Users demand tailor-made solutions and a personalized customer experience independent of the context of consumption, and service providers are required to achieve a successful seamless cross-device and cross-channel content delivery and user identification. Hyper-personalization aims to adapt a product, service or experience to a specific customer through a deep understanding of each individual needs, preferences and context. Each individual's demands, needs and constraints for content and services should be taken into account before providing a tailor-made solution to that person providing such tailor-made solution in real time i.e. one can have different needs and expectations depending on the situational context (location, time, behaviour, mood, ...). Consumption patterns can vary significantly and affect the customer relationship in real-time impacting overall customer experience. Topics as the capturing of user behaviour, user identity and user data management, content discovery, recommendation systems and artificial intelligence become key enablers for the real application of this new paradigm.

The explosion of multiple kinds of "smart worlds" through the Internet of Things (IoT) will generate more synergies between devices and, devices and people thanks to the information they exchange. All this devices generating and exchanging information will impact how we work and communicate with friends and relatives and how we spend our leisure time. The evolution of IoT is also about transforming our lives and spaces (home,

work, public) into a Cyber-Physical-Social Hyperspace based on the continuous flow of enormous quantity of personal and often sensitive data. A situation where the deployment of new infrastructure and the exploitation of software defined networks, slicing and edge computing capabilities will be essential.

The integrity, confidentiality and authenticity of content and users data managed within services platforms are going to be key point for the future successful deployment of media services.

A complete version of NEM SRIA 2018 could be found in the Annex A of this document.

## **NEM research and innovation priorities**

The views of the NEM membership on future innovation directions, including technology trends and research topics, should be relevant to bodies that fund research and development, among them:

- The European Commission, for the H2020 Framework programme,
- The European Union Member States, for their national R&D programmes,
- Other countries that wish to coordinate national programmes with R&D in the EU.

NEM community is particularly convinced about the importance of the next Horizon 2020 program focusing on solving the key challenges for Content & Creative industries at:

- the infrastructure level providing the basis of the development of new generation networks (innovative BB network, virtualization, cloud, flexible architectures...);
- at the data level from new data analysis capabilities to data integrity (metadata, privacy, security,...);
- at the service level promoting hyper-personalized services and data-driven economy (business models, user experience, personalization,...)
- at the content and format level aiming at a completely new and enhanced user experience (immersivity, interactivity, enriching and engaging new formats that deliver added value).

As well as providing new recommendations on how to support media and entertainment sector from policy and standardization.

Following the update of the NEM Strategic Research and Innovation Agenda (SRIA) in 2018, it has been decided to extract the most important research domains and objectives that have to be pushed in the next WP2018-2020, completely in line with the priorities previously elaborated within NEM community during 2017.

The NEM members are supporting the following list of priorities:

### **1. Immersivity**

Immersivity is called to transform the way individuals interact with each other and with software systems. It's the most impacting pure media technology foreseen as immersivity uses a lot of related technologies: visual rendering and capturing, gaze, gesture, physiological and psychological status tracking, auditory and immersive auditory rendering and capturing, audio/video correspondence, audio/video coding, avatar representation and control, human computer interaction (interaction design and user-centred design), information architecture, usability - the service has to be easy to use and attractive, visual design/user interface (UI), psychophysics and 3D modelling.

## **2. Machine learning and AI for creative industry**

Machine learning has moved to a broader implementation across media industries. And this is still the beginning of more extensive use in a near future. Machine learning is providing not only a powerful tool to work with data but a tool able to learn from data and provide predictions.

Current AI applications in the M&E industry are mainly in four categories: Marketing and Advertising (profiling, recommendation,...), Service Comprehension, Search and Classification, and Experience Innovation. But creative industries start to realize how AI and ML can completely reshape their products and services in many other fields.

## **3. Content distribution**

The media sector is looking for new business opportunities as its current business models are being reshaped by challenging technology and market trends. Media is moving to concede more power to users, to achieve higher levels of personalization, and aims to get them engaged by powering emotional and social connectivity with the content.

These paradigms need to be addressed by consolidating new networks capabilities with an improved management. Content distribution strategies need to be supported by technological advancements driving more appealing user experience within the entertainment & media industry.

Content distribution should be the cornerstone of the so-called New Generation Internet which should take content and media experience to a new era.

## **4. Hyper-personalization**

Hyper-personalization is an advanced and real-time customization of offerings, content and customer experience at an individual level aiming at closing the gap between consumers' desires and offers. Hyper-personalization takes into consideration the different aspects of maximizing opportunities to customize content to consistently target the right audience throughout the customer lifecycle through a deep understanding of each individual context. Thus creates meaningful connections and drives engagement among audience. It's a growing trend that can be applied to most of the media markets.

## **5. Social Media**

Social media platforms have a relevant impact on the modern society since they have increasingly been changing people's way of living and interacting with the rest of the world. Taking advantage of user interaction within the community, and by means of Big Data collection and analytics, Social Media platforms can generate useful insights to update and optimize the existing services and to create new services. The proven engagement of users at the disposal of Social Media platforms, and the ease of exploiting information from them in media and entertainment services and applications, make this topic a pillar of new models of collaborative and data-driven economy.

## 6. Data management, security, privacy, trustability.

Considering the huge amount and relevance of multiple kinds of data that media applications and services within a data-driven economy are supposed to handle in the coming years it becomes extremely important to impose to the different actors a correct management of data, especially for user information. This makes extremely relevant the advances regarding data security and protection, data porting and data integrity (ICT tools, protocols, APIs, systems,...).

Three transversal aspects of future research funding programmes should be specially emphasized:

1. **Human centric:** at the service of the people and the society, **with a more dedicated focus on societal challenges**, i.e. the cultural, societal and political aspects of the creative sector, and how ICT can support progress in this field (e.g. Big Data analytics vs. privacy, User Generated Content)
2. **A more dedicated focus on the different creative sectors and their potential synergies:** fashion, film, design, publishing, broadcasting and games all have their own, specific innovation strategies, and also areas where these overlap - yet project calls do not yet focus on different creative sectors, but on the creative industries as a whole - which does not reflect reality (yet).
3. European media and creative industries ecosystem should be:
  - o Trustworthy, pluralistic and sustainable
  - o Safe, inclusive, humanist
  - o Innovative and competitive

The NEM members would also like to point out that several other transversal aspects were not part of the survey, but they are planned to be taken even more into consideration in future programs. This concerns especially:

- a stronger focus on market-uptake in the overall concept of H2020 programs, including: legal aspects, market research & testing, business modeling, sustainability etc.
- a stronger focus on international cooperation
- a stronger focus on accessibility (which can be seen as part of the societal challenges)

Additionally, the NEM members also stressed the interest in applying these technologies to any media & content sectors such as digital cinema, book publishing, design, fashion, music, etc, through large pilots which could show and validate the relevance of the solutions.

**Working methodology**

To come up with the research priorities, VITAL MEDIA analysed the NEM SRIA of 2018, integrating an industrial, societal and academia vision of the sector, and identified new challenges via ad-hoc working groups and position papers on several of the top topics. This work has been led from VM.

These topics has been opened to any NEM member, following the NEM General Assembly.. Two new big topics regarding social media implications (technical, social and political) for Europe and human factors (human-centric design, inclusion) has been included for the first time as part of the community discussion.

From this process the eight main research areas, and up to 37 research topics has been selected and integrated in the document.

**Summary of achievements**

From the analysis of the different inputs for the complete environments the main enabling technologies and user aspects have been defined. From them, a main focus for the topics has been synthetized.

From a holistic view, media innovation community should foster the development of technologies and knowledge that will make possible a European media ecosystem that is concurrently:

- (i) safe, inclusive, humanist, and
- (ii) innovative, competitive and sustainable.

Most of the research topics identified above should contribute to such a goal. We can summarize them in the following tables:

**Table 1. Strategic goals and innovation areas**

Strategic goal	Research and innovation areas	Focus
<b>Safe, inclusive, humanist media</b>		
Mainstreaming accessibility-by-design.	Standards, technologies and tools for intelligent, auto-adaptive contents and experiences are accessible for	<b>Intelligent, autoadaptive, multimodal contents and experiences</b> for people with diverse hearing, movement, sight, and cognitive <b>abilities</b> ; and/or <b>languages</b> .

	all people.	Methods for <b>hyper personalized assessment and adaptation of multimodal content delivery</b> and display to suit user specific needs (abilities, languages).
Safeguarding the rights of children and other vulnerable groups.	Methodologies, technologies and tools for enforcing restrictions and protocols meant for protecting vulnerable groups.	End-to-end <b>privacy-enhanced methods for preventing access to inappropriate or harmful contents</b> , as defined by common laws, by minors and vulnerable populations.
		Privacy-enhanced safeguard systems for the <b>prevention, detection, mitigation and countering of potential infringement and misuse of own image</b> in media contents or for media benefit; including undue profiling, exploitation and abuse.
Ameliorating the weaponisation of information.	Methodologies and software tools for automatically detecting harmful actions, effects and contents (including multimodal), sources, and propagation patterns that can be used for early warning and campaign containment without restoring censorship or hampering freedom of speech.	Self-regulating methods for mitigating AI-generated <b>filtering bubble effects</b> .
		Detecting and countering the actions of <b>fake news bots</b> .
		<b>Automatic detection and countering of harmful multimodal contents</b> that contravenes law or international agreements (e.g. hate speech, apology terrorism, etc.)
		Automatic methods for <b>detecting and countering manipulated multimodal contents</b> .
Maintaining collective memories; imagining futures.	Standards, methodologies, and tools for enhanced enjoyment, preservation, management and reinterpretation of tangible and intangible cultural heritage, as representative collective memory on top of which imagine common futures.	Piloting of interoperable, non-invasive, <b>immersive experiences for facilitating enjoyment and learning in diverse cultural spaces</b> .
		New methods for <b>capturing, preserving and collectively curating intangible cultural heritage, including contemporary practices</b> in all their richness -not just a cultural manifestation, but the wealth of knowledge

		and skills they convey.
		<b>Open, reusable, multimodal assets and environments</b> for the creation, recreation and representation of collective memories and shared futures.
<b>Innovative, competitive and sustainable</b>		
New accessible software and hardware solutions for the creative industries.	Enhanced, cost-efficient technologies for the capture, processing, hosting, displaying and distribution of multimodal contents in the converged era; includes environmental impact of devices, energy consumption, etc.	Novel <b>immersive content capture HW and techniques</b> (360 cameras and microphones, multi-camera, light field, hybrid technologies, acquisition technologies) sustainable and including eco-friendly materials.
		<b>Standards and formats</b> for the <b>representation, processing and distribution of interoperable multimodal and hybrid contents</b> .
		New methods and technologies for <b>optimizing production and post-production processes</b> : automation relying on emergent technologies (e.g. AI, cloud, IoT..), multimodal editing, collaborative editing, immersive/interactive content production tools etc.
		Novel and improved <b>HW and technologies for the consumption of new forms of media content</b> (interactive, immersive, personalized, multimodal) that increase realism and sense of presence, prevent audience isolation and preserve user privacy.
	Seamless, non-invasive sensing, sensing inducing and interpretive technologies for effective multisensory integration in immersive	<b>Sensing and interpretive technologies</b> for capturing, processing and preserving data from <b>multiple sensors</b> , extract relevant features, and infer relations from an increasing array of data and sensor inputs useful <b>for human-machine and human-</b>

	experiences.	<p><b>human interactions.</b></p> <p>Smart <b>sensing inducing technologies</b> for evoking <b>multisensory sensations</b> in collaborative and interactive environments.</p>
	Monitoring and assessment of QoE and novel quality measures for new media and contents.	<p>Advanced <b>QoE definitions and metrics</b> for the characterization, modelling, manipulation and evaluation of sensory processes involved in <b>immersive storytelling.</b></p> <p>Privacy-enhanced and cost-efficient methods, SW tools and applications for <b>enhanced user-aware monitoring and evaluation</b> through precise QoE measurements in real environments.</p> <p><b>Automatic quality control</b> functions, including predictors, for optimizing end-to-end content production processes.</p>
Fostering new business models, services and products for next generation media and contents ensuring plural and quality media and CCI ecosystems	Boosting a transparent, fair, participative, accountable and ethic data-centric economy.	<p>New <b>Social Media network paradigms</b> and enabling technologies for <b>community-owned social media networks and platforms, social connectivity, and social media services.</b></p> <p>Methodologies, standards, platforms and tools for the <b>valuation and management of copyright information and licenses, and rights data management</b> in general, including a focus on <b>user-generated-content ownership</b> and copyrights.</p> <p>Methodologies and tools for <b>estimating and managing the information and economic value of user data</b> hidden in big data (e.g. personal data, data coming from sensors, etc.) and <b>new sustainable models for exploiting the user data</b> in personalised service provisioning.</p>
	Hyper-personalized media and seamless CCI services in a converged environment	New <b>privacy enhancing technologies and methods for mass customization, user profiling, targeting</b> and seamless <b>user-tailored experiences delivery</b> (e.g. cross-



		device, cross-channel)
		Development of methodologies and platforms for <b>detecting bias and discrimination in automated decision making</b> by algorithms operating in the open web (e.g. targeted advertising, e-commerce and online price discrimination).
Empowering users and consumers to play active roles in a rich, transparent, plural and competitive European media ecosystem	Distilling and transferring necessary knowledge for CCI stakeholders to effectively adopt and exploit the novel media and content technologies.	Systematization and standardisation of new languages and narrative possibilities, including <b>notation, composition rules and storytelling guides for new contents</b> (e.g. immersive media).
		<b>Piloting and fostering early adoption of novel technologies in CCI vocational training</b> to obtain feedback from young, creative and future CCI professionals, while increasing their competitiveness due to early exposure.
		Creation and maintenance of <b>open repositories of multimodal content assets, commons, and environments, protected by open licenses</b> , for the use of in-training and job seeking CCI professionals (e.g. practice, portfolio creation).
	Promote media literacy and digital skills initiatives, at all ages, for increased transparency and user awareness.	Mainstreaming <b>media literacy contents into early education curricula, and fostering educational activities that expose and explain how media content technologies work</b> , and how they contribute shaping public perceptions, identities and opinions, and consequently culture and society.
		Tools for <b>opening up and giving visibility to collective dynamics and interaction patterns on online participation platforms, and knowledgebase (e.g. Wikipedia)</b> , in order to

		improve collective awareness and foster effective and transparent deliberation, and collective creation processes.
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## Position papers

Position Papers aim to focus on specific topic in the landscapes of future research and economy from the perspective of New European Media ETP. They express the common view of the NEM community and explain the need for public support for future collaborative research activities in the Media and Creative industries domain. These position papers represent a high-level view for themes, challenges and opportunities that would be relevant for specific topic and particularly in the context of the upcoming H2020 Framework Programme.

The position papers follow up the previous NEM SRIA and they are updated regularly in order to reflect new inputs from NEM members. As complement to these Position Papers, NEM is publishing a list of research topics prioritised in line with comments and ideas expressed by the NEM community that may help to catapult Europe to the forefront of IT development.

The position papers are built upon a three sections structure. Section I describes the scenario settings, an approach to the state of the art for the concrete topic, whilst Section II gathers the main technological trends. Section III concludes on the potential impact of the addressed themes to market, societal challenges and vertical markets involved.

## Working methodology

VITAL MEDIA has followed well recognized approaches to community consultation and engagement, including:

- Initial consultation with the community boosting to get people involved from the very beginning. Fostering brainstorming and other creative and collaborative working methodologies.
- On-going engagement.
- Keeping people informed and up to date with activities and achievements
- A work model based on iterative collaboration on the central points of the publication and cross corrections

Different methods have been used for consulting and engaging the community, as the VITAL MEDIA on-line platform, NEM website, email updates, online surveys, the NEM EG calls and NEM SB meetings and the NEM GA meetings.

## Summary of achievements

VITAL MEDIA streamlined the first three position papers coming from NEM community regarding immersivity, hyper-personalization and content distribution in September of 2017, and one white paper “Policy dialogue in Convergence and Social Media: requirements” in November 2017. The second year, the position papers elaborated has dealt with data for media, Artificial Intelligence (AI) in the creativity industry and the future of social media. Finally, a white paper “Policies and regulation in the Social Media Convergence” in a joint working group besides I3 and Mediaroad CSAs has been deployed.

**Immersivity** is very likely to be one of key drivers of media in the upcoming years to reshape the way contents and services are provided and the user interaction is completely renewed. There are a lot of technical topics along the value chain involved, so it can integrate many NEM actors as well. It should encompass activities as: Storytelling creation for immersive and interactive content, Mixed content immersive technology, Content generation tools for immersive and interactive content, Science, Technology and arts in immersive and interactive media.

**Hyper-personalization** takes into consideration the different aspects of maximizing opportunities to customize content to consistently target the right audience throughout the customer lifecycle. Thus, it will create meaningful connections and drive engagement among audience. It can be applied to most of the media markets and vertical sectors VM has compiled. It also encompasses the ATAWAD (anytime, anywhere, any device) concept which provides to the end user the best format according to the device used.

**Content distribution** gathers all the new trends on the evolution of networks and the provisioning of media services. These include the increased capacity of the actual networks, the potential impact of 5G networks for new business models, the increasingly convergence of “hybrid” services built upon the combination of different networks. The convergence between broadcast, multicast and unicast as well as the potential of SDN networks are integrated in the document. All of them should be a tremendous opportunity for the media and content industry.

**Policy dialogue in Convergence and Social Media: requirements.** In an increasingly complex context of convergence and social media, where continuous innovation changes are taking

place due to the entry of new players into the market and the need for traditional stakeholders to transform themselves, the policies and regulations governing this sector need to be discussed and reviewed on the basis of changing needs. In this perspective, the cooperation of all the stakeholders involved to exchange ideas, current and new needs deriving from these changes becomes fundamental to build in a balanced way an appropriate policy framework that can support the future economic and technological development of the convergence and social media sector.

**Future of Social Media and Enabling Future Social Media.** The first white paper elaborates on several aspects of the future social media by providing relevant service and application scenarios and by deriving corresponding requirements and needed actions on policy and regulation as well as on research and innovation in the area. It has been published in December of 2017. In the second one, published in June 2018, the previously identified aspects, listed below, are further elaborated, providing concrete ideas on the needed approach in the future:

- Data protection
- Trust
- New areas in social media
- Business and cooperation models

**Data for media.** With the growth in data, content, and end-users, information will need to be metered and managed. Data is fuelling many organizations across all industries and 2020 will see the rise of predictive analytics, collaboration and workflows that impinge upon all aspects of media business.

Big Data can open up the lane to fast success to businesses in the entertainment and media industry. It can help negate the biggest risk factor in the industry – changing customer behaviour. In the end, it creates a new ecosystem where customer experience is put as the centrepiece. Insights from data help innovation and make smarter decisions based on facts. The main challenges and risks regarding the unstoppable integration of big data within media workflows and business models are the main purpose of this position paper.

**AI in the creativity industry.** The purpose of this white paper is to understand future technological advances in AI and their growing impact on creative industries. This paper addresses the following questions: Where does AI operate in creative Industries? What is its operative role? How will AI transform creative industries in the next ten years? This white paper aims to provide a realistic perspective of the scope of AI actions in creative industries, proposes a vision of how this technology could contribute to research and development works in such context, and identifies research and development challenges.

**Policies and regulation in the Social Media Convergence.** Another white paper in order to provide the final results, conclusion and recommendations coming from those activities and dialogue is in progress and will be delivered in September 2018 by Vital Media, I3 and MediaRoad projects, as results of the cooperation on those issues among those CSAs.

There is also an agreement, coming from the last NEM Steering Board meeting (and with the commitment from VM to be fostered), to collect inputs from the NEM SB members, in order to create new positions papers for Digital storytelling and the position from the creative industries.

## **Policy related activities**

The activities related to policy aim at taking care of fostering the dialogue between Policy makers and the Convergence and Social Media sector as well as creating concrete relations between policies and research/technological fields.

In this perspective those activities are focusing on:

Analysing European and National Policies on Convergence and Social Media.

Implementing and managing a dedicated area in the VITAL MEDIA social collaborative platform for storing all the documents, such as regulations, strategic agendas and any other kind of relevant information.

Opening discussions and facilitating the exchange of information.

Registering and informing about all relevant events in this topic.

## **Working methodologies**

In order to carry on the activities related to foster the dialogue between policy and research/media sectors, Vital Media project is following the steps shown in the picture and described below:



**Figure 4 Policy activities**

- Desk/general researches
- Policy requirements Survey
- Discussion (Workshop and Online discussion)

The activities have started with a general research and analysis of the state of the art in the media sector about policies and regulations in order to have a first idea about the current status, on going activities and emerged needs (Annex 3). On the base of those studies, a focused survey has been launched inside the NEM community, in order to collect the opinions from media and creative community on which are the relevant topics and related priorities to be addressed and stakeholders to be involved in dialogue related to Media Convergence and Media Policy (Annex 4). The final step is to foster the discussion both by face to face meeting (focus groups, workshops etc) and online tools (forum, NEM Collaboration Platform based on OPENNESS).

### **Summary of achievements**

At the current status, based mainly on the “policy requirements Survey” and the discussion during the Policy Workshop (during NEM GA), the main topics of the discussions, methods to be used to address these topics and stakeholders to be involved in the process have been identified.

The table below shows the suggested topics and the preferences for each of them (where 5 very important) of the NEM community (%) according their answers.

	0	1	2	3	4	5
Customer Protection Policy: new decisions and impact on Media domain	6%	0%	6%	12%	18%	<b>59%</b>
Digital Single Market (DSM) strategy for Europe vs Media domain: policy impact and future expectations	6%	0%	0%	22%	6%	<b>67%</b>
Data protection and privacy issues for Media sector: policy impact and future expectations	6%	0%	0%	11%	17%	<b>67%</b>
Copyright rules vs impact on media sector: current status and next developments	6%	0%	6%	18%	24%	<b>47%</b>
Revision of the AudioVisual Media Services Directive (AVMSD) in order to address digital single market needs, new way of consumption and technological changes	6%	0%	6%	<b>41%</b>	12%	35%
Relevance of self-regulation and co-regulation for media domain regulation-	6%	6%	12%	<b>29%</b>	<b>29%</b>	18%
Relevance of independent and trusted audience measurement for media domain	6%	11%	<b>17%</b>	<b>17%</b>	<b>17%</b>	<b>33%</b>
Standardisation and interoperability policies: current status and next developments	6%	0%	0%	12%	<b>47%</b>	35%
Relevance of policy framework for support of research and innovation in the media sector	6%	0%	0%	6%	35%	<b>53%</b>
Current activities of "Media Policy directorate I"	6%	0%	0%	<b>56%</b>	19%	19%

**Figure 5 Policy requirements survey**

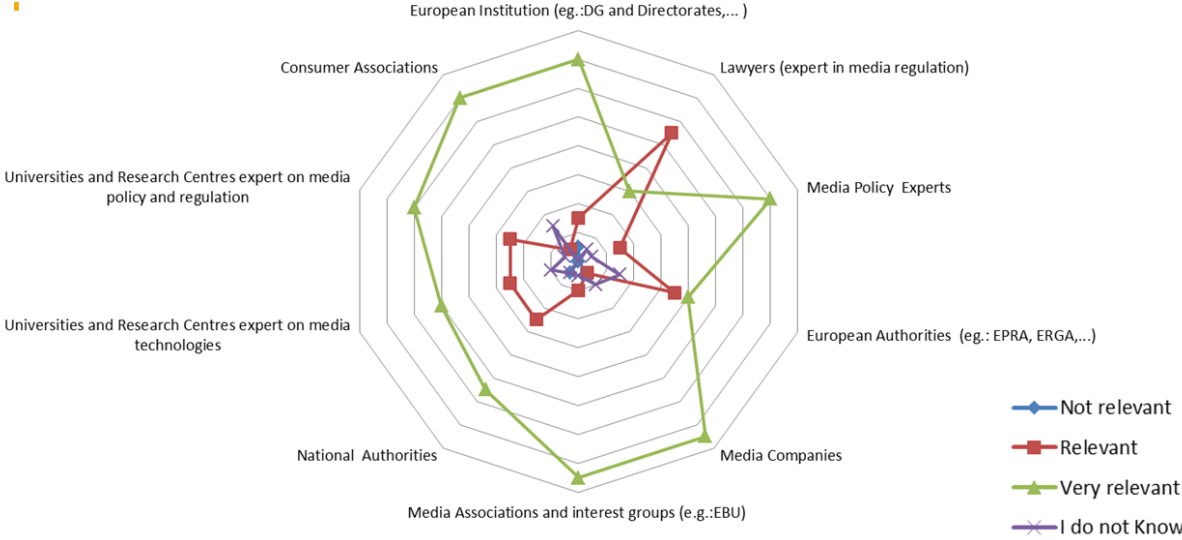
Consequently, the preferred topics in order of importance are:

1. Data protection and privacy issues for Media sector: policy impact and future expectations;
2. Digital Single Market (DSM) strategy for Europe vs Media domain: policy impact and future expectations;
3. Customer Protection Policy: new decisions and impact on Media domain;
4. Relevance of policy framework for support of research and innovation in the media sector.

Others topics suggested, not currently considered, are:

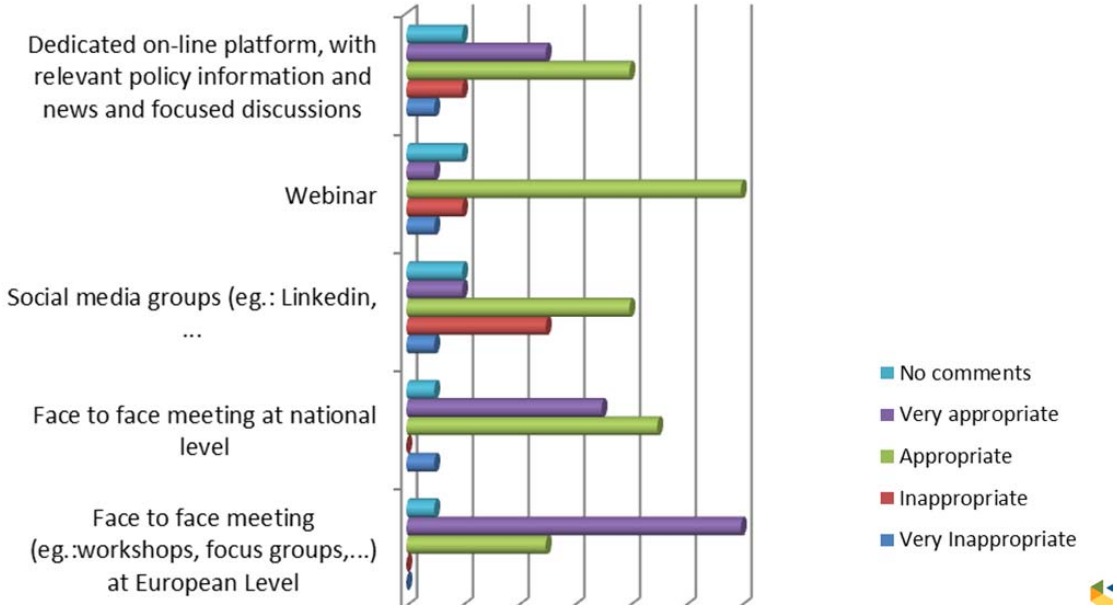
- Media and information literacy
- Accessibility to audiovisual contents
- Media (news and information) plurality and diversity
- Media trust and verification.

As is showed in the figure below, media companies, media associations, European institution, media policy expert but also consumer association result the main actors to be involved.



**Figure 6 Actors involved in Social Media and Convergence**

While the channels and tools considered more appropriate have been in order of importance: the face-to-face meeting at both European and national level and the dedicated on-line platforms.



**Figure 7 Channels and tool for Social media and Convergence**

In order to foster the dialogue, a specific workshop on Policy was organised and held during the NEM GA. The main scope of this workshop was to bring together, at the same table,



media stakeholders and policy makers in order to improve and foster the dialogue among them and to identify and share views on challenges, guidelines, requirements, and barriers in the European Media domain.

During this workshop, the following items were presented:

- the results of the Policy Requirements survey,
- the approach from I3 on the policy activities in order to support Media sector jointly fostering Policy Dialogue at European,
- the point of view of Media Representatives (VRT and EBU) and current EC initiatives on policy on the Media sector (Vita Jukne -EC unit I-2, copyright; Emmanuel Joly - EC unit I-3, Media Programme; Paolo Cesarini - Head of EC Unit Convergence and Social Media).

Other dialogue opportunities were face to face events. Among them:

- the NEM summit in November 2017,
- the The Arts+ (Frankfurt Book Fair) in October 2017, and
- “The Future of Media Innovation in the EU Research Agenda post-2020” in May 2018.

With this perspective, one of the main achievement is to deliver policy recommendations at the end of the project, as a result of the policy dialogue conducted over the project lifetime with a broad range of stakeholders. This results have been shared with the I3 project, with which Vital Media is cooperating and working together on the same online platform “OPENNESS” (managed by Vital Media) in order to launch the discussion on the identified topic to be addressed. In addition, a white paper was prepared and provided in November 2017 with the early results about the policy survey.

Another white paper aiming at providing the final results, conclusion and recommendations, coming from those activities and dialogue, is in progress, and will be delivered in September 2018 by Vital Media, I3 and MediaRoad projects, as a result of the cooperation on those issues among those CSAs.

Finally, inside the OPENNESS platform, a repository has been created about policy, where relevant documents are constantly uploaded and accessible for the platform users.

## **Contributions to media and convergence working groups**

In parallel, VITAL MEDIA has led the discussion groups within the NEM community and has been able to undertake following activities: Discussion, Establishment and Launch of NEM Strategic Working Groups. NEM European Technology platform, during the 27th NEM Steering Board meeting held in Brussels on 10 May 2017, decided to setup 4 working groups in 2017 in order to define the NEM strategies in several contexts:

- NGI WG - The Next Generation Internet flagship
- DEI/DIH WG - The Digitalising European Industry initiative
- 5G Pilot WG - The 5G PPP phase 3 pilots
- FP9 vision WG - The Next Framework program 2021-2027

Provide a vision for new European media as technology enabler and core sector to be integrated in some of the most relevant initiatives launched by EC (i.e. NGI, Digitalising European Industry initiative).

Identify opportunities and relevant initiatives for NEM Community through promoting Media in the next Framework Program 2021-2027 and large scale experimentation for media industry in cooperation with other industries (verticals) in the context of 3rd 5G PPP phase.

### **5G Phase 3 – Media Pilots WG**

NEM joint Working Group with Network2020 ETP (NEM 5G WG) had the objective to identify opportunities for large scale experimentation for media industry in cooperation with other industries (verticals) in the context of 3rd 5G PPP phase and to produce a paper proposing a set of use cases and pilots that could be developed in the framework of the future H2020 - ICT-19-2019 Call - Advanced 5G validation trials across multiple vertical industries - call deadline 14th of Nov. 2018. Media has already been identified as one of these verticals that will be able to help validation of the 5G KPIs such as bandwidth, latency or security/privacy. The paper provided by this working group collect a number of potential use cases/pilots that could be developed together with description of the KPIs that they will be able to validate.

Joint position paper released in February 2018 could be found in Annex I

## **Digitalising European Industry (DEI) / Digital Innovation Hub (DIH) WG**

The objective of the DEI/DIH WG was to prepare a white paper describing what are recommendations, strategies, best practices to develop hubs and innovation ecosystems in terms of media, content and creative industry. The main role of DIH is to help the local industry to use ICT technologies in their process.

It is obvious that media, content are used in the designing phase but also in dissemination activities. Being NEM organized as “cluster-of-clusters”, most of these clusters should be considered as Digital Innovation Hubs (DIH) for Digital European Industry (DEI). The NEM ETP should take the umbrella role of animating the Media DIH and try to catch funding in the WP2018-2020 and further in FP9.

NEM identified national, regional clusters as potential candidates for DIH.

The network of Media & Content Digital Innovation Hub (NEM DEI WG) will play a fundamental role in building the community of developers adopting and contributing to Media & Content technologies adoption in European industry, acting at local level. The NEM DIH WG aims at supporting the creation and the operations of Media & Content DIH nodes worldwide.

Media & Content industry have key ICT technologies that could help European industry in their daily life, such as Augmented reality, Virtual reality in the design phase of new products but also hyper-personalization in the commercial phase and also Social media as well as Media analytics to help customer needs identification.

Three main activities have been planned:

- To support the growth and consolidation of the Media & Content community by working locally on disseminating and introducing the technology to interested parties
- To build local communities, where the position and role of Media & Content would be developed, boosted and consolidated.
- To develop usage of “media and content products and solutions” inside the different industries of their territory

The following action plan is proposed to go further in the Media & Content sector: organization of workshops in key regions with all DIH in order to present existing services, platforms and share best practices and also infrastructures

Many DIH have infrastructures open to their local ecosystems, it will be good to make them known outside the local / regional ecosystems and open it to any industry in Europe or even duplicate it in other DIH if any interest. There is also a need to align standardization in order to facilitate interoperability.

- Identification of Key regions for Media & Content (several DIH in Smart specialized region)
- Management of the heterogeneous missions of DIH and identify complementarities

Complete version of paper, released in December 2017, can be found in Annex J.

### **Next Generation Internet (NGI) WG**

The objective of NEM NGI WG was to provide the NEM recommendations regarding the Next Generation Internet Initiative. Today media and content are just partially present in the NGI program, so the ambition of this WG was to provide a consistent description of the contribution of media, content and creative industry to NGI initiative.

The paper from this NEM NGI WG produced in January 2018 has been proposed to several support action project working on the definition of the NGI Programme.

NGI shall enable the next wave of innovations in digital services for citizens and businesses, and shall accelerate industrial transformation and social inclusion including learning and skills.

Media and content should have a great contribution in order to bring the entertainment dimension to the NGI. Today, most of the social media usages are around pictures and video sharing, and NGI should encompass this domain in order to reach the objective of a human centric Internet.

Two big approaches have been taken into account, first one regarding advanced consumer applications, the second one dealing with secure, energy-efficient and high performance NGI network and service infrastructures

Additionally, the most impacting technology areas and research domains have been discussed. They are listed below.

1. Personal Data Spaces
2. Internet of Things
3. Privacy, Data, Blockchain
4. Artificial Intelligence
5. Distributed architectures and decentralised data governance
6. The future of Social Media
7. New forms of interactions and immersive environments
8. Other important technologies
  - Discovery and identification tools
  - Software defined technologies
  - Networking solutions beyond IP

Complete version of position paper released in January 2018 could be found in Annex K

### 3. CONCLUSION

Media and creative sector is strategically important in terms of research, development, innovation and as an integrated market of big economic impact. However, although huge, it is a very fragmented market, and this is why initiatives such as NEM, that bring together the aims on creative content and media and technology enablers, are key for the management and visibility of the sector; acting as one of the channels of external advice for the programming and implementation of Horizon 2020.

New media is marked by the very fast evolution of its products and their components, which are subject to very short R&D cycles. Thus, analysis of the future societal and business opportunities in the wider media and creative sector become crucial in order to get a predominant positioning for the European enterprises.

VITAL MEDIA has worked to technical, challenging, multi-sectorial, market-driven vision of the content and media ecosystem, and, on the other hand, to establish itself as interlocutor of the community in front of the authorities. It's important for industry leaders to exchange ideas and focus on developing an ecosystem-driven approach.

Thus, VM has collaborated to fostering networking opportunities along the value chain to address cross-sectoral challenges, and promoting the move towards more open models of innovation.

The objective of elaborating White and Position Papers within NEM is to convey the views of the NEM community and, thus, to increase the economic impact of the sector. The ambition of Vital Media is to feed the process of NEM position paper creation in order to have a continuous and updated voice of the community through publishing flow of papers. The second idea is to have already available position paper on several crucial aspects related to NEM in order to be in position to react quickly to any external consultation (coming from any stakeholder or a simple member of the NEM community), even to explain the need for public support for future collaborative research activities in this area.

The eight position papers, two white papers, and the documents coming from the working groups tackle trending topics both technical and economical. The work done in the preparation of these papers show that there is an important potential for growth and expansion of the sector, with the impact in terms of jobs and social and economic wealth.

To achieve this NEM foundational objective, VITAL MEDIA has established four streams of activities that consists of:

- Identifying the points of action that allow sustained and sustainable development of the media and content sector;
- Determining the action lines, the stakeholders, the necessary resources and critical paths;
- Establishing the roadmaps that lead to the achievement of the objectives with measurable and representative KPIs
- Providing main research and innovation topics in a coordinated action with EC and national authorities.

SME's and Research centres are a meaningful part of the particular ecosystem of creative industries. They both require a special treatment due to their volume and their vulnerability. They are called to be key pieces in the overall impact and they need to be protected and supported by means of entrepreneurship aids and networking.

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- NEM SRIA 2025

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Community inputs gathered for a white paper on the strategic Research and Innovation Agenda in 2025 contributing to the design of the next FP9

Consolidation no. 4, 25 June 2018



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## 1) Introduction

This new version of the NEM Strategic and Innovation Research Agenda should be considered as the description of the Media&Content mission. Such a mission should have the objective to design and develop the future European immersive environment. It should be used for entertainment as well as in education but also in manufacturing design or in health services.

In order to achieve such a goal, there is a need to study and to develop a number of technologies that are necessary and also to experiment them in several domains through large scale pilots in order to check the relevance with end users.

Most of these technologies should be part of the Next Generation Internet initiative which should encompass the development of an immersive open platform facilitating the use of immersive technologies in many sectors.

This document is proposing a vision, the potential business impact, the standard and regulation that need to be addressed and the technologies that needs to be studied. To reach the final goal, a roadmap has been designed by 2025 in order to position on a time line the necessary research that have to be conducted.

## 2) Vision

The media sector current business models are being reshaped by challenging technology and market trends. Media sector is moving to even more personalized services, conceding more power to users, aiming at having users more engaged by powering emotional and social connectivity with the content and people.

Technological innovation will be able to break down many of the functional barriers opening a wide scenario of convergence of broadcasting, internet, and communication services. Convergence will ultimately involve seamless access to content, achieving the idea of ATAWAD (anytime, anywhere and on any device). All the potential combinations of content, networks and devices will provide very different service scenarios, providing adequate quality of experience. These paradigms are going to be further addressed by consolidating new networks capabilities (such as 5G networks) with an improved management (such as SDN - Software Defined Networks). User-generated-content and the media shared by social networks are completely changing the media flows through the network, leading to a need for a higher uplink bandwidth. Since currently the majority of Internet exchanged data is media and content, it is of utmost importance to include and promote content technologies in the new developments for both, research and business development purposes.

Next Generation Internet will take content and media experience to a new era, going beyond improving technical capabilities such as bandwidth, intelligence, scalability and performance. It will include immersive technologies, multimodal interaction and hyper-personalized media services, including social media and social networking.

Immersive technologies are going to enable even more natural experiences and natural interactions with objects and/or remote people very similar as real-time face-to-face experiences and interactions. Immersive content will offer novel experiences aiming to improve connection, information, control, cooperation and interaction. Virtual reality (VR) and augmented reality (AR)

transform the way individuals interact with each other and with software systems creating an immersive environment. Immersive experiences with AR and VR are expanding beyond visual immersion to include all human senses.

Immersive, interactive, emotional, aesthetic, entertaining experiences have become the key elements of human existence, having users, even those with no skills or technical knowledge, more active and involved in advanced and interactive experiences. Immersion encompasses sensorial and interactive environments to experiment a "sense of presence" in artificial, interactive, virtual created scene or 'world' within which users can immerse themselves. Immersivity tackles with a lot of related technologies: visual rendering and capturing, gaze and gesture tracking, auditory and immersive auditory rendering and capturing, human computer interaction, visual design/user interface (UI), psychophysics and 3D modelling. A strong interdisciplinary approach is going to offer a great opportunity to improve people's lives and jobs by transforming their experiences through immersive technologies, with technology itself tending to disappear, becoming invisible while becoming substantial.

Users demand tailor-made solutions and a personalized customer experience independent of the context of consumption, and service providers are required to achieve a successful seamless cross-device and cross-channel content delivery and user identification. Hyper-personalization aims to adapt a product, service or experience to a specific customer through a deep understanding of each individual needs, preferences and context. Each individual's demands, needs and constraints for content and services should be taken into account before providing a tailor-made solution to that person providing such tailor-made solution in real time i.e. one can have different needs and expectations depending on the situational context (location, time, behaviour, mood, ...). Consumption patterns can vary significantly and affect the customer relationship in real-time impacting overall customer experience. Topics as the capturing of user behaviour, user identity and user data management, content discovery, recommendation systems and artificial intelligence become key enablers for the real application of this new paradigm.

Users demonstrated they are keen to give away much personal data in exchange for good and free of charge services. Users should be aware of the level of privacy they get in accessing a given service. The challenge is how to improve user awareness and participation in process of management and exploitation of personal data in personalized service provisioning.

The explosion of Internet of Things (IoT) will generate more synergies between devices and people thanks to the information they exchange. All these devices generating and exchanging information will impact how we work and communicate with friends and relatives and how we spend our leisure time. The evolution of IoT is also about transforming our lives and spaces (home, work, public) into a Cyber-Physical-Social Hyperspace based on the continuous flow of enormous quantity of personal and often sensitive data.

The integrity, confidentiality and authenticity of content and users data managed within services platforms are going to be key point for the future successful deployment of media services.

### 3) Business&Market impact

#### 3.1) Market and trends overview

The global Media & Entertainment market, after reaching 1.9 trillions of US dollars, continued to grow in 2017 by almost 5% achieving near to 2 trillion of \$, where US market share represents around the 1/3 of the global figure [1]. Many corporations in the Media & Entertainment sector recently experienced significant convergence and moved from their traditional businesses, such as film production, news, etc., to offer a multitude of various services across the sector. The key trends nowadays which will continue in the coming period are:

- Further industry convergence and consumer involvement as creator and industry driver
- Further development of interactive devices as technical drivers
- Persistent piracy and lack of strong enforcement of copyright laws
- Leading sector's areas are augmented and virtual reality, eSports, streaming and video: OTT/VOD and multichannel networks (it is expected that more than 257 million of VR headsets will be in use by 2021 [7])
- Media development consumption will diversify continuously. Story driven content will become even more relevant and deep. Social media will mix real life and reality TV.

Due to significant increase of world population having access to the global Internet, particularly thank to the currently increasing mobile coverage practically allowing that we are all on line, overall consumption of various Media & Entertainment services is significantly growing as well. Thus, while considering humans ability for multitasking, almost 40% of people's time is spent on media consumption and usage of Media & Entertainment technical devices [2]. While analyzing the media consumption only, almost 50% belongs to digital media sources beside classical TV (~ 30%) and radio (+10%) as well as printed and other types of media.

Even, the Media & Entertainment market will continue to grow, in particular in so-called low per capita markets as well as China and India, and the consumers will continue to spent more money to use the related services, but overall share of the global GDP by the Media & Entertainment sector will decrease (Fig. 1) causing also lost of revenues in the sector [3].

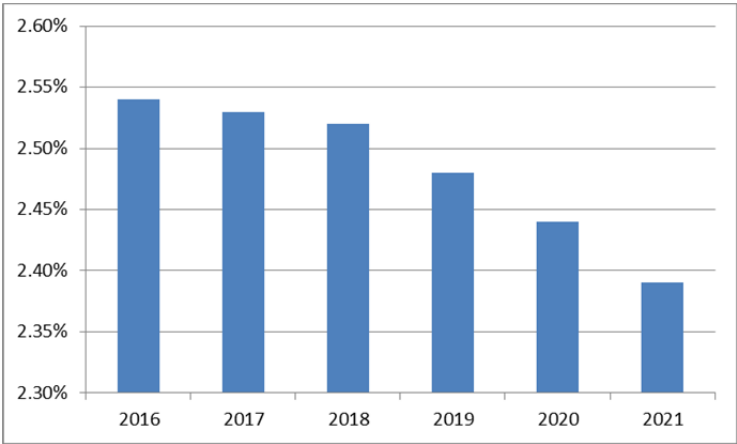


Fig 1: Global GDP share for Media & Entertainment sector

This trend is caused by several factors:

- The time people have to consume media services is finite and the same is with the consumers attention as well as their willingness and need for consumption, which is important for advertising representing the main source of revenues in the sector [4]
- The market in the sector is mature and highly competitive, so that related expenditure streams are and users' subscription models are far optimized
- Number of free offers in the sector is still growing and their quality is increasing

The media industry is facing battles on every front – consumer attention, advertising share, costs management, etc. but also facing a paradigm change in their businesses to have an integrated data driven strategy for the future [7]. The media industry is downsizing to cut the costs, upsizing to build the scale, etc. However, to cope with the negative trend in GDP share for the sector and corresponding consequences in development of revenues, there is a need for novel business models in the Media & Entertainment sector, going beyond traditional, mainly from advertising, revenues streams, and further technology innovation to address, among others, the following trends in the area:

- Virtual reality and interactive technologies
- Establishment of new media services, such as e-Sports, modern TV (different from already collapsing traditional broadcaster services, such as Netflix and Prime kinds of concepts), etc.
- More dedicated content for specific consumers/users groups instead of offers for general public
- Data and big data to be explored and used to enhance Media & Entertainment applications
- Artificial intelligence , expected by large majority of players in the media sector to become a significant business advantage in the future

The innovation is a priority for the future of the media industry, where active participation of the media industry in the innovation, as well as related research, activities is a key for success at the market [7].

### **3.2) Future networks as driver for future media**

Even difficult to predict, as already proven in the past, the prognoses show an increase of overall consumption demand on the future telecommunications networks of 71% in the period 2016-2020 [5], [6], with a further potential to grow afterwards. Beside cloud-based streaming services as well as demand coming from M2M and IoT applications and services, which are expected to grow significantly in the next period, the video consumption will be 20 times larger and around 50% of total streaming services will be consumed from the homes, mainly to consume various media content and for entertainment purposes. It is expected that video will make up to 82% of all internet traffic in 2021 [7]. One important element of the future media immersive video and other immersive technologies, to be established of end users into the media landscape, starting from

storytelling/story living, which will be further enhanced by increased capabilities of the future communications networks.

Also, the emerging 5G communications networks with significantly increased features able to serve services with very high demands on networks QoS are opening doors for Media & Entertainment sector to deploy new sophisticated services and offer them to the consumers, and with it, increase revenues and improve future development of the sectorial share in the global GDP. The Media & Entertainment sector is seen as the main utilization power of the future 5G networks and their enhanced features.

Furthermore, the 5G networks are designed to enable establishment of services and applications tailored for various so-called vertical sectors (such as automotive, health, energy, etc., among media & entertainment). Here, while taking a look into the tendencies of various vertical sectors, the future verticals applications and services will significantly consist of features which can only be designed and established by industries around Media & Entertainment; e.g. assisted overtaking service will strongly depend on information/moving image gathering, processing, transmitting, and presenting.

### **3.1) The social media perspective**

The social media is now accounting for 1/3 of users' online time world-wide and in some world regions, e.g. Middle East, the figure is doubled [8, 9]. Therefore, it is needed to consider business models and their potential impact on overall business models for the future media.

The concept of modern Internet based economy is relying on the fact that the online available information is abundant and its consumption is largely free of charge [Per16]. Furthermore, the most business models applied by the social media platforms today are based on end user attention; the more people are the platforms members or consuming information provided in the social media, the more advertising can be sold by the related social media stakeholders, where the advertising is in most of the cases the only revenue stream for the social media platforms. The attention based business models in social media are also seen as a driver for distribution of disinformation across networks world-wide.

Therefore, there is a need for alternative business models for social media, which might also be imposed by corresponding regulation measures. The challenge is to ensure competitiveness of the proper social media platforms, as news providers, versus so-called fake news/website factories.

Currently, the media and social media sector current business models are being reshaped by challenging technology and market trends, and has already experienced digital transformation being a great example of new digital ecosystems in data-based and algorithm based economy. We live in a world where everything is or will be connected, software becomes embedded in almost everything and data is created almost everywhere becoming an essential input fueling algorithm-based economy. Converting massive amounts of data into actionable insights means that algorithms become a new competitive advantage and will prove to be central to the next wave of economic growth.

There is a need for a program that succeeds in limiting concentration of power on having data among just few global players without compromising the technological innovation and development, from



which our future depends, fostering creation of infrastructures facilitating the circulation of data along the value chains and value webs.

Some relevant statements coming from Ooyala report: State of the Media Industry 2018

“When you think about how many hours people spend watching video versus reading, the audience has already spoken.”

— Chris Altchek, Chief Executive Officer, Mic, as quoted in [Bloomberg](#)

Mobile video continued its double-digit growth in Q4, and now makes up 60.3% of all video plays.

— [Ooyala Q4 2017 Global Video Index](#)

“68% of U.S. adults are now Facebook users.”

— [Pew Research Center: Social Media Use in 2018](#)

“We know that we have to constantly force ourselves to shake things up.... All media companies are going through a period of change, and we’re not immune from that.”

— David Carey, President, Hearst Magazines, as quoted in [The New York Times](#)

In a 2018 survey, 194 leading editors, CEOs and digital leaders said the biggest barriers to success are not tech platforms but internal factors (36%) such as resistance to change and inability to innovate.

— [Reuters Institute: Journalism, Media and Technology Predictions 2018](#)

“Around 257.2 million VR headsets will be in use by 2021.”

— **PwC Global Entertainment & Media Outlook 2017-2021**

“Video will make up 82% of all internet traffic in 2021.”

— **Cisco VNI Global Fixed and Mobile Internet Traffic Forecasts, as published in Recode**

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## 4) User vision & requirements

### 4. 4.1) Human factors

Human-factors engineering, also known as ergonomics or human engineering, is the science dealing with the application of information on physical, physiological and psychological characteristics to the design of devices and systems for human use. [Britannica] It provides a scientific approach to human-centred design, applying these “3Ps” principles to optimise the balance of people’s strengths and limitations.

Human-factors engineering, as a body of knowledge, is a collection of data and principles about human characteristics, capabilities, and limitations in relation to machines, jobs, and environments. Applications of human-factors engineering have been made to such simple devices as highway signs, telephone sets, hand tools, stoves, and to a host of modern, sophisticated complexes such as data processing systems, automated factories and warehouses, robots, and space vehicles.

Human Factors are concerned with improving the understanding of human behaviour and facilitating the design and development of emerging technologies involving the process of interaction design. It refers to the design of machines, machine systems, work methods, and environments to take into account the safety, comfort, and productiveness of human users and operators i.e. gathering user requirements, designing alternative ideas, prototyping and evaluating prototypes by designing experiments and user studies, collecting and analysing data and iteratively improving the design and development of systems. So Design & Human Factors lead to the need of interdisciplinary research about the relationship between humans and technology in a wide sense, with the purpose of contributing to a more user-centered technology development. [Sharples]



*Image source: Shutterstock/violetkaipa*

Technology is at the forefront of all new design processes, and in a relatively short period of time, has experienced exponential growth, which has a great impact on almost everything we do, including the way we work. So, to better address this problem, we need to ask: how do we use our technology? And perhaps more specifically: how much do we rely on our technology? Thus, Human factors should play an essential role in the future of technological advances, where people and technology are being integrated more closely and more intensively than ever before as part of our daily lives taking into account physical, cognitive, affective and social aspects. Technologies for human factors/ergonomics research and practice have seen rapid technological change and

nowadays are facing new challenges resulting from an increasingly complex technological environment. These technologies have largely resulted from the digital revolution in both software and hardware and now the application of new trends in human factors relies heavily on these new interactive technologies. [AppErg]

There are many areas of activity within human factors but today, the research carried out, almost invariably relies heavily computational, information, and communication technologies in one way or another.

### **User Experience**

User experience encompasses all aspects of the end-user's reaction and interaction with the technology through services, and products. The focus lies on the user's perceptual experience and the symbolic aspects of products and product use. User experience design as a discipline is concerned with all the elements that together make up that interface, including layout, visual design, text, brand, sound, and interaction. It's important to distinguish the total user experience from the user interface (UI), even though the UI is obviously an extremely important part of the design. These factors have become increasingly crucial for many companies' ability to create unique deals. In order to achieve high-quality user experience in a company's offerings there must be a seamless merging of the services of multiple disciplines, including engineering, marketing, graphical and industrial design, and interface design. This research area includes design theory and methodology with focus on aesthetics, product semiotics and sensory.

### **Technology Use and Adoption**

Technology use and adoption by users, specially including companies and workers is a critical component of the process of technological change. A solid knowledge of this issue requires studies of the conditions on which people accept and adopt new technological solutions and should assess the causal effects of education on technology use and adoption by using instrumental variables.

