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Article

The (virtual) battle for intellectual property rights in the metaverse: The case of copyright, trademarks and the NFT technology

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Abstract: This paper examines the evolving challenges of intellectual property (IP) rights protection in the Metaverse, with particular focus on the intersection of traditional IP frameworks with emerging Non-fungible token (NFT) technology. While existing research has explored digital IP rights broadly, the unique characteristics of the Metaverse—its decentralized nature, platform interoperability, and novel ownership models—present unprecedented legal and technical challenges that warrant systematic investigation. The research addresses three key questions: 1) How do traditional territorial-based IP frameworks adapt to the borderless nature of the Metaverse? 2) What specific challenges does NFT technology present for trademark and copyright protection? 3) How can existing legal mechanisms be enhanced to provide effective IP protection in virtual environments? Through comparative analysis of recent case law from American and European courts, supported by examination of regulatory frameworks and technological capabilities, this study identifies critical gaps in current IP protection mechanisms. The analysis reveals that while NFTs offer new possibilities for digital rights management, their implementation raises complex issues regarding ownership verification, cross-platform rights enforcement, and jurisdictional authority. The paper proposes a three-tier framework for enhancing IP protection in the Metaverse: 1) Technical solutions incorporating blockchain-based verification systems with practical implementation considerations; 2) legal adaptations to address jurisdictional challenges; and 3) platform-level governance mechanisms. Each tier is evaluated against current technological constraints and legal precedents to ensure practical viability. This research contributes to both academic discourse and practical policy development by providing a structured analysis of Metaverse IP challenges and offering implementable solutions that balance innovation with rights protection. The findings suggest that effective IP protection in the Metaverse requires a hybrid approach combining adapted legal frameworks, technological solutions, and platform cooperation.

Keywords: metaverse; IP rights; copyright; trademark; NFT technology

1. Introduction: From the internet to the metaverse

Despite the widespread integration of the Internet into daily life, its evolution remains an ongoing endeavor. The inception of the World Wide Web in the 1990s marked an era commonly referred to as 'Web 1.0', during which users could navigate a trove of information and news predominantly controlled by a limited number of organizations. This phase of the Internet was characterized by a high degree of centralization of data, complemented by a largely static nature of digital interactions. User engagement during this period was restricted, with interactions being limited to rudimentary email communication or facsimile transmissions.

A significant paradigm shift was realized with the advent of 'Web 2.0', defined by the emergence of social networking platforms that revolutionized the modality of online interactions, communication, content sharing, and e-commerce. Despite fostering an environment that appeared to decentralize information control, this phase ultimately reinforced the dominion of those entities operating the social networking platforms, intensifying their market presence and paving the way for the contemporary economic model known as the 'platform economy'[1] [1–4].

The aspiration for absolute decentralization of information continues to drive progress in the present digital age, underpinned by the development and refinement of advanced technologies including artificial intelligence (AI), Digital Twin 3D, virtual reality (VR), augmented reality (AR), and blockchain technology. This current phase, often denoted as 'Web 3.0', promises an era of unprecedented decentralization, enhanced individual control, and increased data security. Within this context, users are endowed with the power to determine the nature of the information they choose to share on digital platforms. Furthermore, the amalgamation of AI, blockchain technology, and cryptographic systems promises to reinforce the security of online data[2] [5].

1.1. The (un)certain definition of the phenomenon

The concept of the "Metaverse"[3] derives from a fusion of the prefix 'meta-', signifying 'beyond', and the term 'universe'. Its earliest known appearance can be traced back to Neil Stephenson's seminal 1992 science fiction novel, 'Snow Crash'[4]. While the concept has been in existence for some time, it gained mainstream traction only recently, following high-profile endorsements from major corporations such as Google and Meta Platforms, Inc. (formerly known as Facebook). These companies have expressed a commitment to invest in this burgeoning virtual ecosystem, which has been made possible by advances in 'immersive technologies' [6–8].

The Metaverse posits the existence of a comprehensive digital landscape wherein users can not only interact but also form complex social, economic, and political affiliations—thanks to sophisticated systems of augmented reality. Once considered a realm of science fiction, the Metaverse is rapidly emerging as a tangible experience for a growing user base. Given this trajectory, it is imperative to explore its potential for misuse and infringement of fundamental human rights.

One of the central challenges confronting scholars and policymakers alike is articulating a comprehensive definition of the Metaverse, a task complicated by the inherently multifaceted and evolving nature of the technologies that underpin it. Preliminary scholarly endeavors have variably conceptualized the Metaverse as a platform for human-avatar interactions in three-dimensional spaces [9,10], as an immersive digital environment unhindered by temporal or spatial constraints [11], or as a digital space facilitating diverse experiences from exploration to commerce [12].

Certain theorists have underscored the hybrid essence of the Metaverse, referring to it as an immersive three-dimensional virtual world in which individuals interact using real-world analogues but are not bound by physical limitations [13]. Others have directed their focus toward the potential risks and ethical dilemmas posed by a Metaverse that can manifest in culturally, temporally, and politically disparate forms

[14,15]. Despite the heterogeneity in these interpretations, there exists a consensus that the Metaverse represents an evolving paradigm. It synthesizes elements of the Internet, web technologies, and augmented reality, enabling users, via avatars, to engage in a wide array of social, economic, and political activities in an alternative reality. Matthew Ball's recent definition encapsulates this multifaceted nature, referring to the Metaverse as a massively scaled and interoperable network of real-time rendered 3D virtual worlds, accessible by an essentially unlimited number of users [16].

