Strategic Research and Innovation Agenda 2024

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Introduction

The NEM Strategic Research and Innovation Agenda 2024 (SRIA) is the 2024 version of the roadmap for the media technology research, development and innovation developed by the New European Media (NEM) technology platform.

NEM brings together the **European Media and CCI (cultural and creative industries) Innovation Ecosystem**, comprising leading cultural industries, media production and distribution companies, technology providers and researchers, as well as the European Commission -both in its capacity of policy-maker and innovation sponsor. Its mission is to unify the voices of its members, creating technology and content-based innovation road-maps for the sector to grow. NEM wishes to **bridge the gap between knowledge generation, technology and content-based innovation, and market uptake** by promoting disruptive production techniques, delivery platforms, data storage and exchange systems, business models and policies, as well as engaging, human-centred cultural content embedded in European values.

This document contains a set of relevant research and innovation topics considered by the NEM community as key topics to be taken into account by the European Commission in the definition of the next Horizon programme. These topics represent the interests of the community in terms of collaborative research for the period 2025-2030. In particular, 16 topics have been elaborated and organised under 5 different categories. Each topic is self-contained in a category subsection and follows the same structure: scope, specific challenge, research perspectives, expected impact. It takes into account the NEM vision for 2030 established in 2020, updates the NEM work program for 2023/2024 proposed in 2022 with new insights from the group as some of them were discussed during NEM Summit 2023.

List of Authors

Luis Almeida	Institute CCG/ZGDV - Centro de Computação Gráfica
Elmar Arunov	Deutsche Telekom
Giuseppe Amato	CNR, Istituto di Scienza e Tecnologie dell'Informazione
Jovanka Adzic	Telecom Italia
Malte Behrmann	bbw Hochschule
Silvia Boi	Engineering Ingegneria Informatica
Simon Delaere	imec-SMIT, Vrije Universiteit Brussel
David Gal-Regniez	MINALOGIC
Hadmut Holken	HOLKEN Consultants & Partners
Halid Hrasnica	Eurescom
Jeremy Lacoche (editor)	Orange
José Manuel Menéndez	Universidad Politécnica de Madrid (UPM)
Pilar Orero	Universitat Autònoma de Barcelona
Emanuel Sousa	Institute CCG/ZGDV - Centro de Computação Gráfica

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I Sustainable Media

The European Green Deal has been established to transform the EU into a modern, resource-efficient and competitive economy, ensuring:

- no net emissions of greenhouse gases by 2050
- economic growth decoupled from resource use
- no person and no place left behind.

In that context, media is ubiquitous and its impact on the environment is unavoidable. According to a study by the Shift Project, streaming video accounts for about 60% of global internet traffic and generates about 1% of global greenhouse gas emissions. This is equivalent to the emissions of a country like Spain. Environmental Product Information Schemes (EPIS) play an important role in environmental policy. They are used to award and promote environmentally superior goods and services and offer information on quality and performance with respect to consumer health, resource consumption and so on. EPIS are product information tools. They provide environmental information from producers to other producers and to professional and private consumers about the environmental features of a product. The main idea behind these schemes is that information is crucial for consumer choice and that EPIS will make it easier for interested actors to make eco-friendly choices. The European Council Directive 20051321EC of 6 July 2005 establishes a framework for the setting of ecodesign requirements for energy-using products, still no agreed scale for media has been developed.

I.1 Labelling environmental impact of digital media

Scope: The development of adequate measures, certifications and standards are necessary to evaluate and validate the impact of media activities on the environment and the improvements resulting from new technologies**.** These measures need to be agreed by industry so they have a fast uptake. **Certifications and labels begin to appear such as GREEN FILM or** ECOPROD***.***

Specific challenges: This information can be supplied as a) quantitative information (e.g. giving exact figures for emissions of carbon dioxide in making the product, percentage recycled components used, etc.) b) qualitative (e.g. with use of written descriptions of the provenance of the product) and c) graphically (through the use of various kinds of symbols. Further, information might be multidimensional or one-dimensional; labelling can be voluntary or mandatory and its scope might be national, regional, or global.

Some media industrial sectors have made studies, for example: Carbon footprint was measured following the energy it consumed " The carbon footprint for digital terrestrial television was found to be 0.088 kg CO 2 e/viewer-hour and for online delivery of video-on-demand ranges from 0.030-0.086 kg CO 2 e/viewer-hour. This was based mainly on the energy consumption in the use phase. Results were sensitive to the number of viewers per display. It was found that the largest environmental impact from watching television is due to the power consumption of the consumer equipment. This amounts to 76% of the total for digital terrestrial television and 78% and 37% for video-on-demand using desktop and laptop computers respectively. The trend for larger television screens which have higher power consumption could increase this. Programme production

contributes 12% to 35% and distribution contributes 10-28%. It was found that the audience size of a digital terrestrial channel and whether or not an aerial amplifier was used have a large effect on which distribution method appears to be the most energy efficient., and it was initially measured by energy" (Chandaria et al 2011).

Research Perspectives: To address these challenges, multiple research directions should be explored:

- **Gathering data about media production and consumption** and their associated emissions. In that context all media stakeholders, including creators, distributors, technology providers and also academics, must be involved and work together.
- **Developing Intelligent calculators for EU media** or make the existing ones compatible and standardize a methodology that they could converge to. Such calculators could rely on the previously gathered data with the potential use of AI solutions or new dedicated algorithms. Following the GHG protocol, all scopes must be considered : scope 1 (direct emissions), scope 2 (energy indirect emissions), scope 3 (other indirect emissions).
- **Developing new methods and techniques for energy optimization** for content creation, transmission, processing and storage
- **Developing new ways to raise awareness of the consumer** about the environmental features of a media product of service. New graphics representation could be proposed. In the same way, new labels, standards and even regulations could be developed and existing ones should be promoted.

Expected Impact: Evaluating and measuring the carbon footprint will result on several impacts on different stakeholders. First it will raise awareness of consumer about the impact of media consumption and given them information to potentially adapt their behaviours. For instance, watching videos at lower resolutions or. Indeed, reducing the resolution of a video from 4K to 1080p can cut its carbon footprint by up to 80%. Using energy-efficient devices: Watching videos on smaller, more energy-efficient devices can also reduce emissions. Streaming from renewable energy sources: Choosing streaming services that are powered by renewable energy sources can also help to reduce emissions.Then, it will allow reduction of the environmental footprint of media by contributing in the establishment of a media sustainable industry. It will promote sustainable practices, enhance society's global comfort by improving resource efficiency, as well as decrease media procedures' environmental footprint in general and carbon footprint in particular. From a technological point of view these new measuring tools can guide the development of new sustainable media procedures and components.

I.2 Social sustainability through media accessibility

Scope: AI in the media sector can play a dominant and sustainable role to allow people to access videos and interactive media in various languages and sectors (traditional media, social media, education, corporate communication, and others).

Specific challenges: To install a relevant social sustainability impact through media accessibility, the European Commission should include social science economy next to technology. Together it is important to go beyond traditional technological innovation, think out of the box, and include "innovation for the public good". This means that the benefit must firstly be open (source), cannot be (only) private, which is the condition *sine qua non* for a more inclusive society. Secondly, new

approaches to promote perspective thinking, inclusion, and diversity within societies, including capacity building, must come from multiple stakeholders including concerned end-user representatives with various profiles.

Research perspectives: To achieve sustainable results in line with the (to be determined) European expectations, the focus should be on multiple key actions. If for instance involved linguistic representatives should play a pivotal role in ensuring and promoting sustainable results in the multi-linguistic domain, this involves fine-tuning language models creation, developing user interfaces sensitive to local nuances, and tailoring the technology to the cultural context of i.e. low-resource language speakers. Key actions would then be:

- **Local collaboration**: partner with linguistic experts, cultural heritage organizations, and local communities to ensure the accuracy and cultural relevance of language models.
- **Media engagement**: utilize local and national media channels to disseminate information about the project's outcomes, emphasizing the preservation of linguistic diversity, cultural heritage, and inclusion.
- **Conferences and workshops**: organize local conferences and workshops to showcase the project's findings, engaging with stakeholders, linguists, and technology enthusiasts. Additionally, participate in relevant EU conferences to share insights and foster collaboration.
- **Capacity building**: facilitate training sessions and workshops to build local capacity in language technology and artificial intelligence, empowering individuals at local level (low-resource languages) to contribute and utilize the developed resources… and make the available to all (languages).
- **Awareness campaigns:** launch awareness campaigns to highlight the importance of preserving linguistic diversity, emphasizing how technology can be a bridge between cultural heritage and modern innovation.
- **Integration with EU initiatives:** align the project's goals with broader EU initiatives related to linguistic diversity, cultural heritage, and technological innovation. Seek opportunities to contribute to EU-wide projects and discussions.
- **Complementary aspects:** consider integrating a community-driven approach, involving citizens in the co-creation process. Establish mechanisms for continuous feedback, allowing end-users to actively participate in refining language models and user interfaces. This not only enhances the technology's effectiveness but also fosters a sense of ownership and pride within the local community. By focusing on these actions, this contributes to sustainability, promotes cultural heritage awareness, and positions local regions as an active participant in EU discussions on linguistic diversity and technological innovation for a more inclusive and diverse society.

Expected Impact: Work of this nature has the potential to promote the preservation of the European heritage while enabling all Europeans, whatever their background, culture and needs, to have access to content like everyone else. It has also the potential to encourage the creation of type of media content and services.The multi-linguistic domain is one approach for social sustainability through media accessibility. But it stands also for the inclusion for people with special needs, senior populations, migrants, or strangers in each country, etc.

II Future of networks for Media

The future Smart Network and Services has the ambition to design and deploy a scalable, robust, secured, distributed, high-performance, energy-efficient and environment-neutral ubiquitous digital infrastructure, providing also next-generation network based media services for processing, orchestration, synchronization. In a context where media are increasingly varied (high resolution videos, volumetric content, AR, VR, Metaverse, etc.) and demand more and more features and bandwidth, this is essential to enable and promote the Next Generation Internet (NGI) and future media services taking advantage of technologies such as Artificial Intelligence (AI) and Machine Learning, Data Analytics, High Performance Computing, Security etc. As business needs evolve, AI and network infrastructures will become increasingly intertwined. Upcoming smart networks will need to accommodate a wide array of services, each with its own specific demands for Quality of Service and Quality of Experience. Additionally, these networks will have to handle various types of content and media, ensuring seamless end-to-end interactions with user devices.