Knowledge about how technical products are being used and what they mean in people's everyday lives is an important condition for product development, and similarly, how education impacts on the probability of using "tech tools" on a daily basis as well. A basic concept is that the understanding of users and their usage is a good starting point for, first, innovation, and then for validation and proof of acceptance. Technology use and adoption focus on achieving real understanding of the users' needs and the demands they put on technical products and systems. Functional, social, emotional and aesthetic values are all taken into account.

### **Human - Machine Systems**

Human-factors engineers regard humans as an element in systems, and a human-machine model is the usual way of representing that relationship. Two general premises characterize the approach of the human-factors engineer in practical design work. The first is that the engineer must solve the problems of integrating humans into machine systems. This supposes to be rigorous building upon scientific methods and not rely on intuition, or common sense. For long, the complex and unpredictable nature of human behaviour was obviated.

This approach should develop methodology to analyze, design and evaluate the interaction between man and machine in the broadest sense, independently of the socio-technical complexity of the systems.

Main areas of human-machine systems are related to physical and cognitive ergonomics, interaction, learning, risk assessment and 'resilience engineering'.

## Sustainability

Current human activities are seriously eroding the ability of natural and social systems to cope. Human factors and ergonomics can provide relevant skills and knowledge to assist where it can in addressing the commonly identified problem areas (waste management, energy and transport) and to answer questions regarding the technology capability to motivate and support more sustainable behavior among people.

*Sustainable development “means ensuring dignified living conditions with regard to human rights by creating and maintaining the widest possible range of options for freely defining life plans. The principle of fairness among and between present and future generations should be taken into account in the use of environmental, economic and social resources. Putting these needs into practice entails comprehensive protection of bio-diversity in terms of ecosystem, species and genetic diversity, all of which are the vital foundations of life.” [MONET]*

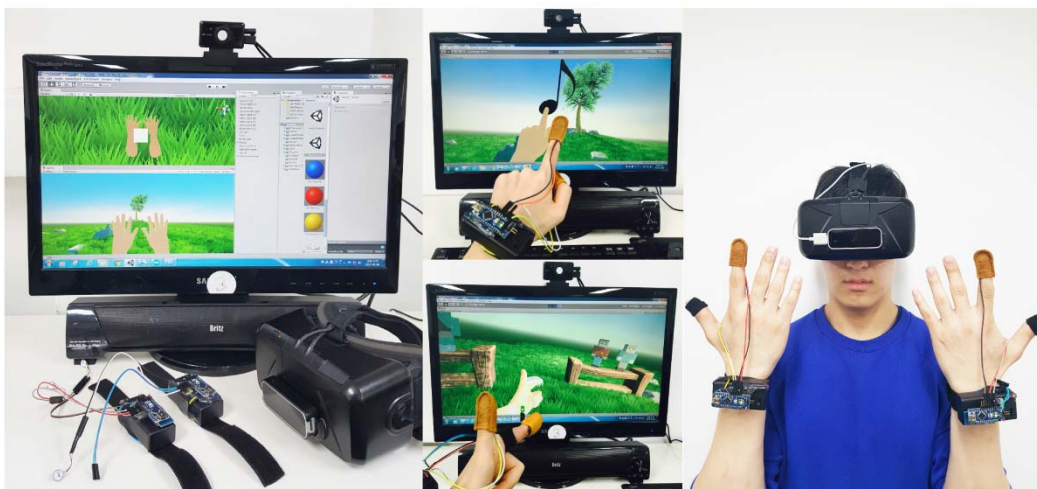
Sustainability focuses on consumption and design theory and methodology with focus on design for sustainable behavior aiming at collaborating to change people behavior as well. An example of sustainable Human Factors Engineering design is of an electric vehicle system to enable energy efficient driving. From a Human Factors Engineering perspective there are a number of sibling systems to consider including the human-software interface, the human-control interface, and the human-human system interactions with passengers and other drivers. [Thatcher]

Human factors research is taking advantage of the advances of key technologies that have been established during last years; mainly virtual reality (VR, due to the fact that can be used in situations when the safety is concerned or those which are not easily replicable), whose application to the field has grown. Researchers are drawn to its interactive and immersive nature, while the intensive interaction through immersive visual fields has strong research benefits, the responses and validity of different levels of immersion remain a question and the physiological and psychological responses of humans need to be further assessed.





The other big family highly involved in human factor is the one related to user interfaces and sensors (depth sensors, accelerometers, gyroscopes, and magnetometers). Depth sensors have become very common in human factor applications. They are able to detect the distances of objects placed in front of them and can provide information useful for evaluating physical exertion and body posture. As technology progress, sensing technologies become smaller while preserving or even increasing their functionality facilitating non-intrusive, easy-to-apply tool deployment. More and more measuring devices can be held in the hand of the user, or directly worn on the body. Specialized wearable systems with multiple embedded miniature sensors can be used to monitor kinematics and physiological parameters. Even smartphones can be used as a rich potential source of parameters directly useful for human factors research as many smartphones contain multiple sensors that can be used for human factors purposes.



NEM community can provide the most adequate technologies to develop new generation tools for human factors practical application. The kind of interactions and developments implemented for the entertainment area fit rather well to this discipline so the evolution of interaction pushed by media area can boost a new generation of human factors applications including novel solutions for the analysis of effects of physical environments on the operator, human reliability and human information processing (going further into the concept of the human as a sensor), training, workplace design, work organization design and the allocation of tasks between humans and computers and other parts of systems.

Media technology can also provide useful inputs for other key activities in the area that include but are not limited to: training, maintenance, safety, reliability, usability, staffing, security, test and evaluation, manufacturing design, task analysis, workload analysis, task allocation (between human, teams, automation, and systems), human performance analysis, human error analysis, anthropometric analysis and risk management.

And last, to help with the sustainability paradigm, some general principles for designing new and enhancing existent approaches of human factors and ergonomics regarding their orientation towards sustainability are proposed.

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## 4.2) Areas of applications

The European media sector is the backbone for the huge cultural richness of Europe. Creativity, press freedom, quality journalism, plurality and diversity of media content are cultural key values to open and drive our society. These values are also important for the strength of all other European industries. Further, the huge resources of data from media sector is of strong interest of other industrial areas. With astonishing speed, the entertainment, media and publishing industries have evolved into highly dynamic ecosystems, interconnected by global digital platforms in a manner that few people could even have conceived of a few decades ago. Media technologies and data can be used and replicated and transferred across the EU industry and in a range of contexts such as entertainment, advertising, telecommunication, Publishing & Broadcasting, but also other sectors such as education, health, automotive, finance, manufacturing etc.

Here below some examples on media technologies and applications applied to different industries and sectors.

- As an example the *Data-driven Content Production* and *Personalisation* technology can support the **telecom operators** with the new services heavily focused on content, while the *Data-driven Advertising* can also endorse and support the global **advertising market** strategy (global advertising media revenues were estimated to be 503 billion dollars in 20157). All these arguments from above prove the necessity to have a large scale project for media sector at this perfect time to innovate, while they also show the huge importance of the sector for the European data economy.

The Media and CCI community need to become a catalyst for the wider deployment and rapid market uptake of innovation approaches involving key European industry actors whilst putting data harvesting and analytics at the core of their businesses. It will do so by creating a converged open innovation ecosystem, which will provide benefits and business opportunities for all the involved stakeholders, through Large Scale Pilot sectorial demonstrations to address the Media Industry, a sector of high significant importance for the EU industry.

- Other important technologies are *Machine learning tools and data analytics* to fight **misinformation** that can have economic effect on different domain such as **climate, finance, politic, social issues** etc.

Europe is lacking of a systematic knowledge and data transfer across organizations to address the aggressive emergence of the well-known problem of fake news and post-truth effect. The possibility to use cross sector Big Data management and analytics, along with an effective interoperability scheme for all our data sources, will generate new business and societal impacts involving several stakeholders and targets such as:

- ✓ Media Companies (Press agencies, news, TV Broadcaster etc)
  - ✓ Governmental institutions and organisations
  - ✓ The overall Industrial ecosystem
  - ✓ The entire society
- In recent years, several *Augmented Reality (AR)-based applications* have been created and aiming to lend support to industrial processes with regards to almost every aspect of the **manufacturing** pipeline e.g. design, planning, production, service and maintenance. Factory facility design and planning is a significant field of industrial AR that has gained significant attention especially within **automotive** industry verticals. For example, Space requirements for new or updated machinery are a significant concern given the investment costs of acquiring new machines for the factory floor. Apart from the obvious, “aesthetic” considerations (“what would it look like?”), additional factors need to be taken into



consideration, as effective planning aims to reduce the risk of faulty layouts. The idea of using Augmented Reality to facility planning is not new, in fact several mature attempts have been made at placing life-size holograms into locations using contemporary smart devices (smartphones and tablets) or even the HoloLens holographic wearable computer and display. The experiences are gaining significant traction with industry verticals, yet remain however isolated experiences. Investment decisions can be supported and accelerated by realistic planning simulations, yet these are still only ‘simulations’, relevant mainly to the design planners and should be properly and effectively communicated to machine manufacturing vendors’ sales teams. On the other hand, travels and related costs for sales representatives of machine manufacturing companies are unavoidable, especially when orders need to be customized to be effectively tailored to the customer’s needs and requirements.

- *Social media* used for communication purposes within **healthcare** contexts is becoming more conventional. The social media users of healthcare communication engage all the involved actors from the general public to patients, health professionals, and health organizations. Social media for healthcare communication are various provide health information on a range of conditions; providing answers to medical problems; facilitating dialogue among patients and between patients and health professionals; collecting data on patient experiences and opinions used for health intervention, health promotion, and health education; reducing stigma; and providing online consultations. With emerging advances over time, including new platforms and purposes, these uses will change and expand, increasing usability and thus providing more opportunities to use social media in connection to healthcare in the future. Also do not forget the importance of media technologies such as *image processing* and *visual representation* in the healthcare daily work.

Another important aspect is **Inclusion, Diversity, Personalization and Migration** Issues. Beyond the users demand tailor-made solutions and a personalized customer experience outlined in the NEM’s vision above (chapter 2), areas of application include social and societal issues. In the following we highlight the NEM perception:

- of future personalized access services,
- recommendations for future research and innovations,
- coming short and mid-term innovation trends,
- as well as Future EU R&D&I funding with personalization and diversity as one key dimension to succeed the integration of migrants.

### **Future of personalized access services**

Technology is transforming the way we work, live and entertain ourselves. Yet, television (watched on a TV set or via the Internet) is still the preferred medium of Europeans: more than nine out of ten (96%) Europeans watch TV at least once a week. Europeans predominantly watch television on a TV set<sup>1</sup>. But television is changing. It is becoming more connected. Hybrid Broadcast Broadband TV

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<sup>1</sup> Media use in the European Union 2014  
[http://ec.europa.eu/public\\_opinion/archives/eb/eb82/eb82\\_media\\_en.pdf](http://ec.europa.eu/public_opinion/archives/eb/eb82/eb82_media_en.pdf)

(HbbTV) is an international, open standard for interactive TV, which enables innovative, Interactive services over broadcast and broadband networks<sup>2</sup>. How can the industry guarantee that as many people as possible benefit from this technological innovation? And, if Europe is to become a world leader in accessibility, a topic raised recently by the European technology platform NEM (New European Media, 2016)<sup>3</sup>, what steps are still needed?

Between 2013 and 2016, the European HBB4ALL project addressed media accessibility for all citizens in the connected TV/media environment. Its main challenge was to consider the delivery of multi-platform audiovisual content (anytime, anywhere, any device) and make this accessible to all. Access services such as subtitles, Audio Description (AD) and sign language have been available for some decades yet often with little research into how they can be optimized. HbbTV opens up new opportunities for the customization of these services. New access services are also being developed, such as Clean Audio (CA): Following testing as part of the project, the HBB4ALL access services are publicly available on air at RBB and ARD in Germany, at TVC in Spain, at SSR/SGR in Switzerland and RTP in Portugal.

### **Recommendations for future research and innovations**

Accessibility research and innovation issues still to be addressed are:

- Tools to enable increased opportunities for employment in the media and creative industries
- Increased access to digital media services
- Automatic translation to sign language, and from sign language to text
- Automatic translation of subtitles (multi-languages)
- Accessible universal remote control
- Screen reader enabling those with a visual impairment to read subtitles
- Improving multimedia accessibility by design-for-all
- Collaborative work within the industries
- Building on existing media access services and innovation systems (open source and others)

### **Future short and mid term innovation trends include**

- For broadcasting: developing and improving sign language production, Audio Description for content (videos and books) with the facility to deliver dialogue and ambiance elements of the soundtrack separately, achieving robust subtitling performance across genres and increasing interoperability, allowing users to consume personalised automatic live subtitles anywhere.
- For web access developments: industrialize existing prototypes e.g.: subtitle renderer; inlay/screen overlay (incrustation) of sign language interpreter; advanced audio functions; improve the quality of automatically generated subtitles, reliable STT technologies, improve avatar based signing services, develop and integrate additional accessibility services into existing online platforms.

From the **user perspectives**, it is important to ensure a design-for-all-approach, while recognising that very specific needs may go beyond design-for-all, like affordable, reliable and interoperable solutions, availability of continuous technical support, information about existing and future services, training support for user groups of all ages.

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<sup>2</sup> <http://HbbTVHbbTVHBBTV.org/overview/#HbbTVHbbTVHBBTV-overview>

<sup>3</sup> NEM-Access Report: Opening Doors to Universal Access to the Media. February 2016.

<http://nem-initiative.org/wp-content/uploads/2016/03/NEM-ACCESS-Policy-suggestions.pdf>

In terms of standards, we recommend to **build on European and worldwide standards** involving all stakeholders to create large-scale usage. Beyond media accessibility, work on issues surrounding the IoT (Internet of Things), i.e. the interconnectivity of all objects that exchange data, where media access is relevant.

Moreover, clear regulations should exist not only at national level but also at a European level.

It remains crucial to **raise awareness** in the value chain through information and media, through education and curricula, by bringing stakeholders together (studies, think tanks, projects, market take-up), and include the content production industries.

This shows the need for a continuing emphasis on media accessibility, while recognizing that many strides have been taken in Europe so far. This is best achieved through education; standardisation and legislation based on sound academic and industry research and by the involvement of all members of the value chain, not forgetting the users. If design-for-all is the fundamental principle, we will ultimately all benefit from the media interconnectivity. Above thoughts and research recommendations aim to guarantee the future of media access services.

### **Future EU R&D&I funding with personalization and diversity as one key dimension to succeed the integration of migrants**

Migration raised major societal challenges within the European Union over the last years, and simultaneously the question of inclusion and access for all through ICT, content and (social) media. Therefore, the NEM Steering Board introduced the migration topic, and organized an exploratory meeting between NEM members & UNESCO during the last NEM Summit in Madrid (30 November 2017).

Out of experiences with migrants, it appeared that UNESCO is concerned about the role that technologies may play with regard to integration of migrants into the society. This should be placed under perspectives to promote multiple knowledge (of and about those who arrive), about cultural differences, and the economical sides: many refugees are coming to Europe, and they can impulse economic growth.

In terms of needs, the personalization of services is a first major issue: we are talking about very different profiles of people. Not just one solution expresses and addresses all those different populations. The second issue: mobile technologies can be seen as part of the solution (not THE solution). Almost 80% would do anything in order to have mobile technologies. All refugees care about being connected. So mobile technologies have to be part of the solution.

UNESCO would welcome to get European wide tools to address the refugees' needs. It is about scaling up something that works first, and international cooperation.

Basic and advanced needs are as follows:

- Basic needs in terms of education, tools for promoting communication. To help children from Syria to learn Arabic, because they have a lack of education (did not go to school). And also learn the language of the country.
- The remedial needs when it comes to education. Many children will arrive to schools that still recall when their schools were bombed (very traumatic souvenir).
- The higher educational sector. We need systems to help them to certify obtained diplomas. Does anybody address them?

- Consider the opportunity to enhance their digital skills (younger, children, and others). Digital skills are part of to live in the society, and relevant content can help them to be fully citizens in the society.

Tools that UNESCO could support for example are real time translations aiming at empowering human contact. Refugees need to be connected to the country's language, but also to their own language. In addition, the situation requests more qualified teachers (not only those of the receiving countries), but the need of tools and content for (social) media has to be qualified, and extra costs per child (+ 33 to 50 % compared to others) must be considered.

Industries helping to shape solutions would be much appreciated, while UNESCO can welcome any kind of proposal and push it, envisage to help to develop the system(s), and be a partner.

Future R&D1&I related topics could be related on a next public EU R&D&I funding, which considers accessibility, personalization and diversity as one key dimension.

Besides the above mentioned translation tools, media (particularly Public Services) can serve as Educational and Knowledge Diffusion Platform for all - both migrants/immigrants and local population. Content creators, creative people, and storytellers should be "encouraged" to produce content related to immigrants (beyond news and reports based on emergency). Different navigations between different rights and administrative issues need also to be addressed. In the forefront, it is also important to collect research literature to make these topics more predictable.

Higher education is one of the issues: there should be a consolidation of treating people in a non-discriminatory way from both sides. Education institutions have to deal with it from now on. It has to be checked whether there is a lack on tools, or methodology, etc. The language tools here apparently are not the big problem. For children, it might be the EC that comes up with bottom-line instructions.

Concerning innovation and refugees, it is important to:

Identify ICT instruments for them: at city level, country level, European level. For example security, tracking.

Innovate with strong PA (Public Authorities) support in order to mitigate possible societal challenges related to "the others" (immigrants).

In the coming month, NEM intends to create a NEM vision taking into account the situation, the needs and further potential NEM solutions, like i.e. create tools to help the programme makers.

## **6) Policy, regulatory and standardization issues**

In recent years, the media sector has undergone a profound transformation process, as a result of the strong growth in video content and online entertainment, posing increasingly complex challenges to policy makers, competition and industry authorities. The Media sector plays a key economic, social and cultural role in Europe. Europe boasts a strong media industry, which creates growth and jobs and represents European life, languages, history, culture and values around the world. Those deeply changes in the media sector are due to the impact of the Information and communication technologies (ICTs) which are revolutionizing the creation, development and distribution of content today. The introduction of new technologies has produced a "disruptive" effect on the traditional media industries. Innovation has become the most important growth driver and has led to the emergence of new operators and business models.

The media landscape is undergoing a transformation, characterized by a steady increase of convergence of media services, with a visible move towards intertwining traditional broadcast and the internet. Audio-visual media content has arrived on non-TV screens and internet content is

arriving on the traditional TV screen. Moreover, the emergences of new technologies like, Virtual reality, augmented reality, IoT, blockchain applied to media sector represent new challenges to be faced and managed in terms of policies, taking in account the advantages but also the risk that they can provide to the end users.

In addition, the growing variety and availability of devices has led to a radical change also in consumer habits, expanding the options and methods of use no longer linked only to traditional devices (i.e. radio, tv). This phenomenon empowers European citizens (including young people) to be able to access seamless and interactive experiences, letting them access any content while being agnostic as to the device or geographic locations from which they interact, but not to the language of communication. Consequently, the proliferation of connected devices and the wide availability of faster broadband connections are affecting existing business models, consumer habits, creating new challenges, and opportunities for the creative industries. The growth of the language industry close to the media industry is a reality in Europe.

In this landscape, TV remains the foremost source of information and entertainment in the EU, but the audio-visual sector directly engages millions of people with other types of media, specifically available through internet, that are spreading more and more in the market. The media and communication sector is therefore increasingly becoming a digital ecosystem, characterised by the group of subjects that produce, consume and exchange information within the area bounded by digital technologies. Sectors previously distinct, such as content and media, telecommunications, information technologies, are now converging, creating a new industrial ecosystem that requires different types of companies with different corporate cultures to compete and collaborate.

Therefore, the impact of the Internet and new technologies on the media and content world is enormous: new business models, new players and new challenges await antitrust and regulatory authorities. The process must find ideas and knowledge from both the "new" and the "old" economy. At the same time, whilst maintaining the focus on the consumer rather than on protecting certain competitors, it allows the benefits of the Internet and new technologies to extend across the economy.

For that reason, one of the most relevant points on the political agenda of the European Commission (EC) is the Digital Single Market (DSM) strategy. It aims to open digital opportunities for people and business, and enhance Europe's position as a world leader in the digital economy. Within the DSM framework some regulations of the Media sector are translated into policies and regulations. In that context, it is important to mention: the regulation on Audio-visual Media Services ( 2010/13/EU (AVMS directive) and its proposed modification with the "COM(2016) 287; the regulations on Copyrights (1996/9/CE; 2001/29/CE; 2006/115/CE; 2009/24/CE; 2012/28/EU and 2014/26/EU) and new directive proposal COM (2016) 593 on copyright in the Digital Single Market; The directives 2006/123/CE and 2000/31/CE on cross-border portability of online content services and the new proposal COM (2015) 627; the directive 2000/31/CE on E-commerce & geoblocking and the new proposal COM (2016) 320, and the new European Accessibility Act.

The preview mentioned panorama lays the foundation for new challenges to be considered at policy level in order to support on one hand the technologies developments but on the other hand to reduce the potential risks coming from them. In this perspective issues like data protection, privacy, customers protection but also the policy framework for supporting research and innovation in the media sector represent relevant topics to be constantly addressed for supporting the right growth of the media sector.

In Europe, there has been an increase in competition in the distribution of video content - an area controlled by traditional television operators - as a result of the following factors: the entry of new global players, starting with Netflix; consolidation, through mergers and acquisitions, by the major telecommunications operators, which allowed the development of the “quadruple play” offer, integrating voice, data with fixed and mobile Internet access and video; direct access by new players to exclusive “sports premium content”, starting with football (national league and Champions League) capable of increasing demand for data and traffic on networks.

In this perspective, the cooperation of all the stakeholders involved to exchange ideas, current and new needs deriving from these changes becomes fundamental to build in a balanced way an appropriate policy framework that can support the future economic and technological development of the convergence and social media sector.

Standardisation plays a leading role in creating the EU Single Digital Market . Standards support market-based competition and help ensure the interoperability of complementary products and services. Standards play a vital (albeit sometimes invisible) part in supporting economic growth by boosting productivity, competitiveness, innovation and societal welfare. The impacts of standards within businesses and their supply chains are less well understood, and the same is true of the public sector: there is sometimes a lack of awareness and information about the impact of applying standards to public policies.

CENELEC makes a classification of standards in four categories:

1. Fundamental standards - which concern terminology, conventions, signs and symbols, etc.;
2. Test methods and analysis standards - which measure characteristics such as temperature and chemical composition;
3. Specification standards - which define characteristics of a product (product standards), or a service (service activities standards) and their performance thresholds such as fitness for use, interface and interoperability, health and safety, environmental protection, etc.;
4. Organization standards - which describe the functions and relationships of a company, as well as elements such as quality management and assurance, maintenance, value analysis, logistics, project or system management, production management, etc.

The three European Standardization Organizations (ESO), CEN, CENELEC and ETSI are officially recognized as competent in the area of voluntary technical standardization. The European Union (EU) Regulation (1025/2012) which settles the legal framework for standardization, has been adopted by the European Parliament and by the Council of the EU, and entered into force on 1 January 2013. The three European Standardization Organizations cooperate on policy and technical matters of common

interest. This cooperation is coordinated by the Joint Presidents' Group (JPG). As its name implies, JPG comprises the Presidents and Vice-Presidents of CEN and CENELEC and their ETSI equivalents (General Assembly Chair and Vice-Chairs, and ETSI Board Chair), together with the Director General of CEN and CENELEC and the Director General of ETSI.

There are some basic understanding regarding standardisation:

5. There are many agencies,
6. Participation tends to be as a representative of a state, or a private company, or trade association.
7. A standard is a very lengthy process
8. A standard is anonymous
9. Participation is time consuming, which can be translated into a costly activity. This is for two reasons: the time required to read, write and work in documents, and the time dedicated to meetings.

Nevertheless it is important to work within the framework of standards since they reduce costs, improve safety, and enhance competition. The EU has an active standardisation policy that promotes standards as a way to better regulation and increase the competitiveness of European industry.

It is important to raise awareness regarding standards towards maintaining and improving the presence of EU industry in international markets since they are key to creating jobs and growth in Europe. Standards facilitate companies' market access worldwide and two main objectives are instrumental in this respect, as identified by the Communication from the Commission to the European Parliament (COM/2017/0453 final)

- strengthening the competitiveness and global reach of European industry by reducing technical barriers to trade (TBTs); and
- enhancing worldwide interoperability by using common technically aligned standards that support trade in goods and services.

These objectives can be achieved, first and foremost, by aiming for the greatest possible coherence between international and European standards, and by facilitating the use of European and/or international standards outside the EU while striking the proper balance between the European, national and international dimensions. In 2018, the Commission will intensify its policy dialogue with international standardisation actors. It will also continue to raise awareness and promote the advantages of the international and European system of standardisation in multilateral fora (e.g. the World Trade Organisation and the relevant United Nations committees) and contribute to the EU's regulatory/policy dialogues with economically relevant partners and to negotiations on the TBT chapters of free trade agreements.

Also from the annual Union work programme for European standardisation for 2018 states that “A year after the publication of the Commission’s priorities on ICT standardisation , the actions outlined in the 5G communication networks, Internet of Things (IoT), cloud computing, cyber security and (big) data technologies as priority domains as well as the sectorial domains on eHealth, intelligent transport systems and connected & automated vehicles, smart energy, digitising industry, smart homes, cities and farming are progressing, in collaboration with the ESOs, global SDOs and the standardisation community. In the same way, the Commission has initiated actions to improve the ICT standardisation ecosystem including work with ESOs and stakeholders on possible measures to improve the Standard Essential Patents (SEP) ecosystem, promotion of open source and its interaction with standardisation, and to strengthen the EU presence in international ICT standardisation. The Mid-Term Review on the implementation of the Digital Single Market Strategy presented the overall implementation of the standardisation actions.

Certain actions are implemented through the related Public Private Partnerships , such as the Alliance for Internet of Things Innovation (AIOTI) , the 5G Infrastructure Public Private Partnership, the Big Data Value Association (BDVA), Factories of the Future PPP, the European Cyber Security Organisation (ECSO) and through Horizon 2020 research and innovation projects . In addition, the ICT standardisation needs in support to EU policies are outlined in the 2017 version "Rolling Plan for ICT Standardisation" 16 , which is established by the European Commission services in collaboration with the Multi Stakeholder Platform (MSP) on ICT standardisation and has been aligned to reflect the priorities identified in the Communication on ICT standardisation priorities. This work is also useful for the accessibility of products and services in the EU. In addition, effort to mainstream accessibility following a Design for all approach should be step up to mainstream disability issues in relevant standardisation processes.

The ESS is an integral part of Europe’s global competitiveness, economic growth, consumer confidence and capacity for innovation. CEN, CENELEC and ETSI agree that the following principles are shared in common in their role as ESOs within the ESS.

The following seven common principles inform each organisation’s strategy implementation in their role as an ESO within the ESS:

1. Create standards, both directly and through relationships with other bodies, that consolidate and strengthen the European Single Market and are used globally supporting European industry in the global markets;
2. Use standardization to remove technical barriers to trade, support economic growth, promote well - being and address societal challenges;
3. Anticipate market, scientific, demographic, social and environmental trends and identify emerging opportunities and innovative and converging technologies that would benefit from early, coherent standardization;
4. Encourage European public and private research programmes to use standardization as a means to codify new knowledge and to impact the market;
5. Deliver market - relevant, cost - effective, timely, usable flexible standards, other deliverables and services;



6. Engage with and reflect the diversity of stakeholders and the breadth of their interests in standardization;

7. Invest in awareness - building activities, education programmes and technical training that serves to attract the next generation of standards makers.

Apart from the EU standardisation agencies, there are well well known agencies such as ISO, IEC or ITU, and NEM should take an active role in the EU Joint Initiative on Standardisation, as foreseen under the Single Market Strategy.

## 7) Enabling technologies

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### Immersivity

Immersive technologies are consolidating as one of the most intriguing topics of the content sector. Advances in the generation of 3D Virtual/augmented reality services and the gradual appearance of a variety of devices (glasses, 3D Screen, windscreen display, ...) open the opportunity for holographic content, i.e. true 3D volumetric media, give an idea of how fast immersivity is emerging.

Improved VR headsets, which currently are positioned for VR gaming and 360-degree video, are evolving towards consumption of Free Viewpoint video. Contents are being provided for any kind of genres currently positioned for 360-degree video: (live) sports, musical performances, virtual tourism, educational content, adult content, fiction, news and documentaries, eSports video streams. User generated content (UGC) are expected to constitute the second wave of content, in the form of short video clips in a social media context of messaging and sharing and live streams shared on social media platforms. Handhelds (smartphones and tablets) with auto-stereoscopic multi-view capabilities will allow users to enjoy the cases described above when they are not in a position to put on a VR/AR headset.

Immersivity challenges include:

- Robust algorithms to create volumetric media from multiple cameras, stereo cameras, smartphones with multiple cameras and/or depth cameras, multiple robotics cameras (e.g. follow-me drones). Hybrid approaches combining local preprocessing and cloud-based synthesis. Calibration-free set-ups.
- Novel volumetric media representation formats, balancing compression processing requirements, compression efficiency, bandwidth and manipulation capabilities. (UGC holographic communication will require manipulation capabilities similar to current visual messaging like beautification, stickers and comments, backdrop changes, fun masks and transformations etc)

- Bandwidth efficient delivery of volumetric video. Streaming of the complete holographic video is bound to pose substantial bandwidth challenges. Research into novel networking solutions that stream personalized perception-based holographic video to users from CDN's, taking into account bandwidth, latency and cloud/local processing loads.
- Human-machine interaction. Many types of human-machine interaction will be developed in the near future, allowing consumers a wider range of activities and a broader spectrum of experiences that can be gained from their engagement with media. New developments are expected for avatars and robots, haptic sensors, Brain Computer Interfaces (BCI), Enhanced Sense of Presence (ESP), sensing and monitoring, Quality of Experience (QoE), audience monitoring and analysis.
- Usage of multiple audio-visual capturing sensors for creation of multi-angle content for creation of free-viewpoint video for consumption with VR and AR HMDs. Capturing modalities include visual, audio and depth (radar, sonar, lidar, time of light), and could incorporate ground-based tele-operated and autonomous vehicles and airborne drones and balloons and definition and implementation of capturing strategies for robotic camera teams.
- Media orchestration tools for managing multiple, heterogeneous devices over multiple, heterogeneous networks, to create interactive and immersive experiences.
- Video 4D (volume capitation) will bring a better experience to end users as they will be provide 6 degrees in a tri-dimension environment

### Hyper-personalisation

Content and Creative Industries, while locally, regionally, and/or nationally implemented or even governed, are moving to a worldwide framework, thanks to the digitisation of the whole value chain, from creation through distribution to consumption. These industries are updating the whole process by paralleling a lot of actions all along that value chain and reducing the production time from capture to access. This diversity often challenges established businesses and their business models, requiring them to be involved in the latest technology research and innovation activities of their sector.

This process opens the sector to apply new paradigms as hyper-personalization bringing new opportunities and challenges technological, infrastructural and regulatory by means of disruptive and focussed approaches.

The European society is based on diversity and only by giving a broad and flexible response, with the assistance of the hyper-personalization paradigm, will this diversity be a resource and not a restriction.

The global trend towards the extreme differentiation of offerings in products and services cannot be foreign to the sector, from the recommendation of content to the integration of the final consumer in the design processes. Hyper-personalization through very precise targeting not only ensures the best potential impact but in parallel increases the added value of products and services.

Hyper-personalization technology will allow the gap between providers' business needs and consumers' desires to be closed, allowing consumers to enjoy an increasing range of products whilst service providers battle against the fragmentation of retailing and media across multiple channels and platforms. Appropriate control should be given to consumers to empower them to tailor and tune how hyper-personalization works to meet their needs.

One of the key challenges will be to give back the control of personal data to the end users. These data are key for hyper-personalisation but should be under the control of the end user instead of being managed by each service providers with a global inconsistency.

### Content distribution

The media sector is looking for new business opportunities as its current business models are being reshaped by challenging technology and market trends. Media is moving to concede more power to users, to achieve higher levels of personalization, and aims to get them engaged by powering emotional and social connectivity with the content.

These paradigms need to be addressed by consolidating new networks capabilities with an improved management. Content distribution strategies need to be supported by technological advancements driving more appealing user experience within the entertainment & media industry. User-generated-content and the media shared by social networks are completely changing the media flows through the network, leading to a need for a higher uplink bandwidth.

Important pan-European initiatives as Big Data PPP and 5G PPP, especially when referring to content distribution, are taking into account media and content singularity. Content and media are, on the other hand, exceptionally useful material to assess the real potential of both technologies and can really bring European innovation horizon at their maximum performance. Since currently the majority of Internet exchanged data is media and content, it is of utmost importance to include and promote content technologies in the new developments for both commercial and research purposes in Big Data and 5G domain.

Content distribution should be the cornerstone of the so-called New Generation Internet which should take content and media experience to a new era. In the way of offering an answer to this reality, content distribution must go beyond improving technical capabilities such as bandwidth, intelligence, scalability and performance. The integrity of content and the confidentiality, authenticity and integrity of private data of the users managed within content services are key to the deployment of successful use cases.

One of the key challenge will be the design of a (or several) 5G slices adapted to media&content requirements and offering open APIs able to give access to media&content producers to a number of network function parameters .

## Social Media

Social Media used to be defined as a set of computer-mediated technologies that facilitate the creation and sharing of information, ideas, and other forms of content and applications via so-called virtual communities taking advantage of modern network and communications infrastructures. Social media uses web-based technologies to create a variety of interactive platforms through which individuals and communities can share, create, modify, and discuss different types of information and digital content which is available in the global Internet landscape. It can be stated that during last one-two decades the social media applications introduced significant changes to way people communicate, as well as businesses, and more over entire communities organized through common interests. Moreover, the recent developments in Internet and communications technologies, media and entertainment sectors, as well as many other spheres of professional activities and life show that social media becomes a standard part of different services and applications offered to people through a variety of communication and consumer devices; computers, tablets, smart phones, smart watches, etc. Furthermore, so-called classical media services, such as broadcasting and even traditional “paper” based media, are more and more introducing and using various social media technologies, to improve the overall user experience and further extend their offers and businesses.

The social media is currently being used to infer social behavior and derive tendencies, in combination with the big-data analysis tools. Its capabilities are tremendous to obtain information about the acceptance of a new product or service, identification of needs, or even the determination of ways to influence particular social acts and events. A practical example of the above ideas is the still open question of whether social media, in combination with big-data analysis tools, influence world-wide elections or not. Furthermore, a concern about digital competition is acute in Europe because quite often digital markets and the social media platforms are dominated by few, big and foreign companies, accumulating volumes of exclusive operating data on their platforms and services and using it as the raw material for artificial intelligence or machine learning could have an insuperable competitive advantage over new entrants. Users gain good services, and often free of charge, from such platforms but there are also some potential drawbacks; e.g. using a predominant position to collect data (even improper), keeping that data exclusive in order to maintain monopoly power, which even might obstruct further innovations and creation of new ideas, or using it to prevent customer to change the platform providers. Therefore, from the competition point of view it is also desirable to ensure Personal Data and Profile Portability in the future social media services.

We can conclude that in the near future it will be more and more difficult to distinguish among traditional media, if we may say so, and social media. Where is or will be the border between traditional media and social media (e.g. shift from off-line to on-line media) as well as the border between social media and any future type of service or application, or will there be any borders in the future? What is and how will the future social media look like, how we are going to get there, and what has to be done to enable the future social media? This White Paper elaborates inputs received from broad European media community, to answer these questions and define a set of actions needed to be taken in a coherent and coordinated way in the next period to enable establishment of a future European social media landscape.

### Immersive cloud platform (I<sup>2</sup>C)

Today's audiovisual media industry is considerably fragmented and whilst it has made large investments to deliver content to consumers, efforts have not been made in a consistent manner. The proliferation of media producers and distribution channels is driving key players to seek forms of increasing the quality of their offer. Approaches that do not require additional large investments and that potentiate fast ROI whilst meeting the customers needs and expectations are being investigated. Another aspect that should be considered within this entangled and pro-liferated world of media producers and distributors is that this fragmentation, although having brought a lot of flexibility and choice to the user, did not necessarily bring in all cases increased content quality, as many small producers do not have technological and infrastructural capacity albeit having contents that strike the consumer's interests. In light of this scenario, it is becoming clear to big intervenient players that it would make much more sense to adopt a global and horizontal technology, instead of dedicated specific equipment. In particular, IP-based/Ethernet transmission technology and Commercial Off-the-Shelf (COTS) equipment. Virtualised and cloud-based services are also envisaged and may bring additional benefits by making possible to democratise high-quality media production for the benefit of an open economy and the final user.

### Human-Machine Interaction

The use of audiovisual media has nowadays become ubiquitous in almost any area of application, businesses, economy sectors or socially. However, in many cases A/V content is merely presented to the user with limited interaction possibilities. Additionally, resorting only to these two senses to illustrate real-world events or to pass information to users may reveal to be insufficient. New forms of interactions with machines and immersive environments should be devised incorporating additional senses other than sight and hearing, which could have a strong impact in our professional and private lives. It is envisaged the use of spatially distributed sensing devices and different rendering technology to provide multi-modal, interactive, augmented reality and immersive experiences to users and replicate such experiences in multiple locations.

### Machine Learning and AI

Content creation and distribution methods should evolve in such a way as to embed computational intelligence and semantic knowledge into the media and throughout the media processing, communication and presentation infrastructures. This would enable:

- to increase the ability to dynamically adapt media to the users, different contexts and technical environments

- to generate more realistic digital models of real-world events, registering multiple sensorial properties of the physical space, allowing to replicating those events elsewhere and enabling content repurposing
- to improve user experience by developing new input/output interaction paradigms and considering additional sensorial properties other than auditory and vision.

Special attention should focus on **challenges** that develop systems for the automatic production of subtitles and sign language of video content using recent developments in Artificial Intelligence applied to machine translation.

3 major technological challenges for the media and creative and cultural industries have been identified:

1. STSME Automated + Multilingual: the goal is to develop solutions that automate the production multilingual subtitles
2. Automated sign language representation by avatar: the objective is firstly to produce a sign language representative for video content, and secondly to synthesize this representation through an avatar.
3. Big Data - Real Time: it is important to produce solutions that can handle large volumes of data in acceptable times, and also to build various large corpus needed to use deep learning.

The NEM position paper “*AI in creative Industries*”, to be published end of 2018 explores more in detail market, user and technical related aspects.

### Cultural heritage

A coherent strategy should be devised to help preserving audiovisual archives as a means to contribute to democratising the access to digital cultural heritage and fulfil the aim of content re-usability. A vast collection of archived records could be open to the public and a common strategy for digitisation, annotation and openness, would stimulate and facilitate the use of valuable material for multiple purposes, namely education and dissemination of culture, expanding public access to important historical and cultural assets. This strategy should focus in particular on the definition of a workflow, data model and usage rights, but as well on the use of COTS equipment and on the possibility of having the contribution of a large community for digitising and annotating assets. This kind of openness, whilst reducing times and increasing the volume and diversity of digitised assets, will create additional challenges namely, the necessity of controlling both the type of content and annotations as well as the quality.

### **7.1) Position with regards to DEI & NGI**

The European Commission has launched two key initiatives that should influence the NEM community as far as Media&Content are one of the main domain embedded in the Digitalising European Industry initiative and in the Next Generation Internet Initiative. The first one is addressing the facilitation of usage of Media&Content technologies in European Industry as the second one is structuring the next internet that should be more human and respective of the digital privacy.

### 7.1.1 Digitalising European Industry

The European Commission has launched the Digital Innovation Hub initiative in the context of the Digitalising European Industry program aiming at facilitating the adoption of ICT technologies in European Industry.

Media & Content industry have key ICT technologies that could help European industry in their daily life such as Augmented reality, Virtual reality in the design phase of new products but also hyper-personalisation in the commercial phase and also Social media as well as Media analytics to help customer needs identification.

Today, 11 NEM clusters are part of the DIH catalogue and 20 other organisations declared to address media & content activities.

Following a recent survey, it appears that almost 20 organisations are ready to join such a NEM DIH network. Such a network should offer a number of activities supporting DIH in their daily life and NEM Initiative is ready to support this network.

The objective of the EC is one DIH in each European region and also 27 National DEI initiatives able to coordinate regional initiatives

The following action plan is proposed to go further in the Media & Content sector: organisation of workshops in key regions with all DIH in order to present existing services, platforms and share best practices and also infrastructures

Many DIH have infrastructures open to their local ecosystems, it will be good to make them known outside the local / regional ecosystems and open it to any industry in Europe or even duplicate it in other DIH if any interest. There is also a need to align standardization in order to facilitate interoperability.

- Identification of Key regions for Media & Content (several DIH in Smart specialized region)
- Management of the heterogeneous missions of DIH and identify complementarities

A survey has been done asking Media & Content DIH registered in the catalogue about their interest to join such a NEM DIH network, a number of them have responded YES meaning that today 14 organisations are ready to join the NEM DIH network.

#### Objective of a NEM DIH Network

The network of Media & Content Digital Innovation Hub (NEM DIH) will play a fundamental role in building the community of developers adopting and contributing to Media & Content technologies adoption in European industry, acting at local level. The NEM DIH Programme aims at supporting the creation and the operations of Media & Content DIH nodes worldwide

Business hubs, determined to incubate and encourage new services, play an important role in the global ecosystem that Media & Content is spinning. As in webs, all nodes are essential to build a

lasting and strong structure; but, in this case the wider the web, the stronger the structure. To encourage the growth of the digital economy, NEM DIH enables local digital hubs to enrich their services, to spin a network of enabling communities and to further support new internet-based business creation at local level. It is an effort to expand the reach of Media & Content technologies, so that as many companies or even individual developers as possible can have an easy first contact with Media & Content and take full advantage of it.

#### Mission of a NEM DIH Network

To support the growth and consolidation of the Media & Content community by working locally on disseminating and introducing the technology to interested parties

To build local communities where the position and role of Media & Content would be developed, boosted and consolidated.

To develop usage of “media and content products and solutions” inside the different industries of their territory

#### Activities of a NEM DIH Network

- Providing local training and support.
- Supporting the acceleration of SMEs and Startups locally.
- Strengthening the links with domain stakeholders. Connecting with the local academic world and defining action plans.
- Connecting with leaders of R&D programs at a local level.
- Instructing about the Programme and impelling its adoption by more hubs, pushing the Programme a step further.
- Sharing best practices within NEM DIH and between local DIH
- Operating a Media & content competencies exchange
- Connecting market business needs and competencies
- Ensuring promotion of training for students but also SMEs workers (online training)

#### **7.1.2 Next Generation Internet**

One of the most important concerns in European landscape is security&privacy linked with service personalisation. Hyper-personalisation is part of the NEM Agenda and related research topic proposals have been clearly identified in dedicated NEM Position Paper. In this context trust is one of the key ingredients to develop the Next Generation Internet fitting user needs and wishes.

IoT will also be one of the biggest sources of content in the future, they should contribute to hyper-personalisation but also augmented reality content.

To achieve such a goal, there is a need to manage and analyse all these big amount of data using new algorithms provided by artificial intelligence, cloud computing and big data technologies.

Worth to say that there is also a need for governance and law in order to avoid problem with such a “Big Brother” running with no rules. Such governance is a huge task, not to be handled by



NEM, but NEM would like to alert the European Commission about such a risk. Data protection is one of the key topics to be regulated at European Union level.

Media&content should have a great contribution in order to bring the entertainment dimension to the NGI. Today most of the social media usages are around pictures&vidéo sharing and NGI should encompass this domain in order to reach the objective of a human centric Internet.

The NEM members have identified the following technology areas and research domains as the most relevant for NGI

1. Personal Data Spaces
2. Internet Of Things
3. Blockchain
4. Artificial Intelligence
5. Distributed architectures and decentralised data governance
6. The future of Social media
7. New forms of interactions and immersive environments
8. Other important technologies
  - **Discovery and identification tools**
  - Software defined technologies
  - Networking solutions beyond IP

\*Human centric: At the service of the people and the society, Address present issue, Make “internet for the people”

- NGI: shall enable the next wave of innovations in digital services for citizens and businesses, and shall accelerate industrial transformation and social inclusion including learning and skills
- Secure, energy-efficient and high performance NGI network and service infrastructures
  - NEM contributes media use cases for beyond 5G connectivity and SDN, to drive the developments wrt. bandwidth, latency, reliability and robustness
  - NEM adds the human/user aspect to the Internet of smart things, towards the Internet of Abilities/Skills, for e.g. industrial transformation and social inclusion.
- Advanced consumer applications
  - highly personalised access to digital/virtual objects, information and content, including social media and networks → here NEM contributes to both key enabling technologies (search, metadata, recommendation, ...) as well as identifying requirements for the application of such personalized access, for e.g. news, learning, entertainment, accessibility, ...
  - ensuring better user control of data;
  - ensuring better user control over hyper-personalized applications and the models that underpin them
  - leveraging new interactive technologies (language and interaction modality of choice; mixed real and virtual world) → here, NEM could argue the importance of extended reality technologies (i.e. spanning the reality-virtuality continuum) in general, as the most likely interface at the intersection between the digital and physical worlds, for interaction, communication and consumption.

## 7.2) Research topics

In order to achieve the vision and the challenge that Europe have ahead in the Content and Media sector, there is a need to address a number of research topics, they are :

1. Sensing and Interpretive technologies - creating and deploying technologies that capture and preserve data from multiples sensors, extract relevant features, and infer relations from an increasing array of data and sensor inputs
2. Wireless sensor networks, immersion and multi-sensory data
3. Interpretative and semantic technologies and metadata
4. Design and human-machine interaction
5. Human-human interactions through devices
6. Augmented reality and virtual reality
7. Holography
8. Immersion and multi-sensory data
9. Semantic technologies and metadata
10. Human-machine interaction including BCI, haptics, vocal
11. Storytelling
12. Data visualization
13. Design
14. On-demand cloud resources
15. Security including block chain
16. Multi-cloud environments (private, public, multipurpose, specific)
17. Virtualization including 5G slices for media&content
18. COTS and open architectures with self-describing, well-documented APIs
19. Annotation and metadata
20. Crowdsourced digitization
21. Interoperable and user-friendly DRM
22. Quality control (end2end)
23. Online catalogues and data visualisation
24. Multi-platform access
25. Multi-device reading software to read standard formats and with accessibility features
26. Standards and tools for the interoperability of learning platforms
27. Standards and tools for the management of copyright information and licences, and rights data management in general
28. Standard technologies and tools for production and distribution of accessible digital books for visually impaired and print disabled people
29. Content discovery online ATAWAD
30. Infrastructure for the use of Big data by SMEs, i.e.: how to transpose the tradition of precompetitive collaboration of the sector about data (with elements such as the ISBN and the books-in-print databases, which allowed ecommerce being launched first in the book sector) to the big data environment
31. Personal data management
32. Personalised language technology (e.g. machine translation with emotions, gender, or other different contexts)
33. Blockchain for language services (e.g. machine translation and post-editing)
34. Multimodal content (e.g. processing image, video, speech and texts in one framework and targeting different outputs)
35. Next generation language translation (e.g. AI-driven machine translation with continuous learning capability and with human in the loop)
36. Explainable language technology (e.g. making the results of natural language processing and machine translation explainable)

37. Greener technology for content (e.g. current AI systems are relying on powerful computational resources, such as GPU, memory, storage space, which are not environment friendly. Green technology will make AI more compact and efficient with low resources, but more applicable and deployable)

### 7.3) Detailed roadmap 2020/22

From 2020 onwards, it is sure that the content digitalization will be quasi definitive and the digital technologies mastering will be key for content creators. Digital creativity will reach whatever corner of the creative world. Creation will be linked to a lot of cooperative objects that will interwork with the end user and the content, promoting cross fertilization of contents. Immersivity of content will be a must, while cyber security of access to content will continue to be a key factor for end user and content creators.

Digitization, (online) globalisation and new media are offering many opportunities and challenges. They are changing the way we connect, interact, participate and co-create and it causes or at least boosts social innovation. Now, there is a growing need for ways to rethink the products and services offered from the creative industries from publishers to game developers, from content generators to multiple business sectors using media as a key element in their value chain.

Technology will allow creating increasingly enhanced and interactive contents, possibly exploiting the opportunities of the IoT in certain sectors; augmented reality could be one a relevant feature of future second screen applications and books, and gamification will play an important role. Social consumption will be increasingly significant. Real-time productions will incorporate social media interaction into story-lines to define new storytelling leading to shared and participative activities within media content.

High-quality content will be available on new kinds of devices improving quality and user experience (e.g. immersive experiences). New formats will be complemented with richer metadata so they will be easily discovered, integrated in smart data engines and automatically adapted to multiple platforms. Content can be defined as atomised, personalised, immersive, and adaptable.

Advances in content processing will provide robust algorithms to create volumetric media (from calibration-free set-ups) from multiple cameras using video information and depth. The innovation in this area will also deal with novel volumetric media representation formats, balancing compression processing requirements, compression efficiency, bandwidth and manipulation capabilities. Multiple robotics cameras (e.g. follow-me drones)

will be integrated in complex generation environments and taught to auto-analyse scenarios (multi-modal data fusion and orchestration). Hybrid approaches combining local pre-processing and cloud-based synthesis supported by edge computing will guarantee computing needs involved. 5G networks will complete the scenario providing reliable network conditions to work.

Non-professional content coming from users as creators/contributors will be increasingly created and shared through social media channels. Crowdsourcing will rise among media-based content creation activities. The use of these contents by traditional channels will bring new developments regarding content analysis (i.e. for feedback, audience tracking and analysis and content shaping), business models (i.e. advertising) and copyright approaches in order to respond to this trend.

User engagement will be the cornerstone of content management. New ways of engaging the online generation in created content will be the main focus of new business models. New routes for engagement through enhanced user interfaces and produced content that utilises multi-sensory engagement through visual and audio immersion, haptic interaction and heightened sense of presence will be a dominant presence in the market.

eSports will exponentially grow, and user generated content related to gaming and gaming experience will become trending. Tele-immersive gaming will include immersive experience both as player or viewer and will be easily deployed taking advantage of edge computing and low latency networks.

Content communities will concentrate many development efforts. They can be engaged through social media based contact or within content platforms aimed at defined social groups who can engage with each other and share information and thoughts within the context of a piece of narrative or informational content based around shared activities (cultural, learning, political, leisure) or interests of many types. Well-known environments in terms of user profiles and preferences will boost personalization capabilities and the creation of new and reshaped services.

Improved user profiling via implicit behavioural analysis will improve the knowledge of final users and targeting, then ROI. Social media interaction will be used by means of big data analysis to improve the “just-in-time” offers. New storytelling and branding experience will promote the engagement of users. Respectability, trustworthiness, and loyalty will become

the main objectives of branding. Multi-access through different platforms will not be longer a problem as more accurate user identification through deep analysis will allow recognizing the end user at the end of the chain, even out of logged environments. Big data technologies and artificial intelligence will support the transformation and edge computing will supply real-time needs.

New media should support the design for all concepts to provide with the most powerful user experience for everyone. Multi-lingual accessible content will be indivisible part of content generation; the same for multiple kinds of content re-purposing. Content media factories built on the cloud and integrating new AI capabilities will be providing customized content. This kind of capabilities will strengthen integration as well.

Audio and music will thrive around 3D experience. Music consumption will be associated to big streaming platforms while new connectivity and network capacity will enable new consumption experience. Even creation will be integrated in this new “platform of integrated services” concept. Immersive systems including 3D audio will allow an improved music experience enabling customizations as selecting specific instruments, moving around orchestras and concerts, and mixing different players and scenarios.

Next content revolution will be leaded by new ways of interaction. Many types of human-machine interaction will be developed in the near future, allowing consumers a wider range of activities and a broader spectrum of experiences that can be gained from their engagement with media. Voice and gestures will become the natural control interface for media services empowering users through an easy but powerful usability.

Fundamental part of this evolution will be the increasing use of (and the innovation developments around):

- Avatars and robots
- Haptic sensors
- Brain Computer Interface (BCI)
- Enhanced Sense of Presence (ESP)

Gaming evolution will be built upon big on-line collaborative and immersive experiences that can be held in different devices, even if the way the game is played need to be adapted or customized. Wearable elements integrated in gaming experience to expand the gaming landscape out of the houses and to integrate interaction with city elements (through IoT and AR) as part of the storyline, besides enhanced real-time tele-immersion (as aforementioned for eSports) will live together as the two biggest innovation in the area, providing a complete new experience and boosting creativity.