This definitional ambiguity extends into the realm of regulatory oversight as well. European legislative bodies, recognizing the complexity inherent in defining the Metaverse, have nonetheless endeavored to describe it as an immersive and constant virtual 3D world where interaction occurs through avatars, facilitating various activities ranging from entertainment to economic transactions using crypto-assets [17].

In summary, while the Metaverse remains an evolving and complex phenomenon, its growing influence on various aspects of human life—social, economic, and political—makes it a subject that merits rigorous academic investigation and thoughtful regulatory consideration.

1.2. Its nature and fundamental characteristics

From a technological perspective, the Metaverse represents an advanced iteration of the Internet, often referred to as "Web 3.0", which is engendered through the amalgamation of a myriad of technologies aimed at delivering an immersive digital experience [18,19]. Scholars have delineated four cardinal technical attributes that characterize the Metaverse [20–22].

Firstly, the notion of 'realism' or 'immersiveness' is emphasized. The computational architecture of the Metaverse creates a space so convincingly realistic that users can physically and emotionally immerse themselves. This is facilitated by a unique feature referred to as 'hyper spatio-temporality', which enables the virtual world to transcend the temporal and spatial limitations inherent to the physical world.

Secondly, the concept of 'sustainability' is invoked. The Metaverse possesses the ability to sustain an enclosed economic system and autonomously generate value[5]. Thirdly, the Metaverse is noted for its 'ubiquity', implying that the virtual space is universally accessible via a multitude of electronic devices. This ubiquity is inherently linked to 'interoperability', a prerequisite for a seamless user experience across varied platforms. Interoperability, in turn, necessitates that the digital resources employed in constructing the information infrastructure be mutually compatible and capable of intercommunication[6].

Finally, the Metaverse must possess 'scalability', meaning that the underlying architecture should accommodate an extensive number of users without compromising on efficiency or user experience [23]. Although these attributes are common to all iterations of the Metaverse, they are contingent upon the specific technologies employed in constructing each particular system.

In terms of technological infrastructure, prevalent technologies include 'Digital Twin 3D', extensively utilized in Industry 4.0, which allows for the replication of objects or individuals within the virtual realm [24]. Additionally, Extended Reality

(XR) devices such as helmet-mounted displays employ miniaturized sensors to facilitate rapid entry into the Metaverse. These devices integrate Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR) to offer an all-encompassing, multi-sensory experience.

Avatars, which serve as digital manifestations of users within the virtual environment, are highly customizable due to the capabilities of Artificial Intelligence (AI) systems. These avatars not only mimic the physical attributes of the users but can also replicate their behavioral traits and gestures.

Furthermore, advancements in network technologies such as 5G, 6G, Software-Defined Networks (SDN), and the Internet of Things (IoT) provide robust, reliable connections and facilitate the high-throughput transmission of real-time data [25]. 'Ubiquitous Computing' further amplifies this integration, allowing users to move fluidly within the Metaverse without requiring external hardware [26–28].

AI plays a pivotal role, enabling personalized virtual services by inferring big data patterns to establish 'intelligent' interactions between the user and the avatar. Another distinguishing feature of the Metaverse is the incorporation of blockchain technology, which provides a secure, transparent, and sustainable virtual environment through cryptographic methods [29,30].

Current manifestations of the Metaverse can be broadly categorized into centralized and decentralized architectures. The former is typically managed by a single corporate entity, while the latter leverages blockchain technology to distribute authority among users [31–33]. This paper will primarily focus on decentralized platforms, given their reliance on blockchain technology and non-fungible tokens (NFTs) for the exchange of goods, specifically artistic works.

1.3. The Metaverse between challenges and risks

While the advent of the Metaverse offers considerable societal advantages, it concurrently presents a multitude of risks that, if not judiciously regulated, could result in deleterious effects transcending the digital realm to impact the material world [34,35]. Among these hazards, immediate concerns pertain to potential detrimental effects on individual health engendered by prolonged exposure to the requisite technologies for Metaverse access. Practical implementations of Virtual Reality (VR), for instance, have been shown to induce physical malaise, including nausea and severe headaches. Beyond mere physical discomfort, these technologies pose psychological risks, especially to vulnerable populations [36–38]. Disorders may range from addictive behavior and social isolation to a troubling disassociation from reality, which in extreme instances could escalate to antisocial behavior, cyberbullying, and various forms of violence [39,40].

Aside from health-related concerns, the Metaverse poses significant ethical and social challenges, particularly in the context of equitable access and infringement on fundamental human rights. Specifically, the platform risks perpetuating economic disparities, as only those with the financial resources to acquire the necessary technological devices can gain access, thereby excluding marginalized communities [41–43].

Moreover, the immersive quality of these technologies amplifies the potential for algorithmic manipulation. Algorithms can harness extensive user-generated data to craft hyper-personalized virtual experiences, tailored to individual preferences and behavioral patterns [44,45]. This, in turn, raises grave concerns about privacy and data protection. The vast data repositories accord dominant corporations, particularly in a centralized Metaverse, the power to unilaterally shape and manipulate user experiences [46,47].

Of particular pertinence to this discussion is the impact of the Metaverse on intellectual property rights (IPR), specifically with respect to copyrights and trademarks. The Metaverse increasingly serves as a platform for brands to advertise and market their products, leveraging blockchain technology and Non-Fungible Tokens (NFTs). Within this context, numerous IPR infringement cases have already surfaced, underscoring the inadequacies of existing legal frameworks to confront the challenges introduced by this emergent technology. These complex issues warrant meticulous academic inquiry and robust regulatory oversight [48].

