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ITU Focus Group on metaverse

Policy and regulation opportunities and challenges in the metaverse

Working Group 7: Economic, regulatory & competition aspects

Technical Report ITU FGMV-07

Policy and regulation opportunities and challenges in the metaverse

Summary

The transformative potential of the metaverse will require policy-makers and regulators to strike the right balance between social, environmental, economic and legal aspects. To support policy-makers and regulators in this important endeavour, this Technical Report looks at the policy and regulatory challenges of the metaverse, including an overview of its key enabling technologies, and regional and national approaches to metaverse development.

With around one third of humanity lacking digital connectivity completely, a primary policy and regulatory concern for the metaverse remains addressing the digital divide and ensuring an open, accessible and inclusive metaverse. To be accessible to all, the metaverse will require energy-intensive data centres and communication networks, presenting substantial environmental challenges. Policy-makers and regulators will need to address environmental concerns, including e-waste, while accelerating the adoption of energy-efficient metaverse practices enabled by Internet-of-Things and digital-twin technologies. Development of standards and interoperability will play a key role in identifying efficiencies as well as providing a seamless and enjoyable user experience in the metaverse while encouraging market competition.

The immersive nature of the metaverse is expected to generate vast amounts of personally identifiable information, making privacy, security and trust vital concerns. Similarly, ethical and human-rights considerations will need to be considered to promote responsible behaviour in the metaverse. Policy-makers and regulators will need to develop guidelines and frameworks to address these concerns and ensure that the metaverse aligns with societal values.

Lastly, the metaverse offers a unique opportunity for policy-makers and regulators to harmonize their policy and regulatory efforts related to the metaverse and its enabling technologies. As whole regions around the world, as well as countries and cities, embrace the potential social and economic benefits of the metaverse, policy-makers will need to be sensitive to different adoption and implementation approaches while promoting interoperability. The same applies to metaverse-enabling technologies such as artificial intelligence (AI), blockchain and cloud computing. This harmonization will not only ensure that the metaverse develops for the benefit of all users but also accelerates sustainable digital transformation and the achievement of the Sustainable Development Goals.

Keywords

Accessibility, AI, big data, cloud, content moderation, digital twin, extended reality, human rights, inclusiveness, intellectual property, interoperability, IoT, metaverse, policy, privacy, regulation, security, sustainability.

Note

This is an informative ITU-T publication. Mandatory provisions, such as those found in ITU-T Recommendations, are outside the scope of this publication. This publication should only be referenced bibliographically in ITU-T Recommendations.

Change Log

This document contains Version 1.0 of the ITU Technical Report on "*Policy and regulation opportunities and challenges in the metaverse*" approved at the third meeting of the ITU Focus Group on metaverse (FG-MV), held on 3-5 October 2023 in Geneva, Switzerland.

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Editor:	Andrey Perez Anatel Brazil	Email: andreyperez@anatel.gov.br
Editor:	Okan Geray Digital Dubai United Arab Emirates	Email: Okan.Geray@digitaldubai.ae

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1   Scope

This Technical Report provides a detailed overview of policy and regulation opportunities and challenges for the metaverse including key enabling technologies. This is delivered by examining the role of policy and regulation in shaping emerging technologies such as the metaverse as well as reviewing regional approaches to metaverse development.

2   References

None.

3   Definitions

3.1   Terms defined elsewhere

This Technical Report uses the following terms defined elsewhere:

3.1.1   artificial intelligence (AI) [b-ITU-T M.3080]: Computerized system that uses cognition to understand information and solve problems.

3.1.2   augmented reality (AR) [b-ITU-T P.1320]: An environment containing both real and virtual sensory components. The augmented reality continuum runs from virtual content that is clearly overlaid on a real environment (assisted reality) to virtual content that is seamlessly integrated and interacts with a real environment (mixed reality).

3.1.3   digital twin [b-ITU-T Y.4600]: A digital representation of an object of interest.

3.1.4   immersion [b-ITU-T G.1035]: A psychological state characterized by perceiving oneself to be enveloped by, included in and interacting with an environment that provides a continuous stream of stimuli and experiences.

3.1.5   Internet of Things (IoT) [b-ITU-T Y.4000]: A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies.

3.1.6   interoperability [b-ITU-T Y.101]: The ability of two or more systems or applications to exchange information and to mutually use the information that has been exchanged.

3.1.7   mixed reality (MR) [b-ITU-T P.1320]: An environment containing both real and virtual components that are seamlessly integrated and interact with each other in a natural way (one end of the augmented reality continuum).

3.1.8   presence [b-ITU-T G.1035]: The subjective experience of being in one place or environment, when one is physically situated in another place or environment.

3.1.9   virtual reality (VR) [b-ITU-T P.1320]: An environment that is fully generated by digital means. To qualify as virtual reality, the virtual environment should differ from the local environment.

3.2   Terms defined in this Technical Report

None.

4 Abbreviations and acronyms

This Technical Report uses the following abbreviations and acronyms:

AI   Artificial Intelligence

AGI   Artificial General Intelligence

ANI   Artificial Narrow Intelligence

AR   Augmented Reality

DL   Deep Learning

DLT   Distributed Ledger Technology

ICT   Information and Communications Technology

IoT   Internet of Things

ML   Machine Learning

MR   Mixed Reality

NFT   Non-Fungible Tokens

PII   Personally Identifiable Information

VR   Virtual Reality

XR   Extended Reality

5 Conventions

None.

6 Role of policy and regulation in shaping emerging technologies

Policy and regulation play an important role in shaping emerging technologies. Regarded by some as the future of online communications [b-World Economic Forum], the metaverse is expected to inherit and potentially amplify many existing policy and regulatory challenges associated with the Internet and its underlying technologies [b-Maciejewski]. Bringing together many pieces of the digital landscape, the metaverse will be subject to current and evolving policy, legal and governance frameworks. It is crucial to prioritize policy coherence and acknowledge that numerous policy and regulatory issues concerning the metaverse are not entirely new, but rather stem from the existing Internet landscape. As the metaverse advances and introduces unique features, these challenges are expected to become increasingly complex and acute. By addressing these complexities, policy-makers can develop a robust and well-rounded approach to effectively govern the diverse aspects of the metaverse and mitigate potential risks.

By carefully considering both positive and negative aspects of the metaverse, policy and regulation can provide a clear framework for metaverse development, deployment and use. For the metaverse policy and regulation to bring benefits such as economic development and innovation, while ensuring it reflects the values of its users, and not only its creators, in a way that benefits society, the metaverse will need to be developed through an open and inclusive process. Regulators and policy-makers can also use their regulatory and policymaking experience in developing frameworks and regulatory sandboxes to incentivize the development of the metaverse to promote universal connectivity and sustainable digital transformation at the national, regional and global levels.