Internet of Things will be integrated in almost any sector or service. Sensing capabilities will be present in any aspect of daily life collecting valuable info and feeding prediction and personalization algorithms. The information processed under Big Data schemas will take autonomous systems to next level: driving, energy efficiency, climate control, logistics ... will benefit from the real-time data acquisition from cyber-physical systems and real-time processing at the edge.

First implementations of 5G networks will offer new capabilities and opportunities to the different actors of the value chain. Topics like decentralization of network caching, new methodologies of media processing and application execution, advanced security, privacy and trust of the content within the network, better QoS/QoE for end-users, improved capabilities and reducing network resources with a flexible architecture, new and enhanced market opportunities for small ISPs and SMEs to join the market of audio-visual content delivery, are expected to be supported by 5G. Another issue to be solved is the increasing need for higher uplink bandwidth as user-generated-content and the media shared by social networks are changing completely the media flows through the network in a way that has not been previously considered.

The role of consumer and its relationship with industry will be completely different. Currently, the customer is usually located at the end of a product's lifecycle. However, by 2020 "crowdsourced design" will have become a serious method for product life cycles. That means the customer will be very actively involved in product design or choice in variants. Consumers form opinions and make decisions about products, using input from a wide variety of sources, necessitating innovative and diverse marketing strategies. Additionally, consumers will provide more input into the design process. Designers will adopt crowd-sourced collections, and sellers will be able to customize their purchases in a variety of ways. This user-centered approach will lead to a new manufacturing model in parallel with the classic product life-cycle of nowadays (e.g. footwear and dresses will be designed, customized and even printed in 3D directly from customers).

Media technologies will support the digital transformation known as Industry 4.0. The integration of design and manufacturing including detailed modelling of manufacturing processes to enable joint optimization of design, manufacturing and organization will be the key in the near future. Design and simulation advances getting closer to implementation will empower industry capacities and speed of reaction to improve competitiveness. Virtual reality for simulation-based learning tools will speed-up the future workers learning curve and will improve security. Problem-solving decision will be supported by methods to capture and catalogue implementations and developments issues through intelligent analysis and visual tools.

Demand for on-trend and in-season products accounts for the explosive growth of fast-retailers—growth outpacing that of specialty retail stores. Vertically-integrated retailers will speed-up product manufacturing in short cycle times, expediting the delivery of them. Wholesalers and department stores are increasingly adopting vertical brand strategies to meet consumer demand for on-trend and in-season product. Deep profiling and behavioural analysis will feed the model both with trend patterns and individual rich personalized information.

Social media will promote not only a new framework for content generation and sharing, but it will enable new models of managing knowledge that involve formal and informal communication, collaboration using a variety of applications. By means of enhanced Platforms (SMeP) for the management of knowledge work (communication and collaboration), new social media-based services will provide mechanisms to support the sharing of workflows within and across multiple communities. They can also provide an answer to global work trends as globalization, supermobility, cloud-based infrastructures, big data and analytics, intelligent devices and distributed computing resources and the proliferation of context rich systems. By adding social networking and crowdsourcing to companies' workflow through social media collaborative tools to boost collaborative behaviors, a new potential to improve organizational agility, increasing productivity, supporting decision making and sparking idea generation is quite easily added to the company work power.

The increasing digitisation of education will boost the creation of digital learning environments, with a high degree of personalisation, specifically to integrate new skills

related to most demanded technical-based knowledge. This way, teachers can enhance their roles as coaches of the educational process, giving students more motivation and aligning teaching methods to the students' individual needs and capabilities. AI will be key part on providing adaptable contents to different learning levels. The establishment of sandbox games will empower teachers to utilize digital gaming technology for learning in classroom environments. Trans-media and collaborative methodologies will fuse to enable the teaching of transversal skills. Educational series for civility, inclusion and inter-cultural knowledge can benefit from gamification. However, all stakeholders involved (teachers, schools, publishers, etc.) need to work together to ensure that ICT and digital materials are properly embedded in a pedagogic strategy, that teachers have the required skills and confidence and that the technological infrastructure (including hardware and connectivity) allows a smooth and safe use of digital learning materials. The implementation of the tools for educators to manage the digital transition will be a big part of the developments of next years.

#### **7.4) High-level roadmap 2020/25**

Content and Creative Industries, while locally, regionally, and/or nationally implemented or even governed, are moving to a worldwide framework, thanks to the digitisation of the whole value chain, from creation through distribution to consumption. These industries are updating the whole process by paralleling a lot of actions all along that value chain and reducing the production time from capture to access. This diversity often challenges established businesses and their business models, requiring them to be involved in the latest technology research and innovation activities of their sector.

Media technology and its potential to disrupt conventional workflows and to provide innovative tools and services for many sectors is drastically influencing European competitiveness. These approaches lead to a consolidated strategy where the foreseen provision of connectivity, networked entities, real-time data, intelligent analysis, pervasive data, natural language and haptic interactions, among others are key topics to be taken into account.

The European media and creativity environment is in perpetual evolution. In order to develop the SRIA we had to consider existing technologies / solutions / services / threats and their possible evolution. In addition, we also have to consider the current and future ICT and ICT market. We are entering a period of transformation due to the nature of systems and services, including new generation networks as 5G, IoT, big data and AI, and more.





The increasing number and complexity of technologies being developed to cope with the ongoing societal challenges and industrial disruption needs calls for holistic views of the ecosystem. For this purpose, VITAL MEDIA has worked on a technology roadmap to support the delineation of the strategic research agenda. VM's roadmaps serve as a framework for technology innovation. It can also be considered a visionary document about the future technologies European media companies are planning to deploy to support the business needs of the user community.

New media is marked by the very fast evolution of its products and their components which are subject to very short R&D cycles. Dynamic, disruptive, visionary, are common adjectives applied to define how media evolution works. Following, some (certainly not exhaustive) high level **"market evolutions / needs"** that may be used to justify the investment are presented. For instance, It should be consider the following phenomena:



## Digital transformation

The rapid developments in the digitalisation of economic activities and societies, the emergence of new technologies and the rise in digital connectivity and interconnectedness have revolutionized all market sectors. The media sector is not alien to this reality; in fact, it is one of the most important engines in the development of this new approach.

This deep transformation, initially focused on the digitalizing of the workflows, has finally brought a wave of empowerment that has hit industry transversally, this time, on the side of consumers.

These changes has leaded to traditional product companies are transforming themselves into providers of services and ecosystems, even experiences; while, service companies are promoting the integration of physical products into their customer experience. However, the capabilities of real-time interaction have empowered users and enabled companies to include them anywhere their feedback provides value.

The digitalization of the media industry has been driven by changing consumer behavior and expectations, especially among younger generations who demand for new media services focusing on convenience, education, premium content and video-on-demand and instant access to content, anytime, anywhere (ATAWAD).

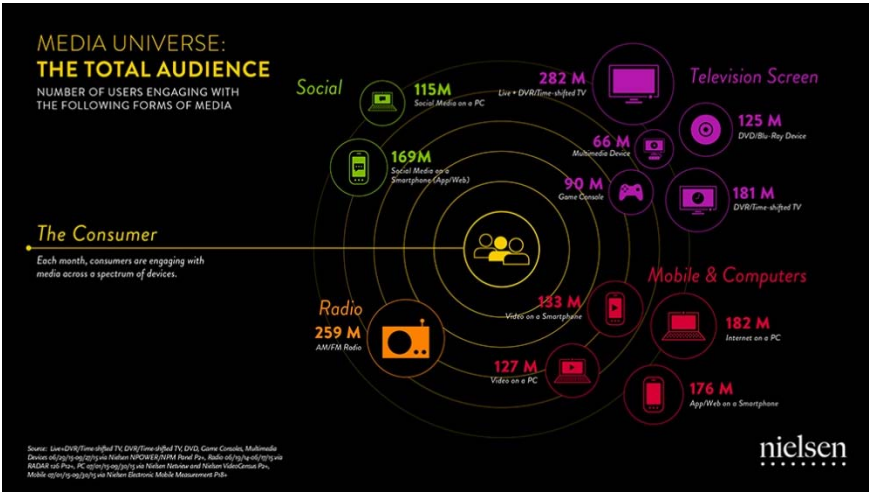
Additionally, other big trend is the industrialization of the media. New digital processes are changing how media is created, distributed and monetized. From a media industry historically focused on creating content and optimizing distribution, to a new reality where many companies are automating the creation, by writing algorithms to create content. Alongside the move toward greater collaboration across the industry, digital transformation

is pushing companies toward the industrialization of their content-creation workflows and the automation of their content distribution processes.

### Content

Much of the disruption is being driven by one overwhelming force: content. One of the most powerful current trends is the convergence of entities from formerly separated spheres: the creators and the distributors. On the other hand, traditional media and entertainment operators are contending with telco companies, social media platforms, and other newcomers reshaping every aspect of the industry. What new performing roles, new structures and partnerships will be established in the industry?

A big part of the challenge will consist of making content suitable. Content production has moved to provide material to a wide spectrum of application consumption. This includes digital platforms (e.g. websites and applications), digitized content (e.g. text, audio, video and images) and services (e.g. information, entertainment and communication) that can be accessed and consumed through different digital devices. All these channels have increased the demand of the volume of content produced, and in parallel, have opened to the users themselves the opportunity of providing content. However, social consumption has the clear lead in terms of sharing user generated content.



Nielsen has collected the number of users engaged with different forms of media across a spectrum of devices and viewing platforms.

The popularity of social media continues to grow. After all, social content is one more step towards human-centered content where the consumer becomes an active node in the flow of media content, as a producer, distributor and collaborator. One reason that social media appeals to users is that it allows them to build up communities focused on particular interests.

New content formats and new type of interactions aiming at revolutionize the experience of the user are crucial part of the roadmap. A great content, along with great user experience, built upon advances in enabling technologies provide the makings of a virtuous circle. Engaging users enables the acquisition of data that feeds the understanding of them and the reconfiguration of services.

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## CONTENT TRENDS    The rise of the amateur content creator

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Content curation

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New content/engagement policies (storytelling, branding,...)

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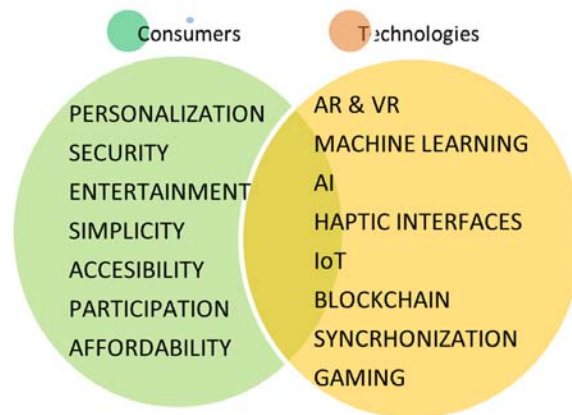
DRM, security, privacy, trust for content services

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### **User-centered approach. User experience**

Media ecosystem is going through big changes in technology, user behaviour, and business models. Today's digital consumer/customer has transformed in a demanding beast. They want what they want, and they want it immediately, and want to be reached in new and exciting ways. So, "products" have become "experiences". Besides attractive content and excellent distribution, services should offer innovative user experience. Products, services, and environments—both physical and online—are converging to anticipate and meet rising customer expectations.

## USER EXPERIENCE



The steady march of digital technology has ushered in a more direct-to-consumer environment characterized by greater choice and user control. In this scenario, the user obtains greater attributions about the flow of content for himself and his social network. From a human-centered perspective, media content becomes the context of social interaction between people, which allows viewers to recommend, annotate, meet and influence the content and consumption of it.

However, these advances have created a gap between how consumers want to experience infotainment and how companies are able to produce and distribute their offerings. And closing this gap, a priority, as the solution may provide the most coveted objective, user engagement. Thus, engaging and intuitive user experience becomes a primary objective.

To engage new audiences, media businesses will need to partner with consumers to co-create and crowdsource material. Enabling audiences to interact with content creators has the potential to build more loyalty and engagement with the content, particularly if seamless second-screen support for an interactive, community-based experience can be designed.

### Hyper-personalization

Hyper-personalization considers the different aspects of maximizing opportunities to customize content to consistently target the right audience throughout the customer lifecycle.

The global trend towards the extreme differentiation of offerings in products and services cannot be foreign to the sector, from the recommendation of content to the integration of the final consumer in the design processes. Hyper-personalization through very precise

targeting not only ensures the best potential impact but in parallel increases the added value of products and services.

Hyper-personalization technology will allow the gap between providers' business needs and consumers' desires to be closed, allowing consumers to enjoy an increasing range of products whilst service providers battle against the fragmentation of retailing and media across multiple channels and platforms.

Here are some **technologies** to consider:

### New content formats

Next years will be defined by flexible, predictive, and precise content creation, including the rise of user and community content generation. On the other hand, by the exploitation of improved computing capabilities to enrich content and to create new immersive formats that aim to provide a completely new user experience.

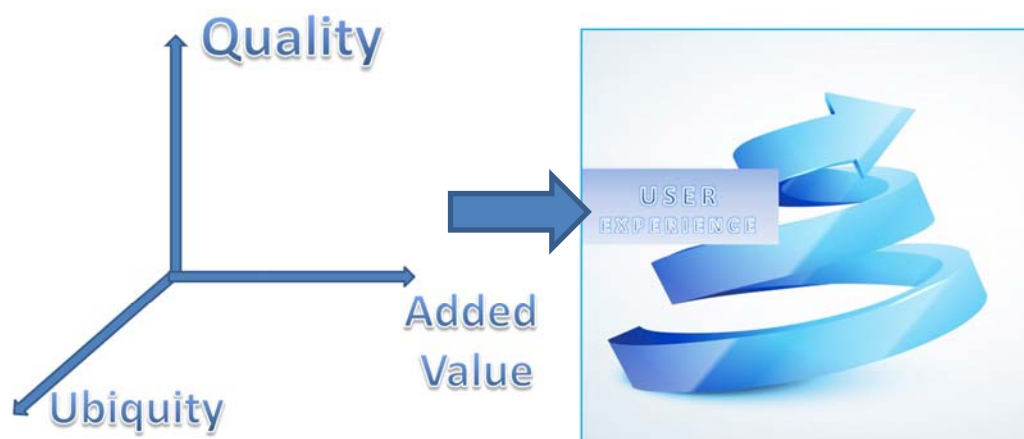


Figure 2: Worldwide Clusters in connection with NEM members

Immersivity will tackle with immersive communication enabling natural experiences and natural interactions with remote people very similar as real-time face-to-face experiences and interactions; and immersive content offering novel experiences aiming to improve connection, information, control, cooperation and interaction.

Immersion encompass sensorial and interactive environments to experiment a "sense of presence", allowing for performing activities in the digital world (immersive capability to engage people), in artificial, interactive, virtual created scene or 'world' within which users can immerse themselves. It also raises important questions about the embodiment of the

user in his/her digital representation. Many applications also expect transfer of experience or skills from virtual reality to real world.

Immersion and Interactivity with content and technology is possible by encouraging users to take a more active role, involving them in more advanced and interactive experiences, even if they have no skills or technical knowledge.

Immersivity tackles with a lot of related technologies: visual rendering and capturing, gaze, gesture, physiological and psychological status tracking, auditory and immersive auditory rendering and capturing, audio/video correspondence, avatar representation and control, human computer interaction (interaction design and user-centered design), information architecture, usability the service has to be easy to use and attractive, visual design/user interface (UI), psychophysics and 3D modelling.

### **Mobile technology**

As we move further into the digital age, consumers' usage of mobile devices has become ubiquitous. Thus, content and networks continue to evolve together.

The buzz in the industry on future steps in mobile technology (5G) has seen a sharp increase, with attention now focused on enabling a seamlessly connected society in the 2020 timeframe and beyond that brings together people along with things, data, applications, transport systems and cities in a smart networked communications environment.

The development of the next 5G network will not only provide more bandwidth and lower latency but also better convergence between networks (fixed and mobile) and also new possibility to configure the network according to the applications needs (SDN/NFV). Powerful NFV and SDN solutions, coupled with open source hardware and software, will be implemented over time to gradually automate network operations to optimize use of spectrum and network resources fundamentally shifting the economics of delivering mobile data. Another key trend is the distribution compute power. 5G takes a cloud-native approach to network design. While the cloud is usually associated with services and hardware centralized in a remote data center, the ultra-low latency of 5G will command a movement of compute power toward the mobile edge.

Another big challenge will deal with user content/data privacy because nowadays people are reluctant to put confidential data in the cloud, we will need to work on data placement and also synchronization in order to offer to end user standard ways to store content (at home, in the cloud, in device, ...).

## **ICT convergence**

All the main trends and technology evolution are mainly software based. In fact, softwarisation and virtualization are included as main paradigms in ICT main evolutions. Scalability and flexibility are two of the main goals, flexible architectures, cloud platform and good automation techniques enable treating software architecture as code, so evolution gets simpler and service deployment more agile. This way, infrastructure, networking, servers, services and interconnections all defined and managed through version controlled text files, and long-time decision related to architecture and infrastructure can be easily moved as new aspects are taking into account.

However, a special commitment to manage risk and opportunities to converge security functions/capabilities in a “Software Defined” approach should be taken. And all softwarisation career should rely on improved cyber-security systems.

Finally, the XaaS (X as a Service) approaches will remain trendy, moving the industry to consumption of services instead of by system property.

## **Cyber-physical systems (CPS)**

CPS are complex embedded systems integrating sensing, computing, communication, networking and control. Nowadays, every single device can provide continuous interaction and deep fusion for open embedded computing, real-time communication, remote managing and planning.

CPS uses embedded sensing devices to acquire data and information, transfer data via the connected network systems, store and process the data and information (with intelligent logistic systems) and make decision according to the results.

The widespread availability of cheap sensors, personal connected devices, as smartphones, and cloud computing, are enabling to reach the potential of The Internet of Things, a network of connected machines delivering smart services, which will offer the media industry a whole range of opportunities to create seamless, personalized services.

## **Big data technologies**

With the growth in data, content, and end-users, information will need to be metered and managed. 2020 will see the rise of predictive analytics, collaboration and workflows that impinge upon all aspects of media business.

Big Data can open up the lane to fast success to businesses in the entertainment and media industry. It can help negate the biggest risk factor in the industry – changing customer behaviour.



Big Data can help have a steady pulse on the shifting customer preferences. It helps reduce customer churn, creates alternate revenue channels and also boosts customer acquisition and retention through data intelligence.

In the end, it creates a new ecosystem where customer experience is put as the centrepiece.

### **Artificial intelligence**

In many interactive systems and medias, AI tools, and notably machine learning, could be used to computationally model the users of such systems. In particular, according to users' input, e.g., their behaviour and interactive patterns, a model of the users traits, states, skills and preferences could be built. This model could then be used in order to provide users' with personalized contents and experience, adapted to each user.

As a matter of fact, recent technological developments keep pushing the boundaries of intelligent systems in creative applications. Simultaneously, the exploratory nature of the creative process is raising important technical challenges for AI such as the ability for AI-powered techniques to be accurate under limited data resources, as opposed to the conventional "Big Data" approach.

Other **non-technical aspects** identified as key in the SRIA an integral part of the roadmap:

- Education, training, skills development.

One of the central problems in contemporary information society is the gap between rapidly evolving technology and the slower production rate of new content for emerging media. To avoid this gap, a new type of education is needed.

Digital skills are in high demand across all industries; new roles are emerging and should be assumed by the entities in charge of providing well-trained people to enter the working world.

- Machine learning and artificial intelligence
- Digital marketing
- Distributed and additive manufacturing
- Internet of things
- Automotive infotainment and connectivity
- Big Data and analytics
- Cryptocurrency
- Cybersecurity and fraud detection

- Fostering innovation: development of a creative and media innovation ecosystem and boosting SME's and startups

Innovation speed is clearly needed within media sector to face the quick evolution of technology-driven opportunities and user expectation. Small and focused enterprises usually are more suitable to cope with this environment, so SME's and startups' activity has become a thermometer of innovation potential within sectorial markets. Talent, access to technology and a 'change the world' attitude are allowing these companies to bloom across the world, creating new businesses and lean models. Once this breed of company reaches scale, it invests both in raising the quality of its content and in offering new services, putting competitive pressure on traditional media companies. Anyway, these companies may flourish as established innovation ecosystems are deployed, and this fact should be guaranteed and pushed through networking and research frameworks where media can be solidly developed (including appropriate funding schemes).

- Redefining the new content value chain moving to user-centered approach

Good user experience dictates that users' needs take priority. A user-centered approach to creating and packaging content focuses on the end-goal the organization has for the audience and the impact the organization wants to have on their audience's behaviour. To increase the ease of usability, readability, and audience engagement, content should be presented with a flexibility that takes into account users' appetites for information.

So, the involvement of users/consumers/citizens in the innovation system developed by a content creator leads to the development of a great deal of ideas, knowledge, and experiences and greatly increases the capacity of innovation of all parties involved.

- Policies: Standardisation, regulation and certification

In an increasingly complex context of convergence and social media, where continuous innovation changes are taking place due to the entry of new players into the market and the need for traditional stakeholders to transform themselves, the policies and regulations governing this sector need to be discussed and reviewed on the basis of changing needs. In this perspective, the cooperation of all the stakeholders involved to exchange ideas, current and new needs deriving from these changes becomes fundamental to build in a balanced way an appropriate policy framework that can support the future economic and technological development of the convergence and social media sector.

In terms of standards, the trend aims to build on European and worldwide standards involving all stakeholders to create large-scale usage.

- Societal aspects

Regarding societal aspects, inclusion, diversity, and migration are the main topics.

Additionally, the ability to send and receive messages is required at an increased level in a modern information society. In Europe, there is a continuous need for people with an understanding of society, cultural identities and media. However, one should not underestimate the importance of technological knowledge; it is essential in bringing out humanistic views.

### 7.5) International cooperation

Involved in the digital economy with R & D & I, societal challenges, industry led media, creative clusters and professional associations/federations/platforms, NEM and its members are ideally positioned to foster excellence of research through worldwide level objectives.

Back in 2014 the NEM EG-group conducted a short survey among NEM members questioning their interest with regard to international cooperation. Since then NEM stakeholders deployed international actions, and thanks to EU financing, various extra European platforms (some are listed below in Figure 1) started – still very modest, but existing – research activities at regional levels.



Figure 2: Worldwide Clusters in connection with NEM members

Today it still appears important to develop a European international research and innovation cooperation strategy. Many European companies are successful in the Europe, but

internationalization, in terms of research, export and sourcing remains a challenge and only a few reach beyond EU borders. Therefore it appears crucial to:

1. Foster excellence of research: attract the best researchers around the world to cooperate with European researchers in the field of NEM technologies,
2. Promote NEM projects and results
  - a. Widen applicability,
  - b. Disseminate project outcomes,
  - c. Favour exploitation and go to the market.
3. Share the NEM vision and SRIA,
4. Take into account specific needs from other worldwide regions: foster international projects with mutual interests,
5. Help the European industry to develop products/services outside Europe,
6. Establish strong links with non-European stakeholders (addressing NEM activities):
  - a. Local clusters and platforms: to reach out easily all stakeholders including SMEs and web entrepreneurs,
  - b. Industry representatives (with R&D departments),
  - c. Academia.

The idea is to develop excellence, for example through artificial intelligence for media and access services, but not only, allowing Europe to compete clearly with the US and China.

Between Europe and other world regions, common grounds out of previous surveys are for example: content search, content processing, data analytics, storage/cloud, user interaction, big & open data, new formats (UHD, 3D video and sound), virtual and augmented reality, metadata, brokering/aggregation, accessibility, publishing, books and text based digital media, emotional monitoring, user behavior and to some extent rights management.

Raise awareness and address bottlenecks (through the clusters/TPs) remains a priority

Feedback from international clusters clearly indicates that awareness creation among the stakeholders about what a cluster/TP is needs time. The concerned communities see as major issue to bring over an abstract concept and become operational locally. Individual investments are necessary to get concrete results. These are common experiences for all CSA related EU projects.

The message to repeat and develop is all about being “strong together” with common NETWORKING, SRIA set-up, LOBBYING, contribution to public calls and societal challenges, COLLABORATIVE work to prepare the future and get collaborative PROJECTS, on an industry led basis. NEM, in strong cooperation with the European Commission should be able in the future to identify and support local clusters and communities to facilitate cooperation. After INCO project times clusters are expected to become / should become a strong vector for sustainability of international cooperation.

Special attention and awareness creation should be paid to SMEs and emerging countries and local clusters as they are very few involved in R&D processes. Perhaps the European Commission could envisage co'-financing and allow European industry leaders to play a key role in developing media and content related research and innovation in those countries, especially as industries may bring long term R&D opportunities against short term business needs in most of these regional businesses.

### How can NEM members contribute concretely on international cooperation?

Globally, the NEM interest in other regions of the world is economically driven and of strategic interest in terms of R&D/innovation.

NEM members have the following interests in international cooperation:

%	Interest in international cooperation
47,6 %	1/ Business development / Market diversification / Global take-up of products and services for R&D activities
30,6%	2/ Knowledge transfer / Knowledge sharing
16,6%	3/ Networking and partnership building
4,7 %	4/ Cooperation for Trustworthy ITC

To achieve this, the members (academia, industry, SMEs, clusters) would bring at different levels the following actions for example:

- Share relevant information and best practices in a specific domain and experience,
- Participate to identify and promote intra/extra European activities,
- Share international experience in given regions,
- Supervise a publication,
- Conduct workshops,
- Integrate a NEM commission and be active,
- Provide and facilitate contacts in different regions,
- Matchmaking with content industries and SMEs,
- Attending networking events for NEM and preparing specific projects and calls,
- Offering research results,
- Organize seminars / symposia / WS, invite colleagues to WS and conferences,
- Expanding the range of partners,
- Establish collaboration agreements,
- Enlarge the NEM community bringing CCIs and ICT incubators working in the cultural and creative sector coming from those countries.

Beyond those actions NEM stakeholders intend to play a role in education through media, fake news eradicating, and inclusion through media, which means to work on artificial intelligence and deep learning, get involved in IoT, the blockchain and other already highlighted issues above (see section 7.2). For coming initiatives it goes without saying that NEM members will involve international cooperation clusters still operating in different regions and in order to capture their priorities: Maghreb (MOSAIC), Africa (African Media Initiative), Latin America (Connecta2020), East Europe (EECA Horizon ), India (FI-MEDIA), ASEAN (Connect2SEA), USA (Picasso) and others.

ate of the vision and the corresponding research that needs to be made in order to achieve the objectives.

EM SRIA is mostly contributing to the Next Generation Internet chapter and the question that NEM is willing to

**“media ecosystem be like?”** the NGI already provides a strong *leitmotiv*: it should be human-centric. Recent events and innovation areas that contribute creating a **trustworthy, pluralistic and sustainable European media and**

**initiative contribute to that vision”?** NEM’s efforts should foster the development of **technologies and knowledge** media ecosystem that is concurrently:

nd  
d sustainable.

bove should contribute to such a goal, we can summarize them in the following tables

nd innovation areas	Focus
technologies and tools for auto-adaptive contents experiences are accessible for all	<b>Intelligent, autoadaptive, multimodal contents and experiences</b> for people with diverse hearing, movement, sight, and cognitive <b>abilities</b> ; and/or <b>languages</b> . Methods for <b>hyper personalized assessment and adaptation of multimodal content delivery</b> and display to suit user specific needs (abilities, languages).
gies, technologies, and	End-to-end <b>privacy-enhanced methods for preventing access to inappropriate</b>

		<b>and countering of potential infringement and misuse of own image</b> in media contents or for media benefit; including undue profiling, exploitation and abuse.
Ameliorating the weaponisation of information.	Methodologies and software tools for automatically detecting harmful actions, effects and contents (including multimodal), sources, and propagation patterns that can be used for early warning and campaign containment without restoring censorship or hampering freedom of speech.	Self-regulating methods for mitigating AI-generated <b>filtering bubble effects</b> .
		Detecting and countering the actions of <b>fake news bots</b> .
		<b>Automatic detection and countering of harmful multimodal contents</b> that contravenes law or international agreements (e.g. hate speech, apology terrorism, etc.)
		Automatic methods for <b>detecting and countering manipulated multimodal contents</b> .
Maintaining collective memories; imagining futures.	Standards, methodologies, and tools for enhanced enjoyment, preservation, management and reinterpretation of tangible and intangible cultural heritage, as representative collective memory on top of which imagine common futures.	Piloting of interoperable, non-invasive, <b>immersive experiences for facilitating enjoyment and learning in diverse cultural spaces</b> .
		New methods for <b>capturing, preserving and collectively curating intangible cultural heritage, including contemporary practices</b> in all their richness -not just a cultural manifestation, but the wealth of knowledge and skills they convey.
		<b>Open, reusable, multimodal assets and environments</b> for the creation, recreation and representation of collective memories and shared futures.
<b>Innovative, competitive and sustainable</b>		
New accessible software and hardware solutions for the creative industries.	Enhanced, cost-efficient technologies for the capture, processing, hosting, displaying and distribution of multimodal contents in the converged era; includes environmental impact of devices, energy consumption, etc.	Novel <b>immersive content capture HW and techniques</b> (360 cameras and microphones, multi-camera, light field, hybrid technologies, acquisition technologies) sustainable and including eco-friendly materials.
		<b>Standards and formats</b> for the <b>representation, processing and distribution of interoperable multimodal and hybrid</b> contents.
		New methods and technologies for <b>optimizing production and post-production processes</b> : automation relying on emergent technologies (e.g. AI, cloud, IoT..), multimodal editing, collaborative editing, immersive/interactive content

		production tools etc.
		Novel and improved <b>HW and technologies for the consumption of new forms of media content</b> (interactive, immersive, personalized, multimodal) that increase realism and sense of presence, prevent audience isolation and preserve user privacy.
		<b>Sensing and interpretive technologies</b> for capturing, processing and preserving data from <b>multiples sensors</b> , extract relevant features, and infer relations from an increasing array of data and sensor inputs useful <b>for human-machine and human-human interactions</b> .
	Seamless, non-invasive sensing, sensing inducing and interpretive technologies for effective multisensory integration in immersive experiences.	Smart <b>sensing inducing technologies</b> for evoking <b>multisensory sensations</b> in collaborative and interactive environments.
		Advanced <b>QoE definitions and metrics</b> for the characterization, modelling, manipulation and evaluation of sensory processes involved in <b>immersive storytelling</b> .
		Privacy-enhanced and cost-efficient methods, SW tools and applications for <b>enhanced user-aware monitoring and evaluation</b> through precise QoE measurements in real environments.
Monitoring and assessment of QoE and novel quality measures for new media and contents.	<b>Automatic quality control</b> functions, including predictors, for optimizing end-to-end content production processes.	
	Fostering new business models, services and products for next generation media and contents ensuring plural and quality media and CCI ecosystems	New <b>Social Media network paradigms</b> and enabling technologies for <b>community-owned social media networks and platforms, social connectivity, and social media services</b> .
		Methodologies, standards, platforms and tools for the <b>valuation and management of copyright information and licenses, and rights data management</b> in general, including a focus on <b>user-generated-content ownership and copyrights</b> .
Methodologies and tools for <b>estimating and managing the information and economic value of user data</b> hidden in big data (e.g. personal data, data coming from sensors, etc.) and <b>new sustainable models for exploiting the user data</b> in personalised service provisioning.		
Hyper-personalized media and seamless CCI services in a converged environment		New <b>privacy enhancing technologies and methods for mass customization, user profiling, targeting</b> and seamless <b>user-tailored experiences delivery</b> (e.g. cross-device, cross-channel)



		Development of methodologies and platforms for <b>detecting bias and discrimination in automated decision making</b> by algorithms operating in the open web (e.g. targeted advertising, e-commerce and online price discrimination).
Empowering users and consumers to play active roles in a rich, transparent, plural and competitive European media ecosystem	Distilling and transferring necessary knowledge for CCI stakeholders to effectively adopt and exploit the novel media and content technologies.	Systematization and standardisation of new languages and narrative possibilities, including <b>notation, composition rules and storytelling guides for new contents</b> (e.g. immersive media).
		<b>Piloting and fostering early adoption of novel technologies in CCI vocational training</b> to obtain feedback from young, creative and future CCI professionals, while increasing their competitiveness due to early exposure.
	Creation and maintenance of <b>open repositories of multimodal content assets, commons, and environments, protected by open licenses</b> , for the use of in-training and job seeking CCI professionals (e.g. practice, portfolio creation).	
	Promote media literacy and digital skills initiatives, at all ages, for increased transparency and user awareness.	Mainstreaming <b>media literacy contents into early education curricula, and fostering educational activities that expose and explain how media content technologies work</b> , and how they contribute shaping public perceptions, identities and opinions, and consequently culture and society.
Tools for <b>opening up and giving visibility to collective dynamics and interaction patterns on online participation platforms, and knowledgebase (e.g. Wikipedia)</b> , in order to improve collective awareness and foster effective and transparent deliberation, and collective creation processes.		

# **ANNEX B            NEM PRIORITY AND INNOVATION LIST 2018**

## **New Generation Networks**

5G

OTT over virtualized infrastructures

Wireless sensor networks, immersion and multi-sensory data

Cognitive technologies

Quality control (end2end)

Standards and tools for the management of copyright information and licences, and rights data management in general

## **Immersive Technologies**

Augmented reality and virtual reality

Holography

Immersion and multi-sensory data

Storytelling

## **Big Data**

Annotation and metadata

Infrastructure for the use of Big data by SMEs

Data visualization

Personal data management

Sensing and Interpretive technologies

Interpretative and semantic technologies and metadata

Semantic technologies and metadata

## **AI**

Annotation and metadata

Cognitive technologies

## **Social Media**

Annotation and metadata

Personal data management

## **Personalization**

## **Human-Machine interaction**

Human-machine interaction including BCI, haptics, vocal

Design and human-machine interaction

Human-human interactions through devices

## **Cloud, virtualization, edge computing**

Virtualization including 5G slices for media&content

On-demand cloud resources

Multi-cloud environments (private, public, multipurpose, specific)

**Cybersecurity**

- Security including block chain
- Personal data management

**Accessibility**

- Multi-device reading software to read standard formats and with accessibility features
- Standard technologies and tools for production and distribution of accessible digital books for visually impaired and print disabled people

**ICT Convergence**

- COTS and open architectures with self-describing, well-documented APIs
- Online catalogues and data visualisation
- Multi-platform access
- Discovery and identification tools
- Software defined technologies
- Networking solutions beyond IP

**ANNEX C**

**WHITE PAPER: “POLICY DIALOGUE IN  
CONVERGENCE AND SOCIAL MEDIA:  
REQUIREMENTS”**

Policy dialogue in Convergence and  
Social Media: requirements



White Paper  
(November, 2017)

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## Introduction and Motivation

In an increasingly complex context of convergence and social media, where continuous innovation changes are taking place due to the entry of new players into the market and the need for traditional stakeholders to transform themselves, the policies and regulations governing this sector need to be discussed and reviewed on the basis of changing needs. In this perspective, the cooperation of all the stakeholders involved to exchange ideas, current and new needs deriving from these changes becomes fundamental to build in a balanced way an appropriate policy framework that can support the future economic and technological development of the convergence and social media sector.

Currently, the technological world and the one dealing with the definition of policies and regulations are often very separate, risking not being aligned in supporting economic development of the European Union. The dialogue between those worlds becomes very relevant in order to identify the best approach to address policies and regulations following technology developments. This white paper aims at reporting on:

- why we need this dialogue considering the current situation in the Media and Social Media sector and their policies and regulations;
- what are the main expectations for the “Policy dialogue” by part of the NEM community - according the results of Policy Requirements Survey - and consequently
- what are the main requirements in order to foster an open and broader dialogue on convergence and social media policy issues and consolidate it during the Vital Media lifetime with the main scope of delivering policy recommendations, as result of the policy dialogue conducted over the project lifetime with a broad range of stakeholders.

## Media and Social Media sector in a convergence era

In recent years, the media sector, in particular the audio-visual one, has undergone a profound transformation process, as a result of the strong growth in video content and online entertainment, posing increasingly complex challenges to policy makers, competition and industry authorities. The Media sector plays a key economic, social and cultural role in Europe. Europe boasts a strong media industry, which creates growth and jobs and represents European life, languages, history, culture and values around the world.

Those deeply changes in the media sector are due to the impact of the Information and communication technologies (ICTs) which are revolutionizing the creation, development and distribution of content today. The introduction of new technologies has produced a “disruptive” effect on the traditional media industries. Innovation has become the most important growth driver and has led to the emergence of new operators and business models.

The media landscape is undergoing a transformation, characterized by a steady increase of convergence of media services, with a visible move towards intertwining traditional broadcast and the internet. Audio-visual media content has arrived on non-TV screens and internet content is arriving on the traditional TV screen.

In addition, the growing variety and availability of devices has led to a radical change also in consumer habits, expanding the options and methods of use no longer linked only to traditional devices (i.e, radio, tv). This phenomenon empowers European citizens (including young people) to be able to access seamless and interactive experiences, letting them access any content while being agnostic as to the device or geographic locations from which they interact, but not to the language of communication. Consequently, the proliferation of connected devices and the wide availability of faster broadband connections are affecting existing business models, consumer habits, creating new challenges, and opportunities for the creative industries. The growth of the language industry close to the media industry is a reality in Europe.

In this landscape, TV remains the foremost source of information and entertainment in the EU, but the audio-visual sector directly engages millions of people with other types of media, specifically available through internet, that are spreading more and more in the market. In Europe, there has been an increase in competition in the distribution of video content - an area controlled by traditional television operators - as a result of the following factors: the entry of new global players, starting with Netflix; consolidation, through mergers and acquisitions, by the major telecommunications operators, which allowed the development of the “quadruple play” offer, integrating voice, data with fixed and mobile Internet access and video; direct access by new players to exclusive “sports premium content”, starting with football (national league and Champions League) capable of increasing demand for data and traffic on networks.

Therefore, the impact of the Internet and new technologies on the media and content world is enormous: new business models, new players and new challenges await antitrust and regulatory authorities. The process must find ideas and knowledge from both the "new" and the "old" economy. At the same time, whilst maintaining the focus on the consumer rather than on protecting certain competitors, it allows the benefits of the Internet and new technologies to extend across the economy.

The media and communication sector is therefore increasingly becoming a digital ecosystem, characterised by the group of subjects that produce, consume and exchange information within the area bounded by digital technologies.

Sectors previously distinct, such as content and media, telecommunications, information technologies, are now converging, creating a new industrial ecosystem that requires different types of companies with different corporate cultures to compete and collaborate.

## **Media and Social Media policies and regulations**

The increase of convergence between traditional information and/or cultural sources and the internet has rapidly changed people's habits. This new model allows citizens to interact not only with other individuals but also with all kind of content providers. The possibilities are huge so are the challenges. The Media sector, which plays a key economic, social and cultural role in Europe, is itself facing great and important transformations.

For that reason, one of the most relevant points on the political agenda of the European Commission (EC) is the Digital Single Market (DSM) strategy. It aims to open digital opportunities for people and business, and enhance Europe's position as a world leader in the digital economy. Within the DSM



framework some regulations of the Media sector are translated into policies and regulations. Specifically, in response to these transformation and challenges, the EC is:

- supporting **media policies** in today's digital landscape through:
  - common approaches for the audio-visual sector and new media sector
  - the creation of a true Digital Single Market of Content
  - the promotion of media freedom and pluralism
- digitising Europe's **cultural heritage**, making the collections held by Europe's libraries; archives, museums and audio-visual archives available to everyone;
- promoting **open data** and, in particular, re-use of public sector information (open government data);
- ensuring that the right regulatory framework in terms of **copyright** is in place for all to fully benefit from the great opportunities offered by a truly connected digital single market.
- Promoting language diversity and multilingualism through ICT EU language industry
- Mainstreaming media accessibility to work towards an inclusive Europe

In that context, it is important to mention: the regulation on **Audio-visual Media Services** ( 2010/13/EU (AVMS directive) and its proposed modification with the “COM(2016) 287; the regulations on **Copyrights** (1996/9/CE; 2001/29/CE; 2006/115/CE; 2009/24/CE; 2012/28/EU and 2014/26/EU) and new directive proposal COM (2016) 593 **on copyright in the Digital Single Market**; The directives 2006/123/CE and 2000/31/CE on **cross-border portability of online content services** and the new proposal COM (2015) 627; the directive 2000/31/CE on **E-commerce & geoblocking** and the new proposal COM (2016) 320, and the new **European Accessibility Act**.

In addition, in terms of regulatory methodology, the traditional command and control paradigm is gradually being replaced by forms of co-regulation and self-regulation from below, more flexible, dynamic, complete and articulated, which redistributes regulatory responsibilities and promote consumer welfare more effectively.

## Policy Dialogue

In this context, fostering dialogue among all the relevant stakeholder becomes of paramount importance in order to address the impact of future technology developments and necessary policies and regulations in media domain. For this reason, the Vital Media project is committed: to support and encourage this dialogue in order to identify the best way to do it; to specifically identify the most relevant topics, the stakeholders to be involved and the most appropriate tools and communication channels to support this dialogue. To this end a survey was launched in the NEM communities.

### Policy requirements survey: Topics, stakeholders, tools and channels

In order to collect the opinions from media and creative communities about Media Convergence and Media Policy, a focused survey was launched inside the NEM community and in other relevant communities.

The main objectives of that survey were to identify:

- a) the relevant topics and related priorities to be addressed in a dialogue;
- b) the main stakeholders to be involved in the dialogue;

c) preferred tools and channels to be used to foster the dialogue among the stakeholders involved.

After a first media and policy context analysis a set of topics were identified as the most relevant to be proposed in the survey for a further analysis by the involved communities. The survey questionnaire suggested ten main policy topics:

1. Customer Protection Policy: new decisions and impact on Media domain;
2. Digital Single Market (DSM) strategy for Europe vs Media domain: policy impact and future expectations;
3. Data protection and privacy issues for Media sector: policy impact and future expectations;
4. Copyright rules vs impact on media sector: current status and next developments;
5. Revision of the Audio-Visual Media Services Directive (AVMSD) in order to address digital single market needs, new way of consumption and technological changes;
6. Relevance of self-regulation and co-regulation for media domain regulation;
7. Relevance of independent and trusted audience measurement for media domain;
8. Standardisation and interoperability policies: current status and next developments;
9. Relevance of policy framework for support of research and innovation in the media sector;
10. Current activities of "Media Policy directorate I"

Participants were asked to express the relevance of the topic on a scale from 0 to 5, where 5 was considered "very important" and 0 not relevant. In addition, participants could list any issues, challenges, guidelines, requirements, barriers that they considered important to be taken into account on the discussed topic.

According to the survey results, the topics in order of importance were the following:

1. Data protection and privacy issues for Media sector: policy impact and future expectations (with 67% of answers on "5" and 17% on "4");
2. Digital Single Market (DSM) strategy for Europe vs Media domain: policy impact and future expectations (with 67% of answers on "5" and 6% on "4");
3. Customer Protection Policy: new decisions and impact on Media domain (with 59% of answers on "5" and 18% on "4");
4. Relevance of policy framework for support of research and innovation in the media sector (with 53% of answers on "5" and 35% on "4");
5. Copyright rules vs impact on media sector: current status and next developments (with 47% of answers on "5" and 24% on "4");
6. Standardisation and interoperability policies: current status and next developments (with 35% of answers on "5" and 47% on "4");
7. Revision of the Audio-visual Media Services Directive (AVMSD) in order to address digital single market needs, new way of consumption and technological changes (with 35% of answers on "5" and 12% on "4");
8. Relevance of independent and trusted audience measurement for media domain (with 33% of answers on "5" and 17% on "4");
9. Current activities of "Media Policy directorate I" (with 19% of answers on "5" and 19% on "4");

10. Relevance of self-regulation and co-regulation for media domain regulation (with 18% of answers on “5” and 29% on “4”);

It is important to highlight that the differences in terms of preference among the proposed topics are minimal. The customer protection seems to be one of the most relevant topics strictly related to the policy on data protection and privacy issues. In addition, the participants, apart from the suggested topics, recommended the following others to be taken in account:

- Media and information literacy
- Accessibility of audio-visual content
- Media (news and information) plurality and diversity
- Media trust and verification.

The second part of the survey aimed to identify the more relevant stakeholders needed to be involved, in order to discuss the main topics emerged from the previews part. A list of potential relevant stakeholders was provided in order to obtain the opinion of the survey participants. Specifically, the proposed most relevant stakeholders were: European Institution (eg.:DG and Directorates,... ), Lawyers (expert in media regulation), Media Policy Experts, European Authorities (eg.: EPRA, ERGA,...), Media Companies, Media Associations and interest groups (e.g.: EBU), National Authorities, Universities and Research Centres expert on media technologies, Universities and Research Centres expert on media policy and regulation, Consumer Associations. In addition, participants could provide further comments and suggestions and indicate relevant events where policy makers should be involved. The follow options were suggested: NEM Summit, NEM General Assembly, Dedicated NEM workshop with EC directorates and Vital Media Event.

From the survey results it emerged that the involvement of almost all of the suggested stakeholders is relevant, but Media companies, Media Associations and interest groups, Media Policy Experts, Consumer Associations and European Institution are judged to be very relevant while the others are a little less important. Moreover, It was suggested to take in account also, "Standards bodies (e.g.:HbbTV Forum, MPEG): which shape the future technologies and the scope that they will have in the implementation of features (privacy, accessibility) that are desirable from a policy perspective as well as Technology providers. The importance of assuring the involvement of the whole spectrum of media companies - not just large established commercial ones – including arts and culture organisations, hyperlocal publishers, content and tech start-ups and SMEs was highlighted. With regards to suggestion as to which is the most suitable event to involve policy makers, the most popular answer was the NEM events with a dedicated workshop with EC directorates.

The last part of the survey aimed to identify the more appropriate and preferred tools and communication channels to improve the policy dialogue. In this case the following options were suggested: Face to face meeting (eg.:workshops, focus groups,ect) at the European Level, Face to face meeting at national levels, Social media groups (eg.: Linkedin, ect), Webinar, Dedicated on-line platform, with relevant policy information and news and focused discussions. According to the received answers, the dedicated on-line platform and webinar

are considered appropriate but the participants find face to face meeting in particular at the European but also at a national level to be more appropriate and profitable.

## Policy Dialogue Workshop

In terms of dedicated events so far arranged at the European level, a specific workshop on Policy was organised and held during the 23<sup>rd</sup> NEM General Assembly. The main scope of this workshop was to bring together at the same table media stakeholders and policy makers in order to improve and foster the dialogue among them and to identify and share views on challenges, guidelines, requirements, and barriers in the European Media domain.

During this workshop the results of the Policy Requirements survey were presented, than the approach from I3 project on the policy activities in order to support Media sector jointly fostering Policy Dialogue at European level, the point of view of Media Representatives (VRT and EBU) and current EC initiatives on policy on the Media sector (Vita Jukne -EC unit I-2, copyright; Emmanuel Joly - EC unit I-3, Media Programme; Paolo Cesarini - Head of EC Unit Convergence and Social Media.

## Conclusion

In the media and social media sector, the dialogue on policy and regulation issues is becoming more and more relevant due to the deep, fast and continues changes which are characterizing the sector and which require continuous adaptation to meet new and emerging trends, and the rapid changes in EU population who consume media.

Consequently, becomes of great importance to have the right opportunities to promote and nurture this dialogue in order to support the proper development of the sector. The NEM community, supported by the Vital Media project, is committed to foster that policy dialogue, among the relevant stakeholders through periodically focused meetings and events as well as day by day discussions on its online platform "OPENNESS" (available on NEM web-site <https://nem-initiative.org/collaboration-platform>). OPENNESS offers a dedicated area which was created in order to provide an open space for policy dialogue and collaboration, where stakeholders can discuss current and forthcoming rules, regulations, and challenges. That space is currently managed by the Vital Media and I3 project, having an agreement to carry on the policy discussion on the OPENNESS on-line platform. Finally, the Vital Media project invites companies, entrepreneurs, policymakers, academics, interest groups, and all interested stakeholders to take part in the discussions inside the OPENNESS platform as well as to participate in the dedicated events, aiming at generating data, input and opinions to be gathered and presented to the European Commission at the end of the project lifetime.

In this perspective, one of the main achievements will be to deliver policy recommendations, as result of the policy dialogue conducted over the project lifetime with a broad range of stakeholders.

**ANNEX D**

**POSITION PAPER “IMMERSIVITY”**



**IMMERSIVITY**

**POSITION PAPER**

**(NEM, September 2017)**

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## 1. INTRODUCTION

NEM, the New European Media initiative, is the European Technology Platform of Horizon 2020 dedicated to Content, dealing with Connected, Converging and Interactive Media & Creative Industries.

NEM focuses on an innovative mix of various media and creative content forms, delivered seamlessly over technologically transparent networks, to improve the quality, enjoyment and value of life. NEM represents the convergence of existing and new technologies, including broadband, mobile and new media, including creativity, across all sectors, to create a new and exciting era of advanced personalised services.

Following the update of the NEM Strategic Research and Innovation Agenda (SRIA) in 2016 [SRIA], it has been decided to extract the most important research domains and objectives that have to be pushed in the next WP2018-2020, completely in line with the priorities elaborated by NEM community. From these priorities, NEM have promoted the presentation of its position papers tackling the main technical and business opportunities for the sector from a holistic view.

The position paper on immersivity will tackle with immersive communication enabling natural experiences and natural interactions with remote people very similar as real-time face-to-face experiences and interactions; and immersive content offering novel experiences aiming to improve connection, information, control, cooperation and interaction. Immersive technologies have been selected as one of the Gartner's top 10 strategic technology trends for 2018. It is expected to generate globally by the end of this year 6,350 M€ and be worth 126,950 M€ by 2020.

Virtual reality (VR) and augmented reality (AR) transform the way individuals interact with each other and with software systems creating an immersive environment. Immersive experiences with AR and VR are reaching tipping points in terms of price and capability and are expanding beyond visual immersion to include all human senses.

Integration, immersion, emotion, aesthetics, entertainment and experience have become the key words of our existence. Immersion and Interactivity with content and technology is possible by encouraging users to take a more active role, involving them in more advanced and interactive experiences, even if they have no skills or technical knowledge.



## 2. SCENE SETTING

By Immersive Content, computer-generated simulation of reality with physical, spatial and visual dimensions is usually referred. Immersive technologies and virtual reality gather computer applications by which humans can interface and interact with computer generated environments. Immersive systems can simulate almost everything from a walk-through of a building prior to construction to simulations of aircraft flight to the operating theatre to new three dimensional forms of interactive entertainment.

As 3D and immersive technology becomes more integrated and accessible for a wide range of applications and publics (professionals and wide public), it will require well-designed user interfaces and innovative content across interoperable platforms including mobile devices, distributed web systems and desktop applications.



Immersion encompass sensorial and interactive environments to experiment a "sense of presence", allowing for performing activities in the digital world (immersive capability to engage people), in artificial, interactive, virtual created scene or 'world' within which users can immerse themselves. It also raises important questions about the embodiment of the user in his/her digital representation. Many applications also expect transfer of experience or skills from virtual reality to real world.

Cognitive and emotional processes about physical content creation and choice will change as well. Virtual sets will allow user to choose the floor tiles or a piece of furniture for their house on the basis of a virtual, immersive, on place, rendering that anticipates how well the tiles or the furniture fits the house. Choosing a different color for the interior of a car, will become possible while looking at the actual physical things inside the car in the show room. In short, several consumer oriented

interactive and immersive experiences will be made available as augmented reality video overlays become accepted and common.

Immersivity tackles with a lot of related technologies: visual rendering and capturing, gaze, gesture, physiological and psychological status tracking, auditory and immersive auditory rendering and capturing, audio/video correspondence, avatar representation and control, human computer interaction (interaction design and user centered design), information architecture, usability the service has to be easy to use and attractive, visual design/user interface (UI), psychophysics and 3D modelling. In summary a very interdisciplinary approach could offer a great opportunity to improve people's lives and jobs by transforming their experiences.

### 3. TECHNOLOGY TRENDS

Immersive technologies have many different implementation models and applications, but its primary objective is to provide a rich audiovisual experience.

#### Tele-immersion

Tele-immersion (TI) is the union of networked VR and video in the context of significant computing and data mining. Tele-immersion enables users in different locations to collaborate in a shared, virtual, or simulated environment, placing their, real-time produced, digital replicas together inside a virtual world [TIT]. It promotes the synergies between networking and media technologies to enhance collaborative environments combining audio, video, virtual worlds, simulations, gesture tracking, facial expression and body position capturing, among others. It was one of five key technologies identified as necessary for the future use of the NGI.