2. Enforcing IP rights in the metaverse

The Metaverse represents, above all, a great new opportunity for brands to offer consumers highly customized products and thus strengthen their loyalty, as well as to expand their market using new, even more effective marketing techniques. For instance, in 2021, the fashion house Gucci held a special event on the 'Roblox' platform during which users were allowed to visit the so-called 'Gucci Garden', a totally virtual space where the designer displayed its digital goods created exclusively for the Metaverse.

The exchange of goods takes place, for the most part, via blockchain technology. Blockchain has been defined in various ways, but for the purposes of this contribution, the definition of the European Union Agency for Cybersecurity (ENISA) is particularly relevant: "Blockchain is a public ledger consisting of all transactions that take place across a peer-to-peer network. It is a data structure consisting of linked blocks of data, e.g., confirmed financial transactions, with each block pointing/referring to the previous one, forming a chain in linear and chronological order". According to this definition, then, blockchain technology can be regarded as a public digital ledger consisting of several 'blocks' on each of which various pieces of information are stored bit by bit until they form a long chain of blocks.

One of the main advantages of this technology is the guarantee of high levels of transaction security because, having a decentralized structure, it allows the participants of a peer-to-peer network to conclude transactions without the need for a trusted central authority, while at the same time relying on cryptography to ensure the integrity of the transactions themselves. This means, therefore, that if a block was altered, this would cause no change in the chain and, indeed, the altered point would be easily identifiable.

It is, then, particularly suitable for the purchase of digital goods in the Metaverse and especially artistic works that are bought and sold through 'Non-Fungible Tokens' (henceforth NFTs). These are a particular type of cryptographic token that "allow[s]

their owner to possess the (digital/virtual) representation of a unique object unequivocally associated with their wallet or user in the virtual space" [49–53].

NFTs are distinguished from fungible tokens because while the former is unique and cannot be exchanged with other tokens, the latter all have the same value and are, therefore, interchangeable with each other, like, for instance, bitcoins. This distinction is explained by the fact that NFTs contain unique metadata (such as, for instance, the artist's signature) that allow their ownership to be verified and transferred from one user to another. They can embed rights in physical goods, in digital native works ('native tokens'), as well as in works created on a material medium and then made digital through a tokenization process (then, we speak of 'non-native tokens')[7] [54].

However, the NFT only represents a certificate of ownership over a digital work and, therefore, whoever buys a work linked to an NFT does not buy the work itself (*corpus mysticum*) but only the proof of authenticity and ownership over it, which is embedded in a smart contract (*corpus mechanicum*). In particular, to create an NFT, the artist saves a photo in digital format, for example, which is then converted into computer language, i.e., into a string of numbers. This number sequence is then compressed into a further, shorter string called 'hash' through a particularly complex process known as 'hashing' [55]. The latter is then recorded on the blockchain with an associated time stamp. The NFT is the buyer's guarantee of the token's authenticity and ownership because it retains within it the traces of previous sales of the hash all the way back to the artist who created it. The smart contract contains all the most important information about the asset that the NFT represents, including all the rights that accrue to the buyer of the NFT and especially those of ownership over the work.

The question is, then, whether and how these rights can be transferred through an NFT and, if so, whether the traditional rules on the subject are applicable and, above all, whether they are still adequate with respect to this new technology [56].

Trademarks and intellectual property: Navigating complexities in a virtual frontier

As previously discussed, Non-Fungible Tokens (NFTs) encapsulate metadata preserved in the form of artworks, which are transacted through smart contracts and recorded on the blockchain. This ledger-based system ostensibly ensures transparency and security, allowing users to authenticate transactions related to specific assets within the Metaverse. Nevertheless, this framework has not precluded legal disputes concerning IP infringement [57], as evidenced by notable U.S. and European cases in the preceding year. One such case emerged in February 2022 when Nike pursued litigation against the marketplace 'StockX', accusing it of unauthorized sales of NFTs representing the company's athletic footwear [58].

Similarly, in New York's federal district, the artist Hermès sued Mason Rothschild for unauthorized creation and sale of 'MetaBirkins', NFTs inspired by the iconic French Birkin bag [59]. Rothschild defended his actions by invoking the First Amendment's protection of artistic expression, as well as referencing the 1989 Rogers v. Grimaldi case that upheld the legality of artistic expression. Nonetheless, the courts concluded that the NFTs infringed upon Hermès's trademark rights, citing misleading consumer perceptions and exploitative marketing tactics[8] [60,61].

Subsequent to a surge of trademark infringement cases in the Metaverse, an increasing number of brands have sought trademark registration through institutional bodies such as the European Union Intellectual Property Office (EUIPO) and the United States Patents and Trademark Office (USPTO). To address these applications, the EUIPO has designated virtual goods under Class 9 of the Nice Classification[9] [62], effectively distinguishing them from their corresponding 'real-world' counterparts. This differentiation has gained the endorsement of the World Intellectual Property Office (WIPO), particularly with its inclusion of "downloadable digital files authenticated by Non-Fungible Tokens (NFTs)" in Class 9 in the 12th Edition of the Nice Classification[10] [63]. However, this categorization has not ameliorated the overarching complexities regarding Metaverse-related trademarks, as evidenced by the recent case involving Burberry Ltd [64].

In its application, Burberry endeavored to register its trademark for a variety of goods and services, including but not limited to NFTs in Class 9, online sales services in Class 35, and provision of virtual content in Class 41. The EUIPO partially approved the application, granting trademark status for digital avatars and video games in Class 9, as well as for digital game and entertainment services in Class 41. Nevertheless, the application was denied for all goods and services falling under Class 35.