7 Understanding the metaverse

The idea of the metaverse has been discussed for several decades, but it was not until the measures taken COVID-19 pandemic caused an acceleration of digital transformation and maturity of a set of key emerging technologies that the metaverse discourse reached global prominence. The public health crisis accelerated how our society, governments and private sector use technologies [b-Goasduff] and emphasized their central role in helping maintain our social connections [b-DeFilippis]. Coupled with advances in artificial intelligence (AI), big data, digital twinning, blockchain, Internet of Things (IoT) and extended reality (XR), the concept of the metaverse no longer felt like science fiction. By the end of 2021, several large technology companies had announced billions of dollars in investments to develop metaverse products and services, promising new market opportunities [b-Bobier].

While an agreed definition of the metaverse is still being considered by experts of the ITU Focus Group on metaverse, several characteristics such as online presence and interactivity are commonly used to describe the metaverse concept. A key differentiating characteristic is the immersive, virtual or augmented reality nature of the metaverse, separating it from other online social experiences [b-Anderson]. One of the main technical challenges in achieving this immersive experience on a global scale is latency, or the delay between action and reaction that a user perceives [b-Dano]. Studies on virtual reality motion sickness consistently demonstrate that lower latency results in less motion sickness and a better user experience [b-Stauffert]. As metaverse-enabling technologies continue to evolve and improve, the metaverse holds immense promise to redefine how we interact and engage with the digital world.

7.1 Concept and vision

Immersion and presence are essential components of the concept of the metaverse [b-Dwivedi]. Immersion refers to sensory fidelity, whereas presence describes the user's subjective psychological response [b-Bowman]. The metaverse aims to use technology to create low-latency virtual worlds that captivate our imaginations, combining senses of presence and immersion to enable users to actively engage with their digital environments [b-ITU-11]. The social aspect of the metaverse is as crucial as its enabling technology, since a large user base is necessary for the metaverse to reach its full transformative potential on a global scale. Early platforms such as Habitat and Second World recognized this, emphasizing the importance of user interaction and expression in their online spaces [b-Brown].

The development of the metaverse has a long history, tracing its roots back to late 19th-century ideas of technologically enabled imaginary worlds [b-ITU-4]. With the emergence of the cyberpunk literary genre in the 1960s, writers began envisioning a future where humans primarily existed in cyberspace. Neal Stephenson's 1992 novel, Snow Crash, coined the term "metaverse" to describe a virtual world in which the dystopian future is dominated by private corporations, reflecting their significant influence and control over society [b-Kafka].

When people envision the metaverse, a variety of perspectives emerge. In 2022, the Pew Research Centre surveyed experts and interested members of the public about their vision of the metaverse in 2040. Results showed a nearly even split in opinions, with 54% of the 624 respondents agreeing that the metaverse would become a refined, fully immersive and well-functioning aspect of daily life for at least half a billion people globally, while 46% disagreed [b-Pew Research Center]. A different survey carried out by Ipsos, also in 2022, found that interest in the metaverse is highest in emerging countries. About half of adults across 29 surveyed countries were familiar with the metaverse and reported positive feelings about engaging with XR in daily life [b-Ipsos].

Visions of the metaverse can be grouped into three primary perspectives. The most optimistic view suggests the metaverse could create a better web, becoming an integral, fully immersive part of daily life that enhances society and generates economic benefits [b-AI for Good-1]. The second viewpoint posits that the metaverse transition will be driven by augmented reality (AR) and mixed reality (MR) rather than fully immersive virtual reality (VR), with AR and MR devices anticipated to gradually

enhance our online experiences [b-Cass]. XR is often used as a catch-all term to refer to AR, VR and MR concepts [b-Arm]. The most pessimistic perspective contends that even if the metaverse achieves widespread adoption, private corporations will likely dominate, exacerbating existing digital issues surrounding privacy, safety and security [b-Hunter].

In this context, metaverse-enabling technologies play a significant role in shaping the future metaverse landscape. Advances in XR technologies will determine the extent to which immersive experiences become part of our daily lives. As the metaverse continues to develop, it is expected to encompass distinct applications across industrial, including smart cities, enterprise and consumer sectors, catering to specific needs and use cases [b-Whiting]. While online gaming has already introduced millions of people to a version of a metaverse [b-Statista], the integration of metaverse-enabled devices into everyday use could enhance our online experiences and alter the way we interact with the digital world. However, to ensure the dystopia depicted in the novel Snow Crash does not become a reality, it is essential to address the policy and regulatory challenges of enabling technologies and the metaverse to ensure it is developed for the benefit of all rather than only for the privileged few.

7.2   Next generation networks

Ensuring robust and high-speed connectivity across both fixed and wireless networks is a foundational aspect of online immersive experiences [b-Ericsson Technology Review]. The metaverse's transformative potential relies heavily on seamless access and interaction with vast amounts of data in real-time.

Fixed networks, leveraging cutting-edge technologies such as fibre-optic communication, play a pivotal role in enabling bandwidth-intensive services [b-ITU-4]. Additionally, addressing spectrum allocation and management for wireless communication is key to maximizing the metaverse's accessibility using mobile broadband connected headsets and devices [b-ITU-6].

Policy and regulatory frameworks need to incentivize investment in high-speed network technologies, supporting infrastructure development and fostering competition among service providers. It is important to strike the right balance between promoting innovation and ensuring affordable, secure and accessible services for all users.

7.3   XR technologies

Policy and regulation play a critical role in addressing the challenges and harnessing the opportunities presented by metaverse-enabling technologies, particularly those related to XR or Spatial Computing capabilities. As XR devices evolve and become more accessible, policy-makers must proactively address usability, security, content and user experience concerns to drive widespread adoption and ensure a seamless and immersive metaverse experience.

Ensuring that XR devices deliver content at low-latency and at high resolution and frame rate is crucial to mitigating motion sickness and discomfort for users. A paradigm shift in user experience is necessary for the successful integration of XR devices into daily life [b-ITU-7]. Policy-makers can facilitate this transition by encouraging the development of user-friendly interfaces, promoting the interoperability of XR platforms and fostering the creation of compelling and diverse content within the metaverse.

Furthermore, data privacy and security should be at the forefront of policy considerations as XR devices collect and process vast amounts of user data. Striking the right balance between user empowerment and data protection will be critical to ensuring public trust in the metaverse.

7.4   Digital twin

Digital twin technology, which involves the creation of digital replicas of real-life objects, has demonstrated its potential as a transformative enabler particularly in the industrial and smart city sectors. The advantages of digital twins are evident in cost-efficient simulation, integration, testing, monitoring and maintenance of physical entities, ranging from a human heart [b-Philips] to a city [b-ITU-8], and even the whole planet [b-ITU-9]. However, as digital twin technologies extend beyond industrial and smart city applications, the role of policy and regulation becomes pivotal in shaping their development.

Effective policy and regulatory frameworks are crucial to address the challenges and opportunities presented by digital twin technologies in the metaverse. Policy-makers should carefully consider data privacy and security concerns, intellectual property rights and ethical considerations, particularly in the context of digitizing the human body for applications in digital human models and health care.