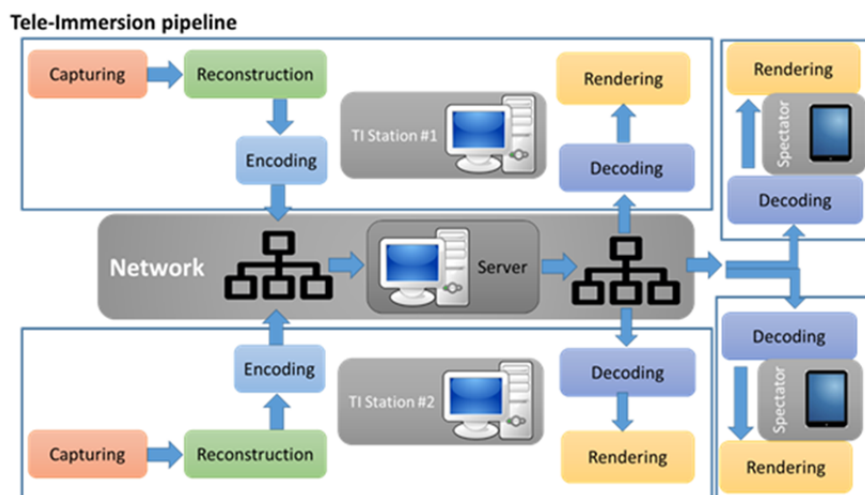


Fig. Tele-Immersion pipeline

TI imposes severe restrictions in terms of bandwidth, latency, storage and computing resources. Quality of Service (QoS) and Quality of Experience (QoE) are top priorities in immersive media whereas availability and real-time interaction between users are considered critical challenges that need to be met as they ensure a smooth user experience. New network capabilities should provide the response to the volume of data produced by real-time TI applications, so 5G is intended as a key enabler for covering the necessities for real time TI applications. [5GENT]

## **Virtual Reality**

Virtual reality is an artificial environment that is created with software and presented to the user “as a real environment”. VR is becoming increasingly more available and commonplace. Because of this, companies are beginning to use the technology to offer consumers new ways to enjoy various forms of media.

VR evolution starts to involve wrap-around display screens, “augmented rooms” equipped with wearables, and *haptics* devices that let you feel the display images. VR evolution using wearable devices raises also the question of controlling, simulating and rendering avatars to ensure embodiment and Presence in places where users cannot directly see their body.

## **Augmented Reality**

Augmented Reality (AR) is a type of interactive, reality-based display environment that takes the capabilities of computer generated display, sound, text and effects to enhance the user's real-world experience by adding a virtual display on top of real images and surroundings.

AR technologies are both hardware and software intensive. Special equipment, such as head-mounted devices, wearable computing gears, global positioning systems, etc., are needed. Real-time tracking and computation is a must, since synchronization between the real and the virtual worlds must be achieved in the shortest possible time interval.

## **3D Modelling**

3D modelling plays a fundamental role in creating objects with geometric shapes and physical behaviors in 3D spaces. Rigid or deformable geometric shapes can be typically represented by polygons (meshes) or freeform surfaces. Meshed geometry is a popular representation widely used today in animation and games. On the other hand, objects' physical behaviors should be modeled as well for the purpose of illustrating their physical properties and dynamic change processes. Avatar raises special questions about capturing and faithfully rendering the interactions between the meshes attached to the body and those modelling the digital environment.

High visual quality 3D reconstructions are created in the form of time-varying meshes (TVM) [TCSVT] that produce a large volume of heterogeneous data, thus, creating a challenging networking scenario. Although TVM data can be compressed via static mesh compression or techniques that exploit correlations of the data over time, existing compression schemes are not yet ready to support real-time applications.

## **User interfaces**

There are several interfaces coexisting and facilitating interactions. Oldest are graphic user interfaces (GUI) used in software applications. Natural Interface (NI) is getting more and more popular (i.e. Microsoft Kinect) for gesture-based human–computer interaction. Tactile/Haptic User

Interfaces (T/HUI) emphasize the experience of touch or force feedback. Several haptic or tactile devices such as phantom and cybergloves are commercially available in the market.

The true revolution for interfaces comes from VR head-mounted displays (VR HMDs) that are attracting users with enhanced full-sensory immersion in virtual environments. A head-mounted display is simply a small monitor that is shaped like or positioned in a visor so that it takes up the entire field of view of the user or at least ensures that whatever the HMD is displaying is always in the field of view of the user. Creating the illusion of immersion on HMDs requires high framerate, low latency, and high visual quality. The Oculus Rift and Vive, virtual reality headset, features high-end performance that no HMD product has ever done before. However, Oculus Rift has a 80° horizontal FOV as Vive has a 100° FOV. Nothing compared to the natural human FOV: 210°.

### **Holography**

The definition of holography is reflection of light projecting an object that is not physically there. A hologram is a photographic recording of a light field used to display a fully three-dimensional (3-D) image of the holographed subject, which is seen without the aid of intermediate optics. At research level, the main goal is to widen the viewing angle and size of 3D images today.

Real-time holography of a live scene, object, or person requires considerable computing resources, including high-resolution cameras, calculation of depth perception using sensors, and accurate and high-rate rendering of the live video. [KIM]

The current major driver for the holographic and volumetric display technology is for entertainment applications, such as 3-D TV and movies, gaming, and mobile devices. [TSAN] But beyond entertainment, there are various fields including arts, biomedical imaging, scientific visualization, engineering design and more that are beginning to incorporate hologram usage, and the technology seems to be making access easier. Industry, marketing and advertising, and training, especially when haptic feedback is incorporated into the interaction with the projected image, are gaining momentum.

There is significant growth in the research and development of holographic (and 3-D volumetric) display technology. In fact, a market research report published in 2015 by Markets and Markets on the holographic display market, estimates that the holographic technology market will grow to an estimated \$3.57 billion by 2020 and grow at a compound annual growth rate of 30.23% from 2014 to 2020. [M&M]

## **4. MAIN AREAS OF APPLICATION**

Immersivity through virtual, augmented and mixed reality technologies have been evolving for many years and are already demonstrating how they can shake up entire industries. They provide the opportunity to solve real challenges when they are well focused to specific industry needs. NEM has identified several industry sectors that are well positioned to take advantage of immersive innovation. Although currently mainly known for consumer applications in the entertainment industry, there is real potential in fields as medicine, science, engineering, data visualization and the military to name just a few.

Improved hardware then will pave the way for a larger consumer adoption. Immersive leisure content (immersive concerts, immersive movies) will likely follow the gaming lead, but after, hopefully shortly after, many more sectors will benefit from effective, open, immersive technologies and content.

Design and engineering in manufacturing, maintenance of complex artifacts by remote maintenance crews, remote health care assistance, virtual immersive fruition of touristic attractions and cultural heritage sites are just the first examples that come to mind... but, in truth, the possibilities are endless.

## 4.1 Gaming

The games industry in general has been a massive driver for technological innovation. There has been a significant improvement in games development and presentation tools across multiple technology platforms, with special importance of virtual world applications which link real-world environmental data to 3D visualisations in virtual world environments.

The technologies of video games, virtual worlds and social networks have become collectively known as immersive technologies. Their ability to engage people is driving massive investment into this kind of technologies.

Gaming is a very powerful market, joining game console and mobile, as there's a high demand for VR on-the-go. Last year, mobile gaming dominated the marketplace by bringing in a whopping \$41 billion dollars in revenue by the end of 2016 [SDATA]. With several announcements being made in regards to mobile VR last year, expect to see an increased emphasis on mobile VR integration.

Besides console games, serious games aim to provide alternatives focused on areas where the cost–benefit ratio of games methodologies was most easily justified and understood, namely in areas of high training costs and/or risks and/or practicality development is still an issue today. [YOUNG]

Serious Games today apply traditional role playing techniques in innovative ways, made possible by immersive technologies and 3D visualisation. As the technologies for 3D visualisation and online multi-player interaction have developed over recent years, there has been a massive increase in the use of associated applications such as virtual worlds and social networks.

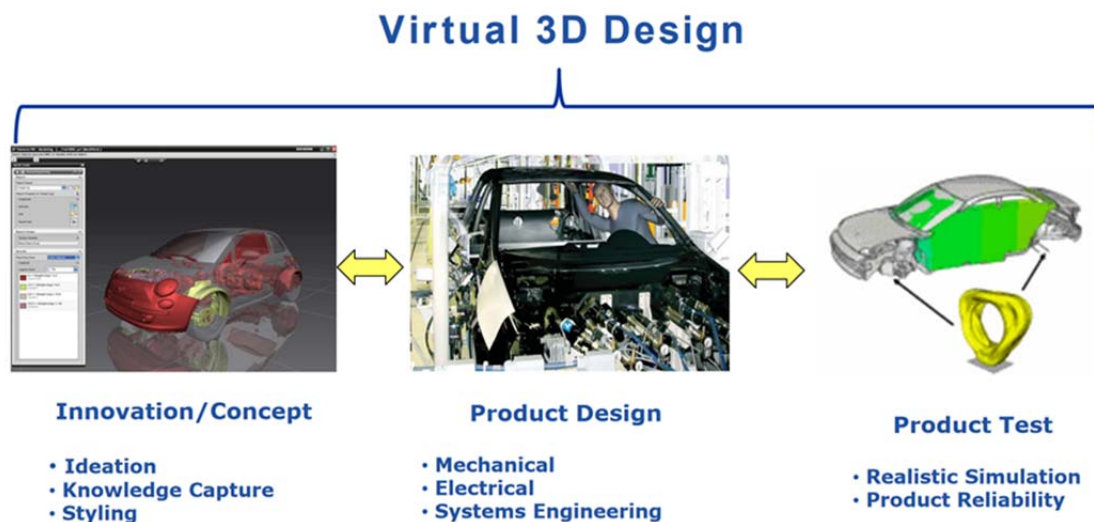
## 4.2 Manufacturing

Manufacturing industry is facing a complex and highly competitive environment. Industrial processes are evolving aiming to respond a more global market where customization is a non-stoppable trend.

An innovative and effective solution to overcome competitiveness is the application of virtual reality and augmented reality technologies to simulate and improve these manufacturing processes before they are carried out.

The application of immersive solutions for manufacturing applications is a strong and growing area. The challenge is to design and implement integrated immersive manufacturing systems that could enhance industrial processes, both for products and processes, leading to shorter lead-time, reduced cost and improved quality, leading to an improvement in productivity. [ONG]

VR applications in mechanical-related areas are quite well established, e.g., design, setup planning, production scheduling, machining, assembly, etc. Many manufacturing tasks have been carried out as information processing within computers, typically prototyping by means of CAD tools. These models aim at representing the precise structures of manufacturing systems and simulate their physical and informational behaviour in real operation. Taking human factors into account at the very early stage of the design process is a challenge with digital mockups, involving plausible and transferrable interactions with the future users in the CAD models.



Manufacturing has two critical phases, product designing and planning how to manufacture a product. Leading manufacturers are applying immersive virtuality technologies at both points. Immersive technologies are supporting the improvement of both by discovering early errors in the design process that leads to eliminate a lot of expensive takes. And by examining 3D models at life-size scale, problems in the product design and its related manufacturing processes can be spotted more readily.

Immersive interactive design software will probably emerge and this together with the almost mainstream adoption of 3D printing hardware would allow for virtual creative crafting of objects, such as small gifts.



### 4.3 Education and learning

Education has traditionally been one of the first areas to use immersive technologies. The use of the technology enables the learner to immerse in an environment that allows for learning through an increased range of sensory experience, which can potentially deepen understanding.

Ensuring the correct balance between real and virtual objects is essential to encourage connections between the learner and content. [YIYU]

Applying immersive and interactive 3D technology, different educational paradigms as Visual Learning, Simulation-based Learning, Constructivist Learning, and Engaged Learning are currently enhanced.

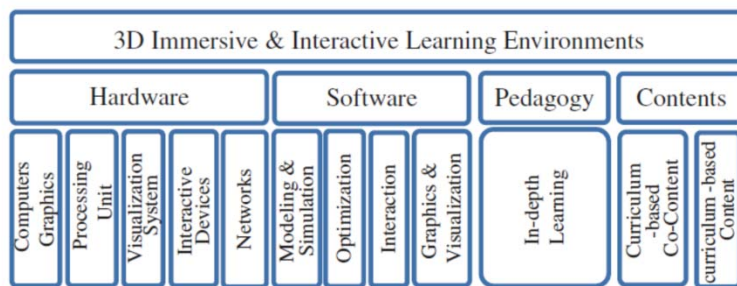


Fig. 3D Immersive and Interactive learning environments

Opportunities for AR in educational settings are rapidly emerging as technology becomes more accessible, recent development of mobile technology provides educators with powerful AR hardware platforms. Furthermore, the use of handheld devices increases experiential authenticity within the classroom environment as being less intrusive than head-mounted devices. [LEE] [WU]

Beyond class education, learning of motor skills and procedures relies on multidisciplinary developments, to associate human and social sciences to technology development. The aim is to propose immersive environments where users can train and learn specific skills with an efficient transfer to real world: learn new profession or procedures, train in sports...

### 4.4 Health care

Telehealth has become an accepted and validated method for the treatment of many different health care concerns. From the introduction of the Web 2.0, that has facilitated the development of new forms of collaborative interaction between multiple users, immersive applications have been progressively developed. The interaction between real and 3-D virtual worlds may convey greater feelings of presence, facilitate the clinical communication process, positively influence group processes and cohesiveness in group-based therapies, and foster higher levels of interpersonal trust between therapists and patients.3-D virtual worlds. With healthcare moving towards more innovative self-monitoring and data-driven models, the opportunities that immersive technologies provide are huge.

Immersive environments are revolutionizing training for healthcare professionals, enabling medical students to practice surgical procedures. Image analysis and reconstruction can improve diagnosis and injury treatment. For stroke rehabilitation, for example, VR technology has the potential to ‘trick’ stroke victims into regaining control of limbs they thought had become powerless, and accelerate rehabilitation times significantly. [DCAT]

#### 4.5 Creative industries

Immersive technologies are already transforming the way that content is created and experienced by the viewer, new immersive-based storytelling is allowing them to feel, act and live the story in a radical new way and astonishing detail. For example, AR technologies are building enhanced experiences for tourists around the world by providing an overlay of the important historical or cultural information relevant to the places.

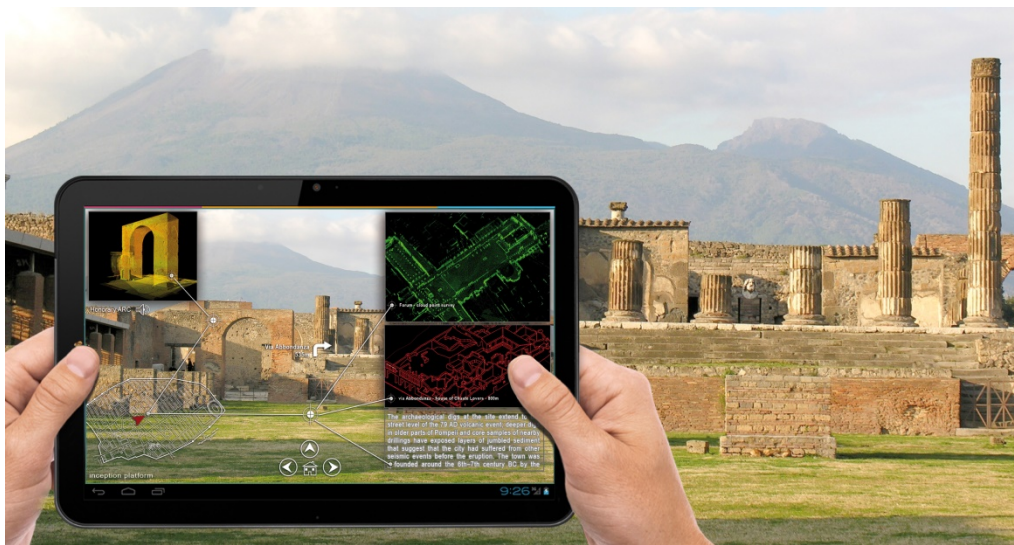


Fig. AR application for tourists. INCEPTION project [INCEP]

Marketing or entertainment are other industries taking a clear advantage of immersivity. New products can be experimented through VR creating a higher impact in the final consumers, offered experiences can be simulated and thus, get the final product or service closer to the user. Music or theatre can be experienced from home as if they would them virtually attend a concert or play, providing an alternative experience.

Museums are renewing their offer by virtual recreations of the original context of the art work. Therefore, immersivity will impact the way of creating content for gaming, entertainment and the arts as long as actors dedicate time and resource into developing content for immersive technologies.





Fig. Smithsonian Western Cultures Virtual Tour

## 5. BUSINESS AND ECONOMIC IMPACT

Immersive content has enormous potential, in disparate sectors of modern economies. Albeit the immersive technologies are still in infancy, think tanks plan uses for immersive technologies, ranging from the more conventional fields of application, like video games and entertainment, to newer concepts.

We have already witnessed an explosion of user generated content, with selfies being perhaps the most evident manifestation of this ever increasing trend. In the near-future, however, people will be doing more than creating media at an increasing pace; they will be creating media passively.

Such an enormous production of content needs new ways of being analysed and harnessed for useful purposes, and immersive technologies (together with big data techniques) are one of the main tools by using which people will be allowed to extract value from data & media.

A wide range of options are foreseeable, but not yet present in the market. For example, smart glasses could quite easily allow storing every word read. This capacity, in turn, would change how users consume text. While reading, images of people, entities, and places could be associated in background with the text and summoned with a touch. This will also affect how text is written and produced. Future media will merge text and images in new and surprising ways.

In order for VR to continue to grow, the price point needs to drop to a level where a large consumer base can get their hands on it. As with the dawn of all technologies, the price starts high, and eventually recedes.

Consumer interest in immersive content is increasing. Hardware sales alone are expected to reach \$2.4 billion in 2017, according to virtual reality consulting firm KZero. For software, which is mostly video games right now, KZero estimates sales of \$2.8 billion by 2018.

Facebook paid \$2 billion for Oculus VR -- mostly known for applying virtual reality to gaming -- opening up the possibilities of what virtual reality's role will be in social media and beyond. Google has already delivered the specs of a simple but functional cardboard headset (Google Cardboard).

But even with all these new uses popping up, the immersive content and technologies can be a difficult thing to explain, and for some aspects, difficult to accept.

There is little or no doubt that immersive gaming will lead widespread consumer adoption, and competition in gaming sector will bring about new/refined hardware, rapidly improving the value/cost proposition for the final user.

Today, albeit not yet available on the mass consumer market, Vive, Samsung gear, the Oculus Rift and Sony's project Morpheus look very promising. Oculus is testing for release the third version of its hardware (the so called "Crescent Bay edition" which adds to the current SDK2 version the support for immersive audio) while Sony seems to be actively refining its hardware for an effective debut probably integrating and revising also its PlayStation Move motion controller (<http://www.techradar.com/reviews/gaming/project-morpheus-1235379/review>),.

Immersive and Interactive content and technology could enable growth and deployment in different sectors of the EU industry thanks to :

- Opening new markets for ICT stakeholders: a pan European open secured Immersive environment offering to third party developers the possibility to develop a wide range of innovative applications.
- Quick response to new and sustainable market opportunities based on converged business models between content, telecom, broadcast and consumer electronics industries.
- Increasing business opportunities for creative SMEs. The Small and Medium Enterprises represent almost the 95% of businesses in the creative sector in terms of employment while they account around the 70% in term of turnover showing a competitive advantage over big companies in terms of efficiency, productivity and competitiveness. SME show also a lack in the capacity to access to risk capital or public subsidisation in order to improve their productive capacity.

The Immersive open environment will enable the creation of creative ecosystems on which SMEs heavily relies, in which the quality and diversity of partnerships across different sectors and types of actors is decisive. The most obvious example is the wider use of design in car industries, adding value to products, services, processes and market structures.

The relevance of new aggregation paradigm, organisational processes and business models is then a key issue for a strong economic impact of immersive content and technologies.

## 6. CONCLUSION

Immersive technologies are consolidating as one of the most intriguing topics of the content sector. Advances in the generation of 3D Virtual/augmented reality services and the gradual appearance of a variety of devices (glasses, 3D Screen, windscreen display, ...) open the opportunity for holographic content, i.e. true 3D volumetric media, give an idea of how fast immersivity is emerging.

Improved VR headsets, which currently are positioned for VR gaming and 360-degree video, are evolving towards consumption of Free Viewpoint video. Contents are being provided for any kind of genres currently positioned for 360-degree video: (live) sports, musical performances, virtual tourism, educational content, adult content, fiction, news and documentaries, eSports video streams. User generated content (UGC) are expected to constitute the second wave of content, in the form of short video clips in a social media context of messaging and sharing and live streams shared on social media platforms. Handhelds (smartphones and tablets) with auto-stereoscopic multi-view capabilities will allow users to enjoy the cases described above when they are not in a position to put on a VR/AR headset.

Immersivity challenges include

- Robust algorithms to create volumetric media from multiple cameras, stereo cameras, smartphones with multiple cameras and/or depth cameras, multiple robotics cameras (e.g. follow-me drones). Hybrid approaches combining local preprocessing and cloud-based synthesis. Calibration-free set-ups.
- Novel volumetric media representation formats, balancing compression processing requirements, compression efficiency, bandwidth and manipulation capabilities. (UGC holographic communication will require manipulation capabilities similar to current visual messaging like beautification, stickers and comments, backdrop changes, fun masks and transformations etc)
- Bandwidth efficient delivery of volumetric video. Streaming of the complete holographic video is bound to pose substantial bandwidth challenges. Research into novel networking solutions that stream personalized perception-based holographic video to users from CDN's, taking into account bandwidth, latency and cloud/local processing loads.
- Human-machine interaction. Many types of human-machine interaction will be developed in the near future, allowing consumers a wider range of activities and a broader spectrum of experiences that can be gained from their engagement with media, embodiment with their digital representation, and transfer of experience between virtual and real world. New developments are expected for avatars and robots, haptic sensors, Brain Computer Interfaces (BCI), Enhanced Sense of Presence (ESP), sensing and monitoring, Quality of Experience (QoE), audience monitoring and analysis.
- Usage of multiple audio-visual capturing sensors for creation of multi-angle content for creation of free-viewpoint video for consumption with VR and AR HMDs. Capturing modalities include visual, audio and depth (radar, sonar, lidar, time of light), and could

incorporate ground-based tele-operated and autonomous vehicles and airborne drones and balloons and definition and implementation of capturing strategies for robotic camera teams.

- Media orchestration tools for managing multiple, heterogeneous devices over multiple, heterogeneous networks, to create interactive and immersive experiences.

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CONTENT DISTRIBUTION

POSITION PAPER

(NEM, September 2017)

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## 1. INTRODUCTION

From the NEM community perspective, “Content Distribution” is a hot topic as far as most of the content need to be delivered before being consumed. The NEM sector is very rich and covers the entire data value chain, from creation, manipulation, distribution, search, and privacy; and as aforementioned, content distribution becomes the cornerstone to enable the contents, products and services consumption.

The digital revolution has a strong relationship with 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 be built upon the evolution of networks, a key element for the content distribution. In fact, for the first time ever, the technologies to transform the way networks are built and services are delivered, to create a global, high performance, scalable, intelligent, integrated IP-IT network are available [Media5G]. In order to achieve this goal, there is a need to insure a complete convergence between the different networks (fixed, mobile, satellite, cable) and also to define how content providers will be able to configure the network according the specific requirement of an application (bandwidth, latency, security, ...)

Technological innovation may be able to break down many of the functional barriers preventing a true compatibility while a wide scenario of integration of broadcasting, internet, and communications is open. Convergence will involve seamless access to content, achieving the idea of ATAWAD (anytime, anywhere and on any device) and attending the needs of transmedia. All the potential combinations of contents, networks and devices will provide very different service scenarios, however, all of them should be ruled by an adequate quality.

Sometimes relegated, broadcasting is still the most spectrum-efficient wireless delivery, infinitely scalable (one-to-many architecture and point-to-multipoint), local (capable of delivering geographically local content), timely (provides real time and non-real time delivery of content) and flexible (supporting different business models as free-to-air and subscription services) [FOBTV].

Regarding economic figures, the media industry has outperformed other industry sectors in terms of returns generated for shareholders over the past 5 years with broadcasting specifically seeing an increase in future value significantly above other industry segments [ACC].



Fig: Year Total Returns to Shareholders (TRS) 2010–2015 (Source Accenture)

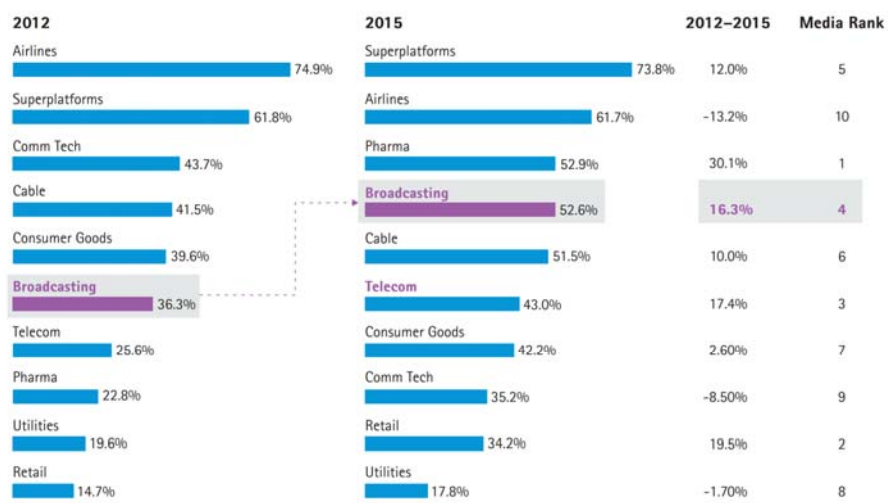


Fig: Future value as a percentage of enterprise value 2012 vs 2015 (Source Accenture)

## 2. EVOLUTION OF THE MEDIA CONTENT DISTRIBUTION

Never before, had content consumption options been so numerous. The way the media is consumed is changing. Consumers access media services by means of increasingly using personal devices such as PCs, smartphones and tablets, and the Internet. There is a real coexistence between live linear viewing, time shifted and on-demand services that are gaining market share. Non-traditional service providers have entered the market and new platforms that use the strengths of online distribution, are competing against traditional TV broadcasting. [EBU Future Distribution]

The use of new technologies, and the new needs in society, has brought an increase in the number of Internet-connected devices. This increment has resulted in an increase of network traffic. Managing such amount of traffic has led to service providers and ISPs to seek mechanisms to improve services, as well as reduce traffic on the backbone network. For this reason, new methods of content distribution have emerged, trying to reduce adverse side-effects when you have to deliver content to a large number of users simultaneously.

Smartphones and tablets are becoming a more common device for accessing multimedia content and services, while mobile networks are becoming increasingly important for the distribution of audiovisual media services. However, it is still a challenge to know the real applicability of mobile broadband for the delivery of broadcasting content and services to large audiences. The fast developments in mobile technologies are largely driven by the ever increasing demand for network capacity resulting from the rapid uptake of innovative services, including audiovisual media, and the growing capabilities of mobile devices. [EBU Mobile Distribution].

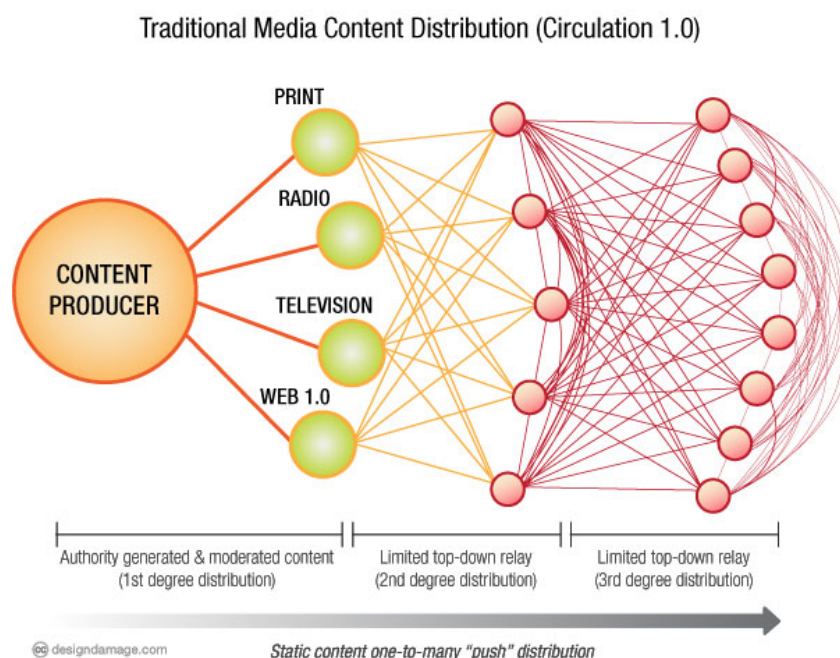


Fig. The evolution of media content distribution (Source: Tsai)

Traditionally, content distribution has been managed by corporations devoted to the process of distributing to the content consumers. Mainstream content continues to be published by selected providers with large budgets, getting pushed out on a *one-to-many* delivery scheme requiring users to retrieve them (Top-Down approach). The relationship network of contents, providers and consumers can be expressed as in the picture [TSAI].

The Internet blew that model apart. The increasing presence of social media is one of the most important factors in this radical change of the ecosystem [SMI].



Fig: Key statistical indicators of media use (Source We are Social)

The initial Web 2.0 revolution introduces the user-generated content, syndication, sharing and pull models for access to contents, and, as a result, the social media as big actor in content distribution. In this model, everyone is a content producer enabling user-generated content to scale efficiently.

The explosion of all new platforms has been great for audiences, but its effects have been more uneven for creators. Today's content creators are aiming at creating direct relationships, putting a lot more effort into building passionate engagement, with audience members by means of niche vertical interest content.

This irruption has led to the current coexistence of the two models in a kind of hybrid model of content distribution as represented in the following picture.

In any case, the social media explosion has made it a key issue to understand the NEM world of the future, and as such will be the platform's priority in the coming months.

## “Hybrid” Model Content Distribution (Circulation 1.5)

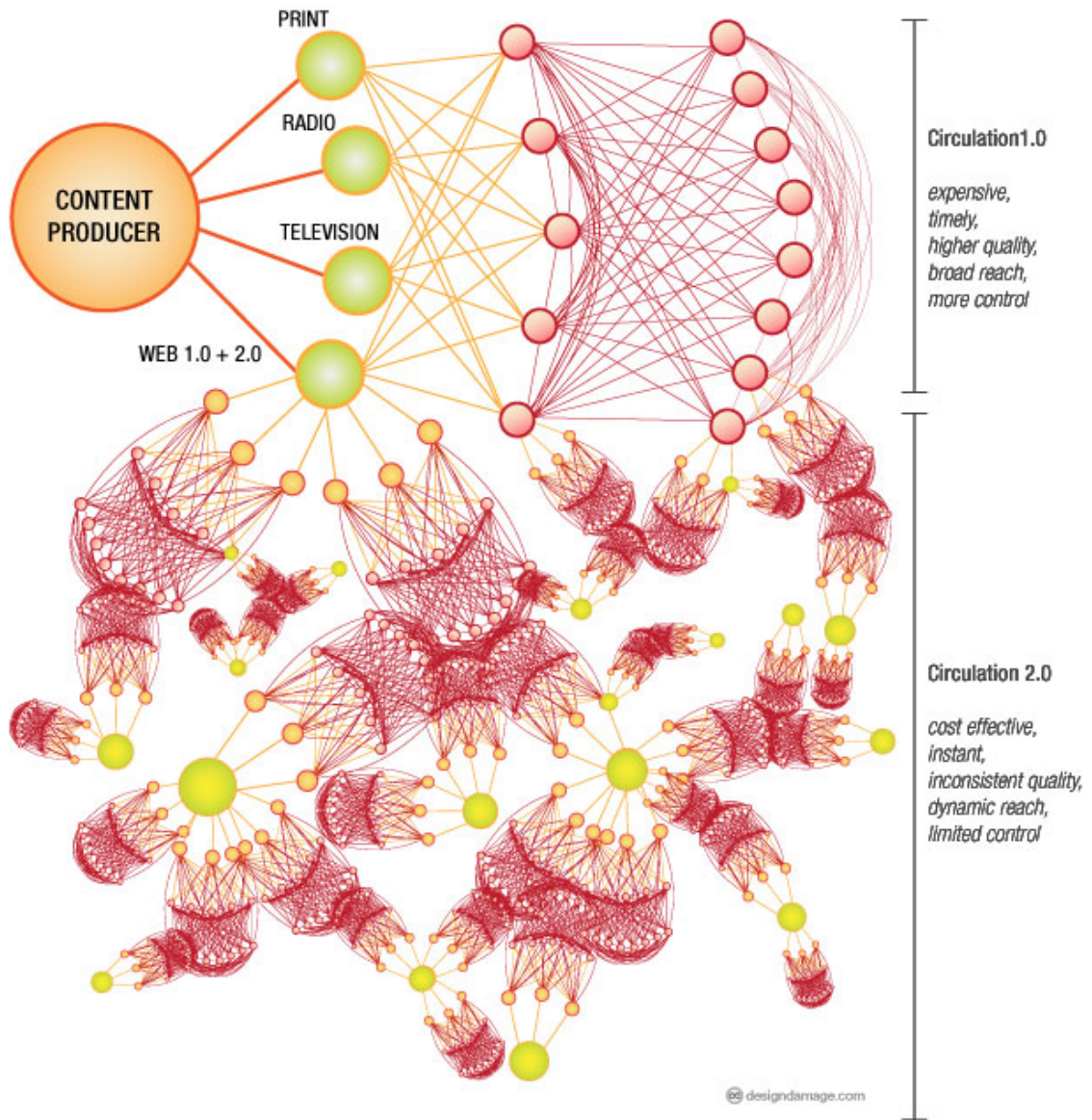


Fig. The evolution of media content distribution II (Source: Tsai)



## 3. TECHNICAL TRENDS

### 3.1 5G

The demands of a fully mobile and connected society are characterized by the tremendous growth in connectivity and density/volume of traffic.

5G will not only be an evolution of mobile broadband networks. It will bring new unique network and service capabilities. Firstly, it will ensure user experience continuity in challenging situations such as high mobility (e.g. in trains), very dense or sparsely populated areas, and journeys covered by heterogeneous technologies. In addition, 5G will be a key enabler for the Internet of Things by providing a platform to connect a massive number of sensors, rendering devices and actuators with stringent energy and transmission constraints. Furthermore, mission critical services requiring very high reliability, global coverage and/or very low latency, which are up to now handled by specific networks, typically public safety, will become natively supported by the 5G infrastructure.

5G will integrate networking, computing and storage resources into one programmable and unified infrastructure. This unification will allow for an optimized and more dynamic usage of all distributed resources, and the convergence of fixed, mobile and broadcast services. In addition, 5G will support multi tenancy models, enabling operators and other players to collaborate in new ways.

The focus of research into 5G networks to date has been largely dedicated to the advances in network architectures, technologies and infrastructures. Less effort has been put on the applications and services that will leverage and exploit such advanced 5G capabilities. Media is indeed one of the most challenging sectors for exploiting 5G. Media applications are amongst the most demanding services in terms of resources, requiring huge quantities of network capacity for high bandwidth audio-visual and other mobile sensory streams; in addition they demand extremely low latency for truly immersive, responsive and tactile user experiences.

So experimentation should report on this marriage, how innovative media-related applications and the underlying 5G network should be coupled and interwork to the benefit of both: to ensure the applications allocate the resources they require to deliver high Quality of Experience (QoE) while at the same time the network is not overloaded with media traffic.

Thus, from 5G is expected that new capabilities and opportunities will be offered to the different actors of the value chain. Topics like decentralisation of network caching, new methodology of media processing and application execution, advanced security, privacy and trust of the content within the network, better QoS/QoE for end-users, improved capabilities and reducing network resources with a flexible architecture, new and enhanced market opportunities for small ISPs and SMEs to join the market of audio-visual content delivery, are expected to be supported by 5G.

### 3.2 SOFTWARE DEFINED NETWORKS and NFV

In recent years, the complexity of telecommunication networks has been increased. More network elements are needed to support the required services, and each network element needs to integrate more functionality.

Software Defined Networks (SDN) and Network Function Virtualization (NFV) present a new network architecture paradigm in the design and management of networking elements. SDN and NFV combine different technological capabilities applied to network functions, network design, and service platforms [JUN].

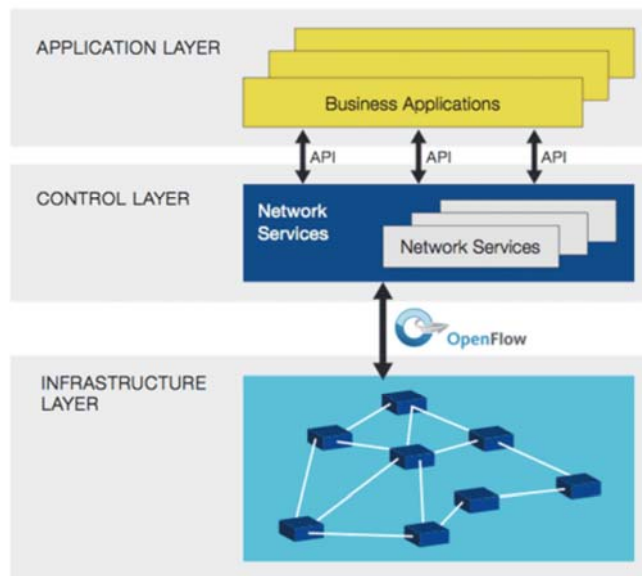


Fig: SDN Architecture (Source: ONF)

Aiming at creating agile, flexible, scalable, and efficient networks, SDN and NFV provide network automation, the separation of control and data plane, taking advantage of the capabilities of cloud computing and virtualization, while lowering capital and operational costs. SDN schemes will change the conception of networks and the way in which they are designed, reducing the complexity and enhancing the possibilities of innovation.

The implementation of SDN provides some benefits:

- Centralization of the FIB ("Forwarding Information Base"): Optimally determined routes deterministically "end to end".
- Dynamic response to application requirements.
- Optimization of network usage and load balancing.
- Security (packet filtering at the edge of networks, redirection of suspicious traffic flows to analysis tools, etc.).

- Better coordination of network behavior by programming applications that deploy functions on the network.
- Much faster and more flexible evolution; since with this scheme the software does not depend on the hardware. It evolves directly on the control plane.
- Much more predictable networks with controlled behaviors.
- It allows the statistical information of the network to be collected in real time, and be used by the different applications to establish policies and program different configurations and services in the network.

Analogously, NFV provides benefits to network operators such as:

- Reduced operator CAPEX and OPEX
- Reduced time-to-market to deploy new network services
- Improved return on investment from new services
- Greater flexibility to scale up, scale down or evolve services
- Openness to the virtual appliance market and pure software entrants
- Opportunities to trial and deploy new innovative services at lower risk

In this environment it is possible to carry out an on-demand provision of network services by reacting immediately to the requests of the applications. It provides, therefore, flexibility, abstraction, global vision of the entire network (having centralized control plane), isolation between applications, and multi-vendor support. All these features fit very well to the problems of media environments; the increasing content resolution HD, 4K and 8K is facing a pressing problem: massive data transfer and very high volume of traffic to bursts. SDN and NFV can contribute to improve the efficiency of content distribution. [SDX]

Additionally, the use of NFV / SDN can contribute to a decrease in costs compared to traditional technology.



### 3.3 CDN VIRTUALIZATION

Content Delivery Network (CDN) is a set of technical solutions taking into account macro and micro traffic characteristics that aim to provide the best Quality of Experience combined with optimal use of end-to-end infrastructures. [REF 5G-PPP]. As seen in 3.2 Software Defined Networks (SDN) and Network Function Virtualization (NFV) are two paradigms which aim to virtualize certain network functions while adding more flexibility and increasing the overall network performance. [LCN]

One of the most important NFV use cases is deploying virtualized CDN (vCDN). The main purpose of vCDN is to allow the operator to dynamically deploy on demand virtual cache nodes to deal with the massive growing amount of video traffic. Scaling in/out, caching as a service etc. are also among the key benefits of vCDN.

Virtual Content Delivery Network (vCDN) migration is necessary to optimize the use of resources and improve the performance of the overall SDN/NFV-based CDN function in terms of network operator cost reduction and high streaming quality. It requires intelligent and enticed joint SDN/NFV migration algorithms due to the evident huge amount of traffic to be delivered to end customers of the network.

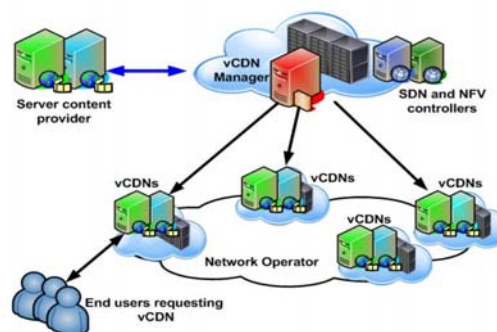


Fig. Virtual CDNs deployment model

This implementation needs to solve issues as the optimal location to migrate a vCDN or to instantiate (place) a new vCDN on demand to satisfy users quality requirements, or to cope with scalability problems when large scale networks need to be optimized. New approaches aim at integrating the placement algorithms using Information-Centric Networking (ICN) context regarding its ubiquitous and in-networking caching features.

According to research commissioned by Amdocs (NASDAQ:DOX) [BTR] on video content delivery network (CDN) virtualization, network functions virtualization (NFV)-enabled multiscreen, 4K video services, combined with revenue from cloud-based DVR upsell, can generate up to \$2.1 billion in benefits over a five-year period.

The study indicated that TV Everywhere and the introduction of new HD formats - 4K/8K/high-dynamic range (HDR) - content are driving cable and other video service providers to upgrade their video networks from legacy systems to NFV/SDN cloud-enabled networks.

### 3.4 4K AND BEYOND

Almost any advance in the world of the contents has been linked to an improvement of the quality of them, typically an increase of resolution. Therefore, UHD TV is at the horizon of the future of broadcasting and content production.

While improving resolution is a huge benefit, UHD enhances other key media features including: [UHD Guidebook]

- Smoother motion by higher frame rates
- Improved contrast by higher dynamic range
- Greater color depth
- Improved audio by high spatial resolution in source localization and an increased sense of sound envelopment.

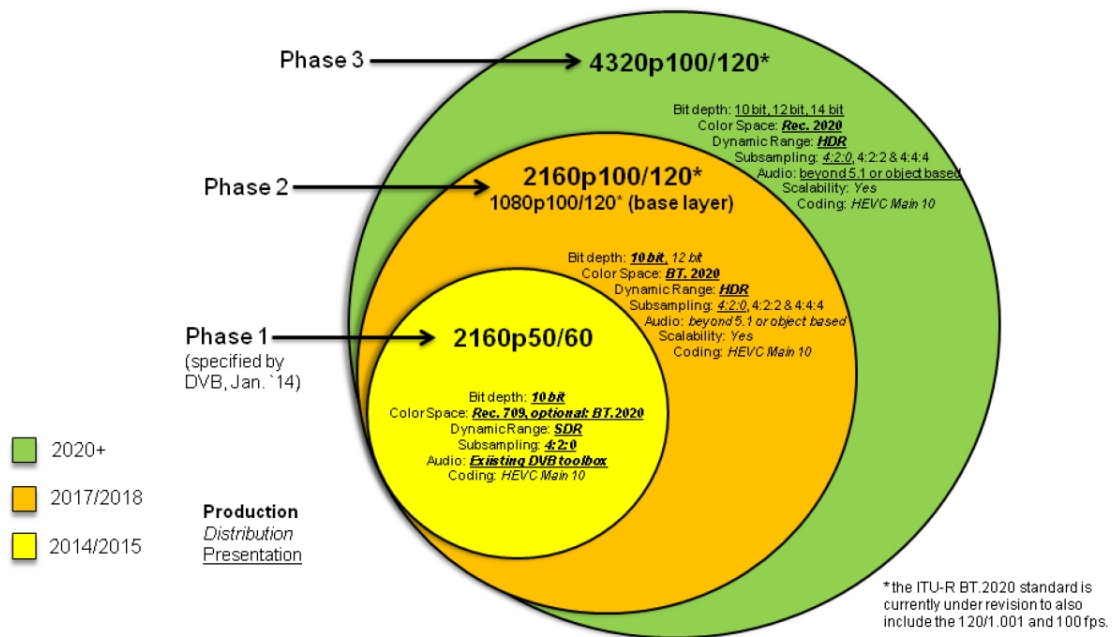


Fig. UHD phases timeline

On the other hand, UHD TV demands four times the bandwidth of HD TV requiring greater storage and transport costs. These two issues are addressed by the improvement in compression mechanisms, currently, through the use of H.265 coding standard.

The successive changes in production formats, and the temporary coexistence of several, leads to market fragmentation. This issue makes the backward compatibility a key problem to be faced. There are different approaches to tackle this topic, especially in the broadcast case, which are under evaluation by DVB. OTT models are more flexible, so the potential solutions can be applied easily, although the costs of transcoding, storage and (CDN) delivery are meaningful.

In any case, UHD TV is progressively consolidating, but content is always going a step further. NHK is aggressively testing 8K in the TV broadcasting environment with public tests having begun in association with the 2016 World Cup Soccer Tournament, with the eventual goal to provide 8K broadcasting feeds for the 2020 Tokyo Summer Olympics. However, beyond technical advances, it is necessary to find a response to how the production in higher resolutions can be cost effective.

Despite 3D TV has been given away, improved immersivity services are proposed and under evaluation. Tele-Immersive (TI) applications enable real-time, multi-party interaction of users spread around the globe, by placing them inside a virtual world. With the ongoing Virtual Reality revolution, specialized hardware entering the consumer market and significant funds coming to VR related technologies, these next generation communication applications are now starting to emerge and are expected to take the networking world by storm. Quality of Service (QoS) and Quality of Experience (QoE) are top priorities in immersive media whereas availability and interaction between users are considered critical challenges that need to be met as they ensure a smooth user experience. High quality 3D reconstructions of users are created, usually in the form of time-varying meshes (TVM), which produce large volumes of heterogeneous data, thus, creating a challenging networking scenario. [5G Network]

All the open issues needs of ambitious R&D programs on those questions in Europe that can stimulate the industry around the technological and economical challenges. They should provide answer to the migration to new methods of production empowering transmedia, on how to produce innovative multi-channel sound, to integrate accessibility to TV and movie content (Audio description, subtitles ...), and improve standardized metadata in new file systems in order to promote new tools and solution that facilitate the use of publishing metadata to create more interactivity between viewers and works; and to help share and organize streamlining the exchange of content from production to distribution and archiving.

### 3.5. HYBRID SERVICES AND OTT MODELS

Over the Top (OTT) services can be defined as those video, audio, voice or data services that are transmitted over fixed or mobile internet platforms and are generally not provided by traditional telecommunication operators.

This type of services includes the distribution of associated audio and video, videoconferences, audiovisual content on demand, messaging services and communication through social networks. In all of them media is of extreme importance.

The provision of content in traditional networks such as free-to-air and pay-tv has spread easily to the Internet, as this platform is very attractive to consumers because of its convergent (through any devices), anywhere (ubiquitous) access features, and anytime. Thus, an OTT platform offers considerable advantages over traditional television services where content is received at pre-set times, in the same location and through a single device.

These services require a terminal device with internet access, such as the computer, smartphone, game console, tablet or smart TV. The attributes of the service offerings depend exclusively on the OTT provider, but the perception of quality received by the user is also influenced by the quality and capacity of the internet access of the network that provides the infrastructure.

One of the most popular OTT services has been the provision of content on demand. This new audiovisual attraction involves broadband service providers in terms of infrastructure and capacity, due to the quality of connection demanded, and OTT content providers, due to the high standards in video definition that clients are used to consume and require.

Convergence and market trends result in that providers of pay-tv have integrated content options on demand and even the possibility of playing content outside the programming time and on devices other than the television. Globally, the pay-TV market has grown as much as the market for OTT platforms for audiovisual content.

The development of OTT services will be the result of the implementation of commercial strategies such as the packaging of services, as well as the exclusivity of content as the main attraction for users, and above all, the growth in penetration and quality of broadband.

Nowadays, new emerging business models for over-the-top (OTT) services are testing the market; however, there are many open issues regarding market policy and regulation with a potential high impact for OTT. Several studies aims to identify costs and barriers to European online service development including OTT while analysing the regulatory environment for online services in Europe, contrasting it with the environment for traditional telecom and media services, as well as the environment in some of Europe's major trading partners. [OTT policy].

## 4. STRATEGIC IMPORTANCE OF CONTENT DISTRIBUTION

Content delivery has been constantly evolving to scale better, accommodate new workloads, and incorporate new actors, new protocols, and new algorithms trying to accommodate the increasing needs from video exchange.

Annual global IP traffic will reach 3.3 ZB (ZB; 1000 Exabytes [EB]) by 2021. Globally, IP video traffic will be 82 percent of all consumer Internet traffic by 2021, up from 73 percent in 2016. Immense growth is realized in the number of Internet-connected devices, which already surpassed the number of humans on the planet in 2011, while the number of mobile connected devices is increasing fast, too; Cisco forecasts that by 2020 there will be 11.6 billion mobile-connected devices by 2020, including M2M modules—exceeding the world’s projected population at that time (7.8 billion). [CISCO]

Media needs to be delivered so efficient technologies and services towards improving the efficiency media is transported are always welcomed.

A big boost comes by creating a unique value proposition through convergence of 5G systems with NFV/SDN paradigm; thus, it is expected to yield significant revenues for involved stakeholders and boost the competitiveness of the EU industry in the mobile media revolution, brought by rich media industries, e.g. virtual reality (VR), augmented reality (AR), etc.

With the emergence of popular video-streaming services that deliver Internet video to the TV and other device endpoints, CDNs have prevailed as a dominant method to deliver such content. Globally, 70 percent of all Internet traffic will cross CDNs by 2021, up from 52 percent in 2016. Globally, 77 percent of all Internet video traffic will cross CDNs by 2021, up from 67 percent in 2016. Any significant improvement on CDN’s is, therefore, critical for the scalability and sustainability of the content ecosystem.

Lastly, work to create a stable technical and regulatory framework that allows for the stable growth and deployment of different solutions and their interconnectivity will have a crucial impact on the success of the proposals in the environment for the coming years.

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HYPER PERSONALIZATION

POSITION PAPER

(NEM, September 2017)

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## 1. INTRODUCTION

NEM, the New European Media initiative, is the European Technology Platform of Horizon 2020 dedicated to Content, dealing with Connected, Converging and Interactive Media & Creative Industries.

NEM focuses on an innovative mix of various media and creative content forms, delivered seamlessly over technologically transparent networks, to improve the quality, enjoyment and value of life. NEM represents the convergence of existing and new technologies, including broadband, mobile and new media, also considering creativity, across all sectors, to create a new and exciting era of advanced personalised services.

Following the update of the NEM Strategic Research and Innovation Agenda (SRIA) in 2016 [1], it has been decided to extract the most important research domains and objectives that have to be pushed in the next WP2018-2020, in line with the priorities identified by NEM community. Taking these priorities, NEM have prepared position papers tackling the main technical and business opportunities for the sector from a holistic view.

The position paper on **hyper-personalization** will consider the different aspects of maximizing opportunities to customize content to consistently target the right audience throughout the customer lifecycle. Thus it will create meaningful connections and drive engagement among audience. It can be applied to most of the media markets, and it also encompasses the ATAWAD (anytime, anywhere, any device) concept which provides the end user with the best format on the device they are using.

## 2. SCENE SETTINGS

Hyper-personalization is an advanced and real-time customization of offerings, content and customer experience at an individual level. Designed to perfectly match a customer's preferences, needs and expectation, hyper-personalization leverages Big Data and Artificial Intelligence technologies to deliver such tailor-made solutions in real time



NEM sectors' offerings have to adapt to customer expectations. Hyper-personalization considers each person as a unique individual. Each individual's demands, needs and constraints for potential content and services should be taken into account before providing a tailor-made solution to that person [2]. In particular such tailor-made solution should be provided in real time i.e. one can have different needs and expectations depending on the situational context (location, time, behaviour, mood, ...)