The EUIPO's adjudication pivoted on the assessment of the distinctiveness of Burberry's trademark, adhering to criteria delineated by the European Union General Court[11]. The authority concluded that Burberry's trademark, characterized by its specific color scheme and patterns, was insufficient in singularly identifying the brand's goods [65,66].

The EUIPO decision raises several contentious issues. Notably, the EUIPO did not differentiate between the application of the trademark in virtual and physical realms[12], assuming that consumer perceptions remain constant across both dimensions. This presumption contradicts the idiosyncratic nature of the Metaverse, which may warrant distinct considerations for brand recognition and consumer behavior. The inconsistency within the EUIPO's decision—approving the trademark's distinctiveness for certain classes while rejecting it for others—further muddles the regulatory landscape.

Moreover, the EUIPO's decision to treat Metaverse and real-world goods equivalently could be critiqued for its underlying assumption that consumer perceptions are identical in both realms—an assertion that remains empirically unsubstantiated [67]. This perspective reduces the complexities of Metaverse commerce to a mere extension of existing legal frameworks without acknowledging its unique characteristics, such as novel conceptions of ownership and challenges related to jurisdiction and territoriality.

In sum, these intricacies neither encapsulate the totality of issues the Metaverse poses for current legal systems nor provide definitive resolutions. Nevertheless, they underscore the pressing need to examine a pivotal question: Should existing legal frameworks adapt to the emergent phenomena of the Metaverse, or should the Metaverse conform to pre-established legal norms[13]?

3. Troubles in paradise: Difficulties arising from the application of the IP rights discipline to the metaverse

The recent case law and regulatory decisions from institutions like the European Union Intellectual Property Office (EUIPO) reflect a propensity to extend real-world legal frameworks to the Metaverse, predicated on the notion that this virtual environment essentially functions as a digital extension of physical reality. However, such an approach may inadvertently neglect unique legal and ethical quandaries intrinsic to the Metaverse, particularly when it comes to the adaptability of traditional legal concepts to this emergent digital sphere [68].

To that end, the latter portion of this scholarly contribution is committed to elucidating the legal complexities introduced by the Metaverse. The inquiry aims to discern whether it is merely a matter of modifying existing legal concepts or if there is a need to establish a discrete body of 'Metaverse Law' for the effective protection of intellectual property rights [69].

At the European Union (EU) level, the discourse surrounding immersive technologies and their requisite regulations has gained traction only in recent years. While a comprehensive historical recounting of EU regulatory milestones concerning the Metaverse is beyond the scope of this contribution, particular phases of legislative development warrant mention. In May 2020, the European Blockchain Observatory and Forum initiated a pilot project designed to expedite blockchain technology's assimilation within the EU[14] [70]. Additionally, as part of its 'A Europe fit for the digital age' strategy, the European Commission announced in February 2022 an upcoming initiative targeting virtual realities, including the Metaverse. This was further corroborated in March 2022 when the Council of the EU released a seminal report accentuating the array of benefits the EU could accrue from embracing Metaverse technologies.

Most recently, on 24 April 2023, the Committee on Legal Affairs (JURI) of the European Parliament convened a hearing specifically to address the 'Regulatory Challenges of the Metaverse' [71]. Subsequently, the European Economic and Social Committee (EESC) issued an opinion underscoring the imperative for an "ethical, safe, and inclusive Metaverse experience" [72]. The EESC thereby acknowledged the urgency of devising innovative mechanisms for sharing and licensing that could facilitate the creation and dissemination of digital content and services while safeguarding intellectual and industrial property rights and user privacy.

In summary, these legislative and regulatory developments indicate not only an acknowledgment of the Metaverse as a novel legal domain but also an emerging consensus on the need for specialized legal frameworks to address its unique challenges effectively. This nascent consensus signals a departure from the somewhat reductionist tendency to transpose existing real-world legal frameworks onto this complex and evolving digital landscape [73,74].

The principle of territoriality and the jurisdiction of courts in case of litigation

The foundational prerequisites for the registration of a trademark encompass its distinctiveness, novelty, and lawfulness [75]. A closer examination of trademark law

reveals a stipulation for the precision of color combinations and shades, thereby necessitating more than just broad color definitions [76]. The European Court of Justice (ECJ) has clarified this aspect by mandating that colors intended for trademark registration must be specified in line with an internationally recognized coding system, notably the 'Pantone code'[15].

Within the context of the Metaverse, this mandates a criterion for "visual coherence" [77], which inherently implies the seamless transition of content across platforms, ensuring its consistent representation. The European Union frequently underscores this as a critical goal. However, reservations exist concerning its complete realization from a technological standpoint. The challenge resides in ensuring the exact replication of asset characteristics when transferred across platforms, which could demand substantial computational resources and energy.

The decentralized framework of the Metaverse casts a shadow over pivotal intellectual property law tenets, including the territoriality principle. This principle delineates trademark rights and protections to the jurisdiction where the mark is registered, defining its use based on that territory's laws [78,79]. The Metaverse, by design, transcends territorial boundaries, offering an interconnected network of platforms aiming for mutual compatibility. Consequently, in a domain void of national demarcations and dominated by platform-specific regulations, the traditional legal categorization of territoriality seems obsolete[16].

This raises the imperative to either redefine 'territoriality' for the Metaverse or conceptualize a 'meta-jurisdiction' encompassing universally applicable regulations. Any such overarching legal framework would necessitate careful consideration of its interplay with national legal systems, especially concerning trademark utilization within the Metaverse. Challenges in intellectual property law within the Metaverse encompass intricate hurdles in detecting counterfeits, enforcing trademarks, and establishing jurisdiction, leading to potential ambiguities for brand proprietors. Consequently, determining the geographic or national jurisdiction of a particular trademark's use within the Metaverse emerges as a pivotal concern [80].