II.1 Mobile communications technology / 6G

Scope: There is considerable research effort ongoing worldwide in industry and academia to define networking technologies for the 2030-2040 decade, including mobile ("6G") and fixed networks. In Europe, the research effort is structured by the Smart Networks and Services Joint Undertaking (SNS-JU), including flagship project Hexa-X-II. A central part of the research work on future networks is to identify the use cases they will need to support, in order to derive relevant performance requirements to drive the design of a relevant technology. As media is a key component of the traffic carried over the networks, outlook on future media formats and technologies is essential to design future networks.

Specific challenges: Future networks will need to support future devices and media formats, under the constraint of being sustainable from environmental, economic and social perspectives. The sustainability imperative calls for the most efficient media formats and compression technologies in order to minimize the amount of data to be transferred over the networks. Conversely, the data rates involved by new media services, devices and transmission formats should be compatible with the capabilities of future networks under reasonable deployment costs. As future networks and media formats should eventually be compatible under sustainability constraints, joint work between the media technology and the networking research communities is needed to align the research targets, and design meaningful transverse solutions.

Also, given the massive investments required to develop and deploy networking technology evolutions, it is critical to form a reasonable confidence about the appetite of the end users for the future services and use cases targeted to be supported, before specifying the technology. Indeed, the value of the service from customer perspective will drive the adoption and business relevance of the technology, and thus its economic sustainability. Early interactions with representatives of end users in order to test the service concepts and verify their interest should therefore be carried out from early research stages.

Research perspectives: in relation with both future media and future networks, the following research areas should be addressed:

- **Cross-domain techniques** involving cooperation between the application layer and the network layer to jointly optimize the media format and the network transmission parameters in order to minimize the network load and energy consumption.
- **Cross-domain media and networks infrastructure** design, to optimize the compute loads between end-user devices, edge nodes, central clouds, as well as the load on the associated network links.

- **Investigate how the distributed compute and storage capabilities envisioned to be embedded in future networks can be exploited by future media** in a platform-based paradigm (network platform offering services to media platforms), and the related needs in term of standardized interfaces and APIs, as well as the associated business models.

In addition, regular interactions between both media and networking research communities are needed in order to ensure coherent technology orientations given the cross-dependencies of the related topics.

Expected Impact: Joint design of future media devices, media formats and networking technology supported by sufficient early evaluation of customers appetite will increase the confidence in the technological relevance, feasibility, sustainability and business relevance of both future media and networking technologies.

II.2 LiFi

Scope: Light Fidelity (Li-Fi), is a revolutionary wireless communication technology that utilizes visible light to transmit data. It operates by modulating the intensity of light signals at a very high speed, allowing for the transmission of information in a manner similar to traditional Wi-Fi but hypothetically at significantly faster speeds. This technology has the potential to transform the way we perceive and interact with wireless communication.

Specific challenges: Besides multiple advantages, Li-Fi presents a spectrum of challenges that demand innovative solutions. One significant challenge involves **mitigating interference** in Li-Fi communication, particularly in environments with multiple light sources. Additionally, **optimizing the range of Li-Fi** signals without compromising data transfer speeds is imperative. **Security concerns** are paramount, requiring the design of robust protocols to safeguard data confidentiality and integrity, considering unique vulnerabilities associated with Li-Fi, such as potential eavesdropping through windows. **Seamless integration with existing wireless technologies**, such as Wi-Fi, poses another challenge. Protocols enabling smooth transitions between Li-Fi and other networks must be developed to ensure uninterrupted connectivity. Addressing **mobility challenges**, especially for moving devices, and adapting to dynamic environmental changes are essential for practical Li-Fi implementation. Energy efficiency is a critical consideration, demanding research into power-saving techniques without sacrificing the speed and reliability of data transmission. Scalability is vital as Li-Fi networks expand, necessitating the development of scalable architectures and efficient network management protocols. Additionally, **the deployment of Li-Fi in harsh conditions**, such as outdoor spaces with variable weather conditions, requires investigation into technologies that can withstand environmental factors while maintaining reliable data transmission. Standardization efforts are crucial to ensure compatibility and interoperability among different Li-Fi products, addressing regulatory issues for global adoption. Finally, **user accessibility and interface design** should not be overlooked, requiring the creation of intuitive interfaces for Li-Fi devices and networks, considering accessibility features for diverse user needs. Lastly, fostering public awareness and education initiatives are essential to dispel misconceptions, promote understanding of Li-Fi's capabilities and limitations, and encourage widespread adoption of this transformative technology.

Research perspectives: A strategic and collaborative approach in the following fields is highly recommended to harness the full potential of Li-Fi for the benefit of the media ecosystem.

- **Research and Development:** Invest in ongoing research and development to enhance Li-Fi technology, addressing challenges such as range limitations and compatibility with existing devices.
- **Industry Collaboration:** Set-up strategic partnerships with media content creators, streaming services, and gaming companies to explore Li-Fi's advantages for specific media applications by integrating it into their platforms.
- **Infrastructure Deployment:** Work towards the integration of Li-Fi infrastructure in public spaces, smart homes, and media production studios to demonstrate LiFi´s capabilities & benefits for media consumption and production.
- **Standards and Regulation Advocacy:** Participate in industry forums and regulatory discussions to establish standards for Li-Fi technology.

Expected Impact: Li-Fi technology provides a huge opportunity for the media industry. By capitalizing on its high data transfer rates, increased bandwidth, low latency, security features, and potential for immersive experiences, media companies can enhance content delivery, improve user experiences, and stay ahead in the rapidly evolving digital landscape.

II.3 Edge Computing

Scope: Edge computing is a paradigm that brings computation and data storage closer to the sources of data generation, reducing latency and enhancing overall performance. Unlike traditional cloud computing, where data is processed in centralized data centres, edge computing distributes computational tasks to the "edge" of the network, closer to the devices producing or consuming the data. This decentralization of computing resources is particularly advantageous in scenarios where real-time processing, low latency, and bandwidth efficiency are critical.

Specific challenges: Addressing the multifaceted landscape of edge computing presents a set of few challenges that demand innovative solutions. Firstly, **achieving optimal resource allocation** is paramount; the development of dynamic algorithms capable of efficiently distributing computational tasks at the edge, striking a balance between minimal latency and overall system performance, stands as a critical challenge. Secondly, the **heightened proximity of computation to data sources amplifies security and privacy concerns**, necessitating robust architectures to safeguard sensitive data without compromising real-time processing capabilities. Thirdly, **standardization and interoperability** are pivotal challenges, requiring the establishment of universally accepted protocols and interfaces to facilitate seamless communication among heterogeneous edge components. Additionally, the **complex task of integrating edge computing with existing cloud infrastructures** poses a significant challenge, demanding the creation of frameworks that ensure smooth communication and data exchange between edge devices and centralized cloud resources. Finally, **overcoming the constraints of edge devices operating under limitation**s such as computing power, storage, and energy is crucial. Innovations in lightweight algorithms, energy-efficient computing, and effective resource utilization are essential to unlock the full potential of edge computing, particularly in scenarios with constrained device capabilities.

Research perspectives: From strategical perspective the following components are key to unlock the full potential of edge computing in the media landscape.

- **Investment in Edge Infrastructure:** Allocate resources to build and maintain a robust edge computing infrastructure.
- **Collaboration with Content Delivery Networks (CDNs):** Set-up strategic partnerships with CDNs to enhance the efficiency of media distribution through edge nodes.
- **Security Integration:** Prioritize the integration of robust security measures at the edge to safeguard media content and user data.
- **User Education and Transparency:** Educate users about the advantages of edge computing, emphasizing improved performance, lower latency, and enhanced security.

Expected Impact: The adoption of edge computing in the media industry presents a great opportunity to revolutionize content delivery and user experiences. And by tackling the challenges mentioned before, will not only enhance the efficiency and reliability of edge computing but also foster transformative advancements across various industries reliant on real-time processing, low latency, and bandwidth efficiency.

III Immersive Content

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. Immersive content holds the promise of transforming social interaction and digital experiences by offering novel ways to communicate, learn, and engage in many domains: entertainment, healthcare, manufacturing, automotive, cultural heritage, marketing, education etc. European XR market is expected to grow between €35 billion and €65 billion by 2025 with the potential creation of 1.2 to 2.4 million jobs.

Nevertheless, this also raises significant ethical, societal, and environmental issues that current legislation, particularly in light of European values, may not be fully prepared to address. From a technological point of view, further advancements across various sector, such as hardware, networking, and content creation, are essential for widespread adoption. Despite Europe's cadre of esteemed academic researchers, the region's industry players have yet to establish a strong foothold in a market largely dominated by American and Asian companies.

In alignment with European Digital Rights and Principles, it is imperative to cultivate a robust, competitive ecosystem where European entities are empowered to significantly contribute to the sustainability, adoption, acceptance, development, and deployment of immersive content technologies. To achieve this, we should leverage existing European initiatives like the AR/VR industrial coalition, the virtual worlds initiative, and networks of stakeholders including XR4Europe and EuroXR.

III.1 Virtual Worlds

Scope: Virtual worlds are immersive, persistent, networked environments that allow people to interact and socialize, transparently mixing physical and digital worlds. Physical and virtual objects, physical and digital landscapes, along with remote and in-presence people, blend and interact together in a totally natural, realistic, and intuitive way, including the visual, perception, and actuation perspective.

Specific Challenges: Despite the great interest from the research and industrial community, there are still several challenges that must be addressed, to make Virtual World widely used and accepted. For instance:

- **Realistic interaction:** Interaction with virtual worlds should be natural. Physical human actions should be correctly interpreted and transferred into the digital world. Digital objects, manipulated in the digital world, should provide realistic feeling (e.g.: weight, temperature, touch feeling, consistency).
- **Realistic physical digital blending:** interaction between physical and digital world should be realistic. Physical and digital elements should blend transparently. Actions in one world should produce effects in the other world. It should be difficult to distinguish between physical and digital elements.
- **Scalability:** Creation of digital twins of large areas has generally a high cost. In addition, applications and current devices cannot generally handle very large and complex digital models of the physical worlds.

- **Device invasiveness:** virtual word devices (e.g.: smart glasses, haptic devices, input devices), used in the physical world, should be as minimally invasive as possible and very easy to use, to be accepted by the general public.
- **Resource constraints:** Miniaturized devices for virtual world have significant resource constraints (e.g.: computing power, graphic power and resolution, network bandwidth, memory size, storage size) that make difficult to handle large and complex digital twins of the physical world.
- **Ethics and Regulation:** A lot of issues arise with the development of virtual worlds in particular the shared ones including ethical (harassment, privacy), societal (isolation, addiction) and environmental that existing legislation is not yet adequately equipped to handle, especially taking into consideration European values.