Consumers have transformed into very active "prosumers": they select offers that fit their requirements well, they opt for content, products or services that seem to have been designed for them, as well as producing and designing them whenever possible, and finally, even customizing them when required.

Hyper-personalization is much more than just adapting well-known segmentation techniques at an individual level. Thus, it goes beyond just improved or enriched clustering and segmentation techniques. Hyper-personalization aims to adapt a product, service or experience to a specific customer through a deep understanding of each individual context or hyper-contextualization. Consequently, consumption patterns can vary significantly and affect the customer relationship in real time which should be modified in terms of the service provisioning and the overall customer experience [3].

Hence topics as the capturing of user behaviour, identity management, content discovery and recommendation systems become key enablers that will define through their evolution the real application capability of this new paradigm. Customers will be able to give instant feedback on the consumed content or services, and will be gradually involved in defining variants of a product. This will assist producers to improve their content, products and services [4].

Of course, the customer will still control the details he wants to share and privacy will remain an important issue.

## 3. HYPER-PERSONALIZATION ENABLERS AND KEY ASPECTS

### 3.1 USER BEHAVIOUR CAPTURING

Any substantial improvement in the personalization of services is through the development and consolidation of models of information capture of user behavior. Until now, this has often been done by the acquisition of explicit information, namely, from the information provided by the users about their preferences and interests. There are several problems associated with this type of approach. On the one hand, users are not always ready to express their preferences, as they may be conditioned by external factors, or simply may not know exactly what their preference is at some point, or the degree of interest that a certain service has for them. In addition, the continuous updating of preferences can become tedious and provoke inconsistency, which may detract from the validity of these preferences which have been explicitly stated.

Therefore, systems mostly function by capturing implicit information that comes from all those observable behaviours that can be collected by a system, without intrusion to the consumer. This information is processed using user models, which enable inferring the interest of the user in a given service, but also using artificial intelligence algorithms which are able to identify even more personalized and contextualized solutions, propositions and recommendations, in real time.

The current trend is to combine these two techniques, using both explicit and implicit information. In any case, it is key to have tools that allow the inclusion of both explicit and implicit information systems, so that this is not a restriction and the system designer can choose one of the two methods or a combination of both depending of their specific needs.

Good user behaviour information capture and management include:

1) **Transparency for the user.** This is an important feature, since implicit information allows the development of models which do not need the active participation of the user, and can lead to diverse types of systems that do not allow such participation. By using implicit information, in addition, it avoids imposing active participation of the user as a prerequisite for the operation of the system. Moreover enabling users to understand how the personalization of the systems operates and even allowing them to scrutinize and control their models can promote user engagement, self-awareness, trust and confidence.

2) **Objectivity.** An explicit capture of information is more easily controlled and manipulated by a user, who can even "trick" the system in one direction or another, for various reasons. By performing invisible capturing and modelling of the user, it could only alter the authentic information by modifying its behavioural habits. This feature may not have relevance to the user, but may have relevance for other actors in the value chain.

3) **Contextualization.** Fine tuning of user information should integrate contextual information such as geolocation, time slot, mood, etc so that real-time data could be combined with an in-depth analysis of customer behaviour. By recording and analysing historical data, the systems can then refine their algorithms so that targeting is based upon patterns, not just one-off interactions. It requires contextual intelligence on customers' interactions, robust content management, and omnichannel automation. Much of this information is strongly related to social media activity, and capturing information from customers by means of their social credentials provides insights about users. The data capture device determines the type of information that can be obtained, influencing in this way the modeling of the data in order to infer the degree of interest and the subsequent recommendation.

Additionally, new trends such as those incorporating psychological-based analysis and integrating information on the quality of the experience represent new opportunities in this area. Personalization systems have focused mostly on gathering information and updating user models to enable the effective delivery of relevant content to individuals. However, there is little research supporting user engagement by keeping individuals in the loop and enabling them to understand, engage with, and scrutinize their user models and the personalization process.

## 3.2 NOVEL RECOMMENDATION SYSTEMS

A recommendation is based on the combination of knowledge that is available from both the content, product and/or service to be recommended, and the user to whom it is recommended. Therefore, the success of a recommendation will depend both on gathering the appropriate information and managing it in a way that provides the best possible knowledge of each person's individualized preferences. Recommendation is built upon the most appropriate algorithms and metrics to generate predictions extrapolating, as precisely as possible, the previous knowledge of user preferences to items whose nature has been previously characterized.

One of the main constraints of recommendation systems is their dependence on the application scenario, since the algorithms may no longer be valid or may be ineffective in certain circumstances depending on both the available input data and the way it is collected or the computational requirements.

Recommendation is still an evolving discipline with many issues to be addressed; for the NEM community this is especially within the recommendation of multimedia content.

Four large blocks make up the biggest challenges for the recommendation systems.

### **Acquisition and modeling user information**

It is important to investigate new and flexible formulas that make it possible to acquire as much information as possible from the users without being invasive and in the most transparent way possible. For this, it is necessary to take into account the type of platform in which the recommendation system is developed, and that serves as the access point to the user's information.

Already within the area of multimedia recommendation, it is especially interesting to consider content distribution platforms, where it is considered a fundamental challenge to characterize the preferences of users from their audiovisual consumption.

Another important line of research is the modeling of heterogeneous information by the user, integrating diverse sources and of a different nature. Consumption, explicit opinions about an item expressed through a valuation, actions executed on the item (either sharing, including in favourites, etc.), or implicit comments or opinions expressed in various media, such as social networks, can be taken into account. It can be seen that social media enriches the information provided by means of the types of relationship between different users and their strength.

Therefore, the main future challenge is to profile each user by integrating explicit and implicit information: the explicit information being that which the user supplies directly to the system, and the implicit information that the system infers from the habitual behaviour of the user, such as the consumption of content, activity or comments in a social network, etc.

#### **Acquiring and modeling content information**

On the other hand, to address the recommendation of media, it is important to improve the annotation and description of the content. The most common problem in the description of the content, especially in the case of annotation and automatic description, is the semantic dependence of the knowledge domain.

For that reason, there are two fundamental areas of research in this area around the recommendation systems. The first of these is semantic analysis of the concepts involved in the content, through the use of ontologies and other semantic technologies. This line addresses the knowledge domains specific to the recommendation. The other seeks to find structural, morphological or other parameters that are transversal to the domain of knowledge and present features common to a given type of media.

#### **Improved efficiency and accuracy of recommendation algorithms**

In general terms, new systems tend to use hybrid recommendation techniques, which include the need to advance content-based recommendation algorithms, collaborative filtering techniques and hybridization methodologies. Artificial intelligence technologies should be also used in order to help in this objective but have to be adapted to this specific domain.

#### **Presentation of results and generation of confidence in the user**

New, apparently collateral aspects that promote predictive techniques, which had previously been left aside, are being progressively incorporated into systems. These aspects can be summarized as the presentation of results to the user and generation of confidence. This implies that the recommendations should be clear and transparent, allowing the user to know the

reasons why a product or service is recommended, regardless of the technique used for this recommendation

In addition, the user must have the option to modify the parameters of the recommendation, so that it is always the user who decides its characteristics, such as generating a riskier but newer recommendation or a more conservative but safer one. The objective is to try to humanize the machine, so that the human-machine interaction is not only more pleasing to the human user, but also more effective in communicating the decisions made.

### **3.3 IDENTITY MANAGEMENT**

Hyper-personalization systems need to reach the same customer across different channels and devices to provide a seamless, fully-connected cross-device user experience. These issues tackle cross-device identification and identity management uses and are closely related to the digital identity in the network.

Customers are no longer passive and now actively interact with services and content. Top-down communication from services is no longer sufficient. Users demand tailor-made solutions and a personalized customer experience independent of the context of consumption. In order to tackle this new phenomenon, service providers are required to improve information flows in order to achieve a successful cross-device and cross-channel identification.

Service providers will need infrastructure, a data repository of user identities and processes in order to manage the identity lifecycle for every user, related to any service on any device, with an easy to use interface. The solution should include not only complete, standards-compliant identity and access management function but should also include a group management and sharing capability, allowing users to create groups (e.g. families), roles and relationships (e.g. mother of), invite users, delegate and revoke access at a granular level to their accounts and services. Capturing every single user interaction across any service or device provides insight on user behaviour and enables rich hyper-personalization of service experiences, seamlessly across services, within individual user privacy settings or established privacy standards.

Service providers should manage a unified user identity management layer across all services that they deliver in order to have a seamless and complete digital relationship with every user based on multidimensional identity and access, user-level data capture, personalization and privacy.

### **3.4 BIG DATA AND ARTIFICIAL INTELLIGENCE TECHNOLOGIES**

Hyper-personalization requires leveraging a huge amount of high-quality and relevant data [6]. The volume of data has significantly increased, with datasets becoming more detailed and more diverse, so Big Data technologies have become critical for hyper-personalization.

Large-scale data collection combined with new methodologies for data processing and analysis, even in real-time, together with artificial intelligence technologies, has enabled systems

to build new models, with an added predictive and prescriptive capability. The large volume of data which is collected, processed and analysed enables more statistical correlations to be found, improving the robustness of algorithms and if so desired, descriptive, predictive or prescriptive outcomes of analysis.

Artificial Intelligence includes time-tested technologies as text analytics, natural language understanding and processing, semantic, machine learning, and others which are relatively new such as deep learning based on artificial neural networks

The variety and diversity of data which is available and processed allows companies to relatively easily integrate new data sources into their analysis, which was previously very difficult to exploit and interpret as unstructured data (such as free text or videos). The analysis of unstructured data lets them take more qualitative data into account, which is required to carry out behavioural analysis [7].

Finally, the velocity of data collection and processing enables analysis to be performed in real time and supports targeting that can be updated depending on the customer's context and environment, in line with the principle of hyper-contextualization. The speed of data analysis also lets companies measure the return on investments and accelerate the reaction capacity.

Big Data and Artificial Intelligence technologies could transform the relationship between people on one side and systems and machines on another, improving how we live and work as individuals and a society. Advanced and integrated analytics will run on large data sets, updating models and algorithms with data in real-time, and combining data from different sources in order to deliver new insights for hyper-personalized services.

### 3.5 PRIVACY

Hyper-personalization can bring great benefits to users' daily lives by making their domestic activities easier and time-efficient, yet it is important to note the underlying risks. The main thing is that through these networks and devices large amounts of data are generated and transmitted whose confidentiality, authenticity and integrity can be exposed and escape from the control of their owners, endangering information, privacy and, in some cases, the physical integrity and patrimony of the people.

There are still some basic problems to solve: security in passwords, encryption or access permissions, and mobile device applications that do not encrypt communications.

Thus, one of the most important challenges facing the new technological scenarios is the protection of users' privacy and personal data. This is because the collection and analysis of the information generated through the interaction of the various devices and services, has a high

commercial value within this scheme of hyperconnectivity, which makes it attractive to obtain illicitly.

On the other hand, even actually when customers are more willing to share his/her personal information, there are serious concerns on the way interaction is made and personal data is transferred. Many may see this as an intrusion and might feel harassed and may refuse to interact.

Therefore, it is necessary to reiterate the need to respect the rights of people over their personal sphere in the digital environment [8]. For this it is required that all the actors involved in the exploitation of the hyper personalization inform the users of all of the aspects concerning the treatment of the information that will be obtained, as much of the personal data as of the patterns of consumption and behaviour. It is necessary to support user engagement by keeping them in the loop and enabling them to understand and engage with personalization process.

Consumers demonstrate they are keen to give away much personal data in exchange for free services. Users should be aware of the level of privacy they get in accessing a given service. The challenge is how to improve user/consumers awareness and participation in process of management and exploitation of personal data in personalized service provisioning. There could be different approaches to private data and profile data management:

- the user profile managed by the user himself - user provides access to the profile to authorised service providers on demand; in such way it is possible to have a single personal data description managed and owned by the user himself and accessible by service providers
- the user profile managed by service provider - user profile is developed and managed by different service providers (several profiles for a single user) and should be validated by end users.

### **3.6 ACCESSIBILITY**

Hyper-personalization can bring great benefits to users' daily lives thanks also to the personalized media services according to users' needs and preferences, particularly including those with special needs, older people and other vulnerable population.

It is important to support the promotion of accessibility across Europe in a digital single market of media services through hyper-personalization and adoption of principles "Designed-for-All". "Design-for-All" improves the quality of service for all users, without discrimination, and means no specialized services for particular groups, therefore not making it perceptible. Consequently, older and disabled consumers do not need to look for specific products and services, as their individual and personal needs are taken into account from the concept to the production and eventually to the delivery of services.

The European society is based on diversity and only by giving a broad and flexible response will this diversity be a resource and not a restriction.



Hyper-personalized services should be appropriate, commensurate with the capabilities and performance of the individual, including the needs of everyone. Capabilities and performances of the individual could be reduced, permanently or just temporary.

In order to maximise the usage of media services by persons with some functional limitations, including persons with disabilities, the service should be available through more than one sensory channel and should be accessible in a consistent and adequate way for users' perception, operation and understanding, including the adaptability of content presentation and interaction, when necessary providing an accessible electronic alternative and or augmentation.

## **4. STRATEGIC IMPORTANCE OF HYPER-PERSONALIZATION**

Content and Creative Industries, while locally, regionally, and/or nationally implemented or even governed, are moving to a worldwide framework, thanks to the digitisation of the whole value chain, from creation through distribution to consumption. These industries are updating the whole process by paralleling a lot of actions all along that value chain and reducing the production time from capture to access. This diversity often challenges established businesses and their business models, requiring them to be involved in the latest technology research and innovation activities of their sector.

This process opens the sector to apply new paradigms as hyper-personalization bringing new opportunities and challenges technological, infrastructural and regulatory by means of disruptive and focussed approaches.

The European society is based on diversity and only by giving a broad and flexible response, with the assistance of the hyper-personalization paradigm, will this diversity be a resource and not a restriction.

The global trend towards the extreme differentiation of offerings in products and services cannot be foreign to the sector, from the recommendation of content to the integration of the final consumer in the design processes. Hyper-personalization through very precise targeting not only ensures the best potential impact but in parallel increases the added value of products and services.

Hyper-personalization technology will allow the gap between providers' business needs and consumers' desires to be closed, allowing consumers to enjoy an increasing range of products whilst service providers battle against the fragmentation of retailing and media across multiple channels and platforms.

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**ANNEX G**

**POSITION PAPER “DATA FOR MEDIA”**



**Data for Media**

(draft v0.1 - April 2018)

## Abstract

With the growth in data, content, and end-users, information will need to be metered and managed. 2020 will see the rise of predictive analytics, collaboration and workflows that impinge upon all aspects of media business.

Big Data can open up the lane to fast success to businesses in the entertainment and media industry. It can help negate the biggest risk factor in the industry – changing customer behaviour.

Big Data can help have a steady pulse on the shifting customer preferences. It helps reduce customer churn, creates alternate revenue channels and also boosts customer acquisition and retention through data intelligence.

In the end, it creates a new ecosystem where customer experience is put as the centrepiece.

### Keywords

Big Data, Media, Social, Monetization,

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  - 3. (Improving) Users' knowledge**
  - 4. Audience measurement**
  - 5. Interest prediction and recommendation systems**
  - 6. Monetization. Branding, marketing and advertising**
  - 7. Data trustability**
  - 8. Personalization**
- Annex. Social Media and artificial intelligence**

## 1. Introduction

Data is fuelling many organizations across all industries. Insights from data help innovation and make smarter decisions based on facts. Being data-driven is about giving the business decision makers the power to explore data and make predictions.

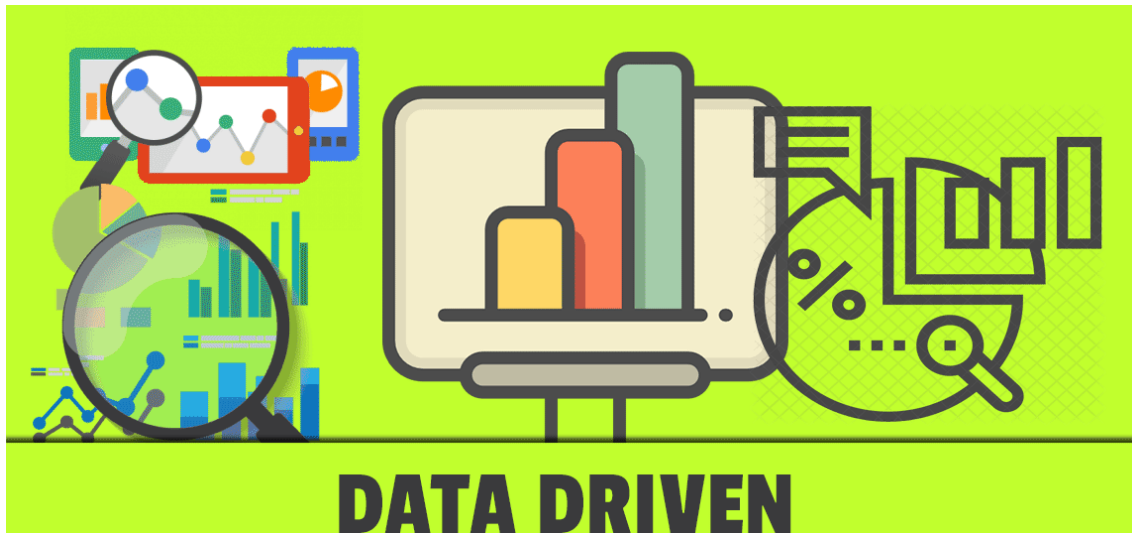


The media sector is no stranger to this trend. This report considers how big data will enable the media, entertainment and information industries to create more value for businesses and audiences. Creativity, media, contents, advertising, marketing, branding and reputation are currently firmly supported by the analysis of data.

One significant change is the undeniable rise in CRM and data-driven marketing that will lead the change in creative direction. Big Data helps drive better consumer insight, but it is necessary to infuse creativity with Big Data. This creative re-imagining of CRM means that advertising is now able to go from “people” to “person”. It is expected to experience another transformational shift in mobile. A brand's ability to connect with a consumer will primarily exist through mobile connections. Such as when, based on consumers' personal preferences, brands provide contextual content that seamlessly transitions into serving a location-specific value.

## 2. Data-Driven Content

Content marketing cannot be successful without data and a data-driven content marketing strategy can be more efficient. The role of advertising now, more than ever, is to create a relevant connection between a brand and what people really care about.



The rise of IoT and users' constant connectivity to the online world through smartphones, wearables and social media has brought a wealth of new data. This serves as a great opportunity for marketers to understand what a modern consumer wants and how to include these findings in a content marketing strategy. This can only happen through a framework that takes into consideration the audience's habits, preferences, and needs.

Social platforms will be considered part of the media mix, alongside traditional TV, print and out-of-home advertising, but it is proving increasingly harder to break through on traditional channels.

Nowadays, it is common to see an acceleration of brands trying to create their own brand platforms, which act as a destination for their consumers to gather around a shared point of interest. Video is becoming increasingly important and powerful because of the ways it can be integrated into social platforms. From them, an analysis of the available data can help tailoring content to the target audience.

Data can provide useful answers to questions such as:

- the customers' reaction to the existing content
- their favorite types of content
- their preferred methods of communications
- the channels they are using
- their browsing habits





### 3. (Improving) Users' knowledge

Digital transformation of the media industry has been driven by changing consumer behaviour and expectations, especially among younger generations who demand instant access to content, anytime, anywhere. Coupled with these changes in consumer habits, impressive technological advances in recent years have enabled media organizations to begin offering the digital services that users are demanding. Big Data has been one of the key technologies to achieve this.

#### Acquisition and modelling user information

It is important to investigate new and flexible formulas that make it possible to acquire as much information as possible from the users without being invasive and in the most transparent way possible. For this, it is necessary to take into account the type of platform in which the recommendation system is developed, and that serves as the access point to the user's information.

Already within the area of multimedia recommendation, it is especially interesting to consider content distribution platforms, where it is considered a fundamental challenge to characterize the preferences of users from their audiovisual consumption.

Another important line of research is the modeling of heterogeneous information by the user, integrating diverse sources and of a different nature. Consumption, explicit opinions about an item expressed through a valuation, actions executed on the item (either sharing, including in favourites, etc.), or implicit comments or opinions expressed in various media, such as social networks, can be taken into account. It can be seen that social media enriches the information provided by means of the types of relationship between different users and their strength.

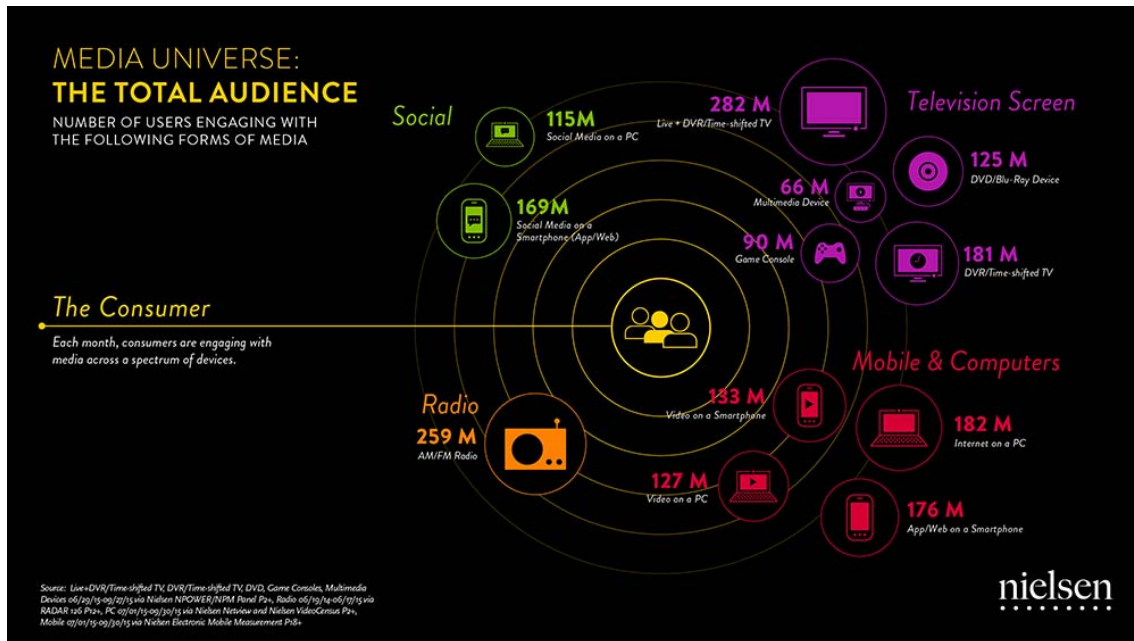
Therefore, the main future challenge is to profile each user by integrating explicit and implicit information: the explicit information being that which the user supplies directly to the system, and the implicit information that the system infers from the habitual behaviour of the user, such as the consumption of content, activity or comments in a social network, etc.

#### Redefining user experience model

Marketing departments are moving from classic advertising and non-interactive communication toward becoming a natural part of the sales cycle and an extension of customer service with the main objective of achieving more effective customer engagement. Marketers, using integrated tools, can engage with customers online, track the buyer's journey, measure sentiment and loyalty, and match behavior with outreach tailored to meet their audience's needs and interests. But for customers already bombarded with information, a great customer experience is becoming baseline.

## 4. Audience measurement

The media and entertainment industry has been searching for a reliable way to measure and engage audiences. This need has become a priority as media consumption is characterized by a combination of audience fragmentation and audience duplication, evolving from few large audiences gathered around a few media outputs.



This disruption has affected primarily to advertising that has been largely migrating to digital platforms. So, capturing this migration through audience research is useful for advertising. It facilitates the decision making on the best advertising media to spread a campaign, although the usefulness of the data it provides also depends on the dominant communicative model.

Data are now more comprehensive, available in real time, and cheaper to acquire, enabling accurate and fine-grained TV audience measurement; audience analytics can help capturing audience response from multiple sources so the right content to the right person at the right time can be delivered. Anyway, Big Data technologies are providing the mechanism for deploying new models of audience measurement and user behaviour understanding. These changes in audience measurement tools represent a new era in the relationship between consumers and producers creating a customized viewing experience that tailors on-demand advertising for audiences.

## **5. Interest prediction and recommendation systems**

A recommendation is based on the combination of knowledge that is available from the content, product and/or service to be recommended, and the user to whom it is recommended. Therefore, the success of a recommendation will depend both on gathering the appropriate information and managing it in a way that provides the best possible knowledge of each person's individualized preferences. Recommendation is built upon the most appropriate algorithms and metrics to generate predictions extrapolating, as precisely as possible, the previous knowledge of user preferences to items whose nature has been previously characterized.

## 6. Monetization. Branding, marketing and advertising

Big Data, including market and customer insight and predictive analytics, has become common tools for taking decision on a market level. Brands' focus is shifting from merely analysing the data to interpret them in terms of return on investment based on patterns, online consumer actions and acquiring behaviour of end users. Thus, relevance across consumers will play a key role.

Content marketing will take a powerful and serious turn from content that is general to relevant to completely personalized. Brands will truly understand the power of content from it being perceived as a factor to improve Search engine optimization or SEO score towards generating true value across end readers. Content marketing will play a crucial role in creating a Knowledge Resource Center for organizations, institutions and individuals with a clear idea of adding real value and building brand ambassadors online for long term loyalty in the form of trust.

At infrastructure level, new storage and computing resources will be required more by corporations that have terabytes, Petabytes<sup>4</sup> and Exabytes of information with them. Improved management systems, including enhanced structured information and the addition of capabilities through deep&machine learning

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<sup>4</sup> A petabyte (PB) is 1015 bytes of data, 1,000 terabytes (TB) or 1,000,000 gigabytes (GB).

## 7. Data trustability

Large amounts of data whose confidentiality, authenticity and integrity can be exposed and escape from the control of their owners are generated and transmitted, endangering information, privacy and, in some cases, the physical integrity and patrimony of the people.

There are still some basic problems to solve: security in passwords, encryption or access permissions, and mobile device applications that do not encrypt communications.

Thus, one of the most important challenges facing the new technological scenarios is the protection of users' privacy and personal data. On the other hand, even actually when customers are more willing to share his/her personal information, there are serious concerns on the way interaction is made and personal data is transferred.

For this it is required that all the actors involved in the exploitation of data inform the users of all of the aspects concerning the treatment of the information that will be obtained.

Consumers demonstrate they are keen to give away much personal data in exchange for free services. Users should be aware of the level of privacy they get in accessing a given service. The challenge is how to improve user/consumers awareness and participation in process of management and exploitation of personal data in personalized service provisioning.

## 8. Personalization

The global trend towards the extreme differentiation of offerings in products and services from the recommendation of content to the integration of the final consumer in the design processes (users are more than active part of the process of creating demand or defining the final service offering) has been progressively built from the increasing capabilities big data technologies are offering. Personalization through very precise targeting is expected to ensure not only the best potential impact but in parallel higher added value of products and services.

## **Annex. Social Media and artificial intelligence**

Two trending topics regarding Data and Media are Artificial Intelligence and Social Media. Both of them has been deeply analysed in other position papers so the final decision has been not to include these two topics in this one.



# ANNEX H      POSITION PAPER “AI IN THE CREATIVE INDUSTRY”



## AI in the creative industry (draft v0.5 - June 2018)

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## Revision History

16/03/2018	Fabien (Inria)	Lotte	First draft table of contents
6/04/2018	Joost (Inria)	Geurts	Move to Google Docs, included proposed contribution of Hadmut
24/4/2018	Fabien (Inria)	Lotte	Designated contributors to sections
15/05/2018	Thierry (Inria)	Viéville	Starting the text Discussion / Ethique / Regulation
17/05/2018	Hadmut Holken		Contribution 3.4.2 Inclusion, Diversity, Personalization and Migration issues through media
18/05/2018	Hadmut Holken		A first draft 3.4.1 on Automated multi-lingual text/subtitling for video distributions
23/05/2018	Joost (Inria)	Geurts	Changed title. was: "Media and AI"
08/05/2018	B. Caramiaux		Reformatting, moving parts in Information to Education

## Abstract

Thanks to the Big Data revolution and increasing computing capacities, Artificial Intelligence (AI) has made an impressive revival over the past few years and is now omnipresent in both research and industry. The creative sectors have always been early adopters of AI technologies and this continues to be the case. As a matter of fact, recent technological developments keep pushing the boundaries of intelligent systems in creative applications: the critically acclaimed movie "Sunspring", released in 2016, was entirely written by AI technology, and the first-ever Music Album, called "Hello World", produced by AI has been released this year. Simultaneously, the exploratory nature of the creative process is raising important technical challenges for AI such as the ability for AI-powered techniques to be accurate under limited data resources, as opposed to the conventional "Big Data" approach. The purpose of this white paper is to understand future technological advances in AI and their growing impact on creative industries. This paper addresses the following questions: Where does AI operate in creative Industries? What is its operative role? How will AI transform creative industries in the next ten years? This white paper aims to provide a realistic perspective of the scope of AI actions in creative industries, proposes a vision of how this technology could contribute to research and development works in such context, and identifies research and development challenges.

## Keywords

Creativity, Artificial Intelligence, Creative Economy, Media

## Note to contributors: structure of the document and workflow

The document proposes to situate AI in the creative industry (Section 2), to describe the most significant use cases organised by application area (Section 3) and to highlight technological challenges (Section 4).

As workflow, we propose to start by completing collegially all the use cases by application area in Section 3. This will provide the paper with an overview of the actual implications of AI in creative industries at large.

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## 1. Summary

## 2. Situating AI in the creative industry (Media et Creation/Culture?)

Categories: creation, production, diffusion, consumption

Transversal challenges

modelling the user

AI tools to help creating (automatic design)

recommendation systems

accessibility

ethical issues

<<definition of creation, production, diffusion, consumption and examples of cross-application tools>>

### 2.1 Creation

NLP-related techniques to be discussed: text generation, translation, summarization (same seq2seq underlying techno)

### 2.2 Production

### 2.3 Diffusion

### 2.4 Consumption

Modelling the user:

In many interactive systems and medias, AI tools, and notably machine learning, could be used to computationally model the users of such systems. In particular, according to users' input, e.g., their behavior and interactive patterns, a model of the users traits, states, skills and preferences could be built. This model could then be used in order to provide users' with personalized contents and experience, adapted to each user. As an example, for music or movie consumption, a model of the users' preferences in terms of music/movie genre can first be built based on the users' previous choices of music/movie. Then, new music/movie, likely to be suitable to this user's taste could be provided based on recommender systems. For games and education, a model of the users' skills can

be built using their past performances at various game difficulty levels (for gaming) or exercises (for education). Then, an optimal sequence of challenges or exercises can be provided to each user, in order to provide the optimal difficulty level to that user, to optimize enjoyment or learning efficiency. Similarly, the users' affective or cognitive states could be modeled according to the users' behaviours and/or physiological signals (e.g., recorded facial expression, heart rate, brain activity) in order to then provide game challenges and training exercises maximizing the user's experience and enjoyment. Overall, AI can be used for modeling the user at two levels: 1) to estimate hidden user states (skills, affective states, cognitive states, etc.) and 2) to learn how to provide optimal content to this user according to these states.

Producing media content

Verifying media content

Accessibility challenges

### 3. A tour of envisioned application areas

#### 3.1 Art

The advent and the development of recording technologies in the XIXth century has undoubtedly created an irreversible revolution in a number of visual and performing arts, by enabling the massive reproduction and wide dissemination of audio, image and video material amidst the general public.

Originally based on physical and then analogical electronic devices, the contents thus created are now essentially digital and therefore have become prone to being handled by all sorts of software tools and applications. This enables infinite possibilities in capturing, generating, transforming, combining and broadcasting digital creations at a scale that is unprecedented in human societies.

Whereas, in the XXth century, the typical structure of the visual and performing art industry was based on a well-defined sequential decomposition of roles into creation, production, distribution, and consumption, a strong paradigm shift has begun in the past decade or so, where these demarcations are fading out.

Today, more and more music soundtracks are composed and produced within a single framework : a home studio with virtual instruments and mixing tools. Similarly, means of video production have become massively accessible. Distribution is so easy that artists can promote their work themselves through the means of their choice. Even the borders between consumption and creation are getting blurred, as it is becoming more and more common for end users to customize their favorite soundtracks or videos by reordering, rearranging, remixing, or repurposing them in a variety of ways.

In this new context, Artificial Intelligence is emerging as the general framework to support this evolution, as it can provide a wide range of concepts, tools and applications leading to new ways of approaching artistic creation, performance and experience.

##### 3.1.1 Music

Many music-related (and audio-related) fields are currently facing important changes due to the intervention of machine learning and artificial intelligence technology in content processing. The specific challenges of audio content for machine learning relate to handling high temporal resolution and long-term structures. Early advances in machine learning for music were initially borrowed from the field of speech or language processing. Research in the field has recently become more

specialized and it has exploded thanks to the creation of massive datasets from music production companies, artist-curated repositories, academic repositories and video streaming platforms. Currently, AI-based technology applied to music has gained interest in a wide range of music-related applications dispatched across creation, production and consumption.

### Creation

The typical workflow in computer-assisted music composition is to feed the software program with scores (the input data) of a certain style or by a certain composer. The program extracts composition patterns from these scores and is able to generate new scores respecting these patterns (Briot 2017; Nika 2017). The very same idea is at the core of most of the so-called AI tools in music creation today: a method able to learn the underlying structure in a set of music pieces or sounds, and generates new content that sounds like the music pieces taken as examples. These tools have recently gained in complexity and expressivity, as they spread outside of academia, pushed by new incentives from the tech and music industries as well as the art world.

While the production of the score for a musical track is often one core part of the creation process, a large body of creations are undergone through manipulating audio directly, e.g. when exploiting loops or samples. As a matter of fact, recent advances in machine learning are demonstrating the capacity of modern methods to efficiently process raw audio signals, as opposed to MIDI scores only. In this respect, different approaches may be mentioned. First, a large body of research on source separation has recently enabled the *demixing* of music, allowing creatives to reuse only some particular sounds within a track, excluding the rest. Second, generative modeling may be considered to directly produce new musical samples after training on audio datasets.

Creation is fueled with inspiration, for which *style transfer* proved a very interesting technological tool in the domain of image processing, where it enabled new ways of graphical creativity (see e.g. <https://www.youtube.com/watch?v=Khuj4ASldmU>.) In the context of music, style transfer would mean transforming an audio piece or a score so that it becomes a representative example of a target style, while retaining its specificities. For instance, transforming rock to tango, saturated to clean vocals, etc.

In any case, these applications of AI technology to music creation are still at their infancy and can still be considered scientific challenges today. This is first due to the inherent difficulty of generating musical content, which is highly structured and requires high sampling rates, but it is also due to the difficulty of gathering large music datasets on which the systems may be trained, as opposed to the plethora of image datasets available. Certain initiatives already exist such as the AudioSet by Google <https://research.google.com/audioset/> that features musical dataset from youtube, but it is far from being an ideal resource for music research, because its core focus is on general-purpose audio processing.

Impacts of AI technology on music creation are diverse. On the one hand, it can be seen as a creativity-support tool for artists to extend their vocabulary. As an example the recently released album "Hello World", advertised as the first-ever AI-based music album, has used a tool that helps an artistic director to generate pieces of sound to be embedded in music soundtrack. Another example is the startup Jukedeck that provides musicians with a set of tools able to generate and personalized musical content. The objective is to offer new creative tools to musicians and producers as well as

accelerating music making by proposing relevant elements to creatives. Another example is the London-based start-up Mogeas that proposes hardware-software solution for musicians to create their own musical instruments by plugging a sensor on everyday objects and by demonstrating to the system how it should sound ([https://www.youtube.com/watch?v=G\\_hBhORGE6Y&t=2s](https://www.youtube.com/watch?v=G_hBhORGE6Y&t=2s)).

On the other hand, this technology makes it possible to bypass content creators (musicians, composers, sound artists) by producing automatically generated audio content. Such an approach could indeed decrease the production cost of music pieces (e.g. sound track of an advertisement).

### Production

Music production is also experiencing profound changes through the use of AI technology. The current trend for musicians is to work more and more independently from production studios, thanks to the availability of affordable technological tools. A first body of AI-based production systems then typically provide the creatives with audio engineering solutions. As an example Landr is a Canadian start-up that develops solutions for mastering, distributing and communicating new music productions. As for creation, AI-based tools can be promoted as ways for musicians to independently release their music and consequently bypassing the traditional workflow of artistic direction and sound engineering.

The wide diffusion of these large-audience tools are powered by well-engineered API (Application Programming Interfaces) which are a set of functions that can be integrated in third-party softwares and commercialized. An example is the NSynth by the Google Magenta group, able to generate new types of musical sounds and that has been already used in the mainstream musical industry (see for instance huang <https://www.youtube.com/watch?v=AaALLWQmCdl> and atmospheric music <https://sevenism.bandcamp.com/album/red-blues>).

Music production however also remains an industry that requires professional tools. In this respect, rights holders often face the problem of repurposing legacy musical content that has a significant cultural value but a very poor audio quality: many musical standards from the 20th century are noisy, band limited and often only available in mono. There is hence a need for a new generation of tools that are able to enhance such content to make it compliant with modern audio quality standards. AI technology such as audio demixing (see e.g. [www.audionamix.com](http://www.audionamix.com)) are promising tools for this purpose, providing professional sound engineers with unprecedented flexibility in audio editing.

Although repurposing legacy content for rights holders is one key application, music creation in the studios or on stage can also strongly benefit from AI technology. In particular, much creativity is lost in the studio when musicians have to record their part independently from one another so as to reduce acoustic interference in the recorded signals. The corresponding recording time is also a waste of time and money for both the artists and the studios. A desirable feature is to process the signals originating simultaneously from all musicians, while preserving audio quality. Similarly, exploiting many low-quality sensors (such as mobile phones) that all take degraded views of an audio scene such as a concert, and combine them to reconstruct a high-quality immersive experience is an important enabling technology.

The core novelty and research challenge in the context of audio engineering is the confluence of AI and signal processing. While signal processing was mostly understood as manipulating audio samples so as to *extract* desired signals from them, AI technology now enables taking signals simply as *inputs* to sophisticated systems that can use training data so as to *extrapolate* information that has been lost and is not present in the input. This line of research is blooming in image processing (see e.g. [https://dmitryulyanov.github.io/deep\\_image\\_prior](https://dmitryulyanov.github.io/deep_image_prior)) but is yet at its infancy for music processing.

### Consumption



Digitization and the Internet already led to a profound change in the way music is consumed, because they enabled the end user to access virtually any music content within a few minutes. Although this was felt as a danger by the music industry for almost two decades, until music streaming services became the core source for funding from the music industry, only recently.

In this context, the added value for selling music moved from providing records in store to providing the users with personalized music recommendations. For this reason, recommender systems became one core activity of companies operating music streaming services such as Spotify, Deezer, Apple, Amazon, etc. Technical approaches for this purpose changed from handcrafted methods to the use of AI technology, exploiting large amounts of user session logs. Music recommender systems are now subject to a blooming research activity.

Another important aspect of music consumption concerns the actual *playback* technology involved. While traditional stereo systems are still omnipresent, a surge of interest in AI headphones or speakers recently appeared, where the loudspeakers are augmented with processing capabilities that enable unprecedented control over the sound. Similarly, it is expected that new software playback systems will soon go beyond traditional multiband equalizers to offer more control of the audio stream by the user, which is called *active listening*. For instance, mature demixing technology will soon allow the user to mute vocals from any song in real time, yielding a karaoke version in one click.

From an even higher perspective, we may expect AI to blur the lines between music creation and music consumption, by making it possible for the user to enjoy musical content that has been specifically produced for him/her, based on past choices and user history. With the ability to demix and analyze music tracks automatically also comes the possibility to combine them so as to create new unique tracks. While musicians may produce complete songs as usual, it is likely that artists will shortly only provide some stems, to be used by automatic streaming services to generate automatic accompaniment to the taste of users.

In any case, considering existing musical content as the raw material for future music consumption also opens the path to *heritage repurposing*, where musical archives may be exploited in conjunction with more modern content to yield new and always different musical creations.

As may be envisioned, putting together AI technology and music analysis and synthesis will offer many new perspectives on the way music is consumed, that are totally in line with current trends of adding value through the analysis and the browsing of huge amounts of tracks. The next step forward appears in this sense to also add value through processing and automatic creation.

### *Blurring boundaries*

Creation, consumption and production

### *Challenges*

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### 3.1.2 Vidéo, Cinema

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### 3.1.3 Images

#### Creation

AI for generating art images such as photos but also non-photorealistic images is an emerging topic. Leveraging on the huge results obtained by deep learning methods on production task such as applying filter and style transfer, approaches have been presented to generate art.

A milestone in the direction of generating art using AI has been DeepDream [Mordvintsev 2015], a Computer Vision program created by Google. DeepDream, uses a Convolutional Neural Network to find and enhance patterns in images via algorithmic pareidolia. The input image is substantially modified in order to produce desired activations in a trained deep network resulting in a dream-like hallucinogenic appearance in the deliberately over-processed images. While Deep Dream requires an image as input, the result of the process is so different from the original and so emotional for the viewer to be considered a AI generate art image.

Originally, the DeepDream was designed to help to understand, how neural networks work, what each layer has learned, and how these networks carry out classification tasks. In particular, instead of exactly prescribing which feature to amplify, they tested letting the network make that decision. In this case, given an arbitrary image or photo, a layer is picked and they ask the network to enhance whatever is detected. Each layer of the network deals with features at a different level of abstraction, so the complexity of generated features depends on which layer we choose to enhance. Thus, the generated image show in each part of the images what has been seen by the network in this specific part even if what has been seen is not likely to be there. Like seeing objects in clouds, the network shows what it sees even if what has been recognized is very unlikely. The dreams that can be drawn by the network are the results of the network experience. Thus, neural networks exposed during training to different images would draw different dreams even using the same image as input.

The interest of researchers on AI applied to art images has recently exploded started from 2016 when the paper “Image Style Transfer Using Convolutional Neural Networks” was presented at ECCV 2016. The proposed method used feature representations to transfer image style between arbitrary images. This paper led to a flurry of excitement and new applications, including the popular Prisma, Artisto, and Algorithmia. Google has also worked on applying multiple styles to the same image.

Almost all existing generative approaches are based on Generative Adversarial Networks (GANs) [Goodfellow 2014]. The model consists of a generator that generates samples using a uniform distribution and a discriminator that discriminates between real and generated images. Originally proposed to generate images of a specific class (a specific number, person or type of object) between the ones the model has been exposed during training, GAN is now used for many other applications.

Leveraging these results, AI has also been used for generating pastiches, i.e., works of art that imitate

the style of another one. In [Elgammal 2017], By building off of the GAN model, the authors built a deep-net that is capable of not only learning a distribution of the style and content components of many different pieces of art but was also able to novelly combine these components to create new pieces of art.

An interesting emerging topic is generating images from captions. Starting from the work [Mansimov 2016], various approaches have been proposed to generate images starting from captions. The goal is to generate photorealistic images, but we expect similar approaches to be applied for generating art images.

The generation of high-resolution images is difficult. The higher resolution makes it easier to tell the AI generated images apart from human-generated images. However, recent works by nVidia [Karras 2018] showed exception results growing both the generator and discriminator progressively.

Generating anime faces is the objective of [Jin 2017]. A DRAGAN-based SRResNet-like GAN model was proposed for automatic character generation to inspire experts to create new characters, and also can contribute to reducing the cost of drawing animation.

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#### *Production*

Production can be seen as the process of creating something capitalizing on something that already exists. In the image scenario, production has various interpretations. It can be seen as the process of editing an image to produce a new one, for instance by using filters or by modifying its content. It can also be seen as the process of using existing images to produce other media, for instance using an image in a video reportage, or in a news.

Artificial intelligence has been extensively used in the image scenario with very significant results, in various applications ranging from enhancing image quality, to editing images, from image retrieval to image annotation. Most of these applications are significant for the production of images.

Artificial Intelligence was successfully applied to reproduce scene dependant image transformations for which no reference implementation is available, as for instance photography edits of human retouchers. For instance, in arXiv:1707.02880 an approach was proposed that learn to apply image transformations from a large database of input/output image transformation examples. The network is then able to reproduce these transformations, even when the formal definition of these transformation does not exist or it is not available.

Approaches were also proposed to automatically apply photo retouching operators to enhance image quality. The use of photo retouching allows photographers to significantly enhance quality of images. However this process is time consuming and require advanced skills. Automatic algorithms based on artificial intelligence are able to mimic the expert's skill and to provide users with high quality image retouching easily. In arXiv:1412.7725 an approach that combines deep learning and hand-crafted features is proposed to perform automatic photo adjustment. In contrast to other existing approaches, this approach takes into account image content semantics, which is automatically inferred, and performs adjustments that depend on the image semantics itself.

Still on the image editing side, recently deep learning based techniques were proposed that allow giving an existing image an chosen artistic style, while preserving its content. For instance it is possible to modify a picture so that it looks like a Miro painting. A significant work in this direction is given by arXiv:1508.06576. Here a Deep Neural Network was proposed that creates artistic images of high perceptual quality. The system was trained to be able to separate content and style information in an image, being able to manipulate and produce artistic styles out of existing images.

Artificial intelligence was also used to produce techniques for image inpainting. Image inpainting has the objective to automatically reconstruct missing or damaged parts of an image. Applications examples are restorations of damaged painting, reconstruction of an image after deletion of objects or subjects. In all these case the aim is to modify the original image restoring or editing it so that the modifications cannot be perceived. A relevant approach in this context was proposed in arXiv:1607.07539. In this paper a Deep convolutional Generative Adversarial Network was proposed that is able to predict semantic information in the missing part and to automatically replace it with meaningful content. For instance if an eye is missing from the image the neural network is able to correctly generate it and correctly place it.

Similarly, also AI based techniques for image resolution enhancements were proposed. The capability of neural networks to infer semantics in an image were exploited in this scenario to accurately increase resolution of an image with an excellent quality. In arXiv:1609.04802, the authors proposed a generative adversarial network also able to recover photo-realistic textures from heavily downsampled images. The proposed approach is able to infer photo-realistic natural images for 4X upscaling factor.

As we stated before, the use of existing images is often necessary for the production of other new contents. For instance, images are often used in reportages, on during the production of news. In these cases, in addition to tools for editing images, also tools to be able to identify and retrieve images relevant to the producer's needs, out of possible very large image repositories, are necessary. Also in this case Artificial intelligence has given a significant contribution. Image retrieval is generally performed using images as queries and searching for other images similar to the queries, or using text queries describing the wanted image content. In the first case, which is typically referred as Content Based Image Retrieval (CBIR), we need a way to compare the query image with the images in the database and to decide which are the most relevant. In the second case, we either need to associate images with textual descriptions, or to generate visual features to be used to compare images, directly from text queries.

For several years CBIR was performed relying on hand-crafted features, that is human-designed mathematical descriptions of image content that can be compared by similarity to judge the relevance of image results to the query image. Recently, a significant step forward was obtained by training deep neural networks to extract visual descriptors from images (Deep Features), encoding significant semantic information. In this case, high similarity between features is an indication of high semantic relationships between images. Deep features can be extracted using Deep Convolutional Neural Networks, trained to perform some recognition tasks, and using the activation of neurons in internal layer of the network as features. This is, for instance the approach proposed in arXiv:1403.6382, where the authors show that performance superior to other state of the art systems was obtained, with the use of deep features.

In order to use text queries to retrieve images, either textual descriptions should be associated with images, or techniques able to generate visual features from text queries are needed. In both cases artificial intelligence has recently provided significant solutions to this problem.

Artificial Intelligence can be used to automatically analyze content of images in order to generate annotations (<https://dl.acm.org/citation.cfm?doid=3095713.3095740>), produce captions (arXiv:1412.6632), identify objects (arXiv:1612.08242), recognize faces (arXiv:1710.08092), recognize relationships (arXiv:1706.01427). This information once extracted can be associated with images and used to serve queries.

On the other side, cross-media searching techniques are able to translate query expressed in one media to queries for another media, relying on artificial intelligence techniques. For instance it is possible to use text to search for images or vice versa. In this case the advantage is that an image database can be indexed once, using visual features, possibly extracted using deep convolutional neural networks. Improvement of the cross-media techniques, where the vocabulary of terms and phrases that can be translated into visual features is increased, do not require to reindex the entire database of images. Just the query-time processing tools need to be replaced. This direction is pursued in arXiv:1606.07287, where a neural network was trained to generate a visual representation in terms deep features extracted from the fc6 and fc7 internal layers of ImageNet, starting from a text query.

## *Diffusion*

## *Consumption*

One of the key features needed for an effective and efficient consumption of digital images is the possibility to easily and rapidly identifying and retrieving existing content, which is relevant to one's needs. However, image content is often not described, annotated, or indexed at the required level of granularity and quality to allow quick and effective retrieval of the needed pieces of information. It is still a problem, for creative industry professionals, to easily retrieve where, for instance, a specific person is handling a specific object, in a specific place. This is generally due to the fact that metadata and descriptions, associated with digital content, do not have the required level of granularity and accuracy.

Professionals that need to retrieve, consume or reuse images, for instance journalists, publishers, advertisers, often have to rely only on experienced archivists, with a deep knowledge of the archival content they hold, to find material of their interest. However, the amount of material generated and distributed every day makes it impossible to handle it effectively and to allow professionals to easily select and reuse the most suitable material for their needs. This happens because annotating

manually, with the required level of detail, the huge volumes images produced nowadays, is extremely time-consuming and thus almost impossible to afford.

Consider, for example, the news production scenario. Every day there is an army of photographers, and journalists, around the world, that send their material to news agencies, related to some event they have witnessed, hoping that their material will be used in tv news, on-line magazines or newspapers. However, just a small percentage of this produced digital content will be actually published and, often, most of this audiovisual material remains buried in the news archives, unexploited because not easily discoverable.

In this respect, artificial intelligence offers effective tools to address this problem. As already discussed in the production subsection of Images artificial intelligence based tools for content based image retrieval, for image annotation, image captioning, face recognition, and cross-media retrieval are nowadays available that allow effective and efficient retrieval of images according to user's needs.

Recently, deep learning techniques, as for as for instance those based on Convolutional Neural Networks (CNN) become state-of-the-art approach for many computer vision tasks such as image classification (<https://dl.acm.org/citation.cfm?id=2999257>), image retrieval and object recognition (arXiv:1310.1531 ).

Convolutional Neural Networks leverage on the computing power provided by GPU architectures, to be able to learn from huge training sets. A limitation of this approach, is that many large scale training sets are built for academic purposes (for instance the ImageNet dataset), and cannot be effectively used for real-life applications.

Face recognition algorithms also benefit from the introduction of deep learning approaches. Among these, DeepFace (<https://dl.acm.org/citation.cfm?id=2680208>), a deep CNN trained to classify faces using a dataset of 4 million facial images belonging to more than 4000 unique identities. More recently the VGGFace 2 dataset (arXiv:1710.08092) was released which contains 2.31 million images of 9131 subjects. A ResNet-50 Convolutional Neural Network was trained on this dataset, which is also able to determine pose and age of persons.

## *Challenges*

## *References*

### **3.2 Interactive Virtual Environments**

#### **3.2.1 Games**

##### *Consumption*

Video games have become one of the main forms of entertainment and a major player in the creative industries. It is currently a market gathering more revenues than other major entertainment medias such as movies and music ([web source](#)). The video game sector has been using AI tools for decades now, in particular for designing artificial characters or opponents. However, the recent progresses in machine learning tools and associated data availability opened up the door to more personalized video game experiences. In particular, video games notably aim at providing enjoyment, pleasure and an overall positive user experience to its players (which can also contribute to more sales and/or more subscriptions to the game).

A key element that has been identified to favor enjoyment and a good gaming experience is to favor the state of Flow in the players (Chen 2007). The Flow is a psychological state of intense focus and immersion in a task (any task), during which people lose the sense of time, perform at the best of their capacity and derive the most enjoyment. Flow can notably occur when the challenges offered to each player match their skills, so that the game is neither too easy - which would be boring - nor too hard - which would be frustrating. However, various players have various skills and seek or need different things in a game to enjoy it. Thus, to ensure maximally enjoyable games for a maximum number of players requires personalized games, whose content and challenges adapt dynamically and automatically to each player.

AI methods could be used to design such personalized games, by 1) modelling the users, 2) providing adaptive content dynamically, based on the model of each player (Cowley 2016a), thus favoring flow and game enjoyment. We detail these points below.

First, in order for a game to adapt to each player, it will have to be able to understand this player, and thus to model it automatically from available data. In particular, a useful player model would have information about the player's skills, cognitive states (e.g., attention level), conative state (i.e., motivation) and affective states (e.g., frustration or joy), and possibly the player's traits (e.g., personality). Such states, skills and traits could possibly be inferred from various data available during play, using machine learning techniques (and in particular classification algorithms). For instance, some player's states, skills or traits could be inferred from the behaviour of the player in the game, depending on his/her actions and the context. The skills can also be inferred from the performance of the user in the game, see, .e.g., (Herbrich 2007) and (Bishop 2013) for a simple skill estimator based on machine learning used for Xbox live. Various cognitive, affective and conative states could also be estimated from physiological signals measured from the player, using sensors embedded in gamepads, in gaming devices, or using wearables. For instance, there are first laboratory results suggesting that some cognitive states such as workload, or some affective states (e.g., positive or negative emotions) could be inferred, to some extents, from rather common physiological signals such as from speech recordings, eye tracking, facial expressions (from photos/videos) (Nacke 2008) or from more advanced ones such as muscle activity (electromyography - EMG), heart rate, galvanic skin response (GSR) (Cowley 2016, Drachen 2010, Nacke 2013) or even from brain signals such as electroencephalography (EEG) (Frey 2014, Frey 2016, Mühl 2014). So far, only a few states can be estimated from these measures, and rather unreliably and unspecifically. Modern AI/Machine learning tools hold promises to estimate a larger variety of states (including, for instance, the Flow state) in a robust way, in order to obtain rich and reliable player models.

Then, once these various states, skills and traits identified and estimated, AI could be used to model and estimate how game events, mechanics and/or difficulty levels would impact the player's enjoyment (as reflected by the player's estimated affective states). This would provide a comprehensive model able to predict how the player will behave and perceive the game depending on its states and skills, and depending on the game context. Once such a robust model of the player obtained, different AI tools could be used to provide adaptive content in the game, dynamically, depending on the player's model. Such AI tools could for instance adapt the game difficulty, change or alter the game story or scenario, trigger various events to induce various emotions, or provide new choices to the players. For instance, the player models defined above could be used to predict the possible impacts of various actions and game adaptations, in order to select suitable actions to maximize Flow and game enjoyment. Some authors have recently proposed that machine learning



tools such as recommender systems could be used to select actions that have a positive impact on the gaming experience, based on the impact similar actions had on similar users in the past (Tondello 2017).

Extending such promising R&D directions would include studying the use of similar techniques to design serious games, e.g., for education. As it happens, in the field of Intelligent Tutoring Systems (ITS - see Section “3.5 Education”), similar user modelling and adaptive AI tools are used for providing personalized education. Such works also raise some crucial ethical questions. In particular, such player modelling and game adaptation aim at maintaining the player in the Flow zone and at maximizing game enjoyment. As such, there is naturally a risk to lead to game addiction, which was recently recognized as a disease by the World Health Organization (<http://www.who.int/features/qa/gaming-disorder/en/>). Such AI tools for gaming should thus also include “ethics by design”, to also prevent gaming addictions.

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### 3.2.2 Design

Fashion, Product design, Web-design

## 3.3 Information

### 3.3.1 Media

#### *Multilingualism*

##### *Description*

The principle of subtitling for the deaf and hard of hearing was introduced in the United Kingdom in the early 1970s to meet the requirements of the hearing impaired people to access TV programs. This first system (Ceefax created in 1972 and Oracle), became widespread on the television channels in 1976.

At that time (1976) appeared in France the Antiope system [1]. Teletext subtitling made its first appearance on Antenne 2 (France 2 today) on November 1st, 1983, on France 3 and TF1 in 1984, on Canal + in 1994, and on Arte in 1998. The Antiope system has been replaced by the European standard Ceefax on January 1st, 1995.

Today, subtitling for the deaf and hard of hearing is governed by the European standard (EBU / EBU-N19).

Now it becomes necessary to define subtitling in a contextualized way, that is to say taking into account the current state of the art, the technique(s), the regulations and relevant market(s), describing it as:

- A sequence of subtitles that restores the meaning of the speaker's speech while adapting his/her words if necessary,
- Free of spelling errors and misinterpretations,
- Respectful of the standards in the country / countries concerned. These standards are of types: techniques (objective standards), and artistic (subjective rules).

This definition effectively eliminates all automatic captioning providers that abound in the relevant market and do not meet any of the points in the above definition. The future technical challenge is to transform / improve this state of fact.

#### *Challenges*

Challenges are about the development of systems for the automatic production of subtitles and sign language of video content using recent developments in Artificial Intelligence applied to machine translation. We have identified 3 major technological challenges:

1. STSME Automated + Multilingual: the goal is to develop solutions that automate the production multilingual subtitles
2. Automated sign language representation by avatar: the objective is firstly to produce a sign language representative for video content, and secondly to synthesize this representation through an avatar.
3. Big Data - Real Time: it is important to produce solutions that can handle large volumes of data in acceptable times, and also to build various large corpus needed to use deep learning.

### *Fragmented subtitling markets*

The market for subtitling is highly fragmented and operates primarily at the national levels. There are no comparative European nor international studies concerning the players involved, their market shares or their intentions for technological development.

According to one of the rare studies on dubbing needs and practices in the audiovisual industry in Europe, there are 631 dubbing and subtitling companies in 31 European countries, 160 of which are leading companies. Their overall turnover was estimated at between 372 and 465 million Euros. 84 companies are located in France, Italy, the United Kingdom and Germany, accounting for 64% of the turnover on these activities. 30% of sales (turnover) would be made on audiovisual work.

At the time, as today, the circulation of programs and the transfer of language could be further developed, accessibility is slowly improving in view of the European directives and some dedicated projects that have emerged, but is not applied equally or consistently everywhere. The absence of multilingualism penalizes certain future technological innovation perspectives, and the quality of subtitles is not always present going together with increasing pressure on the translation professionals.

Therefore, future issues are to contribute to:

- Fluidize/streamline the circulation of audiovisual (or video) programs through machine translation, while humans focus on the quality of work, for example.
- Machine translation would also make it easier for television channels to acquire new foreign customers and allow them to invest more easily in extra-European programs without investing too much in subtitling;
- Encourage more synergies and convergence between subtitling and the development of multilingualism or the integration of foreigners (migrants for example) in a given country.

### *Players involved*

Market players are broadcasters (TV, Web, festivals), laboratories, and freelance writers (subtitlers / adapters / translators).

The strong interaction between these three main actors in the economic model of the so-called subtitling service can be presented as follows:

1. A broadcaster orders a subtitling service to a laboratory.
2. The laboratory has the service performed by integrated or freelance authors.
3. The laboratory ensures by a quality control (simulation, correction) that the program meets the standards (it is therefore necessary that the laboratory has clear and recognized internal processes, i. eg. ISO standard).
4. The laboratory delivers a subtitle file to the broadcasters.

### *Regulation and market opportunity*

Legal obligations[2] have been a real opportunity for many actors. In France, the production of subtitles by its specialized service has increased from 6,045 hours at the end of 2008 (made entirely by authors / adapters) to 8,380 hours at the end of 2009 (with 1,939 hours of live programs) and 13 140 hours at the end of 2010 (with 5 097 hours performed live).

Thus, we observe that the legal context has completely shaped and redesigned the production mode (through the introduction of speech recognition software) and the routing of captioning on the air and the production of subtitles. The regulatory issue clearly favors market opportunities.

Finally, the subtitling market will certainly concern cinema and television, but it also concerns more and more advertising and the world of performing arts, education & training, or even the integration of foreigners into a country.

Many countries (France, EU, Australia, Canada, Germany, Hong Kong, India, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Spain, Great Britain, United States, etc.) have adopted legislation similar to French legislation (cited above) on digital accessibility resulting in the need for the production of appropriate subtitles for audiovisual content.

The leading countries in these areas include the United Kingdom and the United States of America. Extrapolating from the French market, we can reasonably estimate that the annual market for the production of subtitles adapted to audiovisual broadcasters at a global level of several hundreds of millions or even billions of Euros per year.

For players in this market, at European level, the Ericsson Group, including its subsidiary Red Bee Media, is a major player in the field of accessibility, providing more than 200,000 hours of subtitling each year, including 80,000 of live subtitling.

In the UK, BTI Studios has produced more than 350,000 hours of captioning each year. Finally in the United States, 3PlayMedia is a major player.

Among French actors currently known are MFP, ST501, Blue Elements, Dubbing Brothers, Titra Films, Imagine, etc.

Automatic translation out of AI and deep learning instruments will allow to respond to:

- The explosion of content (Big Data aspects);
- Compliance with digital accessibility legislation;
- The reduction of production costs.

IT will redefine this division profoundly because of the emergence of many actors who will constitute as many market targets: universities, administrations, companies, start-ups, producers, etc.

The economic interest is threefold

- First, the automation of the adapted subtitling chain will allow productivity gains that reduce unit costs and increase the volume of processed data.
- Then the production of multilingual subtitles will allow a wider commercialization of the audiovisual contents produced. Distributors of videos and audiovisual programs will be able to market their international programs more easily thanks to the presence of multilingual subtitles.
- Finally, the decrease in subtitle production costs will make captioning accessible to many new players for whom the cost makes captioning impossible.

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### *Inclusion, Diversity, Personalization (Hadmut Holken)*

#### Future of personalized access services

Technology is transforming the way we work, live and entertain ourselves. Yet, television (watched on a TV set or via the Internet) is still the preferred medium of Europeans: more than nine out of ten (96%) Europeans watch TV at least once a week. Europeans predominantly watch television on a TV set [1]. But television is changing. It is becoming more connected. Hybrid Broadcast Broadband TV (HbbTV) is an international, open standard for interactive TV, which enables innovative, Interactive services over broadcast and broadband networks [2]. How can the industry guarantee that as many people as possible benefit from this technological innovation? And, if Europe is to become a world leader in accessibility, a topic raised recently by the European technology platform NEM (New European Media, 2016) [3], what steps are still needed?

Between 2013 and 2016, the European HBB4ALL project addressed media accessibility for all citizens in the connected TV/media environment. Its main challenge was to consider the delivery of multi-platform audiovisual content (anytime, anywhere, any device) and make this accessible to all. Access services such as subtitles, Audio Description (AD) and sign language have been available for some decades yet often with little research into how they can be optimized. HbbTV opens up new opportunities for the customization of these services. New access services are also being developed, such as Clean Audio (CA): Following testing as part of the project, the HBB4ALL access services are publicly available on air at RBB and ARD in Germany, at TVC in Spain, at SSR/SGR in Switzerland and RTP in Portugal.

### *Recommendations for future research and innovations*

Accessibility research and innovation issues still to be addressed are:

- Tools to enable increased opportunities for employment in the media and creative industries
- Increased access to digital media services
- Automatic translation to sign language, and from sign language to text
- Automatic translation of subtitles (multi-languages)
- Accessible universal remote control
- Screen reader enabling those with a visual impairment to read subtitles
- Improving multimedia accessibility by design-for-all
- Collaborative work within the industries
- Building on existing media access services and innovation systems (open source and others)

Future short and mid term innovation trends include

- For broadcasting: developing and improving sign language production, Audio Description for content (videos and books) with the facility to deliver dialogue and ambiance elements of the soundtrack separately, achieving robust subtitling performance across genres and increasing interoperability, allowing users to consume personalised automatic live subtitles anywhere.
- For web access developments: industrialize existing prototypes e.g.: subtitle renderer; inlay/screen overlay (incrustation) of sign language interpreter; advanced audio functions; improve the quality of automatically generated subtitles, reliable STT technologies, improve avatar based signing services, develop and integrate additional accessibility services into existing online platforms.

From the user perspectives, it is important to ensure a design-for-all-approach, while recognising that very specific needs may go beyond design-for-all, like affordable, reliable and interoperable solutions, availability of continuous technical support, information about existing and future services, training support for user groups of all ages.

In terms of standards, we recommend to build on European and worldwide standards involving all stakeholders to create large-scale usage. Beyond media accessibility, work on issues surrounding the IoT (Internet of Things), i.e. the interconnectivity of all objects that exchange data, where media access is relevant.

Moreover, clear regulations should exist not only at national level but also at a European level.

It remains crucial to raise awareness in the value chain through information and media, through education and curricula, by bringing stakeholders together (studies, think tanks, projects, market take-up), and include the content production industries.

This shows the need for a continuing emphasis on media accessibility, while recognizing that many strides have been taken in Europe so far. This is best achieved through education; standardisation and legislation based on sound academic and industry research and by the involvement of all members of the value chain, not forgetting the users. If design-for-all is the fundamental principle we will ultimately all benefit from the media interconnectivity. Above thoughts and research recommendations aim to guarantee the future of media access services.

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### **3.3.2 News**

AI is gradually changing the news media business, impacting all steps from production to consumption.

#### *Creation and production*

On the production side, information gathering and synthesis is benefiting and will continue to benefit from increasing technological achievements to facilitate the analysis and cross-examination of heterogeneous information sources in multiple languages, including linked open data and crowdsourcing, to help validating information and facts on a large scale (so-called *fact checking*), to automatically provide insightful, potentially personalized, digests including enlightening visualization and summarization. Examination of the Panama Papers, leveraging natural language processing and text mining techniques in conjunction with database technology and graph visual analytics, is a recent example of this trend, which also points at the limitations of today's technology. The recently ended EU project [YourDataStories](#) focusing on linked data for investigation journalism is another meaningful example, however limited to homogeneous well-structured data. Addressing technology for heterogeneous sources, [the Inria project lab iCODA](#) focuses on the seamless integration and exploration of knowledge bases, public databases and curated content collections for data journalism.

Fact checking is another emblematic use-case where AI is bound to make a difference, as highlighted in recent initiatives such as the EU projects [Pheme](#), [REVEAL](#) or InVid. Making use of knowledge representation, natural language processing, information extraction, image retrieval and image forensics deeply modifies the debunking of fake news, while social network analytics provides the means to better understand how and by whom fake news are propagated so as to facilitate their dismantling. On the other hand, image and video manipulation is rapidly improving, in particular with recent advances in deep learning for text and image synthesis (cf. [fake discourse of President Obama presented at SIGGRAPH 2017](#)), and fake news producers will sooner or later become aware of the methods used to track them and find workarounds. This calls for the development of efficient countermeasures and adversarial approaches.

### *Diffusion, consumption*

On the consumption side, AI technology also modifies in depth our habits. User profiling and recommender systems are on the verge of being widely used as the number of information sources critically increases. This increase of sources also calls for mechanisms and general public tools for users to assess the reliability of the information they are provided with, beyond the traditional work of press agencies, and possibly across language barriers. News aggregation and summarization is also key in today's news consumption and still requires significant work on automatic multimodal summarization and story-telling easily adaptable to a user's personal expectations, on new content generation, etc. Last but not least, participative journalism is progressively becoming a standard (see, e.g., tweets embedded in newspaper articles or in news shows, videos and photos of events being taken by witnesses and incorporated in professional news reports). This growing trend, which gradually shifts journalist work from professional redaction to the general public, from official news providers to social networks, must be accompanied with intelligent processing tools to maintain high-quality information channels.

Challenges are (to be redacted or moved to the technical section): heterogeneous data integration and querying, with ontology-based access (making the most of participative input, capitalizing on existing knowledge bases and public open data); efficiency, trust and timeliness in information extraction and knowledge discovery (i.e., better collaborative, up-to-date and easy-to-maintain knowledge bases), as well as in content production, whether automatic or not; improve the security of multimedia information retrieval systems and image/video forensics; better personalization and recommendation; trust and transparency of algorithms, and potentially of information (blockchain?) are also at stake here.

## 4. Social Media

Social media, today mostly dominated by large companies in the US such as Google, Twitter, Instagram or Facebook, have become an important channel for information and entertainment, conveying huge amounts of personal information that can be used as a proxy to study and monitor people's mind set on a topic or on a product. AI technology has already revolutionized the way social media content is indexed, searched and used, with key technology such as object, face or action recognition in images and videos, entity detection in texts, or opinion mining and characterization. Highly distributed recommender systems exploiting user profiling are today also instrumental to social networks, including for ad placement. Beyond the analysis of user-generated content for indexing and search purposes, monitoring content and users on social networks can provide valuable information and knowledge on specific communities, on people's behaviour and opinions, on societal trends, etc.

*Opinion mining and trend detection (elections, marketing, etc.), also comes with community detection. Surveillance: national and EU security but also suicide prevention, cyberbullying detection (e.g., [EIT Digital project CREEP](#)). Privacy issues are not to be forgotten.*

## 5. Advertising

## 6. Education

### 6.1 Intelligent Tutoring Systems

### 6.2 Migration and education

Future EU R&D&I funding with personalization and diversity as one key dimension succeed the integration of migrants

Migration raised major societal challenges within the European Union over the last years, and simultaneously the question of inclusion and access for all through ICT, content and (social) media. Therefore the NEM Steering Board introduced the migration topic, and organized an exploratory meeting between NEM members & UNESCO during the last NEM Summit in Madrid (30 November 2017).

Out of experiences with migrants, it appeared that UNESCO is concerned about the role that technologies may play with regard to integration of migrants into the society. This should be placed under perspectives to promote multiple knowledge (of and about those who arrive), about cultural differences, and the economical sides: many refugees are coming to Europe, and they can impulse economic growth.

In terms of needs, the personalization of services is a first major issue: we are talking about very different profiles of people. Not just one solution expresses and addresses all those different populations. The second issue: mobile technologies can be seen as part of the solution (not THE solution). Almost 80% would do anything in order to have mobile technologies. All refugees care about being connected. So mobile technologies have to be part of the solution.

UNESCO would welcome to get European wide tools to address the refugees' needs. It is about scaling up something that works first, and international cooperation.

Basic and advanced needs are as follows

- Basic needs in terms of education, tools for promoting communication. To help children from Syria to learn Arabic, because they have a lack of education (did not go to school). And also learn the language of the country.
- The remedial needs when it comes to education. Many children will arrive to schools that still recall when their schools were bombed (very traumatic souvenir).
- The higher educational sector. We need systems to help them to certify obtained diplomas. Does anybody address them?
- Consider the opportunity to enhance their digital skills (younger, children, and others). Digital skills are part of to live in the society, and relevant content can help them to be fully citizens in the society.

Tools that UNESCO could support for example are real time translations aiming at empowering human contact. Refugees need to be connected to the country's language, but also to their own language. In addition, the situation requests more qualified teachers (not only those of the receiving countries), but the need of tools and content for (social) media has to be qualified, and extra costs per child (+ 33 to 50 % compared to others) must be considered.

Industries helping to shape solutions would be much appreciated, while UNESCO can welcome any kind of proposal and push it, envisage to help to develop the system(s), and be a partner.

Future R&D1&I related topics could be related on a next public EU R&D&I funding, which considers accessibility, personalization and diversity as one key dimension.

Besides the above mentioned translation tools, media (particularly Public Services) can serve as Educational and Knowledge Diffusion Platform for all - both migrants/immigrants and local population. Content creators, creative people, and storytellers should be "encouraged" to produce content related to immigrants (beyond news and reports based on emergency). Different navigations between different rights and administrative issues need also to be addressed. In the forefront, it is also important to collect research literature to make these topics more predictable.

Higher education is one of the issues: there should be a consolidation of treating people in a non-discriminatory way from both sides. Education institutions have to deal with it from now on. It has to be checked whether there is a lack on tools, or methodology, etc. The language tools here apparently are not the big problem. For children, it might be the EC that comes up with bottom-line instructions.

Concerning innovation and refugees, it is important to:

- Identify ICT instruments for them: at city level, country level, European level. For example security, tracking.
- Innovate with strong PA (Public Authorities) support in order to mitigate possible societal challenges related to "the others" (immigrants).

In the coming month, NEM intends to create a NEM vision taking into account the situation, the needs and further potential NEM solutions, like i.e. create tools to help the programme makers.

## 4. Identifying technological challenges / Impacts

### 4.1 AI for humanity



These disruptive technologies indeed raise new ethical and regulation challenges. These aspects are well addressed in several documents, like the Villani et al report on «AI for humanity» and will not be rephrased here. Similarly the General Data Protection Regulation (GDPR) aims primarily to give control to citizens and residents over their personal data and to simplify the regulation. There are however issues that are seldom quoted although essential, especially regarding AI and media.

**AI but what for?** The 1st question is « à quoi bon ? » : What are our real needs ? Are those innovative technologies either answers to real (known or emerging) expectations or offering something new that we consider as a real (may be unexpected) benefit ? It is not obvious that our will reduces to adopt all gadgets and reorganize our life as a function of these gimmicks. A critical example is autonomous cars: the global problem on earth is not that cars are not autonomous, but that there are too many, sub-optimally used, impacting too much our environment. More generally, the society we want to build is not a conjuring show, with amazing new tools. There are real huge challenges to take up. One key example, e.g., in education, is to use these new opportunities to challenge education for everyone.

AI can improve media, but media have a major responsibility in contributing to make appropriate collective choices about AI.

**AI who is behind ?** The idea that IA is "automatic" introduces a huge bias, it hides who decides. This goes far beyond the advertising submitted to us. If an IA is retraining my free will, or cheating on me, i can bet that a human is making profit underneath. Moreover, some aspects of the sovereign power tends to be appointed to those how have the power on the data and algorithms, e.g., in education, where the companies building educational digital resources decide in a much deeper way that with books, what is going to be the learning activity. Regarding the media, i.e., this is our freedom of expression that is put in question, and the notion of net neutrality is to be understood at the Internet network level but also at the Web content level as pointed out by the CNNuM in their report on this subject.

AI can improve media, but media have the duty to make explicit and help us understanding those aspects of AI.

**AI ... only thanks to GAFAMs ?** The fact is Google, Facebook and Microsoft GAFAMs are to a certain extends leading the developments in AI, including by sharing open software widely used in research such as Tensorflow or Malmö. Shall we attempt to do better than they do with their huge resources or build on what they share ? The solution might be elsewhere. On one hand, consider GAFAMs want or need to enhance somehow their image with regard to geopolitical issues. On the other hand, clearly state the frontier between what they can propose, and what is definitely the sovereign domain (e.g., education or health care). In education the Class´Code project is paradigmatic with respect to Google for Education (GfE) will of leading computer science education in France: this initiative has defended its independence with respect to the "giant", and proposes a complete French and soon European common good, without refusing to collaborate with GfE, which supports peripheral actions. Because Class´Code gathers more than 70 partners in the related field, it offers an independent leadership on its targeted topic. This could be generalized to other domains.

**AI science or belief ?** While "weak" IA, (or technical IA, as properly defined by (Ganascia, 2017) is a reality, and corresponds to the fact that « machines can realize tasks which would have been

considered as intelligent if realized by a human » as defined by Minsky, with the intrinsic limit of being always specific to a narrow cognitive task (as formalized by the no-free lunch theorem), what is called "strong" or "global" IA (i.e., that an intelligence with consciousness will (in a near future) emerge from a machine able to reproduce and improve itself) is neither true nor wrong, it is a belief. Very honorable people in the world believe that trees have a soul, and other people believe in strong IA, that will either eliminate the humanity or create a human paradise, for some of us (Ganascia, 2017).

AI can improve media, regarding fake news detection, but media have also to stop propagating fake news about AI.

**AI and human though?** As analyzed by (Romero, 2018) in order to cope with these previous challenges, what should we, and our kids, learn IA ? We definitely need to understand how it works, enlightening the fact that massive calculation, making profit of statistics on large data set, provide approximations of cognitive functions. This allows us to realize that this is not magic, and to construct a representation of what can be done or not with it. Regarding computer science in general, we are now beyond the common wrong idea that we do not need to understand how it works but simply (obediently) use it. This also apply to AI principle and it is a major goal for science outreach and science popularization to produce resources for everyone on these topics. Furthermore, in addition to developing computational thinking, this includes developing creativity (and not only using tools as it), developing critical thinking: We must neither be technophobe or technophile, but technocritic.

AI can improve media, but media should have the goal to help us improving the way we enjoy AI.



## 5G Phase 3 – Media Pilots

(February 2018)

by NEM 5G joint Working Group with Networld2020 ETP



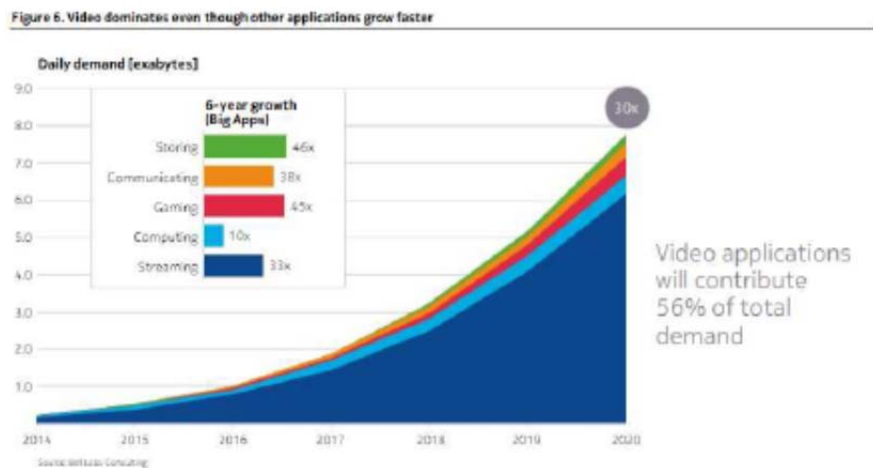
The publication has been supported by the Vital Media project, which initiated creation of the NEM Working Group on 5G, contributed to its content, gathered inputs to the publication from the NEM Initiative community, followed up the publication approval process, coordinated all related activities, and consolidated all version of the publication.

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## Executive Summary

This paper has the objective to describe potential pilots from the Media & Content domain that can be developed to take advantage of the future 5G networks.

Media & Content are one of the most important consumer of network capacities “Streaming and cloud-based services and applications are the biggest demand drivers. They are enabled by better devices and richer applications and reinforced by trends to higher resolution screens and the availability of lower latency, higher performance networks. “The younger generation’s unprecedented consumption of data anywhere and on any device becomes the de facto behaviour in the larger populous” - *Bell Labs Consulting report 2016*.



Given these trends, it is key that the future 5G networks will be able to support requirements from Media & Content applications and services, mainly bandwidth, latency and security.

5G PPP IA has identified 5 KPIs that 5G should reach:

1. 1000 times higher mobile data volume per geographical area.
2. 10 to 100 times more connected devices.
3. 10 times to 100 times higher typical user data rate.
4. 10 times lower energy consumption.
5. End-to-End latency of < 1ms.
6. Ubiquitous 5G access including in low density areas.

Ten potential pilots have been identified by the working group mixing experts from Network (Networld2020 members) and Media (NEM members). These wireless demand will climb even faster, especially where wireline broadband is insufficient or unavailable.

1. NREN for education
2. Next Generation media over 5G enabled cities
3. Large events remote visualization experience
4. Cooperative designing platform
5. Public Protection and Disaster Relief
6. Remote medicine
7. Remote education
8. VR with multiplayer interactions
9. Mixed reality experience
10. Real time video analysis

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## 1. Context

5G promises a wide range of extra features compared to the currently available communication systems. 5GPPP has already identified a list of high level 5G Key Performance Indicators (KPI) which includes: 1000 times higher mobile data volume per geographical area, 10 to 100 times more connected devices, 10 times to 100 times higher typical user data rate, 10 times lower energy consumption, End-to-End latency of < 1ms and Ubiquitous 5G access including in low density areas.

Multi-access Edge Computing (MEC) capabilities enabled by Network Functions Virtualization (NFV) and Software Defined Networking (SDN) are fundamental to realize 5G PPP vision. With the help of NFV and SDN, the embedded resources at the multi-access network edge are employed to offer added value services, improve quality of experience by moving intelligence at the edge and create new business opportunities.

In particular, for next generation media services the virtualization capability offered by NFV and SDN will help media service providers to exploit resources (network and IT) from a central point, without being worried about where the actual hardware is located, how it is maintained, who is the vendor, etc. Moreover, the unified management of computing, networking and storage will significantly reduce media service provisioning time. For example, instead of spending hours to set up a service, it will happen in order of minutes (5G PPP KPI: reduce serviced provisioning time from 90 days to 90 minutes). Orchestration capacity makes it possible to coordinate thousands of devices, thus media service providers can utilize unconventional hardware, e.g. GPUs, in fly and on demand (5G PPP KPI: more connected devices). Programmability and automation are two important features which change the overall media service behaviour towards more automated/intelligent systems able to guarantee QoS and SLA compliance with minimum human intervention and error. Dynamic scaling is another important advantage enabled by SDN/NFV to optimize resource utilization and reduce OPEX (5G PPP KPI: 10 times lower energy consumption). Furthermore, sharing expensive infrastructure among serves tenants/service providers, so called 5G multi tenancy feature, will significantly reduce the required CAPEX for service offering. Last but not least, SDN/NFV create an open ecosystem where a full choice of modular plug-ins can be easily adapted to customize service offering according to the user needs.

After 5G technologies have reached a maturity level beyond pure lab experiments, trials and pilots at local as well as Pan-European level will play a key role to accelerate the deployment of these new technologies. The main target of such trials is the validation of 5G technologies in multi-vendor and multi-user environments. Verifying the stability and advantages in this environment will be an important step in moving 5G technologies from the R&D laboratories into the market. In addition such trials will serve the validation of the technology as well as the identification of further features to serve the needs of specific industry segments and user groups. A secondary and equally important goal is to increase the understanding of the new possibilities 5G technologies offer in industry segments which are less ICT focused and thereby help to jump start 5G adoption across a broad range of industries.



The ambition and the reality of actual demonstrations coming from vertical trials should be considered as with a strong dependency on underlying platform capabilities. Without discussing detailed technical features, one should take into account the platform interoperability issues at least from two different angles:

- Verticals should benefit from a meaningful (representing 5G services offer) common and standard interface such as APIs. This will allow discovering, triggering, negotiating and controlling the platform capabilities through this vertical interaction.
- Since many Verticals should involve several platforms to demonstrate end-to-end capabilities, interoperability between platforms is becoming a must.
- Last but not least platforms should serve for actual KPI validation, benchmarking including vertical missions. Platforms should also be repeatable and deployed where the vertical stands.

Thanks to the work done together with Networld2020 and NEM in 2015, Media & Content has been identified as one of the potential vertical sector able to take part in these pilots. However several other domains have been also selected such as Health, Logistics, Smart cities, Automotive, Agriculture, ... so there is a need to show that Media & Content is really a key sector that 5G could take advantage to validate the technology KPIs but also to get relevant feedback from end users.

There are many use cases that could be developed in the Media & Content sector to validate the 5G KPIs. The objective of the group is to collect those potential use cases and rank them according to the coverage of the KPIs (bandwidth, latency, security,...)

## 2. Potential Media & Content use cases

A few ideas have been identified; this list is not exhaustive and can be extended if needed. This list is coming from NEM members as well as from 5G Media project

### 2.1. Ultrahigh fidelity imaging for medical applications

#### 2.1.1. Description

In events such as disaster relief and first-response triage, technologies such as mobile X-ray radiography, mobile medical ultrasound or even mobile computed tomography can enable onsite medical personnel to receive assistance with diagnostic decisions by remote medical experts.

### 2.1.2. Technical requirements

Concerning the mobile Diagnostic Imaging, the ultrahigh fidelity imaging is fundamental to guarantee the diagnostic value of the received data. Therefore, besides the source quality and the lossless coding, the reliability of the connectivity is a must for this kind of applications.

In addition, near real time data transmission is crucial under critical conditions, while mobile communication can highly extend the availability of these services, for example where xDSL or fiber connections are not available or in mobility, for instance inside an ambulance or an helicopter.

To achieve this it may also be needed to use “bonding”, splitting the video over multiple connections from the same or different technologies or operators, including for example 5G bonded with satellite connection, or 5G from two different operators.

To provide expected level of diagnostic imaging service in case of first-response and disaster relief, devices intended for diagnostic imaging should have guaranteed priorities within the network. Since network overloads are common in case of mass events and/or accidents and disasters, network must provide appropriate mechanisms to prevent denial of service for first responders, medical personnel and similar units' devices.

## 2.2. On site live event experience

### 2.2.1. Description

Places such as stadiums, cinemas and hall parks are becoming increasingly connected to the digital world, with the purpose of further engaging their users.

**Augmented onsite live event experience:** this use case concerns with augmenting the experience of the onsite visitors, for example by means of augmented reality, by providing them with additional information relating to the live event. Such information may be previously available or be created in real-time.

**Personalised onsite live event experience:** this use case caters for personalizing the visitors' experience, for example allowing them to select (additional) camera angles to view, zoom in in certain area of the location which would otherwise be too far away or not visible from their current location, or view re-plays of the just played content or view related content.

On site live events can be classified into scheduled (e.g. sport matches, music concerts, festivals) and unpredictable/unexpected events (e.g live news, emergency support,...).

Scheduled events are planned by TV organizations employing professional equipment like 360 degrees cameras and UHD video streams. Additionally, video streaming produced users attending the event could be properly conveyed by professional equipment to enhance media fruition or delivered directly to final users as direct video communications.

Unpredictable/unexpected events cannot be planned in advance and need to be streamed at unpredictable time, from both TVs and users in the area of the event.

The fundamental difference between the two kind of events is related to the time available for infrastructure setup, being the second one possibly critical also for environmental aspects.

Both cases requires to setup media delivery and the related communication support for a limited period of time, i.e. the duration of the event.

eMBMS, 5G broadcast and multicast and seamless transition to unicast, can also enable delivery of high quality video to many users without consuming more bandwidth.

### 2.2.2. Technical requirements

Onsite live event experiences have to cater for several (hundreds or thousands) users. This means that these use cases will demand large data rates and are characterized by a high number of devices simultaneously active onsite. Additionally, there will be stringent requirements in terms of latency, due to the live and real-time nature of the use cases (especially for the augmented onsite live event experience). A further requirement relating to experience personalization will be the availability of different types, or versions, of content, where therefore caching (both for what concerns capacity and efficiency / management) will play an important role.

The communication support for onsite live event experience calls for dynamic setup capability characterized by different KPIs in scheduled or unpredicted events, even with 'on the fly' service deployment time. Network resources require to be flexibly assigned to the media sources depending on the traffic and device capacity. In fact streaming can be generated by different devices and video formats. Reliable connectivity between the "event site" and the final users should be provided to deliver contents with guaranteed QoS and service continuity. In addition, smart caching techniques should be available for the network to reduce its load.

The above requirements can be met by exploiting the cloud RAN design principle and network slicing. Distributed content caching can be developed accordingly (e.g., placing the cache where some baseband processing functions are placed).

3D Sound should also be a potential interested technology for such a use case.

Low latency, ultra high data rates and high performance compression technologies, capabilities to geo-position sound within video content.

Adding more viewers to the same content without linear increase in bandwidth consumption is required as well as managing several broadcasts at the same location (e.g. transmitting different views of the same event or different events), using 5G broadcast and multicast technologies.

## 2.3. User generated and machine generated content

### 2.3.1. Description

**Connected Drones for Infrastructure or Environmental monitoring:** 3D mapping in various industries, such as oil & gas, agriculture, and logistics, Public safety and surveillance are just a few examples of the services that can be offered through UHD and 360 camera mounted on remotely operated drones. Beside remotely operated drones a large number of drones carrying cameras within a geographic area will:

- navigate themselves automatically,
- taking care of obstacles, weather, charged batteries,
- exchanging each other

Collaborate to cover a specified Area with video feed + ad hoc BS

**Mobile Video Surveillance:** Public Safety Operators can wear connected camera while they are in action and send through the mobile network their video feed to a Video/Management/Localisation Platform that handles the registration and the coordination with the Operation Center. The Video Surveillance could be provided in conjunction with communication push to talk, to guarantee coordination among Operators. Some of the most important use cases are:

1. Support to operational services for mass events (heads of state visits, parades, football games, concerts, ...)
2. Additional tool for managing critical situations in real time by the central from field
3. Surveillance access and sensitive areas on mobility
4. Video surveillance from helicopter.

**Public Protection and Disaster Relief:** body-worn devices, surveillance cameras, sensors may collect and send various parameters regarding environmental conditions (temperature, presence of toxic gases, water level, seismic activity, location of crowds, etc.), vehicular installed sensors (including autonomous driving public safety related vehicles) and responder's physical conditions (position, body temperature, heartbeat, air consumption, etc.) to the Operation Centre where data could be further analysed. Incident commander is therefore better informed about the situation in the field which could be crucial in making decisions.

**Smart City:** Mobile web cam can be installed in the smart city. The images/streams acquired can be remotely processed to enable a variety of applications in different service areas:

- Monitoring parking areas: to determine the availability of parking slots, to verify the appropriate use, etc
- Security reasons: biometric recognition, video surveillance, etc
- Monitoring the environment for safety reasons: management of emergency conditions

**Smart Agriculture:** robots with advanced functionalities related to guidance, detection, action and mapping may be employed in agriculture to better monitor the environmental conditions and increase the production. These robots do not need guides on the floor, and avoid collisions with people and objects thanks to remote real-time processing of sensor data and images.

### 2.3.2. Technical requirements

**The connected drones used for Infrastructure or Environmental monitoring,** requires very low latency for their remote operation and high bandwidth per sending high quality images. In addition the network should be able to operate with systems moving at a speed up to 70 km/h

**For mobile surveillance,** high throughput is essential for the reliability of the service in addition to a secure management of the data both in the phase of sending to the network and in the storage in the cloud. The speed (60 km/h), in some cases the availability of an ad-hoc network

**Public Protection and Disaster Relief:** To provide expected level of service, PPDR devices should have guaranteed quality of service level within the network. Since network overloads are common in case of incidents, network must provide appropriate mechanisms to pre-emptively allocate and preserve level of communication quality and prevent denial of service for those devices.

For **Smart City,** given the potentially high number of devices, the requirements fall in the area of Enhanced Mobile BB and massive IoT.

**Smart Agriculture,** , the bandwidth requirement is high for the tasks based on high quality videos, while the speed of the transmitter and receiver usually is not an issue because these robots move slowly (around 3 m/h) around the fields

## 2.4. Immersive and Integrated Media

### 2.4.1. Description

#### Virtual Reality

The users, wearing a VR headset replacing his whole field of view, will be able to experience 360 videos, lightfields and 3D contents (e.g. 3D reconstructions of environments captured through photogrammetry or laser scan technologies). The user can experience the visit of specific locations of interest, downloading at very high speed all the related content, realizing a virtual reality experience.

This can be exploited to make remotely available specific contents, but also to integrate the existing contents with additional information. Main areas of exploitation could be tourism and education.

### **2.4.2. Technical requirements**

Virtual Reality will require extremely high data rates, in order to transmit 4K, 8K and even 16K video resolutions. WebVR applications will need to dynamically download all the 3D assets and media contents needed to build the VR experience requiring both very high data rates and low latency. Additionally, ultra-low latency (<20ms) will be needed, to avoid motion sickness. Similarly, reliability and video continuity without perceived interruptions are needed, otherwise the VR will not succeed. Delivery into vehicles, such as trains (300 km/hr) or infotainment in vehicles (70 km/hr) is also a technical requirement, at a lower priority than other services in cases of insufficient networks performance.

## **2.5. Cooperative media production**

### **2.5.1. Description**

Immersive videoconferencing and collaborative designing environment will enable people to meet, discuss and collaborate in a virtual location, while having the experience of being in the same physical room or space. To make this possible, each participant needs to be able to receive, in real time, the audiovisual feed of all other participants and be able to smoothly interact with them, both verbally (e.g. speaking or in terms of other environment noises) and visually (e.g. body language, shared document, artifact and/or activity). The experience will be so compelling that the need of physical meetings among distant / international parties will be drastically reduced and possibly no longer required.

### **2.5.2. Technical requirements**

In order to achieve the ambitions of this use case, a combination of networks, processing and device requirements need to be met. Specifically:

- the network shall be capable to transmit, both in uplink and downlink, a large amount of bandwidth at a very low latency
- the audiovisual feeds generated at different locations shall be synchronized before being displayed to the end user, however the introduction of too much additional delay due to synchronization should be limited or avoided, to enable a realtime experience
- solutions shall take device requirements into account, in fact the ability of devices to decode different audiovisual streams may be limited
- scalability, the above properties should scale well for a large and a dynamic number of participants
- dynamic path adaptation based geo-located and physical network architecture.
- high resolution video transfer that includes enriched content, multi-users, multi-sites

## **2.6. Collaborative gaming**

### **2.6.1. Description**

Including immersive gaming (AR, VR)

### 2.6.2. Technical requirements

The requirements include very low latency, certainly including dynamic path adaptation based on geo-localised and physical network architecture.

Also high resolution video transfer that includes enriched content, multi-users, multi-sites, multi-data streams independent of video content streams.

## 2.7. Immersive Applications and Virtual Reality

### 2.7.1. Description

#### **Interactive Virtual Reality**

Virtual and mixed reality technologies are going to have an increasingly important role in the next few years. Through appropriate mobile devices, two or more people interact in a virtual space, experiencing physical interaction even if they are not in the same location. Advanced and photorealistic avatars will replicate eye movements, subtle facial expressions and the movement of the whole body of the user, further enriching the communication. This can be exploited in the area of entertainment, but also in the area of business/enterprise services.

Social VR is possibly the killer application for immersive technologies to succeed, and it likely represents the natural evolution of today's social networks.

### 2.7.2. Technical requirements

For Interactive Virtual Reality, the technical requirements fall in the area of Enhanced Mobile BB and Low Latency.

## 2.8. Remote and Smart Media Production Incorporating User-Generated Content

### 2.8.1. Description

More and more media content is being produced daily. It includes real time video, e.g, very highly promoted on social networks like Facebook or Whatsapp or WeChat, or non-real time – uploaded and shared. More and more professional content is also created, breaking news, Sports events including lower ranking and even local events, reality shows, faith TV and other professional and semiprofessional content which the new technologies in cellular, video compression and editing, cloud editing and social networks distribution, have been enabling. 5G can bring high uplink and downlink bandwidth to support such volumes of content and high resolutions (full HD and 4K), improved congestion handling for multiple transmission from the same area, lower latencies (though of less importance than in other use cases), and mobility – even from/to moving vehicles. Multiple video feeds from the same content owner or from different ones may be transmitted to the cloud or to the professional studio (like TV), potentially in different qualities yet with very much the same latency. Networks, technologies and links other than 5G cellular that may be available in some

locations or venues (e.g. WiFi, fiber, LAN, 4G LTE) should be used seamlessly together with the 5G in order to split the load, reduce congestion, increase video quality and number of feeds.

### **2.8.2. Technical requirements**

Synchronization: between the professional content and user-generated content  
Dynamic network resource allocation: for example to allocate more upload bandwidth to the user devices currently filming the user-generated content; or caching capacity at the edge, where the user-generated content may be further processed (re-encoded, synchronized, integrated with other streams, multicast redistributed), ensure sufficient bandwidth (>12 mbps per a 4K stream, at least 5 streams) using network slicing and multi-link technologies; Be able to use simultaneously any type of other networks together with the 5G connection (satellite, fiber, LAN, WiFi, LTE).

## **2.9. Dynamic and Flexible UHD Content Distribution over 5G CDNs**

### **2.9.1. Description**

In 5G CDNs will heavily rely on virtualization techniques even in the mobile edge segment. With the high reconfigurability and heterogeneity of the network, we can expect novel forms of exploiting traditional forms of adaptive coding. Low latency requirements will require adaptation to be performed in the network, limiting the applicability of pure adaptive streaming protocols such as DASH. For this purpose we can foresee a DASH streaming service to be constructed by not having as many descriptions per segment as allowed qualities but rather being based on scalable coding techniques that can allow exploitation of adaptive modulation and coding (AMC) techniques as well as adaptive scheduling algorithms.

Eventually also multiple description coding could be exploited providing multipath (and multi-radio interface) capabilities.

Other techniques potentially useful could be related to join handover indications with prefetching content to the new site. Also, device mobility information could be used for selecting the most appropriate edge cache holding a copy of the sought content. The testbed could be extended to include a “follow me” feature to allow the user to set requests and the network to comply with them while the user moves.

At the same time, novel network and coding features should also be future proof and be designed keeping the abilities of (legacy) end user devices into account, which should still be able to obtain at least a (basic) version of the content.

### **2.9.2. Technical requirements**

For such a purpose, the testbed should comprise

- a properly populated content distribution service
- a resource orchestrator to match content characteristics with available resources
- a descriptor (and/or) a model of the rate-quality characteristics of the content to be made available to the orchestrator
- a set of heterogeneous radio interfaces with cells of different sizes



- an analysis of the handoff delay characteristics and the time margin
- user devices capable to actually deal with multiple interfaces at the same time
- modified decoders capable to exploit diversity and scalability
- resource orchestration and cache placement close to the edge with clustered small cells coordinated by an edge controller or being based on distributed computation algorithms
- KPIs to be addressed: reduced latency (<1ms), increased spectral efficiency (x1000), reduced service setup time (order of seconds)

## 2.10. Smart Education

The future learning model will be an immediate, virtual, and interactive environment which enables students to learn and interact in different ways than they do today.

This can be envisaged as follows:

By using distributed cloud and mobile edge computing to support such learning models, future mobile technology will enable single device content access anywhere, empowering students to resume their work at the convenient time and place through different devices, with an impression of immediate response time.

The advent of the Tactile Internet in 5G will help us to move from today's content and information delivery Internet to a skillset delivery Internet. This will create new ways of Tele-teaching and Tele-mentoring especially for training and skill development, bringing a new experience for distance learning and distance team-working. It can provide the possibility of removing the physical location constraint for experimental practices, and facilitate the sharing of resources between larger numbers of students irrespective of their physical location.

VR, and AR apart from their expected promising future in gaming and entertainment industry will play a big role in providing quality education and improving understanding-based learning and "reversed classroom" techniques among students and teachers. The nature of these services can make learning much more interesting and fun, and therefore persuading students to spend more time on their subjects. These services will also enable us to provide the right amount of information at the right time to the right users; Context Sensitive Training.

Combination of Tactile Internet with VR and AR will add a new dimension to tele-teaching, tele-mentoring, virtual university, virtual classroom, virtual team-working, etc., helping us to provide more personalised vs. one-size-fits-all, problem-solving and question-asking vs. learning facts and figures, practical application vs. theory, and on-demand vs. time-specific based learning.

New mobile technology and connected devices will give students the opportunity to learn with minimal intervention from teachers and mostly through exploration, discovery and peer coaching. Telcos could provide the connectivity and platforms to enable these use cases out of campus and leverage the existing infrastructures, such as the network to supporting the needs of the research and education communities within a country (i.e., National Research and Education Network) and confederation-based Wi-Fi roaming access service (eduroam<sup>5</sup>) for in-campus services . The wired and wireless systems in the education sector are increasingly diverse with continuously changing experience. Seamless integration of different technologies would be needed to facilitate communication between different organizations and easy roaming procedures. The lack of technical expertise in schools requires plug-and-play and self-organising/ optimising devices that can sense and learn from their environment and autonomously adapt. The applications for education are very diverse with varying requirements. For instance, applications that need Tactile Interaction through the Internet would require extremely low latency, while other use cases can leverage their delay-tolerant nature and ease off on latency requirement significantly.

## 2.11. Professional content production

### 2.11.1. Description

TV and other professional media organizations have already been using cellular networks as their prime vehicle to transmit live video from the field, and also non-live. This has been used for news coverage, Sports coverage, events etc. It has been replacing traditional satellite trucks as well as enriching the professional content generation with a myriad of new applications, like live video from indoors, underground, tunnels, the air, moving vehicles, no-time to going live, etc.

One of the prime technologies to enable this is sometimes referred to as “bonding” – using multiple links/connections/modems/operators simultaneously together, splitting the content over the multiplicity of these links ... Highly reliable bandwidth is even more needed in higher quality video formats such as UHD and AR/VR.

The newest trend in remote production is what sometimes referred to as “at home production”. The idea is to minimize the cost of such field production by sending and deploying the minimal set of equipment and personnel and doing as much as possible of the production in fixed locations. For example, deploying in the stadium only the cameras, send the video from each camera back to the production studio which is then fixed rather than field-deployed and can be located either at the studio or even in the cloud, and do all the production there. The benefits are huge in cost savings, ease of operation, enabling production of more and smaller-scaled and localized events etc.

### 2.11.2. Technical requirements

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<sup>5</sup> [www.eduroam.org](http://www.eduroam.org)

For these use cases, most demanding as they require ongoing continuous video stream, reliability and quality video uplink connectivity is required from anywhere, again supported by “bonding”, involving heterogeneous networks and multi-RAT connections such as cellular+cellular, cellular+satellite, cellular+xDSL/fiber.

Sufficient bandwidth for single or multiple HD to 4K video feeds (cameras), high reliability of this stream, back channel audio and video. Latency should be minimal yet not mandatory for ms-level. Synch of the multiple camera transmissions is required in <200 msec deviation.

### 3. 5G features needed by Media & Content use cases

One important feature is “mobile edge computing”. Another important feature is that it should be easy for Media & Content applications to ‘integrate’ within the 5G architecture, i.e. given the requirements of a certain Media & Content application (bandwidth, latency, edge service) it should be possible for the Media & Content application to communicate it to the network and the network should be able to satisfy these requirements, which may be dynamic in time.

Adaptive coding and transmission is used mostly. Therefore it is recommended to describe the KPIs as such

- The network must be capable to modify and adapt its heterogeneous being according to the timings of the different media applications (frame by frame? segment by segment?) under constraints that quality cannot be changed too much but considering that codecs allow several degrees of freedom (“handoff” latency)
- Proactively estimate along the end-to-end path the actual bandwidth/quality trade-off to avoid bandwidth and energy waste (needs to inspect media or signalling media-network)

This is somewhat a second level KPI, but for 5G use cases related to Media & Content I think it will be relevant reaching very low times to deploy new services.

For example, a VR or AR application may require a video rendering service deployed at the edge, and in case it was not already running (e.g. because it was not being requested by other users), it should be deployed very quickly, in the order of seconds.

In alternative, this requirement may be achieved in the way in which network slices will be designed in 5G: a VR/AR application will be using the “VR/AR slice”, which already runs the edge services that may be needed by the application.

In view of this, I would suggest that the requirements should be something like: “the Media & Content vertical will require 5G networks to be able to carry out 5G application functions, needed by the Media & Content services and available to them in the order of Milliseconds”. It is up to the 5G network to decide whether this means low times for deploying new services or instantiating all possible services in a particular slice beforehand.

## 4. 5G KPIs

### 4.1. KPIs descriptions

Extract from the 5GP Association contract:

*The development of new communication networks is dependent on the emergence of globally accepted standards in order to ensure interoperability, economies of scale with affordable cost for system deployment and end users. This partnership aims to have European industry driving the development of 5G standards and to develop and exploit at least 20% of the 5G SEP (standards essential patents).*

*The following parameters are indicative new network characteristics to be achieved at an operational level:*

- 1. 1000 times higher mobile data volume per geographical area.*
- 2. 10 to 100 times more connected devices.*
- 3. 10 times to 100 times higher typical user data rate.*
- 4. 10 times lower energy consumption.*
- 5. End-to-End latency of < 1ms.*
- 6. Ubiquitous 5G access including in low density areas.*

*This new high-performance network will be operated via a scalable management framework enabling fast deployment of novel applications, including sensor based applications, with reduction of the network management opex by at least 20% compared to today.*

*In addition, new lightweight but robust security and authentication metrics suitable for a new era of pervasive multi domain visualized networks and services will have to be provided.*

AREAS   KPI	A	B	C	D	E	F
1	HOT	LOW	HOT	MED	N/A	MED
2	HOT	HOT	HOT	MED	MED	HOT
3	MED	HOT	MED	MED	N/A	MED
4	HOT	LOW	HOT	MED	HOT	MED
5	MED	MED	MED	MED	N/A	LOW
6	MED	HOT	MED	MED	HOT	HOT

HOT	HOT
MED	MED
LOW	LOW
N/A	N/A

AREAS	KPIs
1 Ultra High fidelity media	A 1000 times higher data per area
2 on site live event experience	B 10-100 times more devices
3 user generated and machine generated content	C 10-100 times higher per user rate
4 immersive and integrated media	D 10 times lower energy consumption
5 cooperative media production	E < 1 ms e2e latency
6 collaborative gaming	F ubiquitous access

A few considerations:

- 5G networks are going to be heterogeneous
- 5G networks are going to be strongly based on software control for re-configurability
- 5G RAN is going to be using cloud-like resource management with small cells
- 5G devices must be capable to opportunistically exploit tx/rx opportunities
- 5G networks must be capable to handle large amount of data but also short and small amounts from sensors

On the content side, I have some experience in only a subset of the proposed areas namely

- (ultra) high fidelity media
- (on site) live event experience

## 5. Potential pilots

### 5.1. Description

#### 5.1.1. NREN for education

Recent developments in mobile access technologies have provided the possibility of having higher availability of the rich digital resources beyond the physical confines of the classroom and in the hands of learners. However, unlimited access to information is only the steppingstone for ubiquitous learning and effective teaching and learning is still required. Advances in mobile technology, IoT and the Tactile Internet, can open a new chapter in Education. NREs (National Research & Education Network) with their dedicated network for research and education community, e.g., Janet <sup>6</sup> can provide a significant role in coordinating such trials. Jisc as the UK NREN is happy to collaborate in holding any pilot in the UK Education Sector. 5G trial in Education can provide the following services:

- **Tactile Internet & Skillset communication** : manual skillset delivery Internet will create new ways of Tele-teaching and Tele-mentoring especially for manual training and skill development, bringing new definition& experience for distance learning, distance team-working, etc. ;
- **Virtual Reality & education** : VR has ever increasing relevance in education and training & will have a big role in providing quality education& improving understanding-based learning;
- **Augmented Reality & education** : AR is an efficient way of providing the right amount of information at the right time to the right audience (contextualised learning). Also, immersive AR can enable new services such as mobile cloud classroom and Virtual Presence.
- **Walled-off classroom:** combination of Tactile Internet & VR can remove the physical location constraint for experimental practices, and facilitate and enable the sharing of resources between larger numbers of students irrespective of their location.
- **Student wireless backpack:** it enables single device content access anywhere by using distributed cloud and mobile edge computing. All the user needs is a device to access any of his personal content and stored files to resume his work with the experience of immediacy.

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<sup>6</sup> <https://www.jisc.ac.uk/janet>

Use Case	Latency	Throughput
Tactile Internet & Skillset communication	1ms RTT	Medium-High
Virtual Reality & education	2-4ms*	High
Augmented Reality & education	2-4ms	Medium-High
Walled-off classroom	1ms	High
Student wireless backpack	Order of 10ms	Low-Medium

\*3GPP SA1, TR22.891 Document

### 5.1.2. Next generation media over 5G enabled cities

Aligned with the 5G Action Plan from the European Commission, the 5G technology is first expected to be deployed in urban scenarios. It is therefore of high interest to investigate, develop, and validate media applications that benefit from 5G infrastructure deployed in European cities.

5G trial requirements in future European 5G cities are expected to provide the following services:

- Mobile edge computing facilities, allowing the deployment of media functions close to the end user.
- Network slicing, in order to provide virtual networks that are customized for specific usage
- Guaranteed service delivery even in the presence of heavy background traffic. For example in crowded events, or demonstrations.
- Broadcasting/Multicasting capabilities to minimize network traffic.
- Delivery of a common time reference to selected points of attachment.
- Real-time APIs providing network status information to the media services, including location, coverage or capacity.
- APIs allowing the media service to request an expected SLA.

Envisioned media applications to be trialled in city environments, may include among others:

- Remote content production, such as providing real-time coverage to crowded events, to localized events in rural areas and inner-city areas,
- Collaborative user based content creation,

- “Follow me” media delivery, where media content moves to the optimal location following a user on the go,
- Advanced gaming applications requiring AR and VR support,
- [OTHER use cases described above]

KPI:

- High bandwidth
- Low latency / jitter
- High network flexibility (realtime network reconfigurations to support use cases dynamicity)
- Localization
- Reliability
- Privacy

### 5.1.3. Large event immersive remote experience

5G will allow the possibility to transmit a high number of parallel communications and large event should take advantage of such capabilities. Stadium could be equipped with several 360° cameras that provide “basic” video that could be enriched by video taken by mobile phones of participants. Immersive sound should also be taken into account.

With such a number of video sources, remote users should be able to select one or several sources to better experience the event.

For professionals, it should also be possible to manipulate these sources in order to provide enriched immersive TV events mixing all these inputs together with augmented reality information.

So end users could subscribe to a professional TV show or could manage by their own the navigation into the multiple sources.

Use heterogeneous networks, multi-RAT and multi-operators technologies to support such transmissions at any conditions.

KPI:

- Very high bandwidth
- Ultra-low latency / jitter
- Network scalability (to support many concurrent users)
- Localization
- Reliability
- Privacy

### 5.1.4. Cooperative industrial designing platform

In many vertical sectors, there is a need to cooperate with a number of competencies to design a product or a service. The objective of such a pilot is to develop an environment facilitating remote cooperative design taking advantage of 5G capabilities.



Several sectors should take advantage of such a tool, we can see car design, home design, fashion design, or any object design that should be made by teams localized in several remote locations.

Several local designing environment exist, the pilot should use one of them and install 3 of them in different locations connected through 5G networks.

Such pilot could experiment co-design of products as well as co-design of services

KPIs:

- Very high bandwidth
- Ultra-low latency / jitter
- Network scalability (to support many concurrent users)
- Privacy

#### **5.1.5. Public Protection and Disaster Relief**

With 10 to 100 times higher user data rates, 10 to 100 times more connected devices and minimal end-to-end latency, 5G will become very promising environment for Public Protection and Disaster Relief communications, operational services and critical applications. Also, according to the EU Commission's 5G Action Plan, the Commission encourages Member States to consider using the future 5G infrastructure to improve the performance of communications services used for public safety and security, including shared approaches in view of the future procurement of advanced broadband public protection and disaster relief systems.

Basic requirement for the network in terms of PPDR is to provide guaranteed service delivery even in the presence of heavy background traffic as load in public networks typically increases in case of accidents, disasters, large events, demonstrations, etc. As described in use cases chapter, 5G will therefore enable flying drones, real-time video streaming from cameras, collecting data from body-worn devices, etc. Devices will be through mobile network connected to Intelligent and Advanced Operational Center and data feed to platform where functions for data storing and processing, data and video analytics, machine learning, predictions will be implemented. Besides data, PPDR services should include voice communications where interoperability with existing PPDR infrastructure (eg. TETRA) might be needed in first 5G PPDR deployments.

5G Action plan also proposes, that such role of 5G network could involve migrating public safety and security services from existing proprietary communications platforms to commercial 5G platforms which will be even more secure, resilient and reliable.

Such pilot could serve for several real situations: maintaining security at large event, supervising country border, firefighting large wildfire, firefighting fire in fire-hazardous environment

KPIs:

- Network scalability (to support many concurrent users)
- Localization
- Reliability

#### 5.1.6. Remote medicine

Remote Medicine Service was designed to serve clients charged with the welfare of those working in extreme environments with limited healthcare but also for people far from specialists to investigate specific diseases.

Rural and remote medicine describes general practice at its full scope. It refers to the professional values, skills and competencies necessary for providing high quality, safe and appropriate care to a rural or remote community.

In situations where patients do not have easy access to a full suite of specialist services and resources the medical practitioner has a heightened level of responsibility to meet community needs. Rural and Remote Medicine encompasses the best models of care for these contexts.

It is typically delivered through private community-based practices and hospitals but also on roadsides, in remote clinics, prisons, Aboriginal Medical Services, military front lines or via telephone or digital health systems.

Remote medicine applies also to exchanges between hospital services that need to cross-check diagnostics before giving a treatment.

There are already a number of examples of applications serving remote medicine and they often use leased line in order to have a good service quality because most of the data exchanged are video and/or high quality pictures. Now, with 5G, it should be possible to get a similar quality of service but it has to be verified through such a pilot.

KPI:

- Very high bandwidth
- Ultra-low latency / jitter
- Network scalability (to support many concurrent users)
- Reliability
- Privacy

#### 5.1.7. Remote education

Remote education services give the possibility to perform both synchronous and asynchronous teaching for children far from their teachers. The system should also monitor the activities. Functionalities as videoconferencing and live communication should be real time monitored in order to tune them on the fly for an effectiveness behaviour. The 5G performances as large bandwidth, low latency, slicing and reliability are key enablers of these services.

Pilots could be done in different areas:

- In suburban areas where children living in small villages spread on a vast region could be gathered in a single virtual class. Nowadays, in these kind of villages, schools gather in one class children with different ages in order to reach the minimal number to form a single class. This means that a single teacher needs to address different level of education in the same class reducing effectiveness and efficiency. The remote education service may be used to create homogenous classes with children of the same age living in different places. In such a way it's possible to create homogenous classes as happens in large cities where a great number of children of the same ages live close to each other and go physically in the same school.
- The same requirement applies to children that are hospitalized for long periods. Nowadays dedicated teachers move to the hospital increasing costs and reducing effectiveness of the education. Through a remote education service hospitalized children may participate to classes with other children augmenting the inclusion.

KPIs:

- High definition videoconference
- Low latency for direct human interaction
- Reliability
- User satisfactions

#### 5.1.8. VR with multiplayer interaction

Virtual Reality experiences including interaction with remote real people inside the VR world could enrich the touristic appeal of many sites. Pilot could be done in particular with the following objectives:

- Visit places that are not physically accessible for any reason (danger, need to preserve the site etc ...)
- Visit places that are far from main touristic sites (e.g. small villages quite far from large cities). In this case it could be a good way to allow people to virtually discover new places and push them to go physically there
- Create thematic visits that link together different sites

In all cases it should be possible to interact through VR with people living in those places that have a strong link with the visited site.

Such a service may help the inclusion of small sites and their growth in terms of touristic and economical opportunities.

Key enablers are the possibility to quickly interact with remote people through VR experience as well as the possibility to quickly and dynamically download contents through the experience providing the feel of being in a real environment.

KPIs:

- Large bandwidth
- Low latency
- Numbers of people involved in the multiplayer interaction

#### 5.1.9. Mixed reality experiences

Mixed reality experience allows the visualization of virtual objects over a real video live stream. This could be done with dedicated devices, like smart glasses, or even with smartphone using their cameras.

There's a number of application fields relevant for pilots:

- Tourism. It could be possible to see a monument as it was originally built. For instance a broken statue or an ancient building.
- Industry. Modelling and prototyping objects, maintenance
- Command and control. Operations in emergency situations or control of risky operations (e.g. load and unload of goods in a port)

In all cases in order to allow a rich experience, dynamically adapted to context and users, processing should be performed at the server side. This implies that a continuous and reliable communication must be available for the devices. Low latency is important in order to track position and movement of users and instantly react. Bandwidth is important to download virtual content as well as upstream video that in some cases must be processed at server side in order to produce relevant virtual content.

KPIs:

- Low latency
- Large bandwidth
- Numbers of people involved in the multiplayer interaction

#### 5.1.10. Real time video analysis

Video stream analysis could be performed for a number of applications and services. In all cases there's a strong requirements in terms of real time video upstream towards server applications for video analysis. Pilots could be done in the following applications domain:

- Public safety. Face and body recognition for access control and suspicious people detection.
- Mobility. Automatic recognition of people flows and vehicle traffic, parking, people counting
- Environment control. Water level, rain detection, landslides monitoring etc ...

KPIs are:

- Large bandwidth

- Number of devices

## 5.2. Trial technical requirements

- Multiple technologies (native 5G, 4G, WIFI, satellite ? ...) and/or multiple operators to demonstrate seamless behavior and the multi-link behaviour Multiple cell size large to small with hand over, simulated international roaming to check E2E QoE.
- Multiple locations
- Several CDN location: centralized, distributed
- Several RAN cloud location: distributed, centralized
- Several mobility schemes including High speed train
- Several devices: mobile phones, (VR and professional) cameras, VR/AR headsets
- Cyber security capabilities (attacks...)
- Virtualization in the Cloud of any existing game. (including 4k games)

## 5.3. Supporting organisations

Aviwest, Orange, Technicolor, Harmonic, Ericsson Envivio, Broadpeak, TDF, Eureva, JISC, ATOS, BBC, Comcast, CWI, Digital Catapult, DTG, Engineering, ESA, Eurescom, Eureva, Eutelsat, FEUGA, I2Cat, Images&Réseaux, IMEC, Intel, Interinnov, IRT, Iskratel, JISC, LiveU, Martel, Netas, Nokia, Quobis, SES, Telecom Italia, Telekom Slovenije, TNO, Ubiwhere, UCL (5G-MEDIA), University Bologna, University Cataluna, University Kent, University Malaga, University of Hertfordshire, University of Pavia, Universidad Politecnica de Madrid, University Valencia, University Vigo, Wings ICT Solutions

## 6. Conclusions & recommendations

This paper is proposing the vision from Networld2020 and NEM European technology platform which represent more than 2000 experts in the domains of network and Media & Content.

The 10 pilots described above should be able to verify the 5G KPIs but should also show case realistic use cases that could be conducted all around Europe during the experimental phase of 5G.

There is no priority in these pilots but all of them have their specific advantage in term of simplicity, disruptivity and KPIs coverage.



## Digitalising European Industry

### Digital Innovation Hubs

(December 2017 – by NEM DEI Working Group)



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## Executive Summary

The European Commission has launched the Digital Innovation Hub initiative in the context of the Digitalising European Industry program aiming at facilitating the adoption of ICT technologies in European Industry.

Media & Content industry have key ICT technologies that could help European industry in their daily life such as Augmented reality, Virtual reality in the design phase of new products but also hyper-personalisation in the commercial phase and also Social media as well as Media analytics to help customer needs identification.

NEM has created a specific activity in this field because NEM is a cluster of clusters and those regional/national clusters could be considered as DIH.

Today, 11 NEM clusters are part of the DIH catalogue and 20 other organisations declared to address media & content activities.

Following a recent survey, it appears that almost 20 organisations are ready to join such a NEM DIH network. Such a network should offer a number of activities supporting DIH in their daily life and NEM Initiative is ready to support this network.

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## 1. Context

Launched on April 2016 -Digitalising European Industry Communication (COM(2016) 180), the overall objective of the DEI (Digitising European Industry) Initiative is to ensure that any industry in Europe, big or small, wherever situated and in any sector can fully benefit from digital innovations to upgrade its products, improve its processes and adapt its business models to the digital change.

Two working groups were established on Sept 20 2016 at the DEI roundtable:

- WG 1: Digital Innovation Hubs: Mainstreaming digital innovation across all sectors  
Hubs will help companies to understand digital opportunities and to get access to knowledge and testing facilities.

WG1 is working on a catalogue template able to verify that a specific organisation has the relevant competencies to become a DIH. A first draft is being checked through a pilot with Netherland clusters.

2017 Time plan:

- April 2017: first draft of the DIH catalogue template
  - August 2017: collection of potential candidates (a web site will be open)
  - End 2017: First version of the catalogue validated
- WG 2: "Strengthening leadership in digital technologies and in digital industrial platforms across value chains in all sectors of the economy"  
The Commission plans to launch a set of initiatives supporting the building of the Digital Industrial Platforms of the future.  
There are large, but fragmented research efforts in key digital technology fields and in their full integration in industry sectors.

NEM clusters should be mostly interested by the DIH part of the initiative in order to be part of the catalogue and also to define a specific network of Media & Content DIH.

The objective of this NEM DEI/DIH WG is to prepare a white paper describing what are recommendations, strategies, best practices.... to develop hubs and innovation ecosystems in terms of Media, content and creative industry. The NEM ETP should take the umbrella role of animating the Media DIH and try to catch funding in the WP2020 and further in FP9.

Each NEM cluster and organization which is already acting as a DIH or which is setting-up a DIH in terms of Media and Creative fill the online DIH questionnaire taking advantage of what is being done by each one of them in order to ensure selection by the committee and get the acknowledgment of their DIH related activities.

## 2. NEM Digital Innovation Hub

### 2.1. Definition

A Digital Innovation Hub refers to an ecosystem through which any business can get access to latest knowledge, expertise and technology for testing and experimenting digital innovations relevant to its products, processes or business models. The Hub can provide also the connections with investors, facilitates access to financing of digital transformations of businesses and help connect users and suppliers of digital innovations across the value chain.

The core of a Digital Innovation Hub is one or multiple "competence centers". These provide advanced technical expertise and facilities (labs, infrastructures, pilot lines for production, etc...). They cooperate within the hubs with the necessary partners in the innovation chain to support businesses in their digital transformation including investors, business development and legal experts, etc. No one competence centers can be excellent in all digital fields. Hence the need of networking between competence centers (and their hubs) with complementary disciplines so to offer a "one stop shop" for businesses.

The goal is to ensure that any business in Europe have access to a DIH at a working distance.

In comparison with traditional technology transfer activities of competence centers that are normally focused on collaboration with the digital supply industry (including start-ups and SMEs), the DIHs will add more intensive cooperation with businesses from all industrial sectors that were so far considered as just users of technology. The activity of DIH is driven by the demand for digital innovations. The approach is "bottom up": By providing access to latest digital knowhow and technology, any business can become an active digital innovator.

Experience so far has shown the demand has grown rapidly. Most businesses today would like to assess what new technology trends (e.g. Big Data, IoT, robotics, AI, VR, etc.) can bring to their products, processes and business models. Digital Innovation Hubs should have the capacity to offer services to a sizeable amount of industry.

#### The role of Competence Centers

Based on experience with existing competence centers and hubs, the following offerings are useful to help companies with their digital transformation:

- Supporting experimentation and testing with new technologies to transform products, processes or business models
- Supporting fabrication of new products and processes
- Showcasing technologies in pilot factories
- Offering introductory courses to understand new technology based on an understanding of the training needs and train a sufficient number of trainers for further upscaling.
- Brokering between users and suppliers of technologies, e.g. on tools, data, and intellectual property around technologies

- Keep track of global developments, propose technology options and provide a flexible support
- Support mobility of experts and entrepreneurs

Competence centres and DIHs should be networked to ensure specialisation and excellence. When certain expertise is necessary which is not available in the centre, it should be possible to find it in another centre. This will ensure that any company can get the help they need, and multidisciplinary is adequately handled.

Competence centers should be networked to ensure specialization and excellence. When certain expertise is necessary which is not available in the center, it should be possible to find it in another center. This will ensure that any company can get the help they need, and multidisciplinary is adequately handled.

## 2.2. List of potential NEM DIH

NEM is encompassing many organisations including clusters. NEM is known as a cluster of clusters. Today, several NEM members constitute or are part of initiated DIHs in the media and creative industries sector declared in the Digital Innovation Hubs Catalogue<sup>7</sup>. Currently DIHs declared are:

Organisation	Web site	Country
Images&Réseaux	<a href="http://www.images-et-reseaux.com/en">http://www.images-et-reseaux.com/en</a>	France
Frankfurt Book Fair	<a href="http://www.buchmesse.de/en/fbf/">http://www.buchmesse.de/en/fbf/</a>	Germany
Digital Catapult	<a href="https://catapult.org.uk/">https://catapult.org.uk/</a>	UK
E!xperience (Experience-based industries Hub)	<a href="https://eurecat.org/en/sectors/cultural-and-creative-industries/">https://eurecat.org/en/sectors/cultural-and-creative-industries/</a>	Spain
Imaginov	<a href="http://www.imaginove.fr/en/">http://www.imaginove.fr/en/</a>	France
IMEC/SMIT	<a href="http://www.smit.vub.ac.be/">http://www.smit.vub.ac.be/</a>	Belgium
Cap Digital	<a href="http://www.capdigital.com/en/">http://www.capdigital.com/en/</a>	France
Madrid Media Cluster	<a href="http://www.clusterict-audiovisual.org/">http://www.clusterict-audiovisual.org/</a>	Spain
eNEM	<a href="http://ametic.es/es/innovacion/plataformas-tecnologicas/enem">http://ametic.es/es/innovacion/plataformas-tecnologicas/enem</a>	Spain
Federation of European Publishers	<a href="http://www.fep-fee.eu/">http://www.fep-fee.eu/</a>	Belgium
NEM Portugal	<a href="http://nempotugal.com/">http://nempotugal.com/</a>	Portugal
WAN-IFRA (GAMI)	<a href="http://www.wan-ifra.org/">http://www.wan-ifra.org/</a>	Germany
Pôle Media Grand Paris	<a href="http://www.lepole.org/?lang=english">http://www.lepole.org/?lang=english</a>	France
Screen Brussels	<a href="http://screen.brussels/">http://screen.brussels/</a>	Belgium
TWIST	<a href="http://www.twist-cluster.com/accueil.htm?lng=en">http://www.twist-cluster.com/accueil.htm?lng=en</a>	Belgium
GI-Cluster	<a href="http://www.gi-cluster.gr/en/">http://www.gi-cluster.gr/en/</a>	Greece
EIKEN	<a href="https://www.eikencluster.com/en/">https://www.eikencluster.com/en/</a>	Spain
RCKE	<a href="http://www.rcke.si/en/">http://www.rcke.si/en/</a>	Slovenia

<sup>7</sup> <https://ec.europa.eu/futurium/en/content/digital-innovation-hubs-catalogue-project-0>

Technopolis	<a href="http://www.technopolis.lt/">http://www.technopolis.lt/</a>	Lithuania
Technology Ireland Innovation Forum	<a href="http://www.isin.ie/">http://www.isin.ie/</a>	Ireland
Danish Sound	<a href="http://www.danishsound.org/">http://www.danishsound.org/</a>	Denmark

In the official web site (<http://s3platform.jrc.ec.europa.eu/digital-innovation-hubs-tool>), there is a number of organizations declared as media DIH. Many criteria's are fitting to the NEM sector:

- Screen and display technologies
- Interactive technologies
- Augmented and virtual reality
- Gamification
- New Media technologies

With such a criteria there are actually 48 organizations claiming to be a DIH but a few of them are NEM members so it is difficult to believe that they are really operational Media & content Hub.

In order to fix this issue, there is a need to define what is a Media & content DIH, what are the minimum requirements to be a Media & content DIH. For that purpose, NEM is proposing a list of criteria's that a Media & content DIH should fulfil. They are:

- Providing local training and support.
- Supporting the acceleration of SMEs and Startups locally.
- Strengthening the links with domain stakeholders. Connecting with the local academic world and defining action plans.
- Connecting with leaders of R&D programs at a local level.
- Instructing about the NEM DIH initiative and impelling its adoption by more hubs, pushing the Programme a step further.
- Sharing best practices between *NEM DIH*
- Ensuring promotion of training for students but also SMEs workers (online training)

For that purpose, NEM DIH should propose the following activities:

- NEM DIH Centre: Definition of the venue
- NEM DIH Training centre: Media & content training program definition
- NEM DIH platform: Identification of open platforms shared beyond the local ecosystem (i.e. I<sup>2</sup>C platform)
- NEM DIH Market: Action which aims to help in the popularization of Media & Content solutions
- NEM DIH Community: Links the local ecosystems so that the local community can grow and consolidate

### 2.2.1. Images&Réseaux

I&R is the digital cluster of France. Building on its excellence strategic domains (the digital technologies (5G, AI, Cyber, VR/AR etc..)) it has developed its strategy in two directions accompanying the usage of these technologies:

The digital economy (the use of technologies to develop; produce distribute digital content (in which ICC have a key role)

The digital society with four target markets in line with its two regions S3 having ICC as part of them: e education, smart home (including content consumption), smart territory and e health.

With more than 250 members I&R has been evaluated last year as a reference of integration of a cluster in its innovation ecosystem working with 11 Technopoles, 7 French Tech and several public and private structures.

Operational DIH services:

- Awareness creation
- Ecosystem building, scouting, brokerage, networking
- Visioning and Strategy Development for Businesses
- Collaborative Research
- Concept validation and prototyping
- Testing and validation
- Incubator/accelerator support
- Voice of the customer, product consortia
- Market intelligence
- Access to Funding and Investor Readiness Services
- Mentoring
- Education and skills development
- Business development / financing

### 2.2.2. Frankfurt Book Fair (FBF)

FBF is the international publishing industry's biggest trade fair, with >7,150 exhibitors from >100 countries, > 278,000 visitors, > 10 000 journalists and bloggers. FBF organises the participation of German publishers at around 20 international book fairs, has 5 offices abroad and hosts more than 50 international trade events outside of Germany yearly. FBF is a subsidiary of the German Publishers & Booksellers Association. THE ARTS+ is a business festival for the cultural and creative industries. The goal of the new format is to exploit the potential of digitalization for creative content and to develop new business areas. [www.book-fair.com](http://www.book-fair.com), <http://theartsplus.com>

Operational DIH services:

- Support of new service/product and start-up development
- Ecosystem building, scouting, brokerage, or networking
- Dissemination, communication and awareness
- Market intelligence (cultural and creative sectors)
- Training, Education and skills development
- Policy stakeholder dialogue

Other:

- Internationalization support
- Business development and strategy

### 2.2.3. Digital Catapult

Digital Catapult is a national, private-not-for-profit research and technological organization set up by the UK Government to drive the digital economy. This is done through the practical application of digital innovation to remove barriers to growth, faced by businesses. By applying business and technology know-how to the new commercial opportunities unlocked through Digital Catapult's programs and collaborations, new markets and opportunities can be created for UK digital companies, in turn making UK businesses more competitive and more productive. Our mandate is also to drive regional growth, which we are doing through our four regional Digital Catapult centers across the UK in addition to its London headquarters. These are currently based in Brighton, North East & Tees Valley, Northern Ireland and Yorkshire. Each Catapult center has a unique focus and is aligned with local digital innovation initiatives.

Digital Catapult focuses on two key sectors: digital manufacturing and creative industries. In addition, it is exploring opportunities in digital health and care. Digital Catapult has also identified four key drivers that we believe can positively disrupt business models, create competitive advantage and deliver superior experience for customers, namely:

- Data-driven: new ways to work with personal data with more control and trust, applications of blockchain and smart contracts, cybersecurity particularly for emergent threats;
- Connected: the Internet of Things and associated enabling networking technologies such as Low-Powered Wide-Area networks and 5G;
- Intelligent: artificial intelligence and particularly machine learning;
- Immersive: augmented, virtual and mixed realities, and related new forms of human interface.

Operational DIH services

The Digital Catapult offers a number of services including

- Building, coordinating and increasing access to large scale testbeds
- Driving engagement between small companies and large companies
- UK, EU or International Collaborative Research & Development projects
- Accelerating the growth of markets by supporting ecosystems and helping exports
- Development of standards
- Building prototypes, testing feasibility of technologies

- Helping large companies become more efficient through the introduction of digital innovation.
- Providing access to facilities, skills and space

Notably, the Digital Catapult HQ hosts a dedicated Immersive Lab, which allows businesses to showcase the latest immersive content and offers cutting-edge testing site for businesses to surface their immersive innovations. Three regional Immersive Labs are also currently in development. The Digital Catapult also runs an IoT innovation program called Things Connected, that delivers the UK's largest distributed IoT LPWAN in collaboration with a range of partners. It is also building a 5G testbed in Brighton to help shape the way services will be delivered by 5G infrastructure in the future and a Machine Learning Lab to enable SMEs to access computer architectures optimized for machine learning and to access research and learning from world-leading experts at the University. As such, the lab will enable knowledge exchange, and help turn research excellence into commercial outcomes.

#### 2.2.4. e!xperience - Experience-based industries hub

The e!xperience is an operational regional DIH promoted and coordinated by Eurecat. It currently comprises 9 partners, including large companies, clusters, catalan government agencies and Eurecat as a competence centre.

The mission of the e!xperience DIH is to promote the competitiveness of cultural and experience-based industries (media and creative industries, tourism and sports) through applied research, innovation and knowledge transfer. The main objectives of the e!xperience DIH are:

- To promote innovation based on creativity (soft innovation) to encourage a better introduction of emerging digital technologies in cultural and creative industries, including experience-based industries.
- To promote new dynamics of development of cultural and creative activities based on collaboration between companies, research and innovation agents and public cultural services providers in Catalonia.
- To strengthen the visibility and the link between production and cultural experiences with their public broadening, diversifying and personalizing their consumption, access and/or interaction.

Operational DIH services:

The e!xperience DIH offers companies:

- Applied R+D and collaborative research
- Technology consultancy, including market intelligence, innovation coaching and visioning and strategy development for businesses
- Concept validation and prototyping to supporting experimentation and testing with new technologies to transform products, processes or business models.
- High specialized training supporting media related skills development
- Ecosystem building, brokering and networking between users and suppliers of technologies.
- Promoting and disseminating technological innovation in the Cultural and Creative Industries and industries based on the experience.



- Access to tools related to strategic design (design thinking, service design, experience design,...)
- Besides, through Eurecat's specific program +PYME, it also offers access to funding to SMEs.

### 2.2.5. Imaginov

Imaginov is a triple-helix cluster, focused on the convergence of the CCI & ICT industries. The cluster gathers media, animation, gaming studios as well as the ICT companies developing the 3D, VR, AR, AI, gamification solutions. The cluster assembles almost 200 members, mostly innovative SMEs, academics, laboratories, R&D centers, universities. It has a wide expertise in methodical approaches for the identification and selection of promising concepts as well as the follow-up of these. Imaginov aims to: boost the innovation and competitiveness of the ICT and CCI Industries ; promote business models that encourage the search for new digital technologies ; Contribute to the development of R&D in all fields related to the ICT and Creative sectors.

#### Operational DIH services

- Research and development activities
- Support of new product and start-up development
- Ecosystem building, scouting, brokerage, or networking
- Dissemination and awareness
- Market intelligence
- Education and skills development

#### Other

- Internationalization support
- Business development and strategy

### 2.2.6. Cap Digital

Cap Digital ([www.capdigital.com](http://www.capdigital.com)) is the French business cluster for digital transformation in the Paris Region, the first digital innovation ecosystem and the largest cluster in Europe. Created in 2006 as a non-profit organization, Cap Digital counts more than 1000 members; mostly SMEs but also large companies, academics and policy makers. It focuses on 6 markets: Culture/Media, Education/HR/Training, e-health/Well-being, Technologies/Data/Artificial Intelligence, Smart Environment, Industries & Services.

Cap Digital provides its members with intelligence, training, matchmaking/networking, funding solutions, project reviews, label accreditation program for R&D projects and business development. Cap Digital received in 2014 the Gold label Cluster management excellence delivered by ESCA. The cluster has been involved in 16 EU projects since 2006 and is currently running 9 of them. It is

also a member of powerful European networks such as the NEM initiative, ECHAlliance, EBN and two KICs: EIT Digital and EIT Health. Cap Digital organizes every year the Futur en Seine, Europe's largest digital Festival showcasing the latest digital innovations to both the professionals and the general public.

#### Operational DIH services

- Awareness creation
- Ecosystem building, scouting, brokerage, networking
- Visioning and Strategy Development for Businesses (including strategic coaching, financial coaching, design coaching)
- Collaborative Research
- Concept validation and prototyping
- Testing and validation
- Digital Maturity Assessment
- Incubator/accelerator support
- Market intelligence (including Market & technology watch and forecast, Publications & studies, Forecasting workshops)
- Access to Funding and Investor Readiness Services
- Mentoring
- Education and skills development
- Others: Intellectual Property Diagnostics, internationalization services (market assessment, market entry, soft-landing packages)

#### 2.2.7. eNEM

eNEM is the Spanish Platform of Multimedia Technologies and Digital Content.

It is a networking group focused on innovation with more than 300 members with entities with different portfolio of profiles, mostly SMEs, big companies, Research Centers and Universities.

eNEM tackles aspects of R&D and innovation of the digital content and creative and cultural industries. It includes sectors and technologies like media and audiovisual, video gaming, animation, digital publishing, e-commerce, internet 3D, virtual and augmented reality, interfaces, simulation, e-learning, apps, transmedia, interactivity, big data amongst others.

The objective of eNEM is fostering and support the R&D and innovation in the field of digital content, creative and cultural industries at national and European level.

AMETIC acts as the Secretary of the platform eNEM since its creation in 2005.

#### Operational DIH services

- Ecosystem building, scouting, brokerage, networking
- Creative Industry common strategy
- Dissemination and awareness
- Projects support

#### 2.2.8. Federation of European Publishers

The Federation of European Publishers (FEP) is an independent, non-commercial umbrella association representing 28 national associations of book publishers of the EU and of the EEA. FEP is the voice of the great majority of publishers in Europe. FEP

deals with European legislation, advising publishers' associations and acting on their behalf in discussions and negotiations with the EU Institutions. FEP works in close collaboration with the EU Institutions to ensure that high quality European content is available to European consumers. FEP advocates positive policies for European publishing, to promote the competitiveness of European publishing and to underpin European educational standards and Europe's cultural identity. In this capacity, FEP also monitors innovation in the publishing sector, encourages exchanges of best practices and informs its members about opportunities related to innovation support programs at EU level, as well as about relevant developments in the field of technology.

FEP can thus help keeping track of global developments and discovering technology options.

### 2.2.9. NEM Portugal

NEM Portugal was created early in 2014 with the support of national clusters ADDICT (for creative Industries) and TICE.PT (Information, Communication and Electronic Technologies), in order to promote the joint activity between technological companies and creative industries together with all research groups relevant to the advancement of the media sector.

Following the original plan, a large mobilizing project (CHIC - Coherent Holistic Internet and Media) has been submitted and recently approved, involving a considerable number of Portuguese members from within the media and creative industries together with academy and organizations from the cultural sector. The funding approved for that project will allow the consolidation of a program of dissemination and networking activities for the benefit of all participants, in addition to a development and innovation work program. These activities will include the participation of representatives from NEM Portugal in the activities of NEM, in order to foster the internationalization of the sector. There is currently a growing interest into the area of Digital Access to Culture and members are looking at the possibility to propose the creation of an important long term activity in that area.

NEM Portugal is currently planning to offer the following services:

- to showcase technologies and services in pilots, demonstrating innovation potential for the media and creative sector;
- to identify training requirements from companies and organizations and to promote academic members the offer the appropriate courses;
- to do brokering activities between users and suppliers of technologies;
- to follow the trends in technology and services, identifying needs and challenges to propose innovative developments and organizing events for dissemination;

- to participate in policy discussions through the creation of teams to produce sectorial analysis and propose *new measures*.

#### 2.2.10. WAN-IFRA

The Global Alliance for Media Innovation (GAMI) is the network for innovation within the World Association of Newspapers and News Publishers (WAN-IFRA).

GAMI is a network of stakeholders involved in the research and innovation in the news media field: media organizations (publishers and suppliers), and academic research labs dealing with technology transfer and research programs on a global level. The Alliance was formed because its members all believe that our industry requires a reliable flood of new technologies, products and business models. To succeed, media companies have to learn to look at markets in new ways, they must invest to create new capabilities and rethink the way they work individually and collectively.

##### *Operational DIH services*

GAMI offers to bridge the gap between industry and research through events (workshops, conferences, media lab days etc.) or matchmaking opportunities (online through [www.media-innovation.news](http://www.media-innovation.news) platform), reporting and knowledge sharing on trends in media innovation and a mapping of media innovation labs, clusters and research projects.

#### 2.2.11. Pôle Media Grand Paris

Le Pôle Media Grand Paris is the cluster dedicated to the audiovisual industry in Ile-de-France Region and was named "Grappe d'entreprises" in 2011. Also founding member and Administrator of Cap Digital competitiveness cluster for Paris region.

It federates a hundred of companies, academic, training institutions and territorial authorities. Its actions are directed toward financing (Prêt d'Honneur Image, a credit loan), innovation (including « Labo », a transmedia project incubator), training, international (coproduction of Cross Video Days, European projects) and the environmental responsibility (ECOPROD).

Our mission is to accompany the digital transformation of the media industry. In the era of digital convergence, our strategy is to accompany the SMEs towards the new digital Media and Entertainment markets.

Services provided:

- Concept validation and prototyping
- Support of new product and start-up development
- Ecosystem building, scouting, brokerage, or networking
- Dissemination and awareness
- Market intelligence
- Education and skills development
- Other (description)
- Advisory services

#### 2.2.12. TWIST

TWIST (Walloon Technologies for Image, Sound and Text) is a triple-helix cluster for Cinema & Digital Media in Wallonia, a region in Belgium. TWIST is the main business cluster active in the sector of digital audio-visual and multimedia technologies in Belgium. It groups together over 100 members, including private companies, universities, research centres, training centres and public authorities working within the media and audio-visual sectors. TWIST has a mission to boost the economic development of its members and to give structure in a general sense to the sector as a whole. Set up as a partnership between private and public players, TWIST is a privately managed network.

TWIST members represent 4,500 employees and a turnover above 1 billion €. TWIST is in charge of several procedures meant to offer its members and their clients a competitive advantage: networking, export missions, commercial monitoring of public calls for tender, strategic monitoring, European projects, etc.

TWIST and the Digital Wallonia strategy are supporting all local companies in their transition to the digital world and their regional and international outreach.

TWIST is facilitating growth and export through various networking actions within and outside the regional borders, presence at international events such as the Cannes festival, setup and management of H2020 projects (i.e.: Eurotransmedia - [www.eurotransmedia.eu](http://www.eurotransmedia.eu)), and organising world class events in the digital field (i.e.: [www.stereopsia.eu](http://www.stereopsia.eu)).

#### **Operation DIH Services:**

- Ecosystem building, scouting, brokerage, and networking
- Dissemination and awareness
- Market intelligence
- Education and skills development
- Internationalisation support
- Business development and strategy
- Funded research projects setup and management

#### **2.2.13. Technology Ireland Innovation Forum**

The Innovation Forum offer members a route into a vibrant innovation ecosystem which promises organisations new opportunities to grow their bottom line. It is an eco-system which requires careful navigation to deliver effective results. The Innovation Forum as a bronze label quadruple helix cluster, has built the required knowledge and experience to achieve those results specifically in digital, ICT, and creative industries, but also permutating across many other pertinent industry sectors.

Within this environment there is a requirement for an innovation broker, one which facilitates organisations across a spectrum of maturity from disruptive start-ups, SMEs, to established players looking for the next competitive edge. The Forum supports organisations to innovate and fosters smart reindustrialisation by enabling

the emergence of new sector specific and cross sectoral innovating value chains. By leveraging the co-operation of global leaders in academia and in both indigenous and multinational organisations located in Ireland, the Forum is well placed to support the digitalisation of industry in Europe.

**Operation DIH Services:**

- Leveraging the excellence in research in Ireland to drive industry to academic collaboration
- Matchmaking Start-ups with SMEs & Start-ups/SMEs with Multinationals to scale collectively
- Hosting innovation clinics and driving innovation fusion across sectors
- Mentoring companies and providing access to domain knowledge experts
- Facilitating introductions to funding and investor frameworks
- Organising Brokerage/Matchmaking events between Irish and EU ICT companies
- Providing dissemination platforms, and the hosting of seminars and networking events
- Participating in FP7, H2020, COSME, and Cost Action frameworks

**2.2.14. Danish sound**

Danish Sound Innovation Network (DSIN) stimulates growth by branding the Danish Sound ecosystem, connecting professionals, and initiating innovative activities across research and business areas. The cluster organization was founded in 2009, is funded by the Danish Agency for Institutions and Educational Grants under the Ministry of Higher Education and Science, part of the national cluster scheme Innovation Network Denmark and holds a Silver Label for Cluster Management Excellence. Danish Sound is hosted, and has its legal entity, at the Technical University of Denmark (DTU).

At DTU there are a number of state-of-the-art research facilities and equipment used for research, measurements, test and teaching related to sound and acoustics. The facilities are regularly maintained and brand new facilities regularly created - often with the support of industrial partners.

Another consortium member of DSIN is FORCE Technology (FORCE) - a European, private-not-for-profit research and technological organization (RTO). FORCE's mission is to transform highly specialized engineering knowledge into practical and productive solutions. They serve 9.700 unique customers yearly covering a wide variety of technological disciplines. Their services related to sound and acoustics are delivered through SenseLab.

In combination, DSIN, DTU and FORCE are strong on anything related to research, education, test and SME targeted services related to sound and acoustics. The partners are moreover within 15km proximity of each other just north of Copenhagen, Denmark.

**Operational DIH services**

A wide selection of both custom and standard compliant listening tests (SenseLab)

Quantifying key perceptual characteristics of products using sensory evaluation (SenseLab)  
 Linking perceptual characteristics to consumer preferences (SenseLab)  
 Test facilities incl. Anachoic Chamber, Radio Anachoic Chamber, Audio Visual Immersion Lab,  
 Electric Lab, (DTU)  
 Education and skills development (DTU)  
 Ecosystem building, scouting, brokerage, or networking (Danish Sound)  
 Dissemination and awareness (Danish Sound)  
 Market intelligence (including Market & technology watch and forecast) (Danish Sound)

### 2.3. Map of NEM DIH

The DIH catalogue developed by the European Commission has collected a number of organizations which applied to be a DIH in any vertical sectors. Some of them declared to address content & media, they are the following ones (31/10/2017).

183 organizations declared addressing one of the 4 domains covered by NEM (Interactive technologies, Augmented and virtual technologies, Gamification, New media technologies)

There are 465 DIH already declared in the catalogue among them, there are 183 which claim to address at least the 4 domains related to NEM (Interactive technologies, Augmented and virtual technologies, Gamification, New media technologies). Looking carefully to those organizations, it happens that a number of them address more or less all the domains. Among those which have a clear focus on these 4 domains, 28 organizations have been identified.

Then, 13 key organizations which are located in regions “Smart Specialized” in Media & content and creative industry and that should be the pillar of the Media & content DIH Network have been identified.

S3	Focussed	Generic	DIH Name	Country
	0	1	Accelerating Photonics innovation for SME's: a one stop-shop-incubator ACTPHAST 4.0	Belgium
1	1	1	ADAPT Centre	Ireland
	0	1	AgriTech BigData Big Data Innovation Hub at the service of the agri-food sector (Agri Tech BigData)	Spain
	0	1	AMRC with Boeing Factory 2050: AMRC Factory 2050	United Kingdom
	0	1	Amsterdam Data Science (ADS)	Netherlands
1	1	1	Arctic Game Lab	Sweden

1	1	1	Associació Clúster Digital de Catalunya	Spain
1	1	1	Barça Innovation Hub (BIHUB)	Spain
	0	1	Basque Digital Innovation Hub	Spain
	0	1	Bavarian Robotic Network BaRoN	Germany
	0	1	BBRI CLUSTER BIM (Belgian Building Research Institute CLUSTER BIM)	Belgium
	0	1	Belgian Building Research Institute BBRI	Belgium
	0	1	Berlin-Brandenburger Cluster ICT media and creative industries	Germany
	0	1	BioNanoNet ForschungsGmbH	Austria
	0	1	BrainsBusiness ICT North Denmark	Denmark
	0	1	Bridgeway Europe Startup Accelerator	Serbia
	0	1	Brussels Creative a Platform to develop Cross-over Innovation in the Region of Brussels	Belgium
No S3	1	1	CAP DIGITAL	France
	0	1	Catalan Robotics Hub	Spain
	0	1	Catalunya Industry 4.0	Spain
	0	1	Center Digitisation.Bavaria	Germany
	0	1	Center for Technology Transfer and Innovation	Slovenia
	0	1	Centre for Advanced Manufacturing Technologies Wroclaw University of Science and Technology	Poland
	0	1	Chalmers Smart Industry Hub - CSI-Hub	Sweden
	0	1	CIT-UPC	Spain
	0	1	Cluster for Innovation and Technology ALT Brasov	Romania
	0	1	Danish Technological Institute Robot Technology - DTI Robotics	Denmark
1	1	1	Deli - Space for creative activity	Serbia
	0	1	Demola-Budapest	Hungary
	0	1	Digital Hub Bonn	Germany
	0	1	Digital Innovation Hub D-LIGHT	Spain
	0	1	Digital Innovation Hub for Customer-Driven Manufacturing @ Norte (iMan Norte Hub)	Portugal



	0	1	Digital Innovation Hub of Eastern Slovenia Abbreviation: DIGITECH SI -East	Slovenia
	0	1	DIGITAL INNOVATION HUB on 'HPC-Cloud and Cognitive Systems for Smart Manufacturing processes Robotics and Logistics.'	Spain
	0	1	Digital Innovation Hub Smart Manufacturing in Zuid-Holland SMIZH	Netherlands
	0	1	Digital Innovation Hub "Smart Production Systems" Saxony– InnoSax SP	Germany
No S3	1	1	Digital place	France
	0	1	Digital Urban Development "DUD"	Spain
	0	1	Digital Water Innovation Hub (Digital Water)	Spain
	0	1	DIGITEC Digital Innovation Hub	France
	0	1	DIH IOT	
	0	1	DIH on Healthcare – Basque Country (BASQUE DIH-HEALTH)	Spain
	0	1	DIH on Traceability and Big data (TBD)	Spain
	0	1	DIH Triveneto	Italy
	0	1	DINAPSIS OPERATION & LAB (DOL)	Spain
	0	1	Ecosistema W	Spain
	0	1	(EFFIRENP) Efficient Ren Power HUB	Spain
	0	1	eHealth Catalonia	Spain
	0	1	Eindhoven Living Lab for Smart Society (ELL4SS)	Netherlands
	0	1	Emerging Transactional and Financial Technology Hub (ETFTH)	Poland
	0	1	European Technology Platform on Smart Systems Integration	Steinplatz 1, 10623, Berlin
1	1	1	Experience-based industries Hub (e!xperience)	Spain
	0	1	Experimental and Digital Factory (EDF)	Germany
	0	1	Flanders' FOOD	Belgium
	0	1	Flanders Make	Belgium

	0	1	Foundation for innovation and technology development INTERA Technology Park	Bosnia and Herzegovina
	0	1	Fraunhofer Future Work Lab (FWL)	Germany
	0	1	Future Cities Catapult	United Kingdom
	0	1	FZI Research Center for Information Technology	Germany
	0	1	Galician Advance Manufacturing Innovation Consortia	Spain
	0	1	Galician Automotive Hub	Spain
No S3	1	1	GjirafaLab	Kosovo
No S3	1	1	Global Alliance for Media Innovation (GAMI)	France
	0	1	Goog Life for Finland	Finland
	0	1	Hahn-Schickard Gesellschaft für Angewandte Forschung e.V. (Hahn-Schickard)	Germany
1	1	1	Haute École Albert Jacquard (HEAJ)	Belgium
	0	1	Haute Ecole Louvain en Hainaut HELHa	Belgium
	0	1	Hub 4.0 of Manufacturing Sectors in Valencian Region HUB4.0MANUVAL	Spain
	0	1	HUB387	Bosnia and Herzegovina
	0	1	iAsturias 4.0	Spain
	0	1	ICT HUB	Serbia
1	1	1	Images and networks	France
1	1	1	IMEC	Belgium
	0	1	Industrial Digital Platforms DIH	Finland
	0	1	Industrial Research Institute for Automation and Measurements PIAP	Poland
	0	1	Industry 4.0 Center at CIIRC	Czech Republic
	0	1	Innovation Centre Kosovo (ICK)	Kosovo
	0	1	Innovation for Manufacturing in the South (I4MSOUTH)	Spain
	0	1	INNOVATION HUB	Albania
	0	1	Innovationsplattform Kufstein / i.ku ('Innovation Platform Kufstein')	Austria

	0	1	Insight Centre for Data Analytics	Ireland
	0	1	Institute of Informatics of SAS	Slovakia
	0	1	Institute of Production Management Technology and Machine Tools (PTW)	Germany
	0	1	Interdisciplinary Center of Security Reliability and Trust (SnT) of the University of Luxembourg	Luxembourg
	0	1	IT and Expert Hub Supporting Biomedical Research Technology and Education (BioMedHub)	Poland
	0	1	IT4Innovations National Supercomputing Center	Czech Republic
1	1	1	KG COWORKING	Serbia
	0	1	KIOS Innovation Hub (KIH) part of the KIOS Research and Innovation Center of Excellence (KIOS CoE) University of Cyprus (UCY)	Cyprus
	0	1	Know-Center GmbH	Austria
	0	1	La Rioja 4.0 Industry Hub to implement Regional Digital Manufacturing Innovation (RDMI) solutions on key sectors (RIOHUB)	Spain
	0	1	Laboratory of ideas - iDEAlab	Serbia
1	1	1	LeanSquare	Belgium
	0	1	LIEU network	Belgium
	0	1	Linares 4.0 Knowledge City (DIH)	Spain
	0	1	Lombardy Intelligent Factory Association	Italy
	0	1	Lufthansa Industry Solutions - Digital Lab	Germany
No S3	1	1	Luxembourg House of Financial Technology Foundation LHoFT Foundation	Luxembourg
	0	1	LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY (LIST)	Luxembourg
	0	1	LUXINNOVATION GIE	Luxembourg
	0	1	Lyon French Tech	France
	0	1	MADE - Manufacturing Academy of Denmark	Denmark

	0	1	Manufacturing Technology Centre	United Kingdom
	0	1	ManuHub@WG	Greece
	0	1	Marche innovation Machine and Market Manufacturing	Italy
	0	1	Medicen Paris Region	France
	0	1	Mittelstand 4.0 centre of excellence Hamburg	Germany
	0	1	Mittelstand 4.0 Competence Centre Chemnitz	Germany
	0	1	Mittelstand 4.0-Competence Center Dortmund	Germany
	0	1	Mittelstand 4.0-Kompetenzzentrum Augsburg	Germany
	0	1	Mittelstand 4.0-Kompetenzzentrum Darmstadt	Germany
	0	1	m:tel Digital Factory (MDF)	Montenegro
1	1	1	National Pole of Digital Content POLO	Spain
	0	1	(National Technological) Cluster of Intelligent Factories	Italy
	0	1	Non destructive trials	France
No S3	1	1	Nyuko a.s.b.l.	Luxembourg
	0	1	One Sea - Autonomous Maritime Ecosystem	Finland
	0	1	Pomeranian Digital Innovation Hub (PDIH)	Poland
	0	1	Pomurje Technology Park Ltd.	Slovenia
	0	1	PrintoCent	Finland
	0	1	PRODUTECH Digital Innovation Hub Platform	Portugal
	0	1	Protik Innovation Center	Albania
	0	1	Region of Smart Factories (RoSF)	Netherlands
	0	1	Regional Platform Industry 4.0.of Tuscany Region (Tuscan Platform Industry 4.0.)	Italy
1	1	1	Rennes Saint-Malo French Tech	France
	0	1	RISE ICT Research Institute of Sweden ICT	Sweden
	0	1	RoboCity2030	Spain
	0	1	ROBOCOAST	Finland
	0	1	Science Technology Park Belgrade	Serbia
	0	1	Seavus Incubator DOOEL Skopje	Macedonia
	0	1	Siegener Mittelstandsinstitut (SMI) / Universität Siegen	Germany

	0	1	Silicon Europe Alliance	France
	0	1	Sirris Hub - Additive Manufacturing Integrated Factory	Belgium
	0	1	Sirris Hub Smart Assembly	Belgium
	0	1	Sirris Hub/smart product	Belgium
No S3	1	1	Skye Digital Publishing (Start-up)	Germany
	0	1	Smart Industry Centre (SmartIC)	Estonia
	0	1	Smart Manufacturing	Finland
	0	1	Smart Manufacturing Innovation for Lean Excellence center	Italy
	0	1	Smart Mobility TransDigi	Finland
	0	1	SmartCityTech	Spain
	0	1	Smarter Access to Manufacturing for Systems Integration SMARTER-SI	Germany
	0	1	Sofia Tech Park	Bulgaria
	0	1	Software Technology and Applications Competence Centre (STACC)	Estonia
	0	1	Software-Cluster	Germany
	0	1	Spanish Digital Innovation Hub for HPC (esHPC)	Spain
	0	1	SpectroNet - International Collaboration Cluster for Global Collaboration in Photonics	Germany
	0	1	Sunderland Software City	United Kingdom
	0	1	Super IoT	Finland
	0	1	Sustainable Construction Hub	Spain
	0	1	SynHERA	Belgium
	0	1	SYSTEMATIC PARIS REGION	France
	0	1	Tallinn Science Park Tehnopol	Estonia
	0	1	Team Henri Fabre	France
	0	1	TechHub Riga	Latvia
	0	1	TECHNICOM	Slovakia
	0	1	Technologies Added	Netherlands

	0	1	Technology Park doo (SEEUTechPark)	Macedonia
	0	1	Technology Transfer via Multinational Application Experiments (TETRAMAX)	Germany
	0	1	TECHNOPORT SA	Luxembourg
	0	1	TechQuartier	Germany
	0	1	TeraLab : Big Data Platform for Research	France
	0	1	The Alexandra Institute - ICT-based innovation	Denmark
	0	1	The Centre for Process Innovation	United Kingdom
	0	1	The High Value Manufacturing Catapult	United Kingdom
	0	1	Transilvania Digital Innovation Hub - Transilvania DIH	Romania
	0	1	TVIBIT - DIH FOR CULTURE AND CREATIVE INDUSTRY	Norway
	0	1	UniTransferKlinik (UTK): Digital Hub Lübeck BioMedTec I4.0 Testenvironment SME BioMedTeIndustrie-in-Klinik-Plattform Lübeck	Germany
	0	1	University College Bruxelles-Brabant - HE2B	Belgium
	0	1	University College EPHEC	Belgium
	0	1	Urban ICT Arena	Sweden
	0	1	VDTC of the Fraunhofer IFF	Germany
	0	1	Ventspils High Technology Park (VHTP)	Latvia
	0	1	VIRTUAL VEHICLE Research Center VIRTUAL VEHICLE	Austria
	0	1	3D Makers Zone	Netherlands
	0	1	5G Fieldlab	Netherlands
	0	1	5G Test Network Finland (5GTNF)	Finland
	0	1	5GBarcelona	Spain

The above map is giving the location of NEM DIH

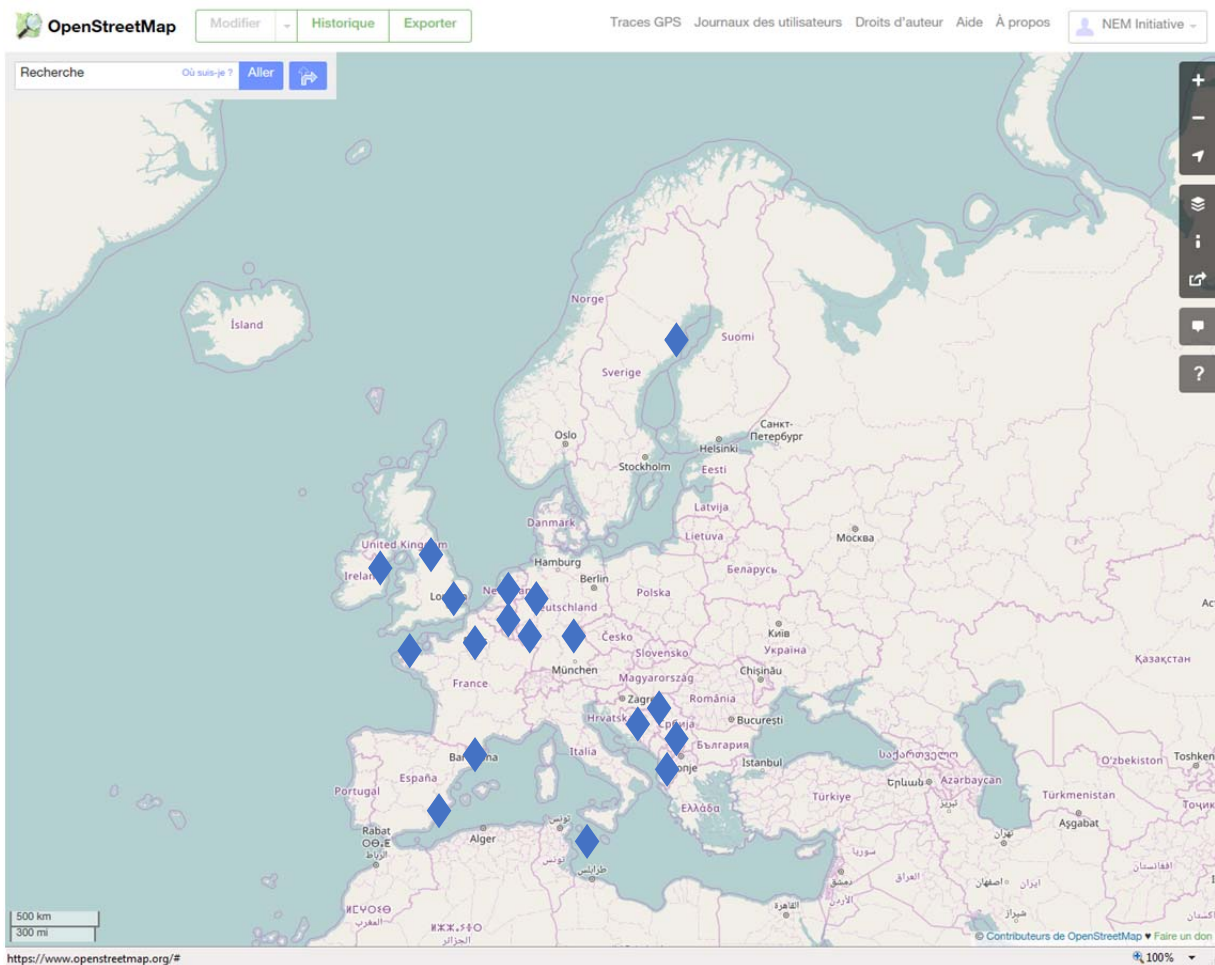


Figure: NEM DIH MAP (focused DIH)

### 3. Network of NEM DIH

#### 3.1. Definition

In order to share best practices and to accelerate digital transformation of Media/Content and creative industry, there is a need to put in place a network that will help the achievement of the Digitalising European Industry initiative.

Such a network should be supported by the NEM Initiative which has already such a role to develop common strategic research and innovation agenda.

As described, the NEM DIH is aligned with the EU initiative **Digitising European Industry**, in particular with the resolution of 13 December 2016 on a coherent EU policy for cultural and creative industries (Texts adopted, P8\_TA(2016)0486.)

The establishment of a DIH network for cultural and creative industries will also facilitate the implementation and monitoring of the measures that arise for leveraging the data

economy, ensuring cybersecurity and trustful and secured online platform at EU level, as stated in the **Digital Single Market** EU priority.

Last but not least, the DIH consolidation is a natural outgrowth of the **NEM Vision & SRIA** - Strategic Research and Innovation Agenda 2016. In July 2013, DG CONNECT and DG RTD recognized 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. NEM is an active community and network of more than 1000 members from industry (including large industrial organizations, start-ups and SMEs) and academia with the goal of being also a centre of influence and a centre for networking. To reach the thousands of start-up companies and SMEs dealing with content in Europe, NEM has organized itself as a 'cluster-of-clusters', whose clusters are key local, regional or national organizations often serving as the local contact points and interfaces working closely with those entrepreneurial start-ups and SMEs on a daily basis. NEM is also working closely with other networks (e.g. Networld2020 and NESSI), industry groups (e.g. BDVA) and platforms (e.g. NIS), as well as with the Coordination and Support Actions emerging from H2020 actions.

### 3.2. Role

- Sharing best practices
- Exchange between industries having similar needs and requirements
- Methodology definition and update
- Identify user needs trends and get ahead of them to define new strategic roadmaps for technology evolution to cope with future and upcoming needs.
- Ease innovation transfer overcoming national/regional frontiers.
- Support and promote a constant dialogue between NEM DIHs to identify complementarities, synergies and potential collaborations leading to a better service offering to its regional companies and businesses.
- Collect requirements from your "customers" in order to influence future research through the NEM Strategic Research and Innovation Agenda
- etc...

### 3.3. Structure

- Such a network should be animated by one moderator helped with social media digital tools.
- NEM is able to setup a specific working group with those clusters and organizations belonging to the Media & Content DIH network and NEM secretariat is able to offer all the digital environment necessary to complete the objective.
- Such a working should be managed as the others through the NEM Executive group for a day to day follow up and through the NEM Steering board for the endorsement of high level decisions including the methodology design.



### 3.4. Added value

Cultural and Creative Industries (CCI) have a key social and economic importance in Europe (see<sup>8</sup>) for the growth of European economy and the competitiveness of the European industry. As highlighted in the study commissioned by the European Commission, this sector is mainly composed of SMEs and micro-enterprises. Furthermore, most of EU CCI areas show a fragmented industry in each country, with companies only serving in their local/national areas. These kind of companies are the ones which can take a great advantage of DIH services and its improvement via the network of NEM DIH.

In this context, the network of NEM DIH is strongly aligned with main objectives of the Digital Single Market strategy and will support it in the field of media/content and CCI industries.

- Given DIHs definition (designed to offer services to companies at a working distance), the majority of NEM DIHs are regional in nature. Linking them and putting them in collaboration strongly benefits European business for receiving more quality services and to harmonize the service offering across Europe.
- The network will identify common needs, technology solutions applicable to the whole European society, opening up and levelling the possibilities for digitalisation and innovative digital products and services across all Europe.
- Currently Europe is the second largest CCI market, behind the leading and fast-growing region of Asia-Pacific and followed by the North American market. The network will also promote joining forces and multiplying the DIH effect on the supporting European media companies in the current competitive landscape with other world regions (USA, Asia). Thus, enhancing Europe's position as a world leader in the digital economy.

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<sup>8</sup> Boosting the competitiveness of cultural and creative industries for growth and Jobs. VVA Europe June 2016

## 4. DIH Network setup methodology

### 4.1. Description

For the setup of network comprising the NEM DIH, the steps defined by the WG1 DIH of the roundtable on DEI will be followed:

Step 1: Identify the target constituency: media and content industries have been already identified as a key target by NEM. It has to be defined the following details:

- a. What types of companies do these sectors comprise?
- b. What are the industry needs?
- c. What are the regional characteristics and specialisms? What support is already available within the region?

Step 2: Develop the vision and business plan for the DIH

Step 3: Identify what is already available at EU level, what regions are represented and what are not.

Step 4: Define the services that the DIH should offer

Step 5: Build links and establish collaboration with other hubs at regional, national, EU and global level.

### 4.2. Time line



### 4.3. Resources

#### 4.4. Links with smart specialisation strategy

At regional level in **Catalonia (Spain)**, The e!xperience DIH is aligned with main digitization strategies and in particular with the “Research and Innovation Smart Specialisation Strategy of Catalonia (RIS3CAT)” launched by the Catalan Government and built around the goals and framework policy announced in the Europe 2020 Strategy. The DIH, which addresses one of the 7 leading sectorial domains identified in the RIS3CAT strategy, contributes to this strategy boosting growth, strengthening competitiveness and promoting economic transformation of the cultural and experience based industries of Catalonia through research and innovation, and the incorporation of key enabling technologies to take advantage of its full potential. e!xperience also links with the objectives of the “[Politica Indústria Sectorial 2014-2020 de la Generalitat de Catalunya](#)” (Catalonian industrial sectorial policy 2014-2020) that recognizes the experience and design-based industries as two of the priority sectors in the region, “[Programa d’Impuls de les Indústries Culturals i basades en l’Experiència - PIICE](#)” (program to promote the cultural and experience-based industries in Catalonia), and the “[Pacte Nacional per a una Societat Digital](#)” (Catalonian National Agreement for a Digital Society).

## 5. Conclusions & recommendations

The objective of the EC is one DIH in each European region and also 27 National DEI initiatives able to coordinate regional initiatives

The following action plan is proposed to go further in the Media & Content sector: organisation of workshops in key regions with all DIH in order to present existing services, platforms and share best practices and also infrastructures

Many DIH have infrastructures open to their local ecosystems, it will be good to make them known outside the local / regional ecosystems and open it to any industry in Europe or even duplicate it in other DIH if any interest. There is also a need to align standardization in order to facilitate interoperability.

- ⇒ Identification of Key regions for Media & Content (several DIH in Smart specialized region)
- ⇒ Management of the heterogeneous missions of DIH and identify complementarities

A survey has been done asking Media & Content DIH registered in the catalogue about their interest to join such a NEM DIH network, a number of them have responded YES meaning that today 14 organisations are ready to join the NEM DIH network.

## 6. Appendix 1

### Mail sent to the Media&Content DIH declared in the catalogue

Dear all,

You are representing one of the DIH registered in the catalog and focusing on Media&Content. One of the ambition of the European Commission is to organize networks of DIH in a number of domains in order to exchange best practices but also to share platforms and any tools facilitating usage of ICT technologies in the European industry.

Looking to Media&Content, I am representing the NEM European Technology Platform ([www.nem-initiative.org](http://www.nem-initiative.org)). The **NEM Initiative** (New European Media Initiative) was established as one of the European Technology Platform under the Seventh Framework Program, aiming at fostering the convergence between consumer electronics, broadcasting and telecoms in order to develop the emerging business sector of networked and electronic media. In order to respond to new need and requirements of the Horizon 2020 program, the NEM initiative enlarged its focus towards creative industries and changed its name from Networked an Electronic Media Initiative to New European Media, dealing with Connected, Converging and Interactive Media & Creative Industries, driving the future of digital experience.

There are a number of you which are already member of this platform (membership is free of charge) and we are investigating the interest to build and animate a Network of Media&Content DIH. Such a network should have the following benefits for you:

- Sharing best practices between DIH
- Exchange between industries having similar needs and requirements
- Methodology definition and update
- Identify user needs trends and get ahead of them to define new strategic roadmaps for technology evolution to cope with future and upcoming needs.
- Ease innovation transfer overcoming national/regional frontiers.
- Support and promote a constant dialogue between NEM DIHs to identify complementarities, synergies and potential collaborations leading to a better service offering to its regional companies and businesses
- Collect requirements from your “customers” in order to influence future research through the NEM Strategic Research and Innovation Agenda

To achieve such a goal we are proposing the following methodology:

For the setup of network comprising the NEM DIH, the steps defined by the WG1 DIH of the roundtable on DEI will be followed:

Step 1: Identify the target constituency: media and content industries have been already identified as a key target by NEM. It has to be defined the following details:

- d. What types of companies do these sectors comprise?
- e. What are the industry needs?
- f. What are the regional characteristics and specialisms? What support is already available within the region?

Step 2: Develop the vision and business plan for the DIH

Step 3: Identify what is already available at EU level, what regions are represented and what are not.

Step 4: Define the services that the DIH should offer

Step 5: Build links and establish collaboration with other hubs at regional, national, EU and global level.

**If you are interested to join such a Network, please let me know replying to this email, we shall setup a specific mailing list and an online repository where you can find relevant documents of the sector.**

## 7. Appendix 2

### Example of Digital Catapult table providing information on DIH requirements

Ecosystem	Service	Activities
	Awareness creation	Information dissemination, conferences, newsletters
	Visioning and strategy development	Scouting, innovation, strategy development
	Brokerage	Workshops, webbased connecting supply and demand, bilateral contacts
Technology	Inter-hub collaboration	Connecting trans-regional needs and services
	CR&D	Technology concept development, proof of concept
	Technical support on scale-up	Concept validation, prototyping, small series production
Business	Commercial infrastructure	Renting for R&D, low rate commercial production
	Testing and validation	Certification, product demonstration, product qualification
	Incubator/accelerator support	Voice of customer, market assessment, business development, consortia building
Education	Access to finance	Financial engineering, connection to funding sources, investment plans
	Business intelligence	Market intelligence, market assessments
	Commercial training	Courses, workshops, and other activities to train personnel
	Trans hubs learning	Training of other hubs and competence centres
	Public education activities	Facilitate student activities by offering technological infrastructure for educational purposes

## \*\*Draft\*\* Digital Innovation Hub Digital Catapult

Ecosystem	Service	Activities	Digital Catapult
Technology	Awareness creation	Information dissemination, conferences, newsletters	Events are organised on a daily basis with our partners such as the Knowledge Transfer Network and others to ensure the UK community remains engaged with the latest technological and policy happenings.
	Visioning strategy development and Brokerage	Scouting, innovation, strategy development	Focused on driving innovation within the UK by aligning our strategy with UK government priorities and industry's needs, both large and small. Addressing the need to connect stakeholders via the value chain from research to innovation, as a neutral broker.
	Inter-hub collaboration	Workshops, webbased connecting supply and demand, bilateral contacts	Our innovation services ensure that we are bringing large industry in contact with small companies through tailored events such as Pit Stops, Innovation Workshops and Hackathons.
	CR&D	Connecting trans-regional needs and services Technology concept development, proof of concept	As a national organisation, we have centres across the UK in order to ensure that regions continue to have access to the latest technological infrastructure and technical and business expertise. We participate in a number of R&I projects on a national, regional and European projects.
	Technical support on scale-up Commercial infrastructure	Concept validation, prototyping, small series production Renting for R&D, low rate commercial production	We run a number of programmes specifically focused on enabling SMEs to scale up. Digital Catapult supplies commercial R&D and exclusive access to academic research as well as access to facilities. Motion Capture studio to develop content for creative and non-creative industries. Immersive Labs equipped with a range of the latest augmented and virtual reality hardware to encourage commercial innovation. Further programmes include the 5G testbed- state-of-the-art 5G testbed to help small innovative businesses across the UK develop new products and services. Things Connected – a testbed to support IoT technologies using an IoT LoRaWAN network across London & UK; the AI Computational Lab will facilitate access to leading cloud compute and state-of-the-art hardware architectures designed by market leaders and emerging providers, the programme will give startups the opportunity to accelerate product development. In addition, companies will also get access to expertise from Digital Catapult's data science engineering team and expert partners.

## VITAL MEDIA Deliverable D3.3

Business	Testing and validation	Certification, product demonstration, product qualification	We have a number of facilities and programmes for testing and validation. These include innovation support programmes such as Things Connected – a testbed to support IoT technologies using an IoT LoRaWAN network across London & UK; the 5G testbed - state-of-the-art 5G testbed to help small innovative businesses across the UK develop new products and services; Immersive labs across the UK available for hire to demonstrate, innovate, test and experience the latest immersive technology and content.
	Incubator/accelerator support	Voice of customer, market assessment, business development, consortia building	We work very closely with industry in order to understand their needs. We have a business development team that looks to identify potential customers that are facing challenges in becoming more digital. We address these needs through our innovation services or by involving such customers in CR&D. We have run accelerator programmes such as <u>Augmentor</u> , a ten-week mentorship programme focused on early stage businesses that are developing innovative and commercially-focused applications of augmented, mixed and virtual reality.
Education	Access to finance	Financial engineering, connection to funding sources, investment plans	Through our programmes we have collaborated with UK investors such as Seedcamp who provided finance, fundraising and product development expertise.
	Business intelligence	Market intelligence, market assessments	We carry out market assessments on our four technology layers and market sectors to understand where the gaps are and how the Digital Catapult can fill them.
	Commercial training	Courses, workshops, and other activities to train personnel	We have organised such trainings such as <u>Cyber 101</u> , a business advice and mentoring programme to help new UK cyber security firms grow and succeed.
	Trans hubs learning	Training of other hubs and competence centres	Sharing of best practices via regular local centres meetings to ensure that lessons learnt are made known. Regular invitations to events to ensure that centres are kept up to speed with the latest happenings.
	Public education activities	Facilitate student activities by offering technological infrastructure for educational purposes	We have offered placements to school work experience students and university interns. We also have Catapult Researchers in Residence (RIR) programme is designed to enable leading academics to spend research visits in one or more Catapult centres. Each Researcher in Residence will undertake a project that will generate impact from research.

## ANNEX K

# NEM POSITION ON NEXT GENERATION INTERNET



## NEM Position on Next Generation Internet

(January 2018 – by NEM NGI Working Group)



The publication has been supported by the Vital Media project, which initiated creation of the NEM Working Group on Next Generation Internet - NGI, contributed to its content, gathered inputs to the publication from the NEM Initiative community, followed up the publication approval process, coordinated all related activities, and consolidated all version of the publication.

VITAL MEDIA is a support action project under the Horizon 2020 Programme of the European Union – number: 688310 – project duration: June 2016 – May 2018.



## Executive Summary

NGI is a human centric\* initiative and NEM is obviously THE European Technology platform addressing human needs in terms of content and interaction. Looking to such situation, this paper is making proposals based on the NEM members vision regarding the evolution of European behaviour in terms of content, media, creative industry and interaction (including immersive technology and accessibility)

One of the most important concerns of European is security&privacy linked with service personalisation. Hyper-personalisation is part of the NEM Agenda and research topic proposals have been clearly identified. In this context trust is one of the key ingredients to develop the next generation internet fitting user needs and wishes.

IoT will also be one of the biggest sources of content in the future, they should contribute to hyper-personalisation but also augmented reality content.

To achieve such a goal, there is a need to manipulate all these big amount of data using new algorithms provided by artificial intelligence, cloud computing and big data technologies.

Worth to say that there is also a need for governance and law in order to avoid problem with such a big brother running with no rules. Such a governance is not handle by NEM, but we would like to alert the European Commission about such a risk. Data protection is one of the key topics to be regulated at European Union level.

Media&content should have a great contribution in order to bring the entertainment dimension to the NGI. Today most of the social media usages are around pictures&vidéo sharing and NGI should encompass this domain in order to reach the objective of a human centric internet.

The NEM members have identified the following research domains as the most relevant for NGI

- 1/ Personal data spaces
- 2/ Internet Of Things
- 3/ Blockchain
- 4/ Artificial intelligence
- 5/ Distributed architectures and decentralised data governance
- 6/ The future of Social media
- 7/ Other important technologies
  - Discovery and identification tools
  - New forms of interactions and immersive environments
  - Software defined technologies
  - Networking solutions beyond IP

\*Human centric:

At the service of the people and the society  
Address present issue  
Make “internet for the people”

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## 1. Context

The Internet of the future should provide better services, more intelligence, more security, more protection, especially to vulnerable audiences, more capacities to discern veracity of information, greater involvement and participation. It needs to reflect the European social and ethical values: free, open and more interoperable.

Several workshops and consultations took place in 2016 and early 2017, the synthesis is available at <https://ec.europa.eu/futurium/en/content/final-report-next-generation-internet-consultation-0>

In order to speed up the definition of the NGI, the EC will be funding three CSA projects under the ICT-41 call (opened in April 2017). The three projects correspond to three different strands::

- Strategic Research Agenda (Think-NGI supported by NEM)
- Ecosystem animation
- Program structure (Think Virtual supported by NEM)

Current draft of the ICT-LEIT-Workprogram 2018-2020 has already defined the shape and content of the NGI, it will include:

ICT-24-2018-2019: Next Generation Internet - An Open Internet Initiative / Unit E3  
ICT-25-2018-2020: Interactive Technologies - *NEM topic* [DG CONNECT Unit G2]  
ICT-26-2018-2020: Artificial Intelligence - *NEM related topic* [DG CONNECT Unit A1]  
ICT-27-2018-2020: Internet of Things - *NEM related topic* [DG CONNECT Unit E4]  
ICT-28-2018: Future Hyper-connected Sociality - *NEM topic* [DG CONNECT Unit I4]  
ICT-29-2018: A multilingual Next Generation Internet - *NEM topic* [DG CONNECT Unit G3]  
ICT-30-2019-2020: An empowering, inclusive Next Generation Internet  
ICT-31-2018-2019: EU-US collaboration on NGI

The objective of this WG is to prepare the WP2020 and the FP9 part of NGI for the media&content sector. It will contribute to the FP9 paper focusing on NGI part.

## 2. NGI short presentation

### 2.1. NGI description

The open consultation for the Next Generation Initiative (NGI) was held between 10th November 2016 and 9th January 2017. 449 people took part with significant input. Participants were asked to rate and comment upon the importance of value statements and technology areas and encouraged for their views on how to support the NGI.

see [full document](#)

#### 2.1.1. Value

Ensuring citizens' sovereignty over their own data and the protection of their privacy is deemed the most important value proposed in the survey by the participants.

Secondly, participants also felt strongly that the Internet should ensure diversity, pluralism and a right to choose.

Thirdly, the concentration of data in a few proprietary platforms is understood as a significant issue today. Internet should ensure citizens' sovereignty over their own data and protect privacy.

Those rating the importance of this value highest also selected Personal Data Spaces as a very important technology area

Therefore an NGI with a focus on Personal Data Spaces (Technology Area 3) may help in addressing the issues of sovereignty over data.

Similarly important across all participant categories this value would make an attractive vision to pursue to attract participation

Internet should ensure diversity, pluralism and a right to choose.

Those that considered this value strongest also consider that Personal Data Spaces is very important and Distributed Architectures and decentralised data governance (Technology Area 4) is next biggest.

Internet should avoid the concentration of data in a few proprietary platforms. There is a close relation between this value and the technology area of Personal Data Spaces (Technology Area 3)

There is strong awareness of the impact of the few proprietary platforms upon the protection of personal data in particular.

Software defined technologies (Technology Area 5) is the second most important technology area for those that hold this value

This value is popular among those already engaged in research funded by the European Commission. This can be useful if progression upon existing initiatives is desired.

#### 2.1.2. Current Internet weaknesses

The current internet weaknesses with regards to the Next Generation Internet are mainly addressing personal data.

Today, personal data are learned by each application and stored in each service provider data base on which a number of Artificial Intelligence treatment are made in order to shape the user profile.

These personal data are not the same for each provider, the value of them is clearly the service provider business model.

In the Next Generation Internet the idea is to give back to the end user the management and the control of its personal data and to separate content and data from internet based software.

This solution has a number of advantages:

- The end user has the complete control of its own personal data
- Service portability, i.e. the possibility to use any service/application without being linked to a specific service provider (OTT)
- Green, instead of multiple storages of personal data in each service provider data center, there will be only one storage location (eventually at home)
- The competition between service providers is no more on the capacity to collect personal data but on the intelligence of their software based on artificial intelligence
- The end user is able to control the access to its personal data which could avoid or at least decrease the number of fake personal information (mainly in young's social networks)

NEM has obviously all the competencies to fix such issue and could bring inputs to the design of such a personal data which needs to offer standardised APIs to service providers.

### 2.1.3. Other visions

Other visions proposed drew considerably less interest; however some had an appeal to certain niches within the consultation. Younger participants were attracted to values of diversity and pluralism and the notion of a level playing field, where older participants preferred values relating to sustainability, resilience and security and a resistance to concentrating data in proprietary platforms.

Respondents from Greece, Belgium and Bulgaria felt strongly about a resilient and secure internet.

Those from Sweden, Greece and Ireland responded more strongly to sustainability than other more dominant countries in the consultation (e.g. UK, Italy, Spain).

Beyond the vision statements proposed in the consultation, participants proposed that a trusted, inclusive internet should be seen as a basic human right and the NGI should be mindful of the protection and safety of its users and their data.

However, they also recognise the tensions between this and the desire for more unencumbered innovation.

## 2.2. NGI research domains

The top two values above were consistently and strongly held by those supporting the most important of the technology areas. Technology Area3 (Personal Data

Spaces) and Technology Area 7 (Artificial Intelligence) were the most important areas as recognised by researchers and the bulk of the other groups that took part in the consultation.

### 2.2.1. Personal data space

There is a trade-off between the benefits of innovation possible with the Internet of Things and Big Data and the need to prevent abuse of personal data.

The NGI needs to keep personal data secure and this means educating and enabling citizens regards of abusive data collecting and processing practices either from legitimate data-centric businesses or illegal, criminal actors.

Systems that allow assurance, transparency and freedom for citizens to control the data that's held on them should not limit access to innovative services. Infrastructures are needed to both enable benefits and minimise exploitation of using personal data

This will include enabling privacy aware access control and enforcing accountability for responsible use of personal data.

The values of this group are related to data sovereignty, and diversity, pluralism and the right to choose.

### 2.2.2. Internet of thing

In the next future, devices will produce a huge amount of information that could be used in the Media&Content industry. The huge diversity of device from sensors, actuators to video cameras will be able to feed data bases and this information should be reused from anyone to create new content and/or to personalize content. For that reason it is crucial that the NGI encompasses Internet of Thing not at the technology level but as creator of new form of content.

In order to achieve this goal, it is important to define standardized data models to facilitate manipulation of this new form of content. We can mention in this context the initiative from ETSI together with the FIWARE foundation which are working on the ETSI CIM standard (NGSIv2), this standard should be very helpful to use a common data set structure for any content providing from IoT devices.

In addition, we can easily linked this point to the social media topic as fare as in the next future we will have not only social media networks between humans but also social media networks of IoT. In this case, IoT will communicate together using artificial intelligence and give back results of their work to the end users (humans). NGI should need to support IoT social media networks

### 2.2.3. Blockchain

Decentralised data management and bloc chain technologies (Magda BROWIK – Fintech Poland)

Blockchain contains what everyone in data management, from data scientist to chief data officer (CDO), wants: Information that comes with complete provenance. That is data showing who did what, when and with full history from day one. Verified by all parties participating in the network, transparent, with complete reconciliation, and secured by the latest in cryptography.

Blockchains are now capable of storing arbitrary data and establishing permissions to modify that data through self-administering and self-executing scripts which are performed by a distributed virtual machine. These scripts are known as smart contracts, and they allow platform operators to define complex and fully customisable rules which govern the blockchain's interaction with its users.

Blockchain technologies are a good candidate to avoid fake news certifying the source of information.

#### 2.2.4. Artificial Intelligence

Despite only a few respondents actually working in this area, many more believed they had a good understanding of the area.

Their visions are strongly in line with retaining data sovereignty, diversity and pluralism and not allowing the data to become concentrated in proprietary platforms.

Technical challenges top the list, requiring interdisciplinary approaches and a top-down vision and application of strong use cases (e.g. autonomous vehicles) to shape the needed activities.

The impact of greater autonomy and increasing "responsibilities" placed on systems requires work on communication, ethics and the inclusion of human factors within these decision "making" mechanisms.

A proper and actionable ethical framework for Artificial Intelligence regarding algorithms becomes essential and deserves long-term project commitments to put some already well documented theory into practice.

Data & algorithms are the 2 sides of a same coin: (N BOUJEMAA-INRIA)

- rising benefits from big data and AI technologies have wide impact on our economy and social organization
- Transparency and ethics of such algorithmic Systems (data&algorithms) become increasingly important properties for trust and appropriation of digital services
- Data analytics is changing from description of past to predictive and prescriptive proposals

Algorithms will become in everyday life to provide recommendation, to personalize services and content but they have to be transparent in order to avoid manipulation from content providers (today big players are able to provide specific content to users fitting more with their business than with the real user needs).

The challenges are to be Transparent and accountable data management and analytics are:



- Explainability & interpretability, reproducibility & robustness, fairness & non-discrimination
- Data provenance and usage monitoring
- Progressive user-centric analytics
- New paradigms for information flow monitoring
- Fact-checking requiring explicit, verifiable argumentation integrating heterogeneous data sources and explainable reasoning

#### 2.2.5. Distributed architectures and decentralised data governance

Participants expressed the potential for a financial revolution from these technologies. A number of specific requirements including the continuance of work on blockchain in particular and the need to deal with the power demands for this technology area proposed.

The main challenges identified were in communicating the business benefits of these digital ledger technologies to existing businesses in a compelling way and collaborating on new decentralised algorithms.

Control for citizens over their own data becomes increasingly important yet challenging in a distributed architecture. Investment is needed in to a diverse future-proof infrastructure that will enable ever greater autonomy.

For all this technology investment is needed to support effective governance that balances rights and supports legislation.

A multi-disciplinary approach is essential.

Separation of content and data from the internet based software is essential and need standardisation of data structures in order to allow anyone to develop applications and services based on personal data.

#### 2.2.6. The future of Social Media

NEM has recently published a white paper describing what should be the future of social media. The White Paper elaborates on several aspects of the future social media by providing identified future related service and application scenarios and by deriving corresponding requirements and needed actions on policy and regulation as well as on research and innovation in the area. Even the inputs and requirements provided in the document cannot yet been seen to cover all aspects of the future social media landscape, it is already possible to identify a number of needed actions to enable a future European social media approach around the following main areas:

- Data protection (Protection of individual user rights, Data portability and competition/monopoly issues, Digital Rights Management – prevention of piracy, Management of user information and portability)
- Trust (Regulation in social media, Ensuring trust and diversity, Social media tools)
- New areas in the social media (Social IoT, Blockchain, Media analytics, Source analysis)



- Business and cooperation models (New models related to search of information, Business models for publishing in social media, Collaborative live production workflow)
- Education
- Regulation

#### 2.2.7. Other technology areas proposed in the consultation

**Discovery and identification tools** need to provide assurance that the use and security of personal data is standardised and respected far beyond the initial commercial interest. Non-proprietary, extensible, future-proof, trustworthy standards for the Internet of Things are needed to support end to end connectivity between the Internet and the edge networks connecting all these devices. Semantic repositories are needed.

**New forms of interactions and immersive environments** face the issues of data privacy, diversity and the concentration of data into proprietary platforms. Intuitive interfaces necessitate work on understanding the psychological & biological effects and the threats and opportunities for industry and citizens of the constant Virtual Reality world. Supporting industry 4.0, embracing immersive distant collaboration and creating market driven products and service are required. An NGI is needed that deals with the packets reliably and with minimal latency. Work is needed in developing the tools for work-flow and process improvements including the advancement of battery technology.

The NGI can be made robust if the agility possible with the **Software defined technologies** is embraced and the right methodologies are employed for small and medium-sized enterprises to take a role in this. Co-developments may fulfill requirements for virtualization and self-adapting algorithms. The protection of such created knowledge will be important. Work on new software specifications is essential as more functionality becomes embedded in soft rather than hardware. Standards need to be future-proofed to accommodate unknown future functionalities that will be required.

**Networking solutions beyond IP** impact the values of sovereignty of data and pluralism and diversity most strongly. An emphasis on security aspects alongside the palpable need for an improvement over the current IP is justified. The Next Generation Internet may benefit from a non-packet-based approach, but backward compatibility issues must be addressed and an optimal migration path proposed. Higher throughput, low latency and secure communications will place significant challenges upon the NGI infrastructure and architecture. A new high-speed TCP protocol and tools are important areas in need of development. New networking approaches may demand that security is built within the protocol. Maximizing security and resilience while assuring good interoperability are key technical challenges.

#### Other important technology areas

Additional technology areas proposed highlight a focus on security in general and then more specific themed technologies around applying autonomous systems to Smart cities and Smart citizens. The desire is for trusted systems to be developed and language technologies are strongly seen as an important investment to achieve this. Beyond this, simulation and large experimentation, as well as more hardware orientated projects such as robotics, are proposed as alternative technology areas.

### **Types of research, who should do it and initiatives to follow**

An analysis on the type of research, actors and initiatives reveals an appetite for collaboration among interdisciplinary groups engaged in a mixture of long term and applied research projects.

Foresight should direct research and guide the exploitation of evolutionary results into today's technology. Transdisciplinary approaches are needed. Importantly research needs guidance by the social sciences, user needs and awareness of the "known holes" in the current internet.

The "citizens" involvement as "actors" in the research is crucial. This may include representative bodies, policy makers and regulators but these need to encompass women, students and activists.

Relevant initiatives exist within established institutions and are often funded through national and EC programmes. The most popular in the consultation involve Smart initiatives, 5G, Internet of Things and language technologies. Initiatives that address Policy and Societal issues should embrace peer networks, digital learning, e-democracy, e-procurement and e-learning.

Finally, the identified on-going work on Public Sector Information (PSI), Big Data and Networking may provide good starting points for prototypes.

### 3. NEM short presentation

#### 3.1. NEM description

NEM, the New European Media initiative, is the European Technology Platform of Horizon 2020 dedicated to Content, dealing with Connected, Converging and Interactive Media & Creative Industries. With the launch of Horizon 2020, the NEM Initiative is pursuing its objective to build sustainable European leadership in content, media, and the creative industries. The NEM Initiative promotes an innovative European approach towards a Future Media Internet that will enhance the lives of European citizens; initially and primarily through a richer and more engaging media experience, but with an increasing potential for contributions in other sectors including education, health and societal inclusion and innovation. NEM has more than 800 members and a number of them are national clusters that also represent hundreds of SMEs and startups.

#### **Content & Creative Industries, a strategic sector in Horizon 2020**

In July 2013, DG CONNECT and DG RTD recognized 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 central in the Horizon 2020 strategy”, as stated by President Juncker in his mission letter to Vice President Ansip : “I also want you to take particular account of the need to promote creative industries in Europe”, “During our mandate, I would like you to focus on the following, in your role as Vice-President: [...] Supporting the development of creative industries, helping Europe’s culture and audiovisual sectors to reach out to new audiences, adapt to the digital era and thrive in the connected Digital Single Market” and Commissioner Oettinger :” “You will also need to ensure that the right conditions are set, including through copyright law, to support cultural and creative industries and exploit their potential for the economy.” “During our mandate, I would like you to focus on the following: [...] Supporting the development of creative industries and of a successful European media and content industry able to reach out to new audiences, adapt to the digital era and thrive in the connected Digital Single Market”.

#### **A diverse but strong economic sector...**

European creative industries are a very dynamic sector, creating many jobs. The aggregate value of the creative sector was roughly €200 billion across the EU-27 in 2011 . It has grown from €170 billion in 2001 with a compound annual growth rate (CAGR) of 2 percent (see Exhibit 5). All growth in the creative industries is driven by digital media (an additional €30 billion in revenues in 2011 versus 2001). The Creative Industries have embraced ICT to develop new business models for the digital environment, thereby generating 4.4% of the European GDP, 6.8% of value added (as a percentage of GDP) in 2011, and representing 3.8% of the European workforce . Recently, the recorded music industry saw revenues from digital channels of 6.8% in 2014 in Europe. Altogether, consumer spending in the creative sector is up 25% from 2001, with all growth driven by digital media.

The latest figures from the United Kingdom show that employment in the creative industries grew by 6.0% between 2011 and 2012, representing 8.0% of overall employment and 5.2% of Gross Value Added. In the EU as a whole, the creative

industries account for 3.0 % of total employment (2008) and 3.3% of GDP (2006). The number of employees in the creative industries in the EU-27 was 6.7 million in 2008. However, the sector, mostly composed of micro SMEs, still suffers a slow adoption of ICT technologies, a precondition for competitiveness. Beyond their direct contribution to GDP, these sectors trigger spill-overs in other economic areas such as tourism, fueling content for ICT, benefits for education, social inclusion and social innovation.

### **...facing key (r)evolutions:**

Content and Creative Industries, while locally, regionally, and/or nationally implemented or even governed, are moving to a worldwide framework, thanks to the digitalization of the whole value chain, from creation through distribution to consumption. These industries are updating the whole process in paralleling a lot of actions all along that value chain and reducing the production time from capture to access. New paradigms are appearing in stocking, processing and accessing the content from the cloud. New ways to consume the content (over the top, on the move, remotely, on devices of all form factors and with increasing degrees of immersivity) are bringing new opportunities and challenges (technological, infrastructural and regulatory). Media convergence means that former “silos” are more and more breaking up, within industries but also between adjacent creative industries. Yet, we are still far away from a unified “creative sector”, let alone from a creative sector with easy access to collaborative research and innovation in ICT. This poses not only challenges for “hard” (technological) innovation, but also for soft innovation (company culture, business development, innovation infrastructure, innovative uses of existing technologies, etc.). Especially in the content access and distribution domains, the market is witnessing the fast entrance of new players with disruptive and focussed approaches. This diversity often challenges established businesses and their business models, requiring them to be the involved in the latest technology research and innovation activities of their sector.

### **... requesting technology and innovation support investments:**

To face this fast growing worldwide environment, to maintain - or even better to increase - the footprint of our Content and Creative industries at a worldwide scale, technology and innovation support investments in the Media & Creative industry need to be increased to a level corresponding to their economic weight. Beyond what has been already covered in 2014-2017 LEIT ICT, the technological building bricks defined in the NEM Vision & Strategic Research and Innovation agenda (SRIA) remain relevant. We are particularly convinced about the importance the next Horizon 2020 program focusing on solving those key challenges for Content & Creative industries at the infrastructure level (formation of an innovation network, virtualization, cloud, ...); at the data level (metadata, privacy, security,...); at the service level (business models, user experience, personalization,...) as well as at the content and format level (immersivity, interactivity, enriching and engaging new formats that deliver added value). Many of these aspects apply to all sectors within the creative industries – including Advertising, Architecture, A/V, Cultural heritage, (Product) Design, Fashion, Film, Games, Publishing, Music – but not necessarily at the same speed. The projects should encourage the integration of the “technical” and

“creative” sectors to achieve platforms, which are fit for purpose to extend the success of the European Media and Creative industries.

**... using a range of instruments:**

As the actors in the creative and content industry cover a wide range of size, market position and fields of application, we would recommend that a variety of actions be formed, including Research, Innovation and Coordination and Support Actions. In particular, CSAs should be stressed more in the upcoming funding periods, providing instruments for setting up innovation networks within and between respective creative industries & ICT research. All actions should have a range of durations in consideration of the fast changing nature of the sector, and should aim to involve SMEs from the creative sector even further. For achieving the latter, administrative overheads should be kept to a minimum.

NEM is covering the following sectors:

- Book Publishing
- Broadcasting
- Music
- Multimedia
- Advertising
- Gaming
- Fashion
- Cultural heritage
- Design
- Education & training
- User and social engagement and collaboration
- Novel storytelling techniques
- IoT integrated environment
- Digital society - Impact of new media on lifestyle

### 3.2. NEM research domains

These are the research domains described in the last NEM Strategic & Research Agenda

- Content Distribution
- Content processing
- Distribution and display technology
- Designing and maintaining security and privacy
- Autonomy and automation
- Service provision innovation
- Enable bimanual interaction, natural walking interfaces, and whole-body involvement in VR
- Maturation and enhancements of Brain-Computer Interfaces
- Augmented Reality for Inquiry-Based Sciences Education
- Challenges in evaluating human-computer interactions (HCI) and immersive content and technology

Following the update of the NEM Strategic Research and Innovation Agenda (SRIA) in 2016, it has been decided to extract the most important research domains and

objectives that have to be pushed in the next WP2018-2020, completely in line with the priorities elaborated in April 2016.

The NEM ETP members are supporting the following list of priorities:

1. Content distribution
2. Hyper-personalization
3. Immersivity
4. Media analytics
5. Professional media workflow
6. Secure and trustable content - Block chain

These topics target technical/technological trends rather than following market trends. They are shared by several of previously identified sector trends (SRIA Section II). SRIA aims at boosting the potential impact and providing a better overview of the NEM community.

For this research priorities enabling technologies shared among them have also been identified

### 3.2.1. Content distribution

**Content distribution** integrates all the new trends on the evolution of networks and the provisioning of media services. These include the increased capacity of the actual networks for supporting new media and immersive formats, the potential impact of 5G networks for new business models, the increasingly convergence of “hybrid” services built upon the combination of different networks. The convergence between broadcast, multicast and unicast as well as the potential of SDN networks should be a tremendous opportunity for the media and content industry.

It also includes aspects regarding security and right management to enable new media business models.

### 3.2.2. Hyper-personalization

**Hyper-personalization** will consider the different aspects of maximizing opportunities to customize content to consistently target the right audience throughout the customer lifecycle. Thus it will create meaningful connections and drive engagement among audience. It can be applied to most of the NEM media sectors. It also encompasses the ATAWAD (any time, anywhere, any device) concept which provide to the end user the best format according to the device used.

### 3.2.3. Immersivity

**Immersivity** should take advantage of all the great work done for the I2C PPP proposal. It is very likely to be one of key drivers of media in the upcoming years to reshape the way contents and services are provided and the user interaction is completely renewed. There are a lot of technical topics along the value chain involved, so it can integrate many NEM actors as well. It should encompass the following activities already described in the I<sup>2</sup>C PP proposal: Storytelling Creation for

I2C, Mixed Content Immersive Technology, Content Generation Tools for I2C, Science, Technology and Arts in Immersive and Interactive Media.

#### 3.2.4. Media analytics

**Media analytics** will cover the media analytics tools for Big Data and Social Media, positioning media as a core sector for Big Data technologies including the social media. It will also address media search engines which is a potential open field for the European industry.

#### 3.2.5. Professional media

**Professional media** workflow to address migration, virtualization, co-creation... aligned with production core technologies. Digital cinema, as well as professional content provider workflows have to deeply evaluate new technologies in order to take advantage of them but also to fit the end-user needs who expect more and more personalised content. As a consequence, the producing environment has to be rethought as well as all the tools used by professional content providers.

#### 3.2.6. Secure and trustable content - Block chain

**Secure and trustable content - Block chain** seems to be promising for DRM and micro payment between users according to recent experiences and publications. This new technology is still very new but seems to have the potential to fix issues that we have not yet solved. A consistent DRM is still expected from end users and for content providers, and as block chain technology is a contract between two entities without any central point, it seems very promising. In the same way, users are increasingly used to creating content with their mobile and are also interested in selling it, micropayment is the solution and the block chain technology could facilitate one to one payment.



## 4. Mapping NGI and NEM research domain

### 4.1. Today mapping

Media and CCI are very closed related and belongs intrinsically to most of the technology areas identified in the NGI initiative. Indeed, the future of media, content and the creative industries rely heavily on the internet.

Thus, there is a close mapping between NGI research priorities and NEM research priorities as well as with NEM identified enabling technologies to be pushed forward in next EU funding frameworks. Most of the aspects of NGI research priorities are contemplated in NEM SRIA. However, given the different focus of both documents, key aspects of NGI are scattered among technology trends identified in NEM SRIA and most of the times there is not a direct match among them.

In the following Table this mapping is made visible, identifying common aspects of NGI Technology Areas and NEM SRIA.

NGI Research priorities	NEM research priorities and key enabling technologies	Comments
Personal data space	Hyper-personalisation Immersivity	Technologies aimed at providing better personalized services have to take into account security aspects for both user data, personnel data captured and data offered by the user. NEM also approaches the need for ensuring user privacy data and controlling data flows through technologies aimed at Hyper-personalisation and immersivity.
Artificial Intelligence	Content distribution  Hyper-personalisation	NEM content distribution also addresses the need for AI technologies to automate the access of distributed sources and to provide them to users, content distribution processes, etc..  Among other technologies needed for hyper-personalised media services and offerings, AI is a key.



	<p>Immersivity</p> <p>Media Analytics</p>	<p>AI has also a great potential contribution on activities and priorities such as storytelling creation, content generation tools, in the form of algorithms that supports and aids the creative process of immersive content.</p> <p>All aspects of Media Analytics relates directly with AI. Nowadays, most analytical algorithms rely on AI algorithms.</p>
<p>Distributed architectures and decentralised data governance</p>	<p>Secure and trustable content - Block chain</p> <p>Content distribution</p> <p>Professional media workflows</p>	<p>NEM research topic covers needs regarding the use of decentralized and secure communications to improve content protection and rights management.</p> <p>Content distribution also address challenges that require new distributed architectures capable of delivering high volumes of content with controlled latency. Also, content distribution services must adapt to new distributed architectures.</p> <p>Enable novel co-creation, collaborative spaces for content production ensuring protection of created data, trusted networks, etc..</p>
<p>Discovery and identification tools</p>	<p>Media Analytics</p>	<p>The need for more powerful media discovery tools (annotation, etc.) and media search tools are contemplated in the Media Analytics priority</p>
<p>New forms of interactions</p>	<p>Immersivity</p>	<p>These two research areas</p>

and immersive environments		are perfectly aligned.
Software defined technologies	Professional media	Challenges addressed by NEM professional media include the need to move towards more software-based workflows to cope with aspects such as co-creation, virtualization, etc..
Networking solutions beyond IP	Content distribution.	Content distribution challenges need for networks that go beyond IP, such as hybrid, decentralized networks, etc..
	Content distribution	Relation with Beyond IP Security and right management key to new business models AI: New media environments appearing thanks to AI applied to Autonomous driving
	Hyper-personalization	Relation with personal data space
	Media analytics	Relation with Artificial Intelligence
	Professional media	
	Secure and trustable content - Block chain	Relation with Distributed architecture and decentralised data governance

The following Eurecat’s contributions are made with the spirit of supporting legitimate media services and business strategies that are respectful of fundamental rights in the digital society. Indeed, the media and creative industries, many of which rely on data-centric business models, ought to create responsible, transparent and rights-respectful mechanisms for ensuring a fair treatment and trade-off for their consumers. On the other hand, individuals need to be aware of their rights, the value of their data and their role as audience and contributing user, so that they can take responsibility in the collective effort of creating a competitive, meaningful, safe and participatory media landscape. Scientists, researchers and companies must keep up innovating in **with technologies that guarantees by-design the protection of consumer’s rights** so that resulting advances are compliant of policy and regulatory frameworks.

NGI Research priorities	NEM research priorities	Comments (how are these related)
<ul style="list-style-type: none"> <li>• Personal data space</li> <li>• New forms of interactions and immersive environments</li> </ul>	Hyper-personalization	<p>Transparent media services in which consumers are empowered to decide. Data sovereignty requires users to be able to make informed decisions about the data they generate, including trading with it under fair and transparent conditions. Consumers should be empowered for deciding and managing to which extent they want their contents to be hyper-personalized, and by whom. Personal Data Spaces would enable them to manage their own user profile and enforcing self-set rules. Also, obtaining data valuation information and decide trading options. In turn, content creators would benefit of better data quality as it is validated by user actually generating it.</p>
	Immersivity	<p>Ethical collection and monitoring of personal and sensitive data. Advances in immersive media will eventually make possible delivery of multisensorial experiences, which in turn will generate user reactions and traces likely to be measured and processed. This may raise ethical concerns about the handling of personal and sensitive data (e.g. resulting from emotional and behavioural monitoring) for increased interactivity and enhanced UX.</p>
<ul style="list-style-type: none"> <li>• Artificial Intelligence</li> <li>• Discovery and identification tools</li> <li>• Software defined technologie</li> </ul>	<ul style="list-style-type: none"> <li>• Hyper-personalization</li> <li>• Media analytics</li> </ul>	<p>Ensuring media pluralism and diversity. Advances in AI have proven successful for content personalisation and recommendation. Nonetheless, there are concerns about how algorithm-driven media services may be inadvertently fuelling threats to pluralism and diversity (e.g. eco-chamber effect<sup>9</sup>, algorithmic bias and discrimination<sup>10</sup>). There are still questions on how media pluralism and</p>

<sup>9</sup> <https://www.wired.com/2016/11/filter-bubble-destroying-democracy/>

<sup>10</sup> <https://www.nytimes.com/2015/07/10/upshot/when-algorithms-discriminate.html>

		diversity can be measured in the digital society, and how algorithmic-driven threats can be addressed in a way that it preserves both societal and business interests.
Distributed architectures and decentralised data governance	<ul style="list-style-type: none"> <li>Secure and trustable content - Block chain</li> </ul>	Systems for monitoring and enforcing rights compliance regarding user generated data, and user generated contents. This line of action should help users to track down transactions involving their data. Also, to register and monitor compliance of IP rights over user generated contents shared online through social media and other webservices (e.g. recording of agreed data transactions with third parties and remuneration; ability to track down information and detect fraud or misuse).

#### 4.2. Additional relevant NEM research domain to NGI

**Content processing.** The content processing research domain as defined in NEM SRIA poses several relevant research topics which are relevant for the NGI.

Technologies to process and manage crowd content (classifying, annotating and fusing open content (optionally with proprietary data) will be needed to handle new open (user-generated) content and ensuring a more level playing field for any citizen and business willing to distribute contents and promote and engage in the participation of society on content generation.

Object-based representation, coding and rendering technologies (object-based, wavefield lightfield capturing, coding and rendering) for representing and coding single visual objects are needed for enabling new immersive media formats and innovations in contents and easing its distribution and consumption via decentralized networks.

Lowest delay capture to photon video delivery. For many applications (augmented reality, interactive applications, tactile internet) lowest delay capture to photon (down to 1 ms) is required.

**Evaluation human-computer interactions and immersive content and technology.** Methodologies, technologies and tools to assess objectively the quality of the experience of an user when interacting with immersive content are a specific area of research which becomes highly relevant for the NGI where novel and more natural ways of interacting with devices based on immersive environments. This research area aims at identifying where and when are the pros and cons of these novel interfaces, based on the user’s mental state during interaction. For instance, estimating the user’s mental workload during interaction can give insights about where and when the interface is cognitively difficult to use. Beyond

evaluation alone, physiological computing could also improve existing interfaces by increasing the symbiosis between the user and the interface, e.g., for visualization and analysis of large amounts of data.

## 5. Conclusions & recommendations

NGI is a human centric initiative and NEM is obviously THE European Technology platform addressing human needs in terms of content and interaction.

One of the most important concerns of European is security&privacy linked with service personalisation. Hyper-personalisation is part of the NEM Agenda and research topic proposals have been clearly identified. In this context trust is one of the key ingredients to develop the Next Generation Internet fitting user needs and wishes.

NEM should have a big role to contribute with the vision of the European Industry to the Next Generation Internet

For such a challenge, NEM is proposing the following approach

- Appetite for collaboration among interdisciplinary groups engaged in a mixture of long term and applied research projects.
- Transdisciplinary approaches are needed. Importantly research needs guidance by the social sciences, user needs and awareness of the "known holes" in the current internet.
- The "citizens" involvement as "actors" in the research is crucial. This may include representative bodies, policy makers and regulators but this need to encompass women, students and activists.