While territorial jurisdiction regarding trademarks might be straightforward in the tangible realm, the Metaverse's lack of physicality complicates matters. Potential infringements lead to dilemmas concerning the applicable jurisdiction—should one consider the trademark's registration locale, the platform of infringement, or another jurisdiction altogether?

Current European regulations, such as the Brussels Regulation (Regulation (EU) 1215/2012)[17] addressing jurisdiction in civil and commercial matters and the Regulation on European Union Trademarks (Regulation (EU) 2017/1001 or REUT), offer some guidance. Notably, the Brussels Regulation utilizes the 'domicile' concept, particularly in Article 4(1), providing that individuals domiciled in a Member State should be subject to that state's courts[18]. However, the Metaverse, with potentially ambiguous user identities, complicates this domiciliation criterion.

Article 7 delineates, concerning trademark disputes, that the jurisdiction ideally rests with the location of the infringement, often termed as 'forum commissi delicti'. It postulates that an individual domiciled in a Member State can be subjected to legal action in another Member State in scenarios involving tort, delict, or quasi-delict, precisely where the detrimental event transpired or is likely to transpire. Additionally,

for contractual matters, the jurisdiction corresponds to the "location of obligation fulfillment". However, it is imperative to highlight the challenges in applying this regulation to the Metaverse. Given the Metaverse's intrinsic nature as a boundary-less digital realm, the conceptualization of the "location of obligation fulfillment" remains nebulous.

Within the purview of European trademarks, the Regulation on European Union Trademarks (REUT) stipulates in Article 125(1) that legal actions can be initiated in the state where the defendant holds domicile, or as per Article 125(2), where they have an established presence. Nevertheless, in instances where the defendant neither has a domicile nor an established presence within a Member State's jurisdiction, the principle of 'forum commissi delicti' becomes applicable. Hence, proceedings related to infringements, as articulated in Article 124, can be undertaken in the Member State where the alleged infringement was executed or is anticipated [81,82].

Incorporating these principles into the Metaverse, characterized by its ubiquitous accessibility, presents inherent challenges. Resolving these complexities necessitates examining the trajectory of community jurisprudence, which has interpreted the 'forum commissi delicti' principle with a certain latitude. The Court of Justice of the European Union (CJEU) has acknowledged that even the mere accessibility of a webpage from a Member State's territory can be sufficient to establish jurisdiction within that state[19]. However, this expansive interpretation still leaves ambiguities. The 'mere accessibility' rationale might inadvertently augment uncertainties, particularly for entities susceptible to litigation solely based on their accessibility within a Member State.

4. The need for an evolutionary interpretation of the IP discipline

The application of traditional intellectual property legislation to the digital realm, particularly the Metaverse, presents inherent challenges, largely due to the incompatibility of conventional categories with the unique dynamics of the Metaverse. These discordances, manifestly illustrated by certain legal precedents, may necessitate an evolved understanding of the domain, recognizing the Metaverse not as a mere replication of the physical world but as an entity possessing its distinct attributes.

The advent of the Metaverse prompts a broader reconsideration of the existing classifications of protected works. Currently, virtual goods and services are largely categorized under Class 9 of the Nice Classification system. However, this approach can lead to overcrowding within the class and induce ambiguities in its practical application [83].

Several alternatives have been proposed to resolve this issue. One suggestion is the creation of a new class within the Nice Classification specifically for virtual goods and services. While this could decongest Class 9, the rapid pace of technological development within the Metaverse could eventually lead to the same overcrowding problem.

An alternative solution is to permit applicants to register virtual goods and services within the same class as their corresponding tangible goods or services. This could limit the scope of the class to relevant goods, facilitating businesses in

identifying marks for related goods and services during trademark searching and clearance.

Both aforementioned methodologies, however, are not devoid of intricacies [84]. The inception of a new class, while potentially decongesting Class 9, might inevitably encounter similar saturation challenges in the long run, especially considering the swift pace of technological evolution.

Conversely, the stratagem of cataloguing virtual items parallel to their physical counterparts might offer an efficacious remedy against populating trademark registries with excessively expansive registrations for virtual entities. By necessitating their inclusion within the respective real-world category, the range of virtual commodities would intrinsically be confined to that particular class. Such an approach would consequently aid enterprises in discerning trademarks pertinent to analogous commodities and services during trademark assessments and clearances. To illustrate, a digital shoe distinctly contrasts with a virtual tennis racket. Yet, under the prevailing Class 9 categorization, both would ostensibly be clustered within a virtual goods search in Class 9. If, however, the virtual tennis racket was catalogued under Class 28 alongside other athletic equipment, and the digital shoe under Class 25 with apparel and footwear, clearance inquiries could more proficiently distinguish marks that could potentially clash in either the digital or physical domain concerning related products.

KYC as a solution

The open-ended, interactive nature of the Metaverse enables a plethora of opportunities for creativity, collaboration, and commerce. Yet, this freedom also carries inherent risks, including cyber fraud, identity theft, and unauthorized access to or misuse of intellectual property. A stringent identification and verification process serves as a critical bulwark against such threats, ensuring that users are who they claim to be and deterring potential malefactors.

Moreover, user identification and verification have pivotal roles in the protection and enforcement of intellectual property rights within the Metaverse. Accurate identification of creators, owners, and licensees of virtual assets is crucial for establishing rights, enforcing contracts, and resolving disputes. The Metaverse's borderless nature further amplifies the importance of these processes, as it necessitates transnational recognition and enforcement of rights and agreements [85].