Research Perspectives: To address the above challenges, research directions should include:

- **Egocentric vision:** real-time analysis of the video stream captured by a wearable camera, possibly installed on smart glasses, is of paramount importance to achieve a convincing interaction, simultaneously, with physical and digital worlds. This allows, for instance, recognizing manipulated objects, people, locations/landscapes of the physical world, executed actions, and to transfer them into the digital world, with non-perceivable delay.
- **Cross-modal interaction**: humans interact with the physical world using many senses, both to acquire information from the world (e.g.: vision, sound, touch) and to provide output to the world (e.g.: speech, actions, movements). Solutions to correctly interpret these multi-modal interactions capabilities and to reproduce them should be investigated, to make physical/digital world blend realistically.
- **Non-invasive interaction devices:** Techniques to develop non-invasive devices that provide highly realistic and natural interaction with the virtual world should be investigated. For instance, in addition to light-weight high quality smart glasses, also non-obtrusive haptic devices, to provide users with realistic physical perception of the digital world, and body machine interfaces, to allow a smooth and very effective interaction of people with the virtual world, should be investigated and developed.
- **Digital twin creation:** Solutions to be able to easily create digital twins of physical elements (e.g.: objects, landscapes, persons), which include also semantic, physical, chemical, and biological properties, in addition to visual properties, should be investigated
- **Creation of human centric ethical, legal and social guidelines:** Establish ethical guidelines that will ensure the well-being, safety, and sustainability of European citizens in the Metaverse. These guidelines should be used for the development and use of virtual worlds technologies and services, ensuring that they are safe, secure, fair,non-discriminatory and sustainable.

Expected impact: Virtual Worlds will have impact in many sectors and will open new opportunities in many use cases. For instance:

- **Industry**: Virtual worlds can be used as a new way to provide training to workers. Procedures can be rehearsed leveraging on virtual words and real-time coaching can be provided in shopfloors. A new paradigm for engineering design is also possible with virtual worlds, where in presence and remote people can participate in collaborative co-design sessions, with the possibility of testing (assembling, evaluating, assessing) in real-time the proposed engineering solutions.

- **Healthcare**: Patients, nurses, and physicians can interact in a novel way, with no need of being all in the same physical environment, yet without losing the possibility of providing effective help to patients. Rather, enhanced diagnostic tools can be accessed in an integrated way and used by operators working remotely, with advanced diagnostic capabilities.
- **Rehabilitation**: New opportunities are provided to patients needed rehabilitation. Through the virtual world patients can execute their exercise at home, have their exercises automatically monitored, can receive advice and suggestions. Exercises can be designed leveraging on features offered by the virtual worlds, reducing the need of moving to specialized rehabilitation premises. Physiatrists can interact with their patients remotely, leveraging on avatars, perceptions, and actuations features offered by virtual worlds.
- **Art and creativity:** In addition to provide new advanced possibility to physical museums and exhibitions. A new dimension for the creative sector will come from the possibility of creating digital artworks persistently blended with the physical environment. It will be possible to blend digital artworks with physical landmarks, such as squares, streets, and buildings.
- **Social life:** social networks will be augmented by the virtual world offering a new paradigm of interacting and socializing in the blended physical/digital world. Imagine a person blocked in his bed being able to participate in parties with friends or visiting an archaeological site in a realistic and immersive way, leveraging on virtual worlds.

III.2 World Scale Augmented Reality

Scope: Large-scale augmented reality (sometimes referred as the “Real World Metaverse”) refers to the use of AR technology on a grand scale, often in public spaces or over extensive areas and can be applied to various use-cases such as entertainment, navigation, cultural heritage, urban planning, etc. There is a need for the development of new technologies, standards and open platforms for the mass adoption of large-scale Augmented Reality: home, building, factory (Industry 5.0), city (Citiverse). Improvements of current hardware and localization solutions are required with EU social and ethical values in mind: sustainability, privacy and inclusiveness.

Specific Challenges: Augmented Reality has the potential to enhance the way end-users interact and operate over their everyday work and life at home, in a city, in their workplace. Before mass adoption, AR requires the development of more lightweight devices with more advanced graphics capacities (field of view for instance) as well as accurate and robust positioning systems to register 3D virtual content. Current AR devices do not have the ability to cover large areas (over 1,000m²) which limits applications just to small-scale. AR Cloud technologies can move localization computation into the cloud based on the creation of a 3D map of the real world and can then be used by a massive number of simultaneous users. It then has the potential to reduce the complexity of AR devices. Linking AR systems with digital twins (in relation with the IoT), for instance in the context of the Cityverse, could also simplify interactions between the real and the virtual worlds and provide users with relevant contextual information in real time. Now, the AR market is dominated by giant multinationals with the development of closed ecosystems including devices and AR Cloud solutions that could, raise privacy issues, limit the diffusion of XR application and the entry of smaller technology developers around Europe. The development of

standards, open sources platforms as well as cutting edge European AR Solutions is then crucial if we want XR to meet the EU's social and ethical values.

Research perspectives: Based on this context and challenges multiple research perspective arise:

- Developing advanced **large-scale positioning systems** combining different modalities including computer vision, radio, GPS etc. More than just considering accuracy, new algorithms must also consider other criteria including latency, security, energy efficiency and privacy (by "filtering" image data for example).
- **Moving rendering and spatial computing into the cloud** with dedicated network solutions (5G slicing for instance) to reduce the complexity of AR devices: reducing cost and energy consumption, increasing autonomy, improving form factor and comfort.
- **Developing new optics** to overcome AR glasses current limitations including reduced field of view, accommodation vergence conflict, opacity, chromatic aberration. Tending towards truly holographic rendering and display could be explored.
- **Developing interoperable and open sources solutions** for AR including content creation tools, localization systems, rendering algorithms, interfaces with digital twin systems, devices architecture etc. Regulations could be considered to foster the use of such standards by technological providers.

Expected Impact: These new advances in the field of AR will unlock a lot of new use cases in many domains, including the previously cited ones, benefiting both citizens and workers alike. Developing interoperable and open sources solutions will also offer unique opportunities for smaller European tech providers to innovate within existing ecosystems or even catalyse the creation of entirely new ones. By offering tailored AR solutions, these providers can contribute to a more diverse and competitive market in the EU. From a user point of view improvements in security and privacy are required to building trustworthiness in AR systems. Indeed, ensuring that AR devices and applications are secure and respect user privacy is essential to fostering user confidence and wider acceptance. AR can then tend to mass adoption, allowing a broader spectrum of society (by enhancing inclusiveness, reducing digital divide) to benefit from the digital enhancements of their physical world.

III.3 Immersive Content Creation Tools

Scope: Based on the two previous topics regarding virtual worlds and large scale augmented reality we can also assess that is a need for proposing innovating solutions for creating such immersive content (AR/VR) allowing creators to deliver high quality immersive experiences that can deliver the sense of reality (photorealism) and also allowing all kinds of users to create and share their own immersive content (user generated content). Improvement of current solutions are required including 3D modelling tools and game engines as well as reality capture and generative AI solutions. Developing immersive creation tools as most of current solutions rely on a 3D space displayed on a 2D screen.

Specific Challenges: In the field of XR content creation, several challenges are currently impeding the democratization and expansion of the domain. Firstly, the market is dominated by proprietary and closed creation tools, which often come with increasing pricing structures, making them less accessible for independent creators and small businesses. This leads to a second issue: the difficulty for non-expert users to create immersive content. The complexity of these

tools discourages a broader range of creators from entering the XR space, as they are typically designed to be implemented by highly skilled creators. For instance, 3D modelling requires skills with dedicated tools while implementing behaviours in virtual worlds requires advanced software engineering knowledge and skills with various programming languages. Lastly, the management of digital assets presents its own set of challenges, including issues related to ownership, portability, and monetization, which are critical for creators looking to protect and profit from their work. This is particularly true in the current context where most shared virtual worlds are closed ecosystems that are not interoperable with each others. Even if there are attempts to overcome these limitations (in the Metaverse Standards Forum or in the Open Metaverse Alliance) the perspective of an open Metaverse based on blockchain technology has yet to be fully realized.

Research perspectives: Based on this context and the associated challenges multiple research direction could be explored

- **Proposing new immersive creation tools** as most of the times, today creating immersive content is done on a 2D screen. A particular focus point could be to ease the implementation of behaviours in virtual worlds (avatars, interactions, UIs, etc.) for instance with immersive visual programming approaches.
- **Offering new generative AI** that can help the creation of virtual environments including the generation of textures, 3D meshes and entire scenes even for users without experience in the field of 3D content creation. For experienced uses, tools could also be proposed to improve, stylize and optimize their creations.
- **Developing fast, and easy to use reality capture tools** (photogrammetry, NeRF, Gaussian Splatting, etc.) that can provide high quality results when creating 3D representation of objects of different scales: from really small objects, to a room, to a whole city.
- **Considering senses that are less addressed** in the field of XR (because of devices limitations but also because of lack of tools) including haptics, olfactory and gustatory.
- Finding ways to **simplify how end users can own, use, share and monetize** their created **digital assets** across different virtual worlds including closed ecosystems. Dedicated regulations could be considered.

Expected impact: Multiple impacts can be expected from simplifying the creation of immersive content even for end consumers. Benefiting from the creativity of an additional number of users and increasing the possibility of current creators will allow the creation of richer virtual worlds, favouring, inclusiveness and diversity and unlocking new use-cases. More content by more people will help XR to reach mass adoption and will then positively impact the technological providers including hardware and software creators. The digital economy within virtual worlds holds the potential to generate novel streams of revenue for European citizens. It will be even more favoured if new solutions for digital asset management interoperability are proposed.

III.4 Human Factors for immersive environments

Scope: Digital immersive environments are technological systems built to enhance the interaction of humans with the digital world. Human factors must be considered to ensure that this new human-machine interaction medium is safe, efficient and pleasant to use. Social, physiological, psychological short and long term impacts of virtual environments must be studied.