7.5   Internet of Things

The widespread adoption of IoT sensors is rapidly transforming how we interact with the digital world [b-ITU-10]. As we witness the digital transformation catalysed by IoT in various sectors, including industry, smart cities, health and commerce, the influence of IoT on the metaverse is anticipated to be even more profound. Real-time data generated by IoT devices will enable new XR applications and services, enriching the metaverse experience [b-IEEE Xplore].

The policy and regulatory landscape must proactively address the challenges and opportunities presented by IoT technologies in the metaverse. Policy-makers should focus on ensuring data privacy, security and interoperability to instil confidence among users, businesses and governments. Data governance frameworks need to strike a balance between protecting individual privacy rights and enabling data sharing necessary for a seamless metaverse experience.

7.6   Cloud and edge computing

With the metaverse expected to require vast amounts of data, it will need reliable and secure data storage while ensuring instant accessibility from anywhere in the world. Data centres and edge computing are likely to form the backbone of the metaverse, necessitating innovative policies to facilitate their deployment and management [b-Carlini]. To meet the metaverse's demand for low-latency transfer speeds, data centres will need to be strategically located closer to large user hubs. This is likely to be accompanied by greater use of edge computing, which allows processing of data at the "edge" of the network and is expected to be a key solution to addressing the metaverse's latency challenge [b-Arif].

Policy-makers will need to navigate issues related to data privacy, security and cross-border data flow, as edge computing brings data processing closer to users and IoT devices. At the same time, it will be key to incentivize investment in secure data centre infrastructure, which promotes sustainable energy use and enables competition among data centre providers to ensure efficient and cost-effective operations.

7.7   Artificial intelligence

AI is expected by some to be the driving force behind the metaverse [b-AI for Good-2]. While so far there is no artificial general intelligence (AGI) that can match the diversity of human abilities, current artificial narrow intelligence (ANI) models are becoming very good at performing specific tasks with the aid of machine learning (ML) techniques [b-OECD]. Recent advancements in AI driven by the availability of vast training datasets have led to significant progress [b-IBM-1]. Policy-makers must ensure transparent and responsible data collection, use and sharing practices to build public trust in AI technologies within the metaverse.

Deep learning (DL) is a subset of ML where the machine aims to predict an output based on a set of inputs. ML transformer machine learning models, which power tools such as ChatGPT, offer tremendous potential in the metaverse to create interactive experiences through virtual avatars or assistants. To achieve this in a secure, accessible, and inclusive way will require robust policies to address issues such as data ownership, intellectual property rights and access to computing resources [b-European Parliament].

7.8 Distributed ledger technology and blockchain

Distributed ledger technology (DLT), in its simplest form, represents an innovative database technology that allows records to be securely stored in multiple locations while maintaining accuracy and up-to-date information. The most common form of DLT is blockchain, which provides a decentralized and distributed ledger, ensuring immutable and secure records across the network [b-IBM-1]. Blockchain is expected to play a key role in facilitating a decentralized model for creating and exchanging data in the metaverse [b-Huynh-The].

As blockchain technology evolves and becomes integrated into the metaverse, policy-makers must address key regulatory considerations to maximize its potential while safeguarding user interests. Data privacy and security are paramount, as blockchain records are distributed and interconnected, necessitating robust measures to protect sensitive information and prevent unauthorized access [b-Huynh-The].

8 Key policy and regulatory challenges and opportunities of the metaverse

To maximize its transformative opportunities of reducing the digital divide, empowering the digital commons, stimulating innovation and industrial development as well as providing a seamless connection between people around the world, the metaverse needs to be developed through an open and participatory regulatory process. A strong standards-based foundation is essential for the development of the metaverse, including the industrial metaverse and citiverse, to ensure quality user experiences and interoperability between its different enabling technologies.

The metaverse offers increased economic and social opportunities across enterprise, public sectors and industry, encompassing the industrial metaverse for streamlined manufacturing processes and the citiverse to advance urban management. However, it also raises important ethical and human rights considerations such as privacy, security, identity and inclusivity. For the metaverse to become a tool for the benefit of all, regulators will need to ensure a consistent application of domestic and international laws to create a safe online environment. Furthermore, in specific use cases such as health care, the metaverse is expected to bring advancements in telemedicine and virtual health care, while at the same time introducing new health risks and data governance challenges.

The metaverse has the potential to drive technological innovations and create new market opportunities, ushering a new era of digital transformation. Ensuring privacy and user protection in the metaverse is crucial to realizing this vision due to the increased collection of sensitive personal information in the metaverse.

To become a global communications platform, metaverse governance and moderation models will need to play a key role in balancing freedom of expression with the need to prevent online harm and abuse. Similarly, robust intellectual property rights will play a key role in incentivizing innovation and investment in the metaverse, including the development of industrial and smart city applications. To develop a metaverse for the benefit of all, governments, industry and civil society will need to work together to address its key policy and regulatory issues [b-Yin].

8.1 Access and the digital divide

The metaverse presents an opportunity to reduce the digital divide by accelerating sustainable digital transformation and the rollout of ICT infrastructure, skills and access to digital communication technologies. An open metaverse can also empower the digital commons by strengthening digital public infrastructure and digital public goods for the benefit of all users [b-Ngodup Massally].

To achieve this ambition on a global scale will first require policy-makers and regulators to address the issue of Internet infrastructure and access. According to ITU research [b-ITU-1], while the number of Internet users has surged from just a few million in the early 1990s to almost five billion today, 2.7 billion people – or around one third of humanity – remain totally offline, and many hundreds of millions more people struggle with expensive, poor-quality Internet access that does little to materially improve their lives.

Furthermore, with just 5% of the global population still physically out of reach of a mobile broadband signal, the "coverage gap" is now dwarfed by the "usage gap". Some 32% of people who are within range of a mobile broadband network and could theoretically connect remain offline, due to poor quality of service, prohibitive costs, lack of access to a device or lack of awareness, skills or ability to find useful content. Early metaverse devices such as headsets are expected to be expensive and require a higher level of digital literacy to operate. Unless the challenge of the digital divide is addressed at the outset, the metaverse risks becoming a tool for the privileged few, instead of a transformational opportunity to connect the unconnected.

8.2 Interoperability and standardization

Having a strong standards-based foundation for metaverse development, deployment, and operation will ensure a better and safer user experience, and stronger platform integration of the industry, smart cities, consumer and public sector segments of the metaverse [b-Koziol]. Policy and regulation plays an important role in reducing fragmentation of technologies by establishing a set of common technical standards and regulatory practices to facilitate greater interoperability [b-Doctorow]. With increased interoperability, the metaverse can expect to attract new users and create new markets to drive innovation, investment and economic growth.

At the user level, standardization and interoperability will allow metaverse users to have a consistent experience and seamlessly move their avatars, digital assets and data between different metaverse platforms. Having this consistency across platforms can also strengthen user privacy and security measures through common protocols that can be developed and audited by a global community of information security experts. In the industrial metaverse context, interoperability can help increase efficiency and productivity by allowing industrial control systems to securely integrate with data and analytical platforms to create remotely accessible digital twin models. The consumer metaverse will require interoperability to increase customer satisfaction and choice by reducing friction for consumers travelling between different retail platforms, encouraging market competition and economic activity. While for the metaverse or citiverse in the smart city context [b-Eurocities], to virtually integrate various aspects of city life such as infrastructure, services and spaces for civic interactions, including virtual tourism, will require interoperability of a significant number of different industrial and consumer platforms.