User identification and verification can be conducted using a variety of methods. Traditional techniques, such as username-password combinations and personal identification numbers (PINs), have long served as the primary means of user authentication. However, these methods are becoming increasingly inadequate, given the sophisticated cyber threats emerging with the evolution of the Metaverse.

Multi-factor authentication (MFA) provides a stronger layer of security. It requires users to present two or more separate forms of identification—typically something they know (like a password), something they have (such as a security token or a mobile device), and something they are (a biometric trait, for instance). Biometric techniques, such as facial recognition, fingerprint scans, and voice recognition, offer high levels of security by leveraging unique physiological or behavioural traits of users.

Yet, the application of biometric techniques in the Metaverse raises additional privacy and data protection concerns that must be addressed adequately.

Digital identity verification techniques, such as Know Your Customer (KYC) and Anti-Money Laundering (AML) procedures, offer another promising solution. These processes, which have been widely adopted in the financial sector, can be used to ascertain the real-world identities of users. However, their application in the Metaverse may be fraught with challenges, as they must reconcile the need for user anonymity and privacy with the necessity of security and compliance with legal requirements.

Blockchain technology presents an innovative approach to user identification and verification in the Metaverse. A blockchain-based identity system can provide a decentralized, secure, and tamper-proof method of storing and verifying user identities. Each user could be assigned a unique digital identity, cryptographically linked to their real-world identity. This digital identity can be used to sign transactions, verify ownership of assets, and establish the authenticity of interactions within the Metaverse.

Blockchain-based identity verification systems can also integrate smart contracts, allowing for automatic enforcement of access permissions, license agreements, and other contractual conditions based on verified identities. Additionally, blockchain's inherent transparency facilitates the traceability of actions, enhancing accountability within the Metaverse. Nevertheless, blockchain-based systems should be designed thoughtfully to respect user privacy and data protection norms [86,87].

While stricter identification and verification processes can enhance security within the Metaverse, they must be carefully balanced against user privacy and the user experience. Overly intrusive identification methods may infringe upon user privacy and deter participation in the Metaverse. Similarly, cumbersome or complex verification processes can impede user experience and hinder the adoption of the Metaverse.

Therefore, the design and implementation of identification and verification processes in the Metaverse must consider these competing factors. Techniques that offer strong security without compromising privacy or user experience, such as zero-knowledge proof protocols, could be particularly valuable. These protocols can prove the veracity of claims without revealing any additional information, striking a balance between security and privacy [88].

5. Conclusion

The rapid and expansive development of digital platforms, epitomized by the emergence of the Metaverse, has posed profound challenges to the established legal and regulatory frameworks governing intellectual property (IP). The very nature of the Metaverse, transcending traditional physical boundaries and definitions, underscores the inadequacy of our current systems in grappling with its intricacies. As we navigate this pivotal juncture, it becomes paramount to reflect on the underpinnings of our intellectual property systems and chart a course that respects both the ethos of IP protection and the unique characteristics of the virtual world.

Traditional IP legislation, rooted in a tangible, physical context, struggles to address the Metaverse's unique landscape. The broad and sometimes nebulous categorizations under the Nice Classification highlight this challenge. When applied

to the digital realm, these categorizations seem ill-fitting, leading to potential overcrowding and ambiguities that neither serve rights holders nor promote a clear understanding for users and creators. The court cases and jurisprudential interpretations discussed earlier only further underline the tensions and inconsistencies arising from shoehorning the Metaverse into antiquated structures.

The potential solutions proposed, such as the creation of a new class within the Nice Classification or aligning virtual goods with their tangible counterparts, are commendable starting points. Each seeks to reconcile the inherent disparities between the virtual and the physical, with the intention of facilitating better clarity and protection. Yet, as dissected, neither is without pitfalls. The former may offer an immediate remedy but risks future complications, especially given the pace of technological advancement. The latter, while seemingly more streamlined, may still not fully encapsulate the multi-dimensional nature of virtual goods, especially when the lines between tangible and intangible blur further.

It is worth noting that beyond classification, the broader challenges faced in the Metaverse—such as issues of jurisdiction, territoriality, and even the very concept of ownership—necessitate a more holistic re-evaluation. The unique non-physical nature of the Metaverse means that traditional markers, be they geographical or tangible, are often rendered irrelevant or inadequate. This extends beyond mere categorization of goods to broader questions of how rights are asserted, protected, and enforced in a space that is inherently global and intangible.

As we move forward, a dual-pronged approach may be worth considering. On one hand, there is a pressing need for specialized, interim guidelines and regulations tailored specifically for the Metaverse. This would provide immediate clarity and protection for innovators and creators actively shaping this digital frontier. On the other hand, a more comprehensive overhaul of IP frameworks should be embarked upon, ensuring they are adaptable, flexible, and future-proof. Such a system should be equipped not just for the current intricacies of the Metaverse but for the myriad technological advancements yet to come.

Moreover, this evolution should not be undertaken in isolation. Collaboration between legal experts, tech innovators, and stakeholders from across the Metaverse is essential. Their collective insights will ensure that the revised frameworks are both robust in protection and facilitative of innovation. Such a multi-disciplinary approach would enrich the discourse and lead to more balanced, comprehensive solutions.

In conclusion, the Metaverse, in all its dynamism and promise, underscores a broader challenge faced by societies today: How to adapt time-honored systems to a future we are still coming to understand. The intellectual property dilemmas of the Metaverse are but a microcosm of this challenge. By addressing these with foresight, adaptability, and collaboration, we not only ensure a thriving digital realm but also chart a course for how we might approach the myriad other challenges that the future will undoubtedly present. As the lines between the tangible and virtual continue to blur, our legal and ethical compasses must be recalibrated, ensuring they remain both relevant and effective in an ever-evolving landscape.