Specific Challenges: The huge interest in virtual worlds during the last years came with new kinds of content and recurrent hardware breakthrough. VR and AR are now used by people of all ages but mass adoption has yet to be realized, and impacts of these evolving technologies still need be studied. Indeed, It is important to see that the missing uptake of XR and spatial computing within the end user segment is much lower than predicted by studies over the last 15 years. Why is this seeming to be mainly an economic phenomenon, we also can identify several technical obstacles, which should be further researched and undergo solution driven process. Technology acceptance is heavily influenced by dimensions of human-machine interaction such as safety, comfort (both physical and mental such as motion sickness), satisfaction and, depending on the specific application, overall efficiency. The quality of the interaction within an immersive environment will be affected by the user devices, such as HMDs or smartphones and by enabling technologies, such as fast network communications or the blockchain. These will influence how the users interact with the world, what they are able (or not able) to do, how they behave and seem to behave (from the perspective of other users). Furthermore, extensions for multimodal interaction have the potential to enhance interfacing, making it more intuitive and capable. Beyond the physical devices and enabling technologies of the immersive reality, the specific applications and their design will be a second layer of the interface between humans and the digital world. The new generation of XR and spatial computing will be confronted with massive data protection challenges using cameras on VR headsets and AR glasses. From a system's point-of-view, the dynamics involving human, device, infrastructure, and applications will define the success of any immersive environment. Understanding the interactions between these parts, how they affect and are affected by the behaviour of the human user will be key to ensure safety, building trust and ensuring user and societal acceptance.

Research perspectives: In that context multiple research directions are open:

- **Understanding the physical ergonomics impact of the mixed reality**: Comfort factors associated with devices such as HMDs, namely, weight, construction (centre of mass and pressure points); Visual fatigue and eye strain associated with the optics technology, resolution and frame-rate; Fatigue and musculoskeletal strain associated with continuous gesture interaction;
- **Understanding the cognitive impact of mixed reality and its multiple realisations**. For instance, how is mental workload affected by the superimposition of visual information in an augmented reality context? And how distractive it is? Can AR pose a physical risk in some circumstances? How can that be avoided?
- **Understanding presence**: how is the sense of presence affected by employing different technologies which may affect responsiveness and predictability of the interactions? And how important is that sense of presence to the overall usability, efficiency and user satisfaction? Presence and subjective evaluations, how presence impacts the ecological validity of immersive testing frameworks simulating real-world conditions.
- **Studying Interaction with AI**: How different materializations of AI (e.g. different kinds of avatars, voice assistants will contribute to the experience in a virtual/augmented world? Which kind of interaction metaphors can be adopted for the design of AI applications and how will they affect trust in the automation?
- **Studying Visual Induced Motion Sickness (VIMS)** is a phenomena associated with VR and AR devices that constitutes a frequent and important cause of discomfort. What are the main causes? How can it affect the performance and experience? How can it be reduced or eliminated?

- **Spatial audio implementation:** Enabling a precise representation of the subjective spatial map is crucial for AR interactions where sound spatial perception ought to match a visual target. Due to differences between users' anatomical features of the outer ear, a veridical auditory spatial perception requires an individualization of the implementation, a process that remains an open challenge. Innovation based in AI methods hold potential for an efficient and fast individualization processing.
- **Investigation on perceptual thresholds of detail resolution**, supporting an efficient balance between perceived realism and computational cost.

Expected impact: Studying XR from a human point of view can lead to a lot of beneficial impacts on the domain. Studying human factors in the domain of extended reality (XR) is essential to increase the effectiveness of this medium for human-digital interaction. By gaining a deeper understanding of how individuals interact with and are affected by immersive environments, we can create more engaging and positive experiences. Furthermore, the insights from such studies will lead to informed regulations and design guidelines that are necessary to mitigate potential psychological, physiological, and social consequences that may arise from prolonged or improper use of XR technologies. Such guidelines can ensure that immersive experiences are not only safe but also optimized for various user needs. Ultimately, a focus on human factors will foster greater acceptance and adoption of XR technologies, as users will feel more comfortable and better supported in integrating these new content and tools into their daily lives.

IV AI for Media and Content

Artificial Intelligence (AI) and its application towards content creation is already transforming the way people work, live and entertain themselves although the full potential of AI still needs to be further exploited within ethical and legal boundaries. In particular, Generative AI (GenAI) can create all kinds of media, including texts, sounds, videos and 3D content. It has the potential to re-shape the concept of creation and affect the operation and business models across the media and cultural sectors. It is expected that the impact on media and cultural and creative industries (CCI) will be huge but needs strong research & innovation support to benefit from these new opportunities. According to multiple studies, the GenAI market is expected to grow substantially in the next years. As an example a recent report from Sopra Steria shows that it could go from around 8 billion USD in 2023 to more than 100 billion in 2028.

At the same time AI can also 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.

In that context, the development of advanced generative AI models, personalization systems and advanced computing capabilities should be promoted at the EU level to make it a place of excellence and allow the creation of global leaders on these topics. In the same time, ethical guidelines and regulation should be developed to address the issues related to such models such as sustainability, safety, intellectual property, bias and trustworthiness. Following the expected EU AI act, a continuous monitoring of the advances of generative AI needs to be performed in order to evaluate their potential impact on CCI, and more generally on the society and the environment, for adapting the regulation and ethical guidelines accordingly.

IV.1 Generative AI

Scope: Generative AI is a set of technologies powered by machine learning algorithms capable of generating various types of content, such as text, images, sounds, 3D models, videos and even computer code. We may be witnessing the early stages of a profound metamorphosis within the cultural and creative industries (CCI), marked by an era where AI not only generates foundational content elements such as scenarios, non-player characters, and 2D/3D assets but also evolves to seamlessly create fully interactive and personalized content in real-time. This trend is illustrated by the AI-driven creation of entire books in 2023, signalling a future where AI's role in content generation could be all-encompassing. It is crucial that EU approaches Generative AI with a comprehensive strategy that encompasses technological advancement, sustainability concerns, ethical considerations, and regulatory frameworks.

Specific Challenges: These technological advancements offer numerous benefits, such as improved creativity, better efficiency, improved accessibility, and greater content personalization. However they also come with various challenges that are not only technological but also ethical, legal, environmental, and societal.

First, generative AI models still **need to be improved on various criteria to meet industry-specific demands for reliability, speed, quality, control, and energy efficiency.** Indeed These models occasionally produce errors (referred as “hallucinations”) or biased results, and the quality of complex outputs like videos and 3D models may not yet satisfy Creative Content Industry (CCI) standards. To continue, prompt engineering is emerging as a distinct discipline but has not yet achieved a level of control over content generation that users desire. Fine-tuning pre-

trained models for specific tasks or datasets can unlock generative AI's potential, but this process is complex. It is even not possible with proprietary models like ChatGPT or Midjourney. Moreover, obtaining or creating additional labelled data for fine-tuning can be challenging. An alternative that is also complex is the combination of generative purpose models such as Large-Language Models (LLM) with highly specific small models based on the data of a given organisation. Another area of focus is reducing the computational resources and energy required for training and inference while increasing their speed. Current generative models demand significant power, which can be expensive and have environmental implications. Addressing these challenges is crucial for the advancement and sustainable application of generative AI technologies.

Second, as mentioned generative **AI also presents ethical, societal and legal challenges.** One of the primary concerns is the potential for job displacement as AI becomes capable of performing tasks traditionally done by humans, particularly in the creative industries. This can lead to economic and social challenges as workers seek new employment opportunities. Additionally, the technology's ability to create realistic and persuasive fake content, such as deepfakes, raises significant issues around misinformation and the erosion of trust in media. This challenge is addressed in detail in Section V.2. Furthermore, the generation of content by AI complicates intellectual property rights, challenging existing legal frameworks and potentially discouraging human creators. There is also a risk that over-reliance on AI could inhibit human creativity and reduce the development of creative skills. Addressing these negative impacts requires careful consideration, regulation, and the development of robust ethical guidelines.

Research perspectives: Regarding these different challenges, several research perspectives should be considered at the European level.

- **Development of open source generative AI models, frameworks, platforms and datasets** will allow the apparition and growth of smaller European stockholders (ie. startups) that would come with new solutions and services and will also favour the confidence in generative AI. High quality public and open source datasets covering all media types, representing European diversity in content creation is of high value to avoid bias from other geographical areas.
- **Development and production of AI semiconductors (AI chips)** at the European Level pushing forwards the domain in terms of energy efficiency, latency, speed and size.
- Algorithms that can differentiate between human and machine-created works, while also establishing intellectual property attribution and ownership. Prevent models from creating harmful and abusive content.
- **Proposing new methods for better controlling** the generated content to match the expectation of the user but also to reduce bias and limit the creation of harmful and abuse content.
- **Addressing interpretability and explainability** of generative AI models as for now there can be somehow considered as black boxes. Make generative models more transparent to understand how and why they generate certain results.
- **Proposing new methods to evaluate the results** of generative AI models. Current methods are mainly qualitative while current qualitative methods (such as BLEU or METEOR) are somehow limited. New methods should also qualify hallucinations and potential copyright infringements.
- **Developing advanced MLOps** methods suited to the needs of cultural and creative industries including continuous training on specific media datasets.

- **Favour the creation of new multimodal generative AI models** allowing simultaneous inputs of text, videos, pictures and sounds and iterative interactions to comply with creativity processes, and promote the initiatives towards multi-sensory **Artificial General Intelligence** (AGI).
- **Taking into account the environmental aspects** at the basis of all development of generative AI solutions. Frugal AI alternatives to Generative AI would be a major economic and green challenge, supporting the creation of new devices and new services opportunities for media creation, and allowing the European Community to become a leader in terms of Green AI, including new standards for audio and video content, limiting the growth of communication networks bandwidth.
- Most of all all, **the use of generative AI must be supervised to** avoid abuses keeping the European values in mind. **Ethical guidelines and new laws** (especially regarding intellectual property) has yet to be developed. The EU AI act is a first step towards this objective but a permanent monitoring of the evolution of AI solutions needs to be performed to adapt the guidelines and laws accordingly.

Expected impact: Advancements of generative AI solutions at the European level can boost innovation and content creativity, favour the creation and the development of new actors in wide variety of sectors with potential important economic benefits. Generative AI can also make all EU citizens active actors in the domain of content creation by favouring User Generated Content (UGC) through various media (videos, Metaverse, 3D content, etc.). The EU can still become a leader in the generative AI field regarding the technological stack but also in terms of how controlled and regulated are its uses. Addressing as soon as possible the benefits but also the potential negative impacts of generative AI is of the utmost importance to reach the goals of the European green deal.

IV.2 Responsible and trustworthy AI in Media Production, Curation and Distribution

Scope: Artificial Intelligence (AI) is revolutionizing every aspect of media production, curation, and distribution, shaping how content is created, consumed, and shared in today's digital landscape. In media production, AI algorithms are employed to streamline workflows, enhance creativity, and optimize resource allocation. From automated video editing tools that can assemble footage into coherent narratives to AI-generated music compositions tailored to specific moods or genres, AI is augmenting human creativity and productivity in unprecedented ways. Moreover, AI-driven content generation systems can produce personalized articles, videos, and advertisements at scale, catering to the individual preferences and interests of diverse audiences.

In the realm of content curation, AI plays a pivotal role in filtering vast amounts of information to deliver tailored recommendations to users. Recommendation algorithms leverage machine learning techniques to analyze user behavior, preferences, and contextual data, enabling platforms like streaming services, social media networks, and news aggregators to offer personalized content suggestions. Through continuous learning and adaptation, these algorithms strive to optimize user engagement and satisfaction while promoting diverse perspectives and minimizing echo chambers.

In distribution, AI facilitates targeted content delivery, dynamic pricing strategies, and efficient distribution logistics. Content distribution platforms leverage AI-powered analytics to optimize content placement, timing, and promotion, maximizing reach and monetization opportunities. AI-driven content moderation tools help platforms maintain quality standards and enforce community guidelines by detecting and flagging inappropriate or harmful content, thereby fostering safer and more inclusive online environments.

Furthermore, AI is instrumental in addressing emerging challenges such as combating misinformation and disinformation, protecting intellectual property rights, and ensuring accessibility and inclusivity in media consumption experiences. However, alongside its transformative potential, AI also raises ethical and societal concerns regarding privacy infringement, algorithmic bias, and the concentration of media power in the hands of tech giants. As such, navigating the ethical, legal, and regulatory implications of AI in media production, curation, and distribution remains a pressing imperative for stakeholders across industries and society at large.

Specific challenges: The pursuit of responsible and trustworthy AI in media production, curation, and distribution presents a complex set of research challenges that intersect technological innovation, ethical considerations, and societal impact. One of the foremost challenges is mitigating algorithmic biases inherent in AI systems, which can perpetuate stereotypes, discrimination, and inequality in media content. Researchers grapple with developing algorithms that not only detect and mitigate biases but also promote diversity, equity, and inclusion across various dimensions of identity and representation.

Another critical challenge lies in enhancing transparency and interpretability in AI models to foster user trust and understanding. Achieving this requires advancing explainable AI techniques that can elucidate the decision-making processes underlying content recommendations, editorial choices, and algorithmic outcomes. Additionally, ensuring the robustness and reliability of AI systems against adversarial attacks, data manipulation, and algorithmic manipulation poses a significant research frontier. Researchers explore methods to fortify AI models against vulnerabilities and exploit vectors while maintaining performance and efficiency in dynamic media environments.

Moreover, safeguarding against the spread of misinformation, disinformation, and harmful content demands innovative approaches to content moderation, fact-checking, and verification at scale. Researchers investigate the development of AI-driven tools capable of detecting and countering deceptive content while preserving freedom of expression and minimizing collateral censorship. Furthermore, addressing the ethical implications of AI in media, including privacy infringement, data governance, and user consent, necessitates interdisciplinary collaboration between researchers, practitioners, policymakers, and civil society stakeholders.

Additionally, advancing AI ethics frameworks and regulatory mechanisms tailored to the unique challenges of the media sector remains a critical research priority. Researchers seek to develop ethical guidelines, governance structures, and accountability mechanisms to ensure responsible AI deployment and mitigate potential harms while promoting innovation and societal benefits. Ultimately, navigating these multifaceted research challenges requires a concerted effort from academia, industry, government, and civil society to shape a more responsible, trustworthy, and inclusive AI-powered media ecosystem.

Research perspectives:

- **Mitigating Algorithmic Bias**: Research focuses on developing algorithms that detect and mitigate biases in media content, promoting diversity and fairness across various dimensions of identity and representation.
- **Enhancing Transparency and Interpretability**: Efforts are directed towards advancing explainable AI techniques to elucidate decision-making processes in content recommendations and editorial choices, fostering user trust and understanding.
- **Countering Misinformation and Harmful Content**: AI-driven tools are developed to detect and counter deceptive content at scale, balancing the need to combat misinformation while preserving freedom of expression and minimizing collateral censorship.
- **Addressing Ethical Implications**: Interdisciplinary research aims to develop ethical frameworks, governance structures, and accountability mechanisms tailored to the unique challenges of AI in media production, curation, and distribution.
- **Advancing AI Ethics and Regulatory Mechanisms**: Efforts focus on shaping ethical guidelines and regulatory frameworks to ensure responsible AI deployment, mitigate potential harms, and promote innovation and societal benefits.
- **Promoting Interdisciplinary Collaboration**: Collaboration between academia, industry, government, and civil society stakeholders is crucial for addressing these challenges comprehensively and shaping a more responsible and trustworthy AI-powered media ecosystem.

Expected impact: Advancements in algorithmic fairness and bias mitigation are expected to promote diversity, equity, and inclusion in media content, fostering a more representative and inclusive media landscape. Enhancing transparency and interpretability in AI models will contribute to building user trust and understanding, leading to increased acceptance and adoption of AI-driven technologies in media workflows. Moreover, research aimed at countering misinformation and harmful content is anticipated to bolster societal resilience against manipulation tactics, promoting informed decision-making and fostering healthier online environments. Additionally, by addressing ethical implications and promoting regulatory compliance, research projects contribute to safeguarding user privacy, rights, and freedoms, thereby upholding fundamental democratic principles.

Economically, these research endeavors are expected to drive innovation and efficiency within the media sector, leading to increased competitiveness, profitability, and sustainability for media organizations.

Furthermore, interdisciplinary collaboration and knowledge exchange facilitated by research projects pave the way for broader societal impacts, including technological advancements, cultural shifts, and policy developments that shape the future of media and society at large.

IV.3 Personalization: Media & Content through GDPR compliance

Scope: In the digital landscape of Europe, personalization has emerged as a pivotal strategy for media access services and will transform the landscape of accessing and consuming media services and content. This paradigm shift will not only be limited to recommendations based on viewing history, rather, it will be a complex integration of cutting-edge technologies that understand, adapt, and predict individual preferences in nearly real time. Indeed, personalization, a concept transcending traditional personalization techniques, entails tailoring content and services to individual preferences with an unprecedented level of precision. This evolution stems from advancements in data analytics, artificial intelligence, and machine learning algorithms, enabling providers to deliver content that resonates deeply with each user. In the realm of media access services, personalization holds the promise of enhancing user satisfaction, engagement, accessibility and overall experience. However, the implementation of personalization in Europe is shaped by the regulations of the European General Data Protection Regulation (GDPR). These regulations impose clear limitations on the collection, processing, and storage of personal data, presenting both opportunities and challenges for media access service providers. This text explores the personalization within the European context, considering the complexities imposed by GDPR and its impact on the industry.

Specific challenges: While the promises of personalization are lucrative, the European media ecosystem faces unique challenges in its adoption. One significant hurdle lies in ensuring that AI algorithms align with diverse cultural nuances, languages, and regulatory frameworks across European countries. Additionally, a balance between tailoring content to individual tastes and respecting privacy regulations presents another essential challenge.

First, **the media access service providers in Europe are facing the challenges of compliance with the data protection regulations under GDPR**. Personalization relies heavily on the collection and analysis of user data to deliver tailored experiences. However, GDPR mandates clear requirements for obtaining user consent, ensuring data transparency, and safeguarding individuals' privacy rights. Compliance with these regulations necessitates robust data governance frameworks, sophisticated encryption protocols, and stringent access controls to mitigate the risk of data breaches and unauthorized access. Moreover, GDPR's principles of data minimization and purpose limitation impose constraints on the types of data that can be collected and the purposes for which it can be used. This could limits the depth and granularity of user insights that media access service providers can gather, constraining the efficacy of personalization algorithms. Additionally, GDPR's restrictions on cross-border data transfers pose challenges for multinational media companies operating across European jurisdictions, requiring them to implement localization measures or secure alternative data processing arrangements.

Second, the **sheer volume and diversity of available content pose another challenge**. Media access services encompass a wide array of content types, genres, and formats, making it challenging to develop algorithms capable of accurately predicting individual preferences. Ensuring that recommendations are relevant and valuable to users requires sophisticated machine learning models capable of processing diverse datasets effectively. Moreover, the dynamic nature of user preferences presents an ongoing challenge. As individuals' tastes and interests evolve over time, personalization algorithms must continuously adapt to reflect these changes. Failure to do so may result in stale recommendations and diminished user engagement. Thus, implementing mechanisms for real-time feedback and iteration is crucial to maintaining the effectiveness of personalized content delivery.

Last, **the potential monopolization by global tech giants demands a careful examination** of how European media entities can thrive in an increasingly AI-dominated environment.

Research perspectives:

- **Enhanced User Consent Mechanisms**: Explore novel approaches to obtain and manage user consent for data collection and personalization, ensuring compliance with GDPR while maintaining user trust and engagement.
- **Privacy-Preserving Data Analytics**: Investigate advanced techniques such as federated learning and homomorphic encryption to enable data analysis while preserving user privacy, thereby addressing GDPR protection on data processing.
- **Context-Aware Personalization**: Research methods to leverage contextual information (e.g., location, time, device) for hyper-personalization in media access services, minimizing reliance on individual user data while enhancing relevance and user experience.
- **Dynamic User Profiling**: Develop dynamic user profiling techniques and adaptive learning algorithms that adapt to changing user preferences and behaviors over time, considering GDPR protection on long-term storage and use of personal data.
- **Algorithmic Fairness and Transparency**: Explore methodologies to ensure fairness and transparency in hyper-personalization algorithms, mitigating risks of algorithmic bias and discrimination while complying with GDPR principles of data ethics.
- **Privacy-Enhancing Technologies (PETs)**: Investigate the integration of PETs such as differential privacy and secure multi-party computation into hyper-personalization systems, balancing the trade-off between personalization and privacy protection under GDPR.
- **Cross-Domain Personalization**: Explore methods for collaborative personalization across multiple domains or platforms while adhering to GDPR principles on data sharing and cross-border data transfers.
- **User-Centric Data Governance**: Research frameworks for user-centric data governance that empower individuals to control and manage their personal data across media access services, aligning with GDPR principles of data sovereignty and user rights.
- **Longitudinal User Studies**: Conduct longitudinal studies to analyze the long-term effects of hyper-personalization on user privacy, trust, and satisfaction within the European context, providing insights into the efficacy and ethical implications of personalized media access services under GDPR regulations.
- **Decentralized Identity Management**: Research decentralized identity solutions leveraging blockchain technology to enable secure and GDPR-compliant user authentication and authorization mechanisms for hyper-personalization systems.
- **Hybrid Recommendation Systems**: Develop hybrid recommendation algorithms that combine collaborative filtering, content-based filtering, and contextual information to optimize personalization effectiveness while respecting GDPR principles on user data usage.
- **Distributed Personalization Infrastructure**: Explore architectures for distributed personalization infrastructure that decentralizes data processing and storage, reducing GDPR compliance overhead and enhancing scalability and resilience of hyper-personalization systems.
- **Self-Sovereign Identity Systems**: Investigate self-sovereign identity systems that empower users to control and manage their personal data across multiple platforms,

enabling GDPR-compliant personalization while ensuring user autonomy and data ownership.

Expected impact: The integration of personalization GDPR aligned into European media access services is poised to have a profound impact on the industry landscape and have a transformative impact on both citizens and the overall ecosystem. The integration of personalization into media access services holds the potential to revolutionize the way users access, consume and interact with digital content. By delivering tailored experiences that resonate with individual needs and preferences, service providers can significantly enhance user satisfaction and engagement. This, in turn, is expected to drive increased usage, longer session durations, and higher retention rates, ultimately translating into improved monetization opportunities and sustainable growth. While GDPR imposes constraints on data collection and processing, it also encourages responsible data practices that prioritize user privacy and consent. By adhering to these principles, media access service providers will build stronger, more sustainable relationships with their users, fostering trust and loyalty over time.

Furthermore, personalization enables media access service providers to differentiate themselves in a crowded market landscape. By offering unique and highly customized experiences, providers can carve out a distinct competitive advantage and attract new users while retaining existing ones. Additionally, personalized advertising and promotional strategies can lead to higher conversion rates and increased revenue streams, benefiting both service providers and content creators alike.

In conclusion, personalization in European media access services presents both challenges and opportunities shaped by the regulatory framework of GDPR. While compliance requires compliance with data protection regulations, it also fosters a culture of responsible data stewardship and user empowerment. By leveraging GDPR-compliant data practices, media access service providers can deliver personalized experiences that resonate with users while respecting their privacy rights, driving engagement, loyalty, and business success in the digital age.

IV.4 AI for Media Access Services

Scope: Artificial Intelligence (AI) and its application towards personalization is transforming the way people work, live, and entertain themselves although the full potential of AI still needs to be further exploited within ethical boundaries. The expected impact on media and cultural and creative industries (CCI) will be huge but needs strong research & innovation support to benefit from these new opportunities. It will also re-shape the concept of creation and affect the operation and business models across the media and cultural sectors.

These are essential to foster both personal and usage data analytics, interconnectivity, and user-generated content (UGC), which will boost creativity and sharing data openly. In the future AI based tools will be developed, such as automatic translation from speech to subtitles, from text to Sign Language, and from Sign Language to text. These actions are essential to maintain Europe's position as the World leader in accessibility and for social and societal challenges.

Specific Challenges: By considering the current state-of-the-art and the relevant techniques based on AI in general, and deep learning in particular, the specific challenges in the next years for the media and CCI ecosystems are multiple and request to develop AI tools in order to:

- **Fluidize/streamline the circulation of audiovisual (or video) programs** through machine translation, while humans focus on the quality of work.
- **Encourage synergies and convergence between subtitling and the development of multilingualism** or the integration of foreigners (e.g., migrants).
- **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).
- **Integrate systematically open-source material for European low-resource or endangered languages** to maintain them alive and allow spread subtitled (media, educational) videos. Each software should be open-source to be re-used for any language subtitling.
- **Develop think-tanks** and do-tanks to maintain Europe's position as the World leader in accessibility and thus for social and societal challenges.

This is a huge thematic complex for qualitative research with the 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 future technical challenge is to transform and improve this further. The automatic translation solutions provided by AI and deep learning tools will allow to respond to the explosion of content, compliance with digital accessibility legislation, recommendations, and the reduction of production costs.

Research perspectives:

To achieve sustainable results in line with the European expectations, the research should focus, among others, on the following:

- **Involve fine-tuning open-sourced language models creation**, developing user interfaces sensitive to local nuances, special needs, and tailoring the technology to socio-cultural contexts of i.e. low-resource language speakers, deaf and hard of hearing, etc.
- **Build and annotate comprehensive datasets** with nuances to specific needs; focus on data normalisation for compatibility across modalities, enhancing quality i.e. by preprocessing to correct noise and variations, and implementing linked data for better contextual understanding.
- **Develop and integrate dedicated frameworks** of innovative AI modules focused on language processing and multimedia understanding, and create tools that can accurately transcribe, translate, and reproduce (and improve) spoken and written content in various languages and expressions modes.
- **Set-up relevant use cases and put them in a real-life environment**s, with different end-user groups to validate the usability and usefulness.
- **Search for comprehensive guidelines and recommendations** for preserving Europe's linguistic capital and promoting the inclusion of diverse linguistic, cultural, and human perspectives through technology. The multi-linguistic domain in the media and CCIs is only one approach for social sustainability through media accessibility. But it stands also for the inclusion for people with special needs, senior populations, migrants, or strangers in each country.

All actions should integrate open-source research, local collaborations, media engagement, capacity building, and integration with relevant EU initiatives.

Expected Impact: AI and personalized services should be appropriate, commensurate with the capabilities and performance of the individual, including the needs of everyone.

Successful projects in this area should solve the problems mentioned above and positively impact on societal levels, market and regulatory issues, and on social solutions for people with specific needs. The problem-solving concerns cinema and television, the CCI ecosystems with advertising, the world of performing arts, education and training, and potentially all corporate and institutional communications.

In terms of market impact and regulatory issues, new research, development, and innovation (R&D&I) projects should have the potential to change disruptively the circulation of programs, the transfer of language and multilingualism. Moreover, regulation clearly favors market opportunities. Therefore public/private projects, and especially think-tanks and do tanks should anticipate future needs and guarantee transparency and go-to-the market approaches for the innovations.

To maximize the usage of media services by persons with some functional limitations, including persons with disabilities or foreigners and migrants, the services 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. This includes the adaptability of content presentation and interaction, when necessary, providing an accessible electronic alternative and/or augmentation.

V Media, citizenship, disinformation and democracy

In today's rapidly evolving digital landscape, the role of media is more crucial than ever in shaping societies, fostering democratic values, and driving cultural enrichment. However, the proliferation of disinformation worldwide undermines these principles, eroding trust in information sources and distorting reality.

As technological advancements continue to reshape the media landscape, it becomes imperative to address key challenges and opportunities to ensure that media remains a cornerstone of democracy and societal cohesion. This comprehensive framework outlines strategies to promote diversity, combat disinformation, catalyse democracy, and establish future-proof policies, all aimed at fostering a vibrant, inclusive, and trustworthy media ecosystem. From safeguarding consumer trust to empowering marginalized communities, initiatives are needed to support the integrity of information dissemination while fostering innovation, competitiveness, and cultural preservation.

To navigate the rapidly changing media landscape, European future-proof policies are essential. Policy-makers must promote and adapt to technological advancements and evolving consumer behaviours, fostering innovation in journalism and enhancing regulatory frameworks to address emerging challenges like algorithmic bias and online misinformation. Investing in a diverse and resilient media ecosystem strengthens democratic foundations and upholds principles of freedom of expression, pluralism, and accountability. Investing in a diverse and resilient media ecosystem strengthens democratic foundations and upholds principles of freedom of expression, pluralism, and accountability. Generally, through collaborative efforts, stakeholders can navigate the complexities of the digital era while harnessing the transformative power of media for the betterment of societies across the globe.

V.1 Promoting diversity, pluralism and quality

Scope: The media serve as foundational pillars of democratic societies, fostering informed citizenship, social cohesion, and cultural enrichment. Diversity in media content encompasses a wide range of perspectives, voices, and experiences reflective of a diverse society. By representing various ethnicities, cultures, genders, sexual orientations, and socio-economic backgrounds, diverse media content promotes empathy, understanding, and appreciation for the richness of human diversity. At the same time, it allows a diverse media economy to thrive, channelling creativity into a kaleidoscope of media outlets and artefacts, mirroring the diverse aspirations and expectations of their viewers.

Pluralism in media refers to the existence of multiple viewpoints, ideologies, and narratives, ensuring that no single perspective monopolizes public discourse. Pluralistic media ecosystems foster critical thinking, debate, and the exchange of ideas, empowering individuals to form their own opinions and engage in democratic deliberation.
Quality in media encompasses accuracy, integrity, and relevance in content production, curation, and distribution. High-quality journalism upholds rigorous standards of factual accuracy, fairness, and impartiality, serving as a cornerstone of democracy by providing citizens with reliable

information to make informed decisions. High-quality fiction tells relevant stories in convincing, ambitious and sometimes innovatives productions and styles to entice audiences.

Furthermore, quality media content transcends sensationalism, clickbait, and misinformation, enriching public discourse and contributing to the intellectual and cultural development of society. Quality journalism holds power to account, exposes wrongdoing, and amplifies marginalized voices, thereby fostering accountability, transparency, and social justice.
In essence, diversity, pluralism, and quality in media are essential for nurturing a vibrant and participatory democracy. They promote tolerance, mutual respect, and civic engagement, counteract polarization and extremism, and empower individuals to engage critically with complex societal issues. Moreover, they contribute to the preservation of cultural heritage, the promotion of human rights, and the advancement of social progress.

Specific challenges: A first challenge lies in enhancing diversity and representation in media content, particularly in addressing systemic biases and underrepresentation of marginalized groups. Media industries grapple with developing inclusive content production processes, algorithms, and editorial practices that amplify diverse voices and perspectives while mitigating stereotypes and discrimination. Researchers struggle to obtain quantitative and qualitative data on marginalized groups, or to get members to participate in citizen science or co-design trajectories.

Similarly, ensuring pluralism in media requires addressing issues such as media ownership concentration, platform dominance, and algorithmic filter bubbles that can stifle diverse viewpoints and limit access to alternative narratives. Researchers explore strategies to promote media pluralism, including regulatory interventions, media literacy initiatives, and technological innovations that diversify content discovery and consumption experiences.

Furthermore, maintaining quality in media content amidst the proliferation of misinformation, disinformation, and sensationalism poses a significant challenge. Researchers investigate methods to combat misinformation at scale, including fact-checking algorithms, content verification tools, and collaborative debunking efforts. Additionally, ensuring editorial integrity, transparency, and accountability in an era of digital journalism and social media poses ongoing challenges, requiring innovative approaches to uphold journalistic standards and ethics.

Moreover, addressing the intersectionality of diversity, pluralism, and quality in media necessitates interdisciplinary collaboration between researchers, media practitioners, policymakers, and civil society stakeholders. Efforts to foster diversity and inclusion in media content must consider the complex interplay of social, cultural, and economic factors shaping representation and access. Similarly, strategies to promote pluralism and quality in media require holistic approaches that address structural inequalities, technological affordances, and regulatory frameworks shaping media ecosystems.

Research perspectives*:*

- **Enhancing Diversity in Content Creation**: Research focuses on developing inclusive content production processes and algorithms that amplify diverse voices and perspectives while mitigating stereotypes and biases.

- **Promoting Pluralism in Media Ecosystems**: Efforts are directed towards diversifying content discovery and consumption experiences through technological innovations, media literacy initiatives, and regulatory interventions.
- **Combatting Misinformation and Disinformation**: Research explores scalable solutions such as fact-checking algorithms, content verification tools, and collaborative debunking efforts to uphold quality and accuracy in media content.
- **Upholding Editorial Integrity and Accountability**: Strategies aim to maintain journalistic standards and ethics in digital journalism and social media environments, ensuring transparency and accountability in editorial practices.
- **Addressing Structural Inequalities**: Research perspectives examine the intersectionality of diversity, pluralism, and quality in media, considering the socio-cultural, economic, and regulatory factors shaping representation and access.
- **Technological Innovations for Inclusivity**: Advancements in AI and machine learning can facilitate diversity and inclusion by automating content analysis, detecting biases, and providing recommendations for more representative content.
- **Regulatory Frameworks for Media Pluralism**: Research evaluates the effectiveness of existing regulatory frameworks and explores new policy interventions to promote media pluralism, prevent monopolization, and ensure fair competition in the media sector.
- **Community Engagement and Participation**: Research perspectives emphasize the importance of engaging communities in the co-creation of media content and decision-making processes to ensure relevance, authenticity, and inclusivity.

Expected impact: Projects should stimulate innovation and competition within the industry, leading to a more dynamic marketplace of ideas and content creators. By broadening representation and fostering inclusivity, these projects unlock new revenue streams and market opportunities, attracting diverse audiences and advertisers alike.

Projects aimed at combating misinformation and ensuring quality in media content should help safeguard consumer trust and confidence, essential for sustaining revenue streams and advertising revenues. This, in turn, contributes to the long-term viability and profitability of media organizations, bolstering economic growth and employment opportunities in the sector.

Socially, projects addressing these challenges should promote a more informed, engaged, and cohesive society. By amplifying diverse voices and perspectives, they should foster empathy, understanding, and social cohesion, bridging divides and fostering a sense of belonging among marginalized communities. Furthermore, initiatives to counter misinformation and promote media literacy should contribute to empowering individuals to critically evaluate information, participate in democratic processes, and make informed decisions.

Finally, by upholding journalistic standards and ethics, projects should contribute to the preservation of democracy and the rule of law, serving as watchdogs of power and holding institutions accountable.

V.2 Combating disinformation

Scope: The media sector is exposed to and undergoing continuous innovations that occur at a pace never seen before. A significant booster behind such ongoing evolution is the intense development of technologies, especially those based on Artificial Intelligence (AI) that heavily influence and shape the online environment. The media sector is not an exception. AI already plays and will continue to play a critical role (both positively and negatively) in creating and spreading information in the current digital era, having a potentially disruptive impact on citizens, democracy, and society as a whole. As a result, there is a tremendous need for innovative (AI-based) solutions ensuring media freedom and pluralism, delivering credible and truthful information as well as combating disinformation and harmful content. This direction of supporting media sector transformation and adaptation is recognized and supported also by the European Democracy Action Plan and the European Media and Audiovisual Action Plan.

Specific Challenges:

- **Raise public awareness** about the development of the new generative AI tools and their impact on disinformation as their possibilities are not yet well known to the general public.
- **Detect as soon as possible sources of disinformation** that can be sophisticated (highly convincing) and can be very numerous and of different nature.
- **Decrease the spread and impact of disinformation** to help reinforce trust in credible media sources.
- **Create a safe online environment** in which users can navigate without the constant risk of being misled.

Research Perspectives: The research should focus on the future evolution of social media and its interplay with the relevant technological developments of generative AI that will finally result in significant facilitation in both the forging and diffusion of disinformation, which might exacerbate the already ongoing and alarming loss of trust in the media ecosystem. To support the media industry in coping with the growing automation of content creation and the complexities of new forms of social interaction, it is essential to identify and propose adequate technological solutions. In this sense, the goal is to support media professionals and media organisations to develop and evolve new business models, creating value, not only for their users but for the whole of society. Therefore, two hot topics to be taken in consideration are the **next generation of social media** and **Generative AI**.

- **Next-generation social media** refers to the anticipated evolution towards more **AI-based decentralised and immersive virtual environments** (e.g., fediverse or metaverse, which are sometimes also jointly denoted as Web 3.0). Such digital experiences, which emerge in the new kind of virtual environments, build on the rapid development of new technologies, especially federated digital platforms, augmented reality (AR), virtual reality (VR), extended reality (XR), gaming techniques, as well as artificial intelligence (AI) algorithms in general. However, the explosion of these technologies legitimately broaches

new concerns and challenges due to a potential growth of disinformation accompanied by a lack of trusted information. Federated social media such as Mastodon represent an opportunity for creating safer communication spaces through novel practices of content moderation (Ermoshina and Musiani 2022), but a similar design could be misused to create isolated communication niches where targeted disinformation can activate a digital movement of opinion (Marwick and Lewis 2017; Barisone et al. 2017). For example, due to their decentralised nature, these services can also be used by extremists and disinformation actors to circumvent content moderation policies, as for instance happened with PeerTube that is used by right-wing actors in a targeted manner to circumvent regulation and moderation and spread anti-vaccine disinformation and propaganda (Gerster et al., 2022). A wide diffusion of metaverses would instead represent an opportunity for malicious actors who could take advantage of generative tools at the intersection to craft what has been called*immersive falsehood*, i.e. fake immersive reality landscapes deliberately constructed for malicious ends (Aliman and Kester et al., 2020).

- **Generative AI** refers to such algorithms that can automatically generate content in multiple modalities, including but not limited to images, videos, or text. It can be used to create realistic fake content that can be difficult to distinguish from real content. This can be used to spread disinformation and propaganda, which can have a significant impact on public opinion, political processes, and social stability. **Generative AI can become the most prominent enabler of the envisioned threats caused by next-generation social media.** For example, deepfake videos created using generative AI can be used to impersonate political leaders, celebrities, or other public figures, spreading false information or inciting violence. Fake content tailored to individual user's interests can be generated in order to manipulate or deceive the selected target groups. Disinformation can be spread through fake personas and manipulated interactions. People may be deceived into believing that they are interacting with real people and organisations when they are actually interacting with bots or automated systems designed to spread disinformation. The use of AI poses risks and challenges, raising concerns about whether AI systems (inclusive of data, algorithms and applications) are worthy of trust. The **human-AI collaboration** allows for improved identification and for making significant improvements based on model predictions. All these potential cases, which illustrate how technologies can be misused in distributed and immersive online environments, can have serious consequences for social and political processes within the new virtual environments and beyond in our physical world.

Following these topics, potential perspectives include:

- **Coaching media professionals** to understand how virtual environments and generative AI work, including the benefits, limitations, and potential risks, and thus prepare and train media professionals **to utilise generative AI effectively and credibly in trusted information production,**
- Implementing tools to **detect new forms of content forging, tampering, and its use for social manipulation,**
- Implementing tools to **assess the reputation and credibility** of sources and their content, while taking the increased complexity of the next-generation social media into account,
- Increasing **transparency and trustworthiness of AI-based models** by allowing media professionals to understand the inner workings of available solutions as well as track their changes in time,

- Implementing **a platform for processing, understanding, and tagging multimedia content**, which will allow media professionals operate with multimedia content more efficiently,
- **Educating and guiding junior and/or inexperienced and non-expert journalists to exercise critical thinking** to interpret and critically assess the reasoning and arguments involved in a disinformation related statement or narrative.

Expected impact: Based on these perspectives, effective tools that can reliably support media professionals, not only to verify or debunk suspicious content that they encounter in a multitude of online platforms, but to also take proactive steps towards countering disinformation-related risks. By equipping media experts with advanced verification technologies and critical digital literacy skills, we can foster a more resilient information environment. The overarching aim is to preserve the integrity of information ecosystems within Europe and protect them from attempts to manipulate public opinion. This unified endeavor is crucial for reinforcing democratic principles, fostering a well-informed population, and preserving the foundational trust that is vital to the cohesion of European communities.

V.3 Media as a catalyst for democracy

Scope: In our open democracies media serve as a vital column of any open democratic discourse – the fourth power besides legislative, judicative and executive. The freedom of media and the protection of its sources **literally constitute our representative democracy**. Printed newspapers at the outset, later broadcasting enabled the dialogue and discourse among the stakeholders in democratic decision making – opening gradually to larger parts of the open society. This development has now been escalated and propelled to a new level with phenomenon's like of social media and AI. Current political discussions refer less to the fading influence of printed news-media. Traditional public broadcasting does barely reach the younger half of our electorate**. Technical access to broadcasting** is often hampered and less evident as at the terrestrial age. Information is conveyed in other ways, social media networks, like TikTok, Instagram, or Facebook (for the older generations) allow open discourse in the prosumer approach. Discussions become speedier, but not necessarily more accurate. Facts – whether true or false - are less curated or researched, the ongoing debates tend to separate the electorate into bubbles and lead to the disintegration of our society into different communities. On the other hand, information cannot be withheld anymore; government-driven communication agendas see themselves often confronted with facts, which are spreading virally. Mechanisms concerning **fake news and false information** in the context which have been implemented are still not sufficient.

Technologies become more and more central for the democratic discourse themselves. When Marshall McLuhan stated, "the medium is the message" we could say today that the "**media technology is the message**". The fact that Europe does not control the central social media networks, but they come either from China or from the US is a handicap for European democracies. Europeans cannot really guarantee that the data collected is not misused for political purposes; we have no influence on the algorithms of dispatching news information. The outcome on our democratic decision-making process is futile. This has been well documented in in the popular vote concerning the Brexit decision. Companies like Meta, TikTok, but also companies like Google or OpenAI (ChatGPT) base their business model mainly on the

exploitation of personal data. The European approach to data protection is different: They belong to human beings. It is evident, that the new popular movements in different European countries - and in the US - have to a lot to do with the new communication technologies. The gaps - including the generation gap - leads to a less and less coherent European society; this endangers our values and eventually our democracy. Its not limited to journalism but encompasses entertainment as the values which lead to democratic decisions of the electorate are also lead by emotions, not only by facts.

Specific challenges: It is necessary that Europe can provide own **tools and technologies** to offer solutions to counterbalance; the role of independent public broadcasting becomes crucial. Additionally: The fact that we do not control the **App Stores** in Europe refrains Europeans from insights in the end users and their behaviour. Europe does not even have substantial market shares in simple and safe **videoconference solutions** anymore. **Game engines** from overseas are currently losing trust but remain nevertheless less and less in European hands. To re-establish sovereignty for the European approach of democracy, it is necessary to develop and emphasise the development of **standards, media technology and tools**, which are relating to social and interactive media as well as linear media, such as public broadcasting. The challenges and opportunities of **AI** need to be embedded universally in this approach. Technologies and tools which culturally and commercially allow to leverage our diverse **heritage**, our democratic society, and our rich **culture -** for which we are envied across the globe - to transfer these assets in the next age: **social media, gaming, media and enhancing technologies**. An important solution is the **opening of information channels and data** for research and investigation. Technologies **linking linear and interactive information as well as entertainment** in an increasingly AI driven environment must defend a **user driven** European approach by complying to **European standards of data and personality protection**. Ubiquitous and universal technical access to public broadcasting needs to be secured.

Research perspectives:

- Technologies, which allow to enable **technical access to European public broadcasting** in a **universal and ubiquitous** way even though former OTT services from overseas have increasing factual ownership to the final mile towards the end user.
- Better mechanisms concerning **fake news and false information** based on AI
- European alternatives to following technologies: **App Stores** in the App economy ecosystem, **Video conferencing** technologies, **Game engines** and comparable tools.
- Technologies **linking linear and interactive information as well as entertainment such as social media, gaming, media and enhancing technologies**.
- Activities enhancing the **opening of information channels and data** for research and investigation.
- Establishing activities relating to **European standards of data and personality protection** in emerging virtual spaces and social media including the so called metaverse.
- European **AI technologies** defending a **user driven** European approach.

Expected Impact: Projects should stimulate innovation and competitiveness within the media. industry, tackling the specific challenges of European democracy. They will be balanced innovation with consumer protection. Research projects will encourage investment in media technologies, infrastructure, and content creation, to stabilize our democracies, but nevertheless fuelling economic growth in Europe. By promoting diverse voices, perspectives, and content

formats, these projects enhance audience media pluralism in both journalism and entertainment. The enhance trust and confidence in European digital media. By developing robust privacy-enhancing technologies, these projects create a conducive environment for responsible data.

V.4 Future-proof policies for rapidly changing media markets

Scope: Media policy and regulation are articulated across various ways and subdomains to ensure the orderly functioning of the media landscape while safeguarding public interest and democratic values. Firstly, **content regulation** encompasses rules governing the production, distribution, and consumption of media content, addressing issues such as hate speech, harmful content, and advertising standards**. Broadcasting regulation** focuses on licensing, spectrum allocation, and public service obligations for traditional broadcast media, ensuring quality, diversity, and accessibility of content. **Telecommunications regulation** governs the infrastructure and services enabling media distribution, including broadband networks, mobile communications, and internet access. This domain covers issues such as net neutrality, spectrum management, and universal service obligations to ensure equitable access and fair competition in the telecommunications market. **Data protection and privacy regulation** are crucial in the digital media landscape, governing the collection, processing, and sharing of user data by media companies and online platforms. This includes regulations such as the General Data Protection Regulation (GDPR), which establishes principles and safeguards for data protection, privacy rights, and user consent.

Competition law addresses market concentration, anti-competitive practices, and monopolistic behavior in the media sector, promoting fair competition and consumer choice. Intellectual property regulation, particularly copyright law, protects the rights of content creators and owners while balancing access to knowledge and cultural expression.
Furthermore, media policy and regulation intersect with **cultural policy**, addressing issues of cultural diversity, linguistic plurality, and support for the creative industries through funding, subsidies, and cultural programming mandates. Lastly, cross-border and **international cooperation** mechanisms facilitate coordination and harmonization of media policies and regulations across jurisdictions, including **standardization**, in order to ensure coherence and effectiveness in addressing transnational challenges and opportunities in the global media landscape.

Addressing many of these domains and involving multiple policy instruments, the European media policy and regulatory landscape is intricate. The **Audiovisual Media Services Directive** (AVMSD) is a cornerstone of EU media policy, regulating content distribution across traditional and online platforms, promoting cultural diversity, and protecting minors. The **General Data Protection Regulation** (GDPR) governs data protection and privacy rights, impacting media companies' handling of user data for targeted advertising and content personalization. In telecommunications, the **Electronic Communications Code** (EECC) harmonizes rules for electronic communications networks and services, ensuring fair competition and consumer protection. Additionally, the **Digital Services Act** (DSA) and the **Digital Markets Act** (DMA) aim to regulate online platforms and address issues such as disinformation, harmful content, and platform dominance. Copyright legislation, including the **Copyright Directive**, modernizes copyright laws in the digital age, balancing the interests of content creators, platforms, and users. The European Union also promotes media pluralism and freedom of expression through initiatives like the **Media Pluralism Monitor**, the **European Audiovisual Observatory** and the **European**

Digital Media Observatory. In 2024, a **European Media Freedom Act** should see the light to complement this. Moreover, the upcoming **AI Act** is expected to have a significant impact on the media.
Finally, initiatives such as the European Film Forum and Creative Europe support the European audiovisual sector's competitiveness and cultural diversity through funding, training, and cross-border collaboration. All of these initiatives interact with and complement national policy and regulations.

Specific challenges: Over the next decade, media policy faces a multitude of challenges as technological advancements, societal shifts, and global dynamics reshape the media landscape. One key challenge is balancing regulatory oversight with innovation in the digital age, particularly in regulating online platforms and addressing emerging issues such as disinformation, algorithmic bias, and platform dominance. Achieving a harmonized regulatory framework across borders is another challenge, as divergent national policies and differing cultural contexts complicate efforts to address transnational issues like hate speech and copyright infringement.

Furthermore, ensuring the sustainability of public service media in the face of digital disruption poses a significant policy challenge, requiring support mechanisms to preserve plurality, quality journalism, and public service content. Specific questions in this regard concern the discoverability and prominence of such content in the context of new, algorithm driven hardware and interfaces. In a broader sense, advancing cultural diversity and preserving cultural heritage in the digital era requires policy interventions to support the creation, distribution, and preservation of diverse content, particularly in smaller markets with minority languages and underrepresented cultures. Moreover, preserving media pluralism and independence amidst increasing concentration of media ownership and commercial pressures is essential for safeguarding democratic discourse and citizen engagement. This entails promoting diverse ownership models, strengthening editorial independence, and combating undue political influence and censorship.

Additionally, data privacy and protection remain paramount, necessitating continual adaptation of regulatory frameworks to address evolving privacy threats and technological capabilities.

Finally, addressing inequalities in access to media and digital infrastructure, both within and between regions, is crucial for fostering social cohesion and inclusive development. This involves tackling barriers to media access, promoting digital literacy, and bridging the digital divide.

Meeting these policy challenges requires proactive and adaptive approaches that engage stakeholders across sectors and jurisdictions to shape a resilient and inclusive media ecosystem for the future.

Research perspectives:

- **Balancing Regulatory Oversight with Innovation**: Research perspectives focus on developing flexible regulatory frameworks that stimulate innovation while effectively addressing emerging challenges such as disinformation, algorithmic bias, and platform dominance in the digital age.
- **Harmonizing Regulatory Frameworks Across Borders**: Efforts are directed towards understanding and reconciling divergent national policies and cultural contexts to facilitate

the development of harmonized regulatory approaches for addressing current issues like investment obligations for platforms and OTT players, copyright regulation, ownership regulation and financial transparency, accessibility, discoverability and prominence.

- **Sustainability of Public Service Media and other providers of quality conten**t: Research aims to identify support mechanisms and funding models that ensure the sustainability of public service media, preserving plurality, quality journalism, and public service content in the face of platformisation and algorithmisation. Specific questions revolve around the discoverability and prominence of such content in algorithm-driven environments.
- **Advancing Cultural Diversity and Heritage Preservation**: Studies explore policy interventions to support the creation, distribution, and preservation of diverse content, particularly in smaller markets with minority languages and underrepresented cultures, to promote cultural diversity and heritage preservation in the digital era.
- **Preserving Media Pluralism and Independence**: Research investigates strategies for promoting diverse ownership models, strengthening editorial independence, and combating undue political influence and censorship to safeguard democratic discourse and citizen engagement amidst increasing concentration of media ownership and commercial pressures.
- **Addressing Inequalities in Media Access and Digital Infrastructure**: Research focuses on identifying and addressing barriers to media access, promoting digital literacy, and bridging the digital divide, both within and between regions, to foster social cohesion and inclusive development.

Expected impact: Projects should stimulate innovation and competitiveness within the media industry, driving technological advancements, business model innovation, and market expansion. By fostering a supportive regulatory environment that balances innovation with consumer protection, research projects encourage investment in media technologies, infrastructure, and content creation, thereby fueling economic growth and job creation.

Moreover, research projects focused on diversity, pluralism, and cultural heritage preservation should contribute to the vibrancy and inclusivity of the media ecosystem, fostering creativity, talent development, and cultural expression. By promoting diverse voices, perspectives, and content formats, these projects enhance audience engagement, satisfaction, and loyalty, leading to increased consumer spending and advertising revenues. Additionally, initiatives aimed at addressing inequalities in media access and digital literacy can empower marginalized communities, bridge digital divides, and promote social cohesion and inclusive development.

Furthermore, research projects on data privacy and protection contribute to building consumer trust and confidence in digital media platforms, safeguarding individuals' rights and freedoms in the digital age. By developing robust privacy-enhancing technologies, regulatory frameworks, and best practices, these projects create a conducive environment for responsible data stewardship, innovation, and ethical use of personal data.