8.3 Sustainability and environmental impact

Compared to what is possible today, the immersive nature of the metaverse presents an opportunity to significantly increase the number of social, retail and professional activities online. From work meetings, shopping and visits to the doctor, to social gatherings and tourism, the metaverse aims to provide a similar level of experience to the physical world without having to commute from one location to another. Reducing the amount of travel using carbon-intensive modes of transport and increasing energy and resource efficiency using digital twins can theoretically produce positive environmental results [b-Zhao].

Digitally replicating industrial processes, or creating a digital twin, to allow remote teams to identify improvements before committing resources to projects in the physical world, is expected to increase energy efficiency and emission reductions in the industrial sector. For example, a beverage bottling manufacturer used a digital twin of its process to cut energy consumption by 20% and water usage by 9% [b-Honaman]. Similarly, a car manufacturer expects its metaverse-enabled factory to provide a 50% reduction in the carbon footprint of its vehicle manufacturing process by 2025 [b-Renault Group]. With cities contributing more than 70% of annual global carbon emissions [b-IEA], metaverse-enabled smart cities are expected to significantly contribute to a sustainable world by using their resources more efficiently.

On the other hand, the increase in energy-intensive communication and computing infrastructure, as well as in the new wearable devices required to achieve the metaverse-powered digital transformation at scale, may have an adverse sustainability and environmental impact if not adequately managed through policy and regulation. One of the likely drivers is expected to be the growing demand for local data centres and Internet exchange points to reduce the distance travelled by data from its source to the metaverse device [b-Dano]. At the time of writing, a data centre could consume the equivalent electricity of 50 000 homes, while the cloud, a global network of servers [b-Microsoft], has a greater carbon footprint than the airline industry [b-Gonzales Monserrate].

Another area of possible adverse environmental and sustainability impact of the metaverse is e-waste. In 2019, only 17.4% of e-waste was officially documented as having been formally collected and recycled. Toxic and hazardous substances are found in many types of electronic equipment and pose severe risk to human health and the environment if not handled in an environmentally sound manner [b-ITU-1]. For the metaverse to be transformative on a global scale, it will require a significant demand for new metaverse devices which, if not recycled, will exacerbate the existing e-waste crisis.

8.4 Human rights and ethical considerations

The metaverse is expected to not only inherit but in some cases exacerbate the ethical and human rights considerations present in online communication technologies at the time of writing [b-Rodriguez]. These include questions around privacy, security, identity, autonomy, inclusivity, ownership, social justice and algorithmic bias.

The main difference between current online communication technologies and the metaverse is its virtual, or immersive, dimension. Current experience with VR has demonstrated its significant emotional impact on the user, as well as the user's privacy from the far greater amount of personally identifiable information generated during a VR experience. When expanded to include concerns around virtual property ownership, virtual crime and the algorithmic biases of the AI-supported virtual world, it is possible to see the metaverse facing some unique ethical and human rights challenges.

Using a human rights-based, people-centred approach during the development of the metaverse can ensure that issues of the right to privacy, right to safety, right to non-discrimination, right to property, freedom of expression and right to access are carefully considered [b-Norwegian National Human Rights Institution]. Developing the metaverse so that it respects human rights and ethical principles will require policy-makers, industry leaders and civil society organizations to work together on guidelines for the ethical development and use of the metaverse.

8.5 Legal jurisdiction and data governance

The metaverse promises to seamlessly connect national, regional and international communities. To realize this vision, regulators and decision-makers will need to not only ensure that user data freely and securely travels between domestic and international borders, but also that domestic and international law is consistently applied in the metaverse, similarly to current efforts to regulate the Internet. Regulators, platform owners and users will need to work together to ensure the metaverse complies with unique requirements of national laws while at the platform level providing a consistent

approach to protecting user privacy, security and respect for international law. When it comes to norms, rules and principles of responsible behaviour of States in the online world, in 2015 the UN General Assembly unanimously adopted resolution 70/237 on this subject. The resolution agreed that international law, in particular the Charter of the United Nations, applies online and by extension to the metaverse [b-UNODA].

When it comes to data governance, particularly across borders, data access, sharing and use have become central drivers of economic growth and social well-being. Nevertheless, it is important to recognize the barriers currently faced by developing countries. As the metaverse creates even more valuable user data, regulators will need to redouble their efforts to ensure global data governance maximizes development gains, to ensure that those gains are equitably distributed, and to minimize risks. According to UNCTAD, current regional and international regulatory frameworks tend to be either too narrow in scope or too limited geographically. These fail to enable cross-border data flows with an equitable sharing of economic development gains while properly addressing risks [b-UNCTAD].

8.6 Health risks and opportunities

Digital technologies have played a key role in advancing modern medicine; however, they also brought new challenges. This dynamic can be expected to continue in the metaverse, which on the one hand is promised to usher in a new age of telemedicine and virtual health care [b-Garavand], while on the other to introduce a new category of health risks, related to the negative impacts of using of digital technologies, and health data governance issues [b-Kostick-Quenet].

The COVID-19 pandemic shone a spotlight on how telemedicine can help to deliver health care to more people, especially those living in remote areas and underserved communities [b-WHO]. Just as with telemedicine, it is essential to ensure that in the metaverse persons in key populations, such as persons with disabilities, ethnic minorities that have traditionally faced discrimination and persecution, older persons, children and youth, undocumented persons, refugees, asylum seekers or persons with uncertain status, and persons from poor socio-economic backgrounds are not forgotten and do not experience extra difficulties in accessing online health services. The metaverse promises to create new ways to deliver health services, ranging from consultations to surgeries where a surgeon may provide instructions remotely while monitoring the vital signs of a digital twin of the patient or even control a surgical robot. Already today VR is used to treat conditions such as anxiety disorders and phobias. The immersive and online nature of the metaverse can further expand and improve the availability of such services to patients remotely. However, new questions can also arise, such as the selling of medicinal products in the metaverse, concepts of legal personhood of avatar patients and issues of bioethical informed consent.

As the first generation of digital natives comes of age, there is a growing body of research about the adverse impacts of the online experience on human well-being, which include anxiety, addiction and depression. These risks are expected to not only be present but also to potentially be exacerbated in the metaverse. Its immersive nature could lead to anxiety in users who feel overwhelmed by the virtual environment. When combined with addictive behaviour, metaverse users may find it hard to disconnect from it, leading to physical health problems such as eye strain, headaches and musculoskeletal issues [b-ScienceDaily].