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Notes

1 The new business model of the platform economy raises several definitional issues. On this point, there have been many attempts by both the European legislator and the literature to find a common definition of the phenomenon, but without yet succeeding.

2 However, it also raises a number of criticalities.

3 In a 1999 essay, Stephenson explained the title of the novel as his term for a particular software failure mode on the early Macintosh computer. Stephenson wrote that "When the computer crashed and wrote gibberish into the bitmap, the result was something that looked vaguely like static on a broken television set – a snow crash".

4 Neil Stevenson referred to the Metaverse in the sense of a reality where the offline and digital worlds interact and create value through user activities and interactions.

5 It should be noted that for there to be such independence, it must also be 'open' and 'decentralized' because, otherwise, it would be run by a few large companies for their own profit.

6 There will be some reflection on this topic later.

7 Note that there can be different types of NFTs, such as 'asset tokens', 'utility tokens' and 'security tokens'.

8 On that occasion, the Court had affirmed the principle that users of a trademark are protected if their use can be considered artistic expression and if it does not explicitly mislead consumers. Thus, the First Amendment protects against infringement claims "if the defendant's use of the mark is (1) 'artistically relevant' to the work and (2) not 'explicitly misleading' as to the source or content of the work".

9 It included "Scientific, research, navigation, surveying, photographic, cinematographic, audiovisual, optical, weighing, measuring, signalling, detecting, testing, inspecting, life-saving and teaching apparatus and instruments; apparatus and instruments for conducting, switching, transforming, accumulating, regulating or controlling the distribution or use of electricity; apparatus and instruments for recording, transmitting, reproducing or processing sound, images or data; recorded and downloadable media, computer software, blank digital or analogue recording and storage media; mechanisms for coin-operated apparatus; cash registers, calculating devices; computers and computer peripheral devices; diving suits, divers' masks, ear plugs for divers, nose clips for divers and swimmers, gloves for divers, breathing apparatus for underwater swimming; fire-extinguishing apparatus".

10 It is necessary to note that marketplace and financial services related to virtual goods belong, respectively, in Classes 35 and 36 of the Nice Classification. On this point, the EUIPO also specified that since NFTs are unique digital certificates registered on a blockchain that prove the authenticity of a certain digital asset but are distinct from it, it is also necessary to specify the type of digital asset that the NFT authenticates. Note that it is specified that services related to virtual goods and NFTs must be classified in line with established principles of service classification.

11 Suffice it to mention General Court (Second Chamber), Louis Vuitton Malletier v. Office for Harmonisation in the Internal Market (Trade Marks and Design), 21 April 2015, Case T-359/12.

12 It should be noted that the Court of Rome was of the same opinion, which by order of 27 July 2022 in the case R.G. no. 32072/22, upheld the appeal of the football club Juventus Football Club S.p.a. against the company Blockeras S.r.l. for having marketed certain NFTs and other digital content depicting the former footballer Christian Vieri wearing the Juventus jersey without the latter's prior consent. The court therefore held that the protection provided by trademark law was also applicable to the virtual world and then emphasized that it was appropriate to extend trademark registration to the metaverse.

13 Scholars recognize that "while the scope of intellectual property protection in the metaverse is not clear, the new NFT market

has already seen a number of intellectual property disputes. The possibility of disputes in the metaverse is even greater. Traditional approaches to the enforcement of intellectual rights will need to be revised".

[14] The EU Commission in its communication "An Action Plan to Support Recovery and Transformation" of 2020 listed measures to boost, among others, virtual reality experience by fostering a European Virtual and Augmented Reality (VR/AR) industrial coalition (action 5).

[15] ECJ, Libertel Groep BV v. Benelux-Merkenbureau, 06 May 2003, Case C-104/01, ECLI:EU:C:2003:244.

[16] The platform economy is seen as a private system.

[17] Regulation (EU) 1215/2012 of the European Parliament and of the Council of 12 December 2012 on jurisdiction and the recognition and enforcement of judgments in civil and commercial matters. It should be noted that national provisions on the jurisdiction of courts apply residually or if the European Regulations themselves expressly so provide.

[18] Article 5 also provides that persons domiciled in a Member State may be sued in the courts of another Member State only by virtue of the rules set out in Sections 2 to 7 of this Chapter. In particular, the rules of national jurisdiction of which the Member States are to notify the Commission pursuant to point (a) of Article 76(1) shall not be applicable as against the persons referred to in paragraph 1".

[19] Among others, see CJEU, 21 December 2016, Concurrence, C-618/15; CJEU, 22 January 2015, Hedjuk, C-441/13; CJEU, 3 October 2013, Pinckney, C-170/12; CJEU, 19 April 2012, Wintersteiger, C-523/10.

References

1. Vallas S, Schor JB. What do platforms do? Understanding the gig economy. Annual Review of Sociology. 2020; 46: 273–294. doi: 10.1146/annurev-soc-121919-054857
2. Sutherland W, Jarrahi MH. The sharing economy and digital platforms: A review and research agenda. International Journal of Information Management. 2018; 43: 328–341. doi: 10.1016/j.ijinfomgt.2018.07.004.
3. Bertolini A, Episcopo F, Cherciu NA. Liability of online platforms. 2021. Available online: https://www.europarl.europa.eu/RegData/etudes/STUD/2021/656318/EPRS_STU(2021)656318_EN.pdf (accessed on 12 May 2024).
4. Bertolini A, Sposini L. Digital Platforms and Liability in Bertolini (ed), Regulating Advanced Technologies: Policy Papers on the Jean Monnet Centre of Excellence on the Regulation of Robotics and AI. Il Campano. 2022; 22–38. Available online: https://www.iris.sssup.it/retrieve/831dc622-ae91-46e3-ac06-2a55c2035fec/EURAPolicyPapers.pdf (accessed on 12 May 2024).
5. EY, LUISS. Web 3.0: Metaverso e NFT. 2023. Available online: https://www.ey.com/it_it/newsroom/2023/02/web-3-0-prossimi-10-anni-previsto-un-tasso-di-crescita-dei-ricavi-superiore-del-40-per-cento (accessed on 15 May 2024).
6. Suh A, Prophet J. The state of immersive technology research: A literature analysis. Computers in Human Behavior. 2018; 86: 77–90.
7. Blyth C. Immersive technologies and language learning. Foreign Language Annals. 2018; 51: 225–232.
8. Handa M, Aul G, Bajaj S. Immersive technology–uses, challenges and opportunities. International Journal of Computing & Business Research. 2012; 6: 1–11. ISSN (Online): 2229-6166.
9. Lee SG, Trimi S, Byun W, Kang M. Innovation and imitation effects in Metaverse service adoption. Service Business. 2011; 5: 155–172. doi: 10.1007/s11628-011-0108-8
10. Schroeder R, Huxor A, Hudson-Smith A. Activeworlds: Geography and social interaction in virtual reality. Futures. 2001; 33: 569–587.
11. Jaynes C, Seales WB, Calvert KC, et al. The Metaverse: A networked collection of inexpensive, self-configuring, immersive environments. Proceedings of the workshop on Virtual environments. 2003; 115–124. doi: 10.1145/769953.769967
12. Rymaszewski M, Au WJ, Wallace M, et al. Second Life: The Official Guide. Wiley; 2007.
13. Owens D, Mitchell A, Khazanchi D, Zigurs I. An empirical investigation of virtual world projects and metaverse technology capabilities. SIGMIS Database. 2011; 42: 74–101. doi.org/10.1145/1952712.1952717
14. Zackery A, Shariatpanahi P, Zolfagharzadeh MM, Pourezzat AA. Toward a simulated replica of futures: Classification and possible trajectories of simulation in futures studies. Futures. 2016; 81: 40–53. doi: 10.1016/j.futures.2015.11.002
15. Cameron A. Splendid isolation: 'Philosopher's islands' and the reimagination of space. Geoforum. 2012; 43(4): 741-749. doi: 10.1016/j.geoforum.2011.12.008

16. Ball M. The Metaverse: And How It Will Revolutionize Everything. Liveright Pub Corp. 2022; 29.
17. Council of European Union. Analysis and Research Team (ART), Metaverse—Virtual World, Real Challenges. March 2022; 3. Available online: https://www.consilium.europa.eu/media/54987/metaverse-paper-9-march-2022.pdf (accessed on 15 May 2024).
18. Kovacova M, Horak J, Higgins M. Behavioral analytics, immersive technologies, and machine vision algorithms in the Web3-powered Metaverse world. Linguistic and Philosophical Investigations. 2022; 21: 57–72. doi: 10.22381/lpi2120224
19. Voshmgir S. Token Economy: How the Web3 reinvents the internet. Token Kitchen. 2020; 2.
20. Lee LH, Braud T, Zhou P, et al. All one needs to know about metaverse: A complete survey on technological singularity, virtual ecosystem, and research agenda. arXiv preprint arXiv:211005352. 2021.
21. Belk R. Mariam Humayun and Myriam Brouard, Money, possessions, and ownership in the Metaverse: NFTs, cryptocurrencies, Web3 and Wild Markets. Journal of Business Research. 2022; 153: 198–205. doi: 10.1016/j.jbusres.2022.08.031
22. Park A, Wilson M, Robson K, et al. Interoperability: Our exciting and terrifying Web3 future. Business Horizons. 2023; 66(4): 529-541. doi: 10.1016/j.bushor.2022.10.005
23. Kanematsu H, Ogawa N, Shimizu A. Skype Discussion for PBL Between Two Laboratories and Students Biological/Psychological Responses. Procedia Computer Science. 2017; 112: 1730–1736. doi: 10.1016/j.procs.2017.08.200
24. Kantaros A, Piromalis D, Tsaramirsis G, et al. 3D printing and implementation of digital twins: Current trends and limitations. Applied System Innovation. 2021; 5(7). doi: 10.3390/asi5010007
25. Wang Y, Su Zhou, Zhang N, et al. A survey on metaverse: Fundamentals, security, and privacy. IEEE Communications Surveys & Tutorials 2022; 319–352. doi: 10.1109/COMST.2022.3202047
26. Lyytinen K, Yoo Y. Ubiquitous computing Communications of the ACM. 2002; 45: 63–96. doi: 10.1145/585597.58561.
27. Friedewald M, Raabe O. Ubiquitous computing: An overview of technology impact. Telematics and Informatics. 2011; 28: 55–65. doi: 10.1016/j.tele.2010.09.001
28. Krumm J. Ubiquitous computing fundamentals. CRC Press; 2018.
29. Olshavsky RW. Time and the Rate of Adoption of Innovations. Journal of Consumer Research. 1980; 6(4): 425-428. doi: 10.1086/208786
30. Wu J, Lin K, Lin D, et al. Financial Crimes in Web3-empowered Metaverse: Taxonomy, Countermeasures, and Opportunities. IEEE Open Journal of the Computer Society. