NEM: List of topics for the Work Program 2023-2024

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www.nem-initiative.org

Introduction

The **NEM Initiative** (New European Media Initiative) was established as one of the European Technology Platforms under the Seventh Framework Programme, 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 programme, 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.

The NEM constituency includes all major European organisations working in the networked and electronic media area, including content providers, creative industries, broadcasters, network equipment manufacturers, network operators and service providers, academia, standardisation bodies and government institutions. Those actors share a common Vision and have been producing a Strategic Research and Innovation Agenda (SRIA) as well as position papers, in order to accelerate the innovative development of the new sector in a harmonised and fruitful way and to place European industry at the forefront of the information era.

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Immersive Social Networks: SocialXR or the Metaverse

Immersive social networks, social XR, or the metaverse are concepts used to refer to a set of hyper realistic immersive digital environments in which humans and machines interact among each other to develop certain actions together. In this section different topics that will impact the deployment of immersive social networks are described.

Topic 1: Lightweight and low-cost volumetric capture

Volumetric capture is the process of capturing moving images of real-world subjects (humans and objects) so they can be viewed from any angle at any point in time during playback. It usually involves multi-camera systems to reconstruct the subjects in 3D (volumetric reconstruction) with many cameras mounted on custom apparatuses in large enough spaces in order to capture the (moving) subject from multiple angles. Volumetric capture rigs usually employ a variety of industrial camera sensors, such as color, depth, light-field cameras, infra-red, or structured light projectors in order to accurately capture 3D and color information of the subject scene. In addition, the scene's lighting is of great consideration as the final 3D representation does not contain baked lighting and shading artifacts and thus can be faithfully shaded in virtual 3D environments.

Despite the great potential of such volumetric capture infrastructures, the diversity of their applications in entertainment (filmmaking, gaming industries), the XR sector, or in collaborative virtual environments, and the new perspectives that they create for content creators, they still present a great set of challenges of both financial and technical nature. First, the cost and the technical know-how required to build such volumetric capture rigs hinders small enterprises (SMEs) in assimilating relevant technologies in their pipelines. On the delivery side, the produced volumetric video content is not usually conformant with the current pipelines already present in 3D production software (such as gaming engines) and feature large payloads per frame, impeding real time streaming and processing by lower-end devices, such as smartphones, or standalone VR headsets.

Therefore, research is needed for bringing volumetric capturing closer to smaller enterprises and content creators, i) closer in terms of their budget, i.e the amount and type of hardware needed to build 3D capture rigs based on commercial-graded sensors - and thus produce lower-cost solutions -, ii) closer in terms of their shooting needs, thus offering mobility, i.e. developing rigs that are portable, not confined to fixed spaces and are easy to set up, and iii) in terms of developing automated plug-n-play solutions, accommodated with the corresponding software, or integrated in already existing software with which content creators are familiar with, and achieve equivalent quality with that of high-end volumetric capture pipelines. On the other end, 3D video production pipelines should become more lightweight by extendending current compression algorithms to the 3D domain, or developing novel ones, taking into consideration current adaptive streaming solutions. Additionally, other directions for

volumetric video production pipelines should also consider to become more compatible with the current technologies already utilised in 3D production software (e.g. gaming engines), such as animation, temporally aligned textures and 3D triangle meshes.

Topic 2: Mulsense

To design and implement a highly efficient, cost-effective and manageable HMI-based system there is the need to provide a highly adapting technology that is able to understand and adapt to the context, the human behaviour and human needs. Systems based on gesture control, haptic technology and eye movement tracking go beyond traditional computer mouse or remote-control interaction. Besides that, the metaverse will be only a reality if it really allows XR adopters to feel the proposed reality, by providing feedback to all human senses more effectively.

With the proliferation of sensor networks and increased diversity in sensory modality (stimulus modality), sensors will play a key role in creating the metaverse and boosting its experiences. Creating realistic XR objects with full sensing capabilities while enabling high-accuracy physical interactions with the created objects in the metaverse, will require a wide range of sensors that are capable of building, learning, monitoring, perceiving and interacting with all metaverse entities.

Sensors should be compact and miniaturised, replicate the functions of the human senses (including touch, smell and taste), and measure key information about XR objects such as surface properties, scent and tactile cues, depth and contact forces, on top of the usual audio-visual features. The acquisition, processing, detection, transmission, and fusion of multi-sensory data for creating a natural, low-latency, high-accuracy, realistic, multimodal, and fully responsive metaverse experience will present a whole range of new challenges to digital media researchers as they work to build, populate and animate the metaverse.