8.7 Accessibility and inclusion

As a new paradigm, the metaverse presents an opportunity to build on previous experience with digital platforms and networks to create a truly accessible and inclusive environment for all [b-Appel]. By taking into consideration issues of physical accessibility, interaction disabilities, cognitive accessibility and social inclusion it is possible to envisage a metaverse that enables marginalized people to meaningfully participate in online social activities or access services that may be difficult for them in the physical world. Furthermore, the metaverse can level the playing field both

economically and socially for those who feel marginalized in the physical world, like the opportunities presented by remote-controlled robots today [b-Nakatsuka]. Accessible and affordable metaverse technology can also offer marginalized groups an opportunity to establish safe spaces where they can share experiences and advocate for their rights. The metaverse can promote diversity and representation by allowing users to create avatars that reflect their identities and backgrounds.

In terms of risks, key population groups such as persons with disabilities, ethnic minorities that have traditionally faced discrimination and persecution, older persons, children and youth, undocumented persons, refugees, asylum seekers or persons with uncertain status and persons from poor socio-economic backgrounds will face barriers to access and navigate metaverse environments if they are not designed with accessibility in mind. If virtual spaces are created by users from a particular target population, specific cultural backgrounds or with a particular set of values, it may lead to exclusionary practices that limit access for individuals from other backgrounds to certain metaverse spaces. Without a concerted policy and regulatory effort to build an accessible and inclusive metaverse, it risks becoming a metaverse only for a privileged few [b-Zallio].

8.8 Competition and market dynamics

The metaverse has the potential to create new technological innovations and competitive markets [b-Wenzel Bulst] on the scale of change brought about by broadband, mobile, and social media technologies. Each technological advance offers lessons for policy-makers and regulators on how to approach the metaverse. The ubiquitous nature of the Internet has demonstrated the creative and economic energy unleashed by a bottom-up developed, interoperable, standards-based communications infrastructure. At the same time, the adverse societal impacts of digital platform monopolies and profit driven decision-making have demonstrated the limits of unregulated markets and the need for cross-border and cross-sectoral collaborative policy and regulatory approaches to ensure that the digital world reflects the values and behaviours expected by society in the physical realm.

By having clear competition laws and regulatory frameworks for digital markets, the metaverse can create business opportunities in virtual commerce, virtual real estate and the sale of virtual goods [b-Chee]. These opportunities can stimulate economic growth and competitive markets on a global scale, irrespective of whether the business or consumers are from a remote region or a large city. In addition, the metaverse can create new market ecosystems by enabling more engaging platforms for remote work, virtual events, education and community building.

For a dynamic metaverse market to be realized, policy-makers and regulators will need to incentivize the fragmented digital ecosystem to strengthen its interoperability through open standards. Privacy and security concerns will need to be addressed to build trust in the metaverse to attract and retain users. Lastly, for the metaverse to represent a global market and generate significant economic activity, it would need to be globally accessible by addressing the digital divide.

8.9 Data privacy and user protection

To create immersive and lifelike user interactions in the metaverse will require a significant amount of personally identifiable information (PII) about each user. This PII may include information such as user's name and location, voice, gait and facial biometrics. The expected increase in the level of collection of sensitive personal information presents unique privacy and user protection challenges for the metaverse.

According to the UN Human Rights Office, there is universal recognition of the fundamental importance, and enduring relevance, of the right to privacy and of the need to ensure that it is safeguarded, in law and in practice [b-UNHCR]. Policy-makers [b-Council of the EU] and other stakeholders [b-Morozov] recognize the challenges of balancing rights to privacy, security and profits for the private sector with the enhanced capacity of digital technologies to conduct surveillance and collect data. In the metaverse, this challenge can be expected to become both more urgent and acute.

Using current technology, researchers have shown that with just 100 seconds of data of a virtual reality game user's head and hand motion they can uniquely identify the user with 94.33% accuracy [b-Nair]. VR headsets available in 2022 could already scan parts of the user's face to realistically represent their facial features in a virtual environment, adding additional tracking data points [b-Johnson]. With the push to collect more data to create immersive experiences, researchers have identified the following data points which may be collected by metaverse platforms in the future:

•   Geospatial telemetry (height, arm length, interpupillary distance and room dimensions);

•   Device specifications (refresh rate, tracking rate, resolution, device field-of-view, GPU, and CPU);

•   Network (bandwidth, proximity);

•   Behavioural observations (languages, handedness, voice, reaction time, close vision, distance vision, colour vision, cognitive acuity and fitness) [b-Noah].

When analysing privacy policies of all available VR devices on the market in 2022 [b-Common Sense Media], researchers found that every single device in one way or another put children's and families' personal privacy or safety at serious risk. With VR devices creating over 2 million unique data points within 30 minutes of use, current privacy regulations are seen as being insufficient. Unless concerted efforts are made to better understand the implications on privacy and security of the metaverse, this regulatory gap can be expected to significantly increase with adverse consequences for privacy and security of metaverse users [b-Tricomi].

8.10   Security and trust

The metaverse will present unique security and trust challenges due to its interconnected and multisensory nature. These vulnerabilities and risks can be broadly divided into three categories of threats to metaverse devices, such as headsets; threats to the metaverse network or its infrastructure; and threats to users inside the metaverse. For the metaverse to reach worldwide adoption, it is paramount that participants have confidence that their information, monetary dealings and private data are safeguarded by suitable security measures, legal provisions and governance structures.

To deliver a low-latency metaverse experience, an increase in the use of edge computing devices is expected [b-Meta]. Changing from the current, centralized data storage and processing model to a distributed one is expected to increase security risks due to a larger number of devices with sensitive information becoming targets for attackers [b-Xiao]. When it comes to metaverse devices, VR headsets of today are already vulnerable to a range of attacks. These include the eavesdropping attack or monitoring user's speech and facial movements, as well as other device sensor data without their knowledge [b-Everson Layden]. Another possible attack is a human joystick attack, where the attacker can control immersed users and move them to a location in physical space without their knowledge [b-Casey]. Ransomware and malware are attacks that render the VR device unusable and risk the user getting injured by being disorientated. A further source of attack is the ability to recover from a VR device memory personally identifiable data about the user, including physical dimensions of their room where the device was used [b-Vondráček].

Security threats inside the metaverse are expected to result from the blurring of physical world crimes such as identity theft, money laundering and scams, including Sybil attacks, harassment, child abuse and exploitation, terrorism and spreading of disinformation, with new technologies of blockchain, non-fungible tokens (NFTs), and cryptocurrencies [b-Europol]. Furthermore, there are substantial policy challenges arising from crime jurisdiction and cross-border data flow, which have yet to be resolved.

While laws and regulations tend to lag behind new technologies, for the metaverse to realize its transformative potential on a global scale, its users will need to have confidence not only in its security but also in its legal protections. Legal questions around novel issues such as virtual property ownership, virtual harassment of an avatar or even real-life murder due to an initially virtual dispute,

or how to further protect children from harms, will need potentially new laws, legislations and jurisprudence which recognize the unique nature of the metaverse [b-Murray].

This also opens the issue of policing in the metaverse [b-RMA], whereby questions of prevention of crimes, disruption and enforcement need to be addressed. Some challenges have already been identified. For example, most national regulatory systems are not metaverse-ready. In alignment with the fundamental points raised in this Report, there is further a lack of international agreements to promote law enforcement participation, as well as a deficiency in the technical expertise of law enforcement.

The challenge for policy-makers and regulators will be to anticipate how well-known attack techniques and criminal methods can evolve into new threats in the metaverse with a novel impact. Compared with online technologies at the time of writing, the metaverse will collect far more sensitive information about users while also increasing the attack surface of both metaverse devices and infrastructure. Building a secure metaverse for all will require a collaboration between all stakeholders to ensure that the metaverse is not only built with safety, security and privacy by design, but that its users have control over their private information and are aware of security risks and responsible behaviour in the metaverse.

8.11   Content moderation and digital governance

The way the metaverse develops will in large part inform which governance and moderation models would be most appropriate. In general, there are two main models which can be considered: a centralized or top-down model and a bottom-up or community-led model. In each case it can be envisaged that to manage a virtual community on a global scale will also require some form of automated assistance to either identify or police inappropriate content and behaviour. Whichever model is used, the challenge for the metaverse, as for the Internet at the time of writing, will be how to balance freedom of expression with the need to prevent harm and abuse.

The top-down model will require a central authority to control the process and decision-making. While this model can provide strong, clear and consistent enforcement of rules, it can also be susceptible to bias, censorship and limited user participation. The community, or bottom-up model, can offer more flexibility and better reflect the values of its users, but at the expense of scalability and consistency in how rules are applied.

For the bottom-up model there is also a possibility for the metaverse to use a decentralized blockchain-based governance model which promises to distribute the governance rights and create a neutral and mutually beneficial infrastructure for its users. But even decentralized models can be subverted if not carefully designed [b-Goldberg]. Another way to approach the bottom-up governance and moderation question is to consider designing the metaverse experience with a clear purpose that responds to user's needs [b-Schultz], while promoting community bonds and cooperative behaviour between users and empowering them to call out inappropriate actions of others [b-Robertson].

If the Internet at the time of writing is any guide, the metaverse can expect to have a mix of both models. A multistakeholder or bottom-up community model could govern how various aspects of the metaverse operate at the global level, while a top-down model is used in certain national and commercial contexts. The global scale of the metaverse can be expected to rely on automated assistance for some of its moderation and governance activities. While acknowledging the efficiency benefits of using AI powered tools, it is important to also recognize the risks of bias in AI [b-NIST], as well as the significant human cost to manual data labellers who create this training data, often in damaging and exploitative conditions [b-Perrigo].

8.12   Intellectual property and virtual assets

Intellectual property is expected to be a key tool in incentivizing innovation and investment in the metaverse. One of the promises of the metaverse is the creation of new economic and creative opportunities for users from around the world, irrespective of their physical location or social status.

To establish this vibrant metaverse creator economy will require clear and enforceable intellectual property rights around copyright, trademarks and patents. To realize the vision of a metaverse for all on a technical level, many innovations are still required, ranging from hardware to payment systems and platforms. Many of these innovations will depend on co-development from a diverse set of players, relying on robust intellectual property agreements, licensing and negotiations [b-WIPO-1].

The World Intellectual Property Organization (WIPO) has identified three possible categories of metaverse intellectual property disputes, namely, between user and platform, between users and between user and a service provider [b-WIPO-2]. In addition, regulators and policy-makers will need to consider questions of intellectual property both for the software and hardware that run the metaverse, as well as the works created inside the metaverse that may blend real and virtual world artefacts to create new hybrid objects [b-Verborgh].

The metaverse is often associated with blockchain-enabled technologies such as NFTs, smart contracts and cryptocurrencies, which promise to strengthen ownership and protection of intellectual property rights in the metaverse by providing a public record of transactions. What is often left unclear for creators and purchasers of virtual assets is a distinction between ownership of the software code and its reproduction [b-European Commission-1]. This is similar to the real-world difference between buying the original manuscript and reproduction rights of a book or only its signed copy. The currently blurry nature of existing regulation on this question has already led to a number of legal disputes [b-Rizzo].

Much of the current understanding of intellectual property is based on the idea that a human author has either economic or moral rights over their creation [b-University of Cambridge]. The advent of generative AI tools adds a new layer of complexity. In 2024, it remains unclear what are the intellectual property consequences of a generative AI tool using copyrighted material as part of its training data to then create new content based on unique user prompts, on an online platform owned by a private company which provided the service [b-Appel].

9   Regional and national approaches to metaverse development

In recent years, the metaverse has emerged as a significant area of interest for governments around the world, with different regional and national approaches to promote metaverse development [b-Kshetri]. Smart cities and industry have been early adopters, leveraging metaverse strategies to optimize operations, stimulate economic growth and enhance accessibility to services.

Comparing approaches of different countries to metaverse governance and development, three broad trends emerge: a centralized, state-led approach; a bottom-up, industry-led approach; and a values-based approach. It is important to note that each country's approach is influenced by its legal system, political environment and socio-economic factors. In practice, most countries adopt a hybrid approach, balancing innovation, public safety, security and ethical considerations.

The list of approaches mentioned in the clause are based on the FG-MV analysis at this stage; they are not meant to be exhaustive nor to represent the whole world.

9.1   China

The approach of China to metaverse policy and regulation is characterized by centralized planning and a strong focus on industry, services and smart cities. This follows the inclusion of the term "virtual reality' in 'the 14th Five-Year Plan of China, which emphasizes the development of digital economy and promotes collaboration between municipal governments, various ministries and the People's Bank of China [b-State Council Digital].

The Ministry of Industry and Information Technology and other five departments issued the Three-Year Action Plan for the Innovative Development of Metaverse Industry (2023-2025), proposing to promote its development by building advanced metaverse technology and industrial

system and other initiatives. By 2025, metaverse technology, industry, application and governance will make breakthroughs and become an important growth pole of digital economy.

The plan puts forward the goal of industrial development: By 2025, the basic support capacity of industrial technology will be further consolidated, three to five ecological enterprises with global influence and a number of specialized, special and new small and medium-sized enterprises will be cultivated, and three to five industrial development clusters will be created. The development of the industrial metaverse will see initial results, create a batch of typical applications and form a batch of benchmark production lines, factories and parks. Typical software and hardware products of metaverse will realize large-scale application and a batch of new business, new modes and new industries will be formed in the fields of life consumption and public service [b-State Council].

Centralized planning allows the Chinese government to prioritize specific aspects of the metaverse that can directly benefit the economy. For instance, the "New Metaverse Sectors Incubation Plan" released by Shanghai Municipal People's Government aims to develop a metaverse-related industry worth CNY 350 billion by 2025. This plan outlines 50 metaverse application scenarios across seven sectors, including smart manufacturing and digital city development, demonstrating the government's commitment to fostering innovation in these areas [b-Shanghai Action Prog].

Moreover, the Central Commission for Discipline Inspection of China has defined the metaverse as a combination of digital twins, mixed reality and blockchain technologies. By focusing on these technologies, the Chinese government aims to support the growth of the virtual reality industry and facilitate the implementation of metaverse applications in various sectors, such as smart city initiatives and industrial processes [b-Jiang].

9.2 Finland

While the national metaverse strategy is under development [b-Business Finland], cities such as Tampere and Helsinki are taking the lead in embracing the metaverse. The city of Tampere is currently conducting research, in collaboration with industry-leading companies and research institutions, to explore the potential of the metaverse for cities, businesses and residents [b-City of Tampere]. Key areas of investigation include the creation of a digital environment that enhances the lives of inhabitants, transforms urban planning and promotes sustainability, responsible data utilization and ethical metaverse practices [b-Wray].

Helsinki, on the other hand, has launched the Virtual Helsinki initiative as part of its broader digital strategy. The initiative aims to establish the city as the virtual capital of the world by recreating its most famous landmarks through virtual reality. This approach enables Helsinki to be experienced by visitors without reliance on carbon-intensive travel, aligning with global sustainability goals [b-Helsinki].

9.3 Germany

The metaverse presents an opportunity for Germany to maintain the strength of its advanced industrial sector [b-Claussen]. Although there is no specific government strategy on the metaverse, German industry is actively pursuing the development of an industrial metaverse. One of the biggest players, Siemens, has committed EUR 2 billion, with approximately EUR 1 billion allocated specifically to projects within Germany aimed to enhance the nation's technological edge.

Siemens announced the establishment of a new Technology Campus in Erlangen, Germany, with an investment of around EUR 500 million to expand development and manufacturing capacities. The announcement of a new Technology Campus in Erlangen, in the presence of the German Chancellor Olaf Scholz, is expected to position Erlangen as a global industrial metaverse research and development hub [b-Siemens].

9.4 Latvia

With extensive national ICT infrastructure and digital public services, Latvia is a prominent ICT hub in the Baltics [b-Live Riga]. Its capital city, Riga, has an ambitious plan to develop its own metaverse and become one of Europe's largest metaverse projects. In 2022, a Memorandum of Understanding was signed between 22 industry partners to commence this project. Riga's extensive connectivity infrastructure, innovative technology sector and strong academic institutions make it well placed to become a central authority on XR and coordinate the development of citiverse related projects [b-The Baltic Times].

9.5 Indonesia

Indonesia is actively developing its approach to the metaverse in line with its national vision to bolster the digital economy and propel Indonesia into the top 10 global economies by 2030. This is highlighted by the establishment of the Indonesia Metaverse Collaboration Initiative and the Metaverse Research & Experience Center (MREC) [b-KEMLU].

The MREC programme, announced in 2023, is a public–private partnership that aims to support research, innovation and development in the Indonesian metaverse ecosystem. The Centre will also facilitate collaboration and networking among regulators, policy-makers, industry and academia.

In 2022, the President of Indonesia, Joko Widodo, inaugurated the Jagat Nusantara social media platform, which features a digital version of the' future capital city of Indonesia, Ibu Kota Nusantara (IKN), in the metaverse. The IKN metaverse offers a platform for people to exchange knowledge and engage with others across Indonesia and the world [b-Garda Bhwana].

9.6 Japan

Focusing both on its social and economic opportunities, Japan has taken proactive steps to coordinate its digital transformation initiatives, including the metaverse. In August 2022, the Ministry of Internal Affairs and Communications (MIC) of Japan convened a Study Group on the Utilization of Metaverse Towards Web3 Era (chaired by KOZUKA Souichirou, professor, Faculty of Law, Gakushuin University) to analyse and organize issues regarding the utilization of metaverse in various fields, including education, industrial fields and economic activities such as virtual markets. The study group's report was published in July 2023 [b-MIC-1]. The 2023 white paper of the Information-technology Promotion Agency of Japan on digital transformation highlights how the metaverse can help socially isolated individuals re-engage with the workforce [b-IPA]. Its Japanese Metaverse Economic Zone project, entitled Ryugukoku, aims to create an Open Metaverse Infrastructure for various applications, such as marketing, insurance, payments and services.

Ryugukoku brings together 10 prominent Japanese technology companies. It incorporates elements of an online alternate-world role-playing game, featuring moving "cities," "castles," and "vehicles" that users can explore in a virtual environment. The project also focuses on developing open and secure systems for identity authentication, payments, data infrastructure and insurance through collaboration with leading Japanese financial institutions and corporations. By offering this infrastructure to companies and government agencies outside Japan, the country aims to expand the Japan Metaverse Economic Zone globally, positioning itself as a world metaverse leader [b-Fujitsu].

Another private sector movement is the Virtual Market (Vket), organized by HIKKY. In the "Virtual Market 2022 Winter" held in December 2022, 70 companies exhibited, including department stores, fashion brands, securities firms, TV stations and local governments. In addition, 540 exhibits by creators have been displayed, making the event a new business venue. The event has attracted a total of more than 1 million attendees [b-MIC-2].

Through these efforts, digital transformation, including metaverse, is being realized by the public and private sectors.

9.7 Republic of Korea

The Republic of Korea has set an ambitious goal of becoming a top-five metaverse leader by 2027, investing heavily to develop its metaverse ecosystem [b-Wonju]. The Ministry of Science and ICT of the Republic of Korea has outlined a policy direction to foster a sustainable metaverse ecosystem through the Emerging Metaverse Industry Promotion Strategy, focusing on cooperation between companies, technology development and regulatory innovation [b-MSIT].

To ensure a safe and trusted metaverse ecosystem, the MSIT plans to develop "principles of ethical metaverse" for voluntary compliance and establish a government-wide metaverse committee to address various legal issues, including personal information protection, intellectual property and unethical and illegal activities. Major projects for supporting the creation of a metaverse ecosystem include developing metaverse platforms for industrial convergence and daily life/economy, nurturing experts through the Metaverse Academy, supporting specialized companies and fostering a trustworthy metaverse environment by improving laws and regulations related to it.

Another area of focus is smart cities. Launched in January 2023, the Metaverse Seoul platform serves as an important communication tool for citizens, offering inclusive administrative services without time and space constraints. By focusing on the core values of freedom, inclusion and connection, Metaverse Seoul aims to establish a hyper realistic community space for creativity and communication accessible to all users [b-Seoul Metropolitan Government].

Metaverse Seoul emphasizes accessibility, allowing users to interact as avatars without barriers or discrimination. Users can access various facilities, including Seoul Fintech Lab, Seoul Business Support Center and top tourist attractions. The platform also aims to build a virtual world that provides immersive experiences, enabling students to consult with mentors virtually and citizens to file complaints, obtain official documents and pay local taxes. The project plays a strategic role in city marketing, branding and urban revitalization driven by the metaverse environment [b-Goretti Feijó de Almeida].

9.8 Saudi Arabia

Saudi Arabia is actively investing in research, development and innovation to position itself as a leading technologically advanced economy in line with its Vision 2030 programme. One key area of focus is the metaverse, with initiatives centred on online gaming and smart city industries [b-Saudi Vision].

The approach of Saudi Arabia to the metaverse is best demonstrated by NEOM, a multi-billion-dollar futuristic city project. NEOM will feature a digital twin in the metaverse, enabling individuals to experience life, work and play within the city before its physical construction [b-Oglesby].

Additionally, the Kingdom has launched the National Gaming and Esports Strategy to develop the gaming and esports value chain. This strategy aims to transform Saudi Arabia into a global hub for the gaming industry by 2030 while supporting the broader objectives of Vision 2030 [b-Al-Turki].

9.9 United Arab Emirates

The United Arab Emirates has been actively engaging in metaverse initiatives across various sectors, including digital economy and social services. Emphasizing the importance of developing intellectual property (IP) systems and legislation, the United Arab Emirates aims to capitalize on the potential of technologies such as AI and the metaverse to enhance creativity, innovation and safeguard IP rights. The metaverse is seen as a promising opportunity to launch a unified global digital economy, creating new possibilities in sectors such as real estate, virtual advertising and digital fashion [b-United Arab Emirates Ministry of Economy].

The most ambitious plan is the Dubai Metaverse Strategy which aims to establish Dubai as a top 10 metaverse economy and global hub for the metaverse community. The strategy focuses on XR technologies and digital twins, as well as promoting the deployment of next generation networks to

support edge computing. This Strategy is expected to create up to 40 000 virtual jobs by 2030, foster innovation, enhance economic contributions through R&D and promote advanced technology ecosystem development [b-Telecommunications And Digital Government Regulatory Authority].

Currently, XR technologies contribute USD 500 million to the United Arab Emirates's economy and support 6 700 jobs [b-Emirates News Agency]. To further capitalize on this, the Dubai Airport Freezone (DAFZ) launched the METADAFZ project, which provides clients with a seamless digital experience in the metaverse for conducting meetings and business activities [b-DAFZ]. Similarly, the Abu Dhabi Global Market (ADGM) Arbitration Centre has introduced a "mediation in the metaverse" service, providing a new format for international dispute resolution [b-ADGM].

In the health-care sector, the United Arab Emirates Ministry of Health and Prevention (MoHAP) has introduced a 3D Digital Metaverse Assessment Service to evaluate health-care professionals. This innovative service supports the country's efforts to attract and retain global talent in key sectors, enhancing the delivery of both Government and private health-care services [b-MoHAP]. Lastly, Ajman Police has initiated a trial project allowing community members and police officials to interact in the metaverse, strengthening cooperation and involving the public in service design and development [b-Ali].

9.10   United States of America

The approach to metaverse policy and regulation in the United States of America is shaped by the country's prominent role in the global technology sector and as a home to numerous metaverse-enabling hardware and software producers. As key players in the metaverse ecosystem, these companies significantly contribute to the development of metaverse-enabling data and network infrastructure, as well as hardware and software.

While there is no national metaverse strategy, the Government has released the National Standards Strategy for Critical and Emerging Technology. The Strategy renews the United States' commitment to a rules-based approach to standards development, with a particular emphasis on supporting international standards for critical and emerging technologies (CETs). This approach is designed to accelerate private sector-led standards efforts, fostering global market growth, interoperability and the promotion of the country's competitiveness and innovation [b-The White House].

9.11   European Union

The European Union's approach to metaverse policy and regulation is rooted in a values-based framework that prioritizes EU values and fundamental rights. Recognizing the transformative potential of Web 4.0 and virtual worlds, the European Commission has adopted a new strategy to guide the next technological transition and ensure an open, secure, trustworthy, fair and inclusive digital environment for EU citizens, businesses and public administrations. The overarching objective of the initiative is for the EU to become a prominent Web 4.0 market. It expects the XR sector in Europe to generate approximately 860 000 new jobs by 2025 [b-European Commission-2].

Aligned with the 2030 objectives of the Digital Decade policy programme, the strategy encompasses four themes drawn from the programme and the Commission's Connectivity package: (1) People and Skills; (2) Business; (3) Government (i.e., public services and projects); and (4) Governance. These themes are addressed through 10 action points that build on the work of the European Commission, consultations with citizens, academia and businesses, and a European Citizens' Panel on Virtual Worlds.

The panel's 23 recommendations have informed specific actions in the strategy on Web 4.0 and virtual worlds, emphasizing the importance of inclusivity, fairness and openness in the development and governance of virtual environments. Additionally, the EU has established the Virtual and Augmented Reality Industrial Coalition to facilitate collaboration between industry and policy-makers, further ensuring that metaverse policy and regulation remain in line with EU values and objectives [b-European Commission-3].

10   Importance of multistakeholder collaboration

Developing the metaverse for the benefit of all requires governments, industry and civil society to work together. The global nature of the metaverse will need input from a diverse set of voices at each step of the policy, regulation and standardization cycle to address challenges such as interoperability, security and privacy. Over its long 150 year history, the International Telecommunication Union (ITU) continues to provide an open and impartial platform for all stakeholders to come together and address some of the world's key telecommunication and digital technology issues. Today, the ITU Focus Group on metaverse is supporting global discussions to agree on a metaverse standardization roadmap which will encourage greater interoperability of metaverse platforms through open and international standards.

The ITU Focus Group on metaverse, established in December of 2022, set up several working groups to analyse the following requirements of the metaverse:

•   Applications and services;

•   Architecture and infrastructure;

•   Virtual/real world integration;

•   Interoperability;

•   Security, data & PII protection;

•   Economic, regulatory and competition aspects;

•   Sustainability, accessibility and inclusion;

•   Collaboration.

The Focus Group provides a unique platform for all interested stakeholders to join and contribute their expertise to the development of a metaverse standardization roadmap [b-ITU-2].

11   Conclusion

The metaverse has significant transformative potential. Nevertheless, a multitude of policy and regulatory challenges first need to be carefully considered and actioned by policy-makers and regulators to mitigate harms to the environment and metaverse users. Closing the digital divide is crucial to ensure an open, accessible and inclusive metaverse for all. Environmental concerns of energy consumption and e-waste must be addressed through the adoption of energy-efficient practices and technologies, while promoting the development of standards and interoperability for seamless user experiences and economic development.

Privacy, security and trust are paramount in the metaverse, given the vast amount of PII generated by users. Policy-makers and regulators must develop guidelines and frameworks that address ethical and human rights considerations, promoting responsible behaviour and aligning the metaverse with societal values. Harmonizing policy and regulatory efforts related to the metaverse and its enabling technologies, such as AI, blockchain and cloud computing, is essential for promoting interoperability and sustainable digital transformation.

As whole regions, countries and cities embrace the potential social and economic benefits of the metaverse, regulators must remain alert to different metaverse adoption and implementation approaches. The metaverse's impact on the industrial sector and smart cities will be significant, driving innovation, fostering new business models and transforming urban environments. This harmonization will not only ensure that the metaverse develops for the benefit of all users but will also accelerate the achievement of the Sustainable Development Goals and enhance global economic competitiveness.

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