Topic 3: Scalability in Holoconferencing

Social VR, AR and MR platforms enable users to meet, immersed or not, in 3D environments, to develop a certain task, such as learning and training, designing and engineering, entertaining, etc. These platforms aim to go far beyond the typical mosaic of upper body video representations in video-conferencing platforms. Social XR promises to provide higher levels of realism, immersion and interaction, and steer collaboration through higher levels of (co)presence, thus overcoming current limitations of 2D user representations in multi-party conferencing. Most of the existing Social VR platforms rely on the use of synthetic avatars, Computer Generated Imagery (CGI)-generated, to represent the participant users while the latest volumetric capture developments enable the recreation of photo-realistic volumetric replicas of humans, which can be in turn inserted in such collaborative 3D environments. Moreover most of them do not vest from Europe. It is necessary for European digital

sovereignty to win back control over most of the videoconferencing systems we use in Europe in the next level.

Holoportation, volumetric video, 3D lightfields, from capture to transmission and display, will enable the deployment of holo-conferencing services but holoportation is expensive in terms of computation and network needs. Major efforts need to be made in order to allow the scalability of such systems, so an increasing number of users, accessing from different device types, heterogeneous in terms of display and capture hardware, can participate in sessions with multiple users maximising the quality of experience for each user type. Similarly to what videoconferencing systems do for the integration of different 2D video flows, the challenge is to define communication architectures adapted to three-dimensional environments, and providing adaptive volumetric video streams according to new parameters besides computational and network capacity per client, like, for instance, the relative position among users, or even the relevance of a user in a given scene.

Topic 4: Lighfield pipeline, from capture to display

Populating the metaverse with holograms that offer photorealistic representations of the physical world subjects, including humans, require the amalgamation of a range of light field technologies from acquisition to display. In the near future, more portable devices are expected to emerge that can capture 360-degree light fields with high fidelity, low cost and fairly high speed of processing to functions such as depth estimation, scene reconstruction and view synthesis. Moreover, the use of light field displays in the context of the metaverse is anticipated to visualise extremely small or extremely large objects and this will therefore require the creation of a new generation of light field display technologies that will go beyond the metaverse services to benefit medical microscopy (to assist surgical procedures) and cinematic experiences, hence making the “smart life” perceptions more attainable. Also in scenarios of daily use (virtual, parallax-enabled mirrors in cars, parallax-enabled TVs etc.) light fields will play an important and increasing role due to their self-explanatory nature (human beings are used to see parallax; actually looking at 2D-projections is less natural).

Despite the fact that recent core results in light field representation (e.g. Neural Radiance Fields, so called NeRFs) have been introduced by US-based companies and Universities, Europe always has played and continues to play an important role and is able to maintain its scientific, economical and societal share. Current challenges in this domain are:

- Application of light field technology in mass market products like mobile phones. There’s no mobile phone manufacturer left in Europe so that one very important device type for such kind of capture is missing.
- Highly complex neural network-based representation and processing of light fields. Training of networks for Neural Radiance Fields requires an enormous amount of computational power and hence currently is majorly done with support by US-based companies (Google, Facebook, Amazon) or in China. Europe’s core strength is on applicability of light fields in specific scenarios.

- Rendering of light fields on commodity devices (mobile phones, tablets, TV sets, car dashboards etc.). Here the knowledge base is solid but since the market for commodity devices has moved outside Europe we need to concentrate on a component business, integrating rendering solutions into European platforms (automotive, health).

Topic 5: Immersive sound pipelines

The conception of immersive works (music, digital arts, VR films, etc.) implies thinking about the image as well as the sound. The technologies concerning this sound dimension are evolving very rapidly today. However, immersive audio, to date, is mainly based - economically speaking - on two technologies developed by non-European companies (Apple's Audio Spatial and Sony's Dolby & 360 Reality Audio).

Thinking about audio in an immersive creation pipeline means defining new audio capture processes, new sound creation tools and new volume restitution technologies. It also means providing international formats and standards in order to promote quality sound processing and its interoperability with the images that will potentially be associated with it, whatever the context and the equipment used. Finally, thinking about the sound dimension also means getting closer to the artists and allowing them to translate their creative intentions that sound can bring (scripting of an immersive game, special sound effects, physicality of a sound environment). Finally, it means guaranteeing a set of technologies that take into account the health of individuals and the hearing problems that could be caused, amplified or solved by immersive sound technologies. It also means thinking of volume sound as a source of well-being and therapy (music therapy).

Multiple challenges remain to be addressed in the immersive (and interactive) audio domain: how interactive audio systems can use non-tactile data such as listener location, orientation, gestural control and even biometric feedback such as heart rate or skin conductance, to intelligently adjust immersive sound output How to develop spatial audio research on binaural measurement, analysis and modeling as well as Ambisonic decoding for immersive and interactive technologies? how to simulate the emergence of new digital sound instruments and enhance creativity as well as reinforce musical practice for all? how to facilitate the Virtual Reality capture and rendering of sound environments? how to make possible and easy automated identification of soundscapes?

Topic 6: Positioning

Hyper-accurate positioning is key to providing a highly immersive experience to end users. and the current challenges depend on the context of use (indoor vs outdoor) and the underlying basic technology (network based vs vision based).

In indoor environments, UWB (Ultra Wide Band) - based RTLS (Real Time Location System) solutions appear as an interesting alternative for precise positioning achieving accuracies of tens of centimeters. These solutions are commonly based on the deployment of a surrounding infrastructure and Time of Flight (ToF) or Time Difference of Arrival (TDOA) measurements to locate objects/people. One of the challenges of these solutions is the impact of Non Line of Sight (NLOS) situations between the infrastructure and the locating object on accuracy. The

challenge here is to develop better mechanisms, algorithms and analytical methods to enhance UWB-based RTLS, in order to improve their localization performance in terms of accuracy, precision and robustness, especially in the z-axis. Hardware modules with multiple antennas have recently appeared in the market facilitating the implementation of AoA strategies. Furthermore, UWB is being introduced in smartphones (Iphone, Samsung, Xiomi). Apple already provides third party libraries for the deployment of applications, what would allow to locate people with precision without the need of additional hardware.

In outdoor environments, satellite technologies are the most common positioning technologies. The European Galileo GNSS will offer a High Accuracy Service (HAS) less than 2 Decimeters which is not sufficient for most of XR applications. Thus, further research is needed to enhance the positioning accuracy. For instance, Real Time Kinematic (RTK) mechanisms allow to improve the accuracy of GNSS systems up to centimeter-level accuracy, however, this accuracy will require an excellent sky visibility and the frequent reception of correction data from an accurately located reference station.

Finally, computer vision based systems for localization, mostly referred as Visual Positioning Systems (VPS), such as SLAM (Simultaneous Localization And Mapping) can also provide precise positioning by using images from one or multiple cameras while constructing a map (dense or sparse point cloud) of the environment. In addition to the captured images, other kinds of data can be used to increase the accuracy of the localization such as Lidar and Inertial data. Despite the extended use of SLAM methods, there are still multiple challenges that need to be solved to increase the accuracy and reliability (drift, loop closure) of such algorithms. New algorithms must a) incorporate the capacity to deal with all kinds of environments (textureless, small to large-scale) including changing environments such as crowded places, places under construction, and places with evolving lighting conditions; b) must be deployable in Cloud and Edge infrastructures to provide high performance relocalization for use-cases with critical latency issues (autonomous vehicles, augmented reality); c) must preserve privacy of the visual data collected by end-users by incorporating the anonymization of the flows from the source; d) must be interoperable with other data types (e.g., satellite imagery, drone imagery, Lidar) including geometry semantics.

Topic 7: Media Searchability/Discoverability/Traceability

With a shift in business mindset - from looking at VR as a primary medium for gaming and entertainment to exploiting the metaverse to create, explore, identify, express, work, collaborate and socialise etc. – new communities, assets, arts, content, fashions, designs, worlds and experiences will be created in the metaverse. This will necessitate people and businesses to venture out of their usual real world into the immersive XR communities where they will need to encounter and adapt to new economies, environments, trends, behaviors, brands and social cultures etc. making it essential to innovate in how the XR objects can be searched, identified, discovered, and tracked within the metaverse.

In order to make XR objects identifiable and searchable within the metaverse, new metadata generation schemas and asset tagging techniques will need to be developed and uniformly applied. Traditional annotation methodologies that are based on low-level processing of audio-visual content for tagging media assets are not fit for purpose as XR objects are multimodal and exhibit several layers of complexity in their digital representation formats, data structures and diverse sensory modalities. Therefore, new schemas that enable the visual searchability and traceability of the metaverse objects should be developed with a clear stake in multimodal queries and multi-sensory asset discoverability.

Topic 8: Access, Inclusion and Diversity in a Responsible Metaverse

Challenge: Building an inclusive metaverse. After worldwide anticipation of a big post-pandemic reopening, people are "resigned" to the permanence of some form of virtual work: millions of workers are already meeting in virtual spaces. Tech companies are looking to transform virtual workspaces into a "metaverse" of social and business interactions in a 3D environment. The potential to improve collaborative equity is significant and building the metaverse responsibly is key. While building these virtual worlds, three things are most important: prioritize inclusivity, learn from grassroots innovation, and foster transversal collaboration. The **scope** is consequently threefold:

- **Ensure inclusivity for all from the starting point**. In some advanced (high-tech) companies, almost the whole workforce is enabled to work from anywhere. Increased inclusivity is needed and an inherent benefit of virtual environments where a person's location, gender, physical attributes, or personal circumstances are less important than their ideas or the quality of their work. As a result, organizations will benefit from diverse new talent pools from previously underrepresented groups. It is not just about giving people laptops and creating diverse-looking avatars, but also addressing people's physical challenges, such as providing control interfaces for those unable to use a conventional keyboard. These issues need to be addressed for the metaverse's foundations. *Example*:
- **Embrace grassroots initiatives** is a way to ensure virtual environments and represent the people using them is to tap into the existing work by those driving innovation from the ground up. Such grassroots initiatives highlight the needs of those vulnerable to marginalization as the metaverse grows. Europe has a role to play in keeping access advantages and key regulations to make such evolutions happen transversally.
- **Collaborate to build the metaverse**: no single company, country or culture can build an equitable and inclusive metaverse. That's why the global research, media and IT communities, and regulators should unite with the communities they serve to develop open, secure and trusted virtual environments. Technology has an excellent track record in helping to level the playing field in society and the metaverse is the next chapter. If developed properly, it could help foster the global inclusivity, diversity and exchange of ideas necessary for the future.

Sustainable Media

One of the main societal challenges of today is to organize our lives, businesses, and any kind of activities in a sustainable way, following an overall goal to reduce negative impact on environment, prevent the climate change, optimize energy consumption, and reduce the CO_2 footprint - as it is intended in the European Green Deal and also targeted by the EC Horizon Europe research and innovation program at large - as well as to reduce related implementation and deployment costs and increase energy efficiency. In this respect, future solutions and implementations in the world of digital media should follow this goal and must be reflected in the Horizon Europe calls for projects. Accordingly, the NEM Initiative emphasizes the following three related research and innovation topics, to be considered as important pillars towards implementation of the European Green Deal from the media perspective.

Topic 9: Optimization of digital content distribution and storage

During recent years, extensive research has been conducted to enable novel formats and ways of providing complex video experiences to the end users. A good example is the immersive omnidirectional video (ODV) streaming experiences, where already a variety of immersive displays solutions and 360° cameras are currently available in the market. However, the immersive audio-visual media streaming applications supporting high-quality live streaming and Video on demand require a very high-resolution (i.e. 8K) and very-low low response time. On the other hand, due to the growth of computing capability in devices and overall network capabilities (e.g. 5G networking and beyond), wide deployment in the field seems to be possible. **In order to optimize the video streaming pipeline, there is a need for cost-effective integrated immersive pipeline taking advantage of concepts such as edge computing, 5G, cloud rendering, etc., optimizing the dynamic adaptive streaming to reduce network requirements and device constraints, maximize the end-user quality of experience (QoE), and reduce the overall energy consumption of the streaming platforms and services.**

Today, the size of the content created by users tends to be larger in terms of the needed storage capacity and more sensitive in respect to the storage quality requirements (360 videos, 3D content, Light fields), not forgetting proper consideration of all related privacy and right management issues. Nowadays, multiple copies of the content elements are available/stored in several locations which imply three main concerns:

- Not energy efficient at all, storage servers and also network upload/download actions are consuming a lot of energy that could be easily saved.
- Not cost-efficient as the quantity of storage space needed is proportional to the number of times each content element is duplicated.
- No possibility to control the access and the content and no possibility to remove exhaustively a specific content.

Future solutions should explore how to optimize content management in order to limit the storage multiplication of the content element while preserving the speed of access, data integrity, and security concerns. Solutions have to leverage machine learning algorithms in order to deal with the previous issues, also focusing on data visualization systems to show how the content is stored, from where it is accessed, and to help to identify under-exploited storage spaces, supporting storage shareholders for their decision-making processes. Solutions should be also dedicated to end-users, in order to allow them to understand how and where their content is stored and strengthen their confidence in cloud storage services, especially during deletion processes.

Topic 10: Labeling environmental impact of digital media

The British Academy of Film and Television Arts (BAFTA) estimates that the annual emissions from UK film production total in excess of 149,000 tonnes of CO_2 (the equivalent of the total CO_2 output of a small village), while Greenpeace suggests that Information and Communications Technologies generate up to 3% of global carbon emissions (on par with air travel) and by 2030 ICT electricity usage could contribute up to 23% of the globally released greenhouse gas emissions. Therefore, digital assets need to be labeled as any other energy consuming good, towards understanding of the pollution generated by daily media consumption activities, such as storing pictures and videos, remote meetings, etc. Thus, the media industry also needs to be aware of their input to global warming, where transparency in the information is one of the most powerful arms, including establishment of a EU system to measure and label CO_2 emission. **The mentioned issues should be addressed through the following actions:**

- To assess the wide range of environmental impacts of digital media technologies, including CCI, across the entire workflow from production, distribution, storage, to the end user consumption, a bottom-up approach is needed to identify and elaborate on all the related impact variables, including investigation and experimentation of ways to reduce negative environmental impact, e.g. by reducing CO_2 footprint, in the future media landscape. An important outcome of related actions should be **to suggest appropriate mechanisms for an environmentally conscious European digital media market.**
- **To establish simulation, analytical, and/or other appropriate tools to estimate the environmental media impact**, in order to ensure that the media and cultural industries become aware of their environmental impact. Here, beyond local and national initiatives, it is a more universal approach that needs to be put in place through indicators, exchange platforms (of information, good practices, materials, product recycling, etc.), simulation tools and even digital twins.
- **Ecological sustainability within the content sectors, with a focus on circular economy models in the value chain** - Circular economy is at the heart of the EU Green Deal. It is therefore crucial to find ways to implement circular economy models into the content sectors, with a focus on business models and value chains. Content sectors are one of the drivers of a growing ecological footprint of ICT, which is predicted to cause

23% of GHG emissions globally by 2030. The target is to avoid or reduce the emission with the help of new technologies such as AI, print-on-demand; new materials, etc.

- **Community building around sustainability of the media and content sector** to support deployment of ecologically sustainable good practices within the entire media sector, to define policy recommendations for the support of sustainability-oriented innovation within regional, national and EU policies, initiate creation of incubators supporting SMEs and start-ups to adopt green and digital business models.

Topic 11: Media contribution to the European Green Deal

Books, news, any kind of human beings publications have been the cornerstone of our knowledge society for the past 500 years. However, the changing role and functions of the publishing in general in facilitating implementation of the European Green Deal have not yet been substantially and scientifically explored. Thus, how publishing and news manifest cultural values, what impact they have on the change of mindset and, what is their potential for innovation and reaching the European Green Deal are still open questions.

Media in general can have a significant impact on the design, formation and implementation of the New European Bauhaus in particular and on Europe's Green deal in general). In particular, the media is important when it comes to new narratives for a sustainable, inclusive and aesthetic lifestyle , as well as when it comes to the diffusion of new meanings. Very often, suggestions of new meanings and new narratives are confused with “censorship” and an intrusion into the freedom of art. To open up a space for imagining inspiring and incentivizing lighthouse projects, collaboration is needed all along the value chain of the content sectors.

Creating creative spaces for the role of CCS in achieving the EU Green Deal is of paramount importance, where the role of media, ICT, and the CCI in creating new narratives has yet to be explored. The challenge is to increase the participatory aspect from stakeholders and citizens as well as arenas where the main activities towards the Green Deal will happen in practice; Where are the citizens going to be able to participate and how? Which technologies, especially XR, will play an important role in spreading the messages and ensuring an active citizens’ participation, etc. Final goal is to develop a Lighthouse Projects within the New European Bauhaus, featuring media and ICT-driven CCI

In addition, sustainability and power usage should become part of the curriculum of universities in Europe and the rest of the world. Similarly to how we moved from “security as an add on” to “security by design”, we should strive for “low power usage and sustainability” by design.

Next Generation Digital Life

Digitization processes have accelerated dramatically during the last 3 years in most of the aspects of human life. Digital Art, remote work and decentralized exchange of digital goods and services are different sides of the same coin, and present common and new opportunities to tackle, challenges to overcome and threats to avoid. Creativity, interdisciplinarity, competitiveness and European values are necessary to prevent the risks that a hyperdigital life may provoke in our society while strengthening the position of Europe in the globe.

Most innovations in the space of the platform economy (or APP economy) come from business and/or design innovations. Not only do technical innovations drive them, but also the other way around. This is traditionally the weak area of Europe. Europe needs to become more aware of the fundamental implications and changes in the innovation ecosystem. Here is the decisive role of culture and creative industries. The pioneers of shaping the digital life of the future are between art and technology.

Topic 12: Art to influence innovation in vertical applications

In the recent decades the world has been moving at a faster pace shifting away from traditional manufacturing towards a knowledge driven society[1]. Art is at the forefront of services and innovation. If Europe wants to remain competitive in this changing global environment, it needs to put in place the right conditions for art and innovation to flourish in a new entrepreneurial culture[2]. Europe's cultural and creative industries offer a real potential to respond to these challenges thereby contributing to the Europe 2020 strategy and some of its flagship initiatives are the Innovation Union and the Digital Agenda.

The challenge is to accelerate the introduction of art and creativity into innovative technology-based processes and services for a smart society. Among the various meanings of a complex concept such as "smart", this objective adopts the concept of a mix of a creative, sensitive and participative intelligence in society. These principles of technological evolution will contribute to improve the experience of those who will benefit from a digital service. This new approach will therefore produce a Creative User Experience.

When a human being interacts in an environment, virtual or real, he or she might enter into an experiential dimension composed of expectations, judgments and choices, therefore, an aspect of the design and creativity of artifacts that focuses on the users characteristics and needs and on their context of use. One focus could be the sum of the emotions, perceptions and reactions that a person feels when he/she comes into contact with a brand, a product or a service.

This involves several fields and mainly, such as **Social Humanities**, (Cognitive psychology, Cognitive Ergonomy, Human factors, those disciplines that deal with the study of the human mind and its information elaboration), **Human Computer Interaction**, (such as Interaction Design (IxD)/ User Centered Design (UCD)), **Information Architecture** (such as information design of a product, namely the organization, navigation and labeling of content), **Usability** and **Visual Design/User Interface.** This is the part of design that covers the sensory and emotional aspects of the product such as visual appearance and branding in general.

In summary, the aim of this interdisciplinary approach is to create attractive and pleasant technological tools, that are at the same time ergonomic and functional; and to do whatever is necessary to activate the creative process of planning and design. Design is not just what it looks and feels like, design is also how it works. The scope is to foster transdisciplinary dialogue and innovative research, including artistic research, to support and produce creative practices, and engage in a critical reflection about the social and ethical dimensions of our technological global moment.

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[1] GREEN PAPER Unlocking the potential of cultural and creative industries. Brussels, COM(2010) 183

[2] As expressed by President Barroso in his Political Guidelines for the next Commission. Full text: http://ec.europa.eu/commission_barroso/president/pdf/press_20090903_EN.pdf

Topic 13: Immersive Working environments

There is a need to look into the effects the pandemic has had on our working environments and the rough transition to online meetings. Our communication has changed completely: Employees can work from home, families can keep in touch, students are able to keep their education going. In this crisis, for those who have, access to the Internet is not a luxury, it is a lifeline. The most common platforms used today are simple video conferencing solutions with more or less smart use of audio and video. The solutions have proven to be efficient and work, however, there is a severe lack of immersion and very low potential for creativity and high-quality working.

As in times of Covid19 communication runs primarily through digital platforms it is becoming more relevant to make sure that some of the broadly used solutions in the actual marketspace come from Europe. Systems like Google Meet, MS Teams, Skype, Zoom, WebEx etc. unveil the digital dependency from non-European providers. To position European companies at the front of the communication tools, specially those used in work environments, it is time to look into new ways of working together utilizing new technologies, specially immersive ones, to increase the Quality and creativity of work, even remote. The inclusion of XR technologies in the workforce is crucial to provide added benefits and increase the impact of online meetings. The added immersive functionalities should be closely linked to the interactivity and the new immersive technologies in Section 1.

Topic 14: Societal impact of metaverse

We have all felt the fatigue experienced through endless meetings at our home offices and the lack of social being. The societal impact of the situation is yet to be assessed and must be said to be unknown at this stage. Metaverse brings the promise of stepping up the game and brings in elements of eXtended Reality (XR) technologies to enhance home working and bring elements of reality and society closer to each and one of us. Early research shows the reduction in meeting time and interactions and an increase in the sense of being there and belonging.

The hype about NFT's at the moment might be overestimated. But the underlying legal changes are leading to new business models and a new form of internet: The introduction of possession in juxtaposition to the licensing of digital artifacts in the virtual space will lead to new challenges and opportunities. For Europe this means in part the "restart button", when we manage to take these stakes faster. The business ecosystem will become more federated.

The dependency on large giant corporations will be reduced or at least thoroughly challenged. If Europe knows this area well, and keeps the overview we might come out of this new phase of shaping, what some call the internet 3.0, then we went into the race. We Europeans own more artifacts, we have the renowned artists. Europe should act quickly here, massive and - above all - robust.

The challenges we face are simple: will any use it and what quality implications does it have on the experience and ultimately what societal impact will it have. These challenges obviously need to be addressed in a transdisciplinary way taking into account both technology and digital humanities. Main focus should lie in the triangle business, culture and technology. The field is still open, perfect for shaping the future.

Media Dataspace

Content is a set of data and metadata subject to the same considerations of ethics, personal data protection and trust as any other data. Individuals must have the right to control their personal data and the data generated through their use of content products, i.e. usage data. Immersive social networks will multiply these issues, since not only content consumption data may be gathered but also sensory perception of various human senses. Immersive social networks should allow for the personalisation of the provision of content but also for control of potential abuses such as misinformation, digital harassment, ostracisation of communities and individuals. Artificial Intelligence (AI) should come to the rescue to generate intelligent media services that would adapt to the user needs in terms of the environment and the personal capabilities, including the need for accessible multi-language multimodal media services as prerequisite to enjoying any XR media content.

This area of research must be linked to the approaches developed in the NGI - Next Generation Internet programme, which aims to contribute to an Internet that meets people's basic needs, including trust, security and inclusion, while reflecting the values and standards enjoyed by all citizens in Europe (accessibility, transparency, respect for diversity and minority representation).

Topic 15: Personal Data

Hyper-personalized Digital Lifestyle is very often based on personal data exploitation, with Artificial Intelligence (AI) and Machine Learning (ML) algorithms that rely on one fundamental thing: **collecting and analyzing information coming from on-line activities of**

private citizens. In the future, everything we do will be possible to trace and rate, AI will become "normal" and "present" in all aspects of our daily private and professional lives and devices will allow the extension of sensory perception of various human senses (e.g. touch, smell and taste). The expected impact and diffusion of personal data exploitation (e.g. AI analytics) are likely to be profound and transform all areas, from employment markets to personal and social practices. Therefore, **privacy regulation and personal data rules enforcement** is the key enabler for the future media platforms (e.g. Metaverse/SocialXR). The EU's recent GDPR regulation gives citizens more insight and control on their digital personal data. The advances in the usage of digital media services, as shown during COVID-19 pandemic, is unstoppable. It is fundamental to avoid and manage the criticalities to which the collection of large masses of data may lead: from illicit behavior to individual or massive violations of fundamental rights.

Governing such networked society and data-driven economies is not an easy task. High standards of data protection and facilitation of market developments must necessarily go together, knowing that the protection of personal data is not negotiable in trade agreements. Several corporations achieved unprecedented roles as the arbiters of online public square/sphere rising even above governments and the democratic institutions. Many are convinced that Europe can lead this "digital mission" (i.e. not China, not US) and **be a leader in exploitation of personal data while preserving human rights, diversity, ethics, pluralism in culture, opinions, lifestyles and ideas**. This requires to address specific challenges:

- EU and global regulatory regime to effectively rebalance the distribution of power on personal data between corporations, governments and citizens.
- pan-EU sovereign digital capacities and infrastructures, leveraging on the European telecom networks, becoming a data hub where data is stored, shared and processed in a secure way, ensuring the EU rules and values while boosting the media services enabled by 5G.
- Federated marketplace for data services that comply with EU regulation, in terms of data sovereignty, security, portability, or energy efficiency, and contribute to breaking down silos and accelerating integration of the entire market.
- Secure control over the actors and players in pan-EU infrastructure, providing the overall system orchestration and assurance layer, mechanisms and interfaces to secure the pan-EU infrastructure of data services.

Topic 16: Artificial Intelligence and Hyper-Personalisation for Media Access Services

Artificial Intelligence (AI) and Hyper-Personalisation are transforming the way people work, live and entertain themselves, including the way they access media services. There is opportunity for Europe to play the dominant role in technology that might fundamentally change the way we create and consume visual content access services. The automatic translation solutions provided by AI tools will allow for an explosion of content, compliance

with digital accessibility legislation, and the reduction of production costs. There should be different calls focusing on media access services over the duration of Horizon Europe fostering European academia and economy, and simultaneously addressing social and societal challenges (inclusiveness, access for all, nobody left behind).
The economic interest is therefore fivefold:

- The automation of the adapted subtitling chain will allow productivity gains that reduce unit costs and increase the volume of processed data.
- The production of multilingual subtitles will allow a wider international commercialization of the audiovisual contents produced.
- The decrease in subtitle production costs will make captioning accessible to many new content producers for whom the cost makes captioning impossible.
- The improvement of Sign Language production and Audio Description for content (videos and books) with the facility to deliver dialogue and ambiance elements of the soundtrack separately, enables robust subtitling performance across genres and increasing interoperability, allowing users to consume personalised automatic live subtitles anywhere.
- Web access developments allow the commercialization of existing prototypes e.g.: subtitle renderer, inlay/screen overlay (incrustation) of Sign Language interpreter, advanced audio functions, improvements to the quality of automatically generated subtitles, reliable Speech-To-Text technologies, improved avatar based signing services and integrate additional accessibility services into existing online platforms.

The specific challenges in the next years for the media access services are multiple and request to develop AI tools in order to:

- Fluidize/streamline the circulation of audiovisuals through machine translation, while humans focus on the quality of work, for example.
- Promote the development of multilingualism and the integration of foreigners (migrants for example) through subtitling.
- Develop AI tools for automatic translation from speech to subtitles, from text to Sign Language, and from Sign Language to text.
- Develop AI tools for robust automatic translation of subtitles (multi-languages).
- Develop think-tanks and do-tanks in order to maintain Europe’s position as the World leader in accessibility and thus for social and societal challenges.

Topic 17: Disinformation

Disinformation is a hot issue in Europe as well as worldwide, particularly referred to Political and Social Challenges that reflect in business as well as in industry. Europe is lacking 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 data sources, will tackle this urgent problem, generating new business and societal impacts involving several stakeholders: a) Media Companies: news agencies,

broadcaster, newspapers, etc, b) Governmental institutions and organizations, c) The overall industrial ecosystem, d) The entire society.

It is important to stress how this specific problem needs the aggregation of a multidisciplinary scientific community from **Artificial Intelligence** to **Complex Networks analysis**, from **video and image processing** to **Cross media exploration**, from **Social Science and Humanities** to **Natural Language Process** Moreover, this must be integrated, also with Research Infrastructures and High Performance Computing and new calculation procedures.

The main challenge, to address this aggressive emergence of fake news, post-truths, and disinformation, is to provide **online web app and services** that will support professionals and citizens with high-level features, such as:

- **automatic mis-information detection and trustworthiness scoring**, based on **Big Data analysis techniques** (ML models and Graph Analysis), to understand if the news has been manipulated
- tools to support user data investigation, through an interactive exploration of news, open data and verified claims databases.

Topic 18: Content Exchange

The media ecosystem in Europe is rich and diverse. Many media companies operate only in certain countries and are serving certain languages. This leads to a disadvantage of scale with respect to the larger (non-EU) players and platforms operating in the global market. Furthermore, the EU also fosters open borders for the European content market, making all audiovisual content available everywhere in Europe. In order to overcome these challenges, more collaboration between companies operating in the EU media market is needed.

The recent move from hardware-based to software-based technologies for media production, distribution and consumption offers an opportunity to collaborate on the exchange of content and data between players in the EU media market. The fact that more and more media organisations move part of their infrastructure to the cloud offers even more opportunities. However, the lack of common standards, standardized infrastructure and metadata models makes it difficult to set up and maintain collaborations. Every content exchange collaboration is ad hoc and requires a lot of integration work to make the corresponding business processes work.

In this software-based world, **interoperability** is a major requirement for smooth collaborations in the EU media market. Interoperability is one of the central aspects of the EU's claim for digital sovereignty. To achieve interoperability, data standards are crucial. Content sectors such as book publishing have been leading the way when it comes to collecting data and devising standards which ensure ethical use of data, and a high level of trust all along the value chain. To ensure the link between analogue and digital data and to explore new software-based solutions for standards we need new forms of collaboration and exchange between creators, innovators and users. There is a particular need for

- common infrastructure specifications
- common standards for the exchange of both content as well as metadata and other content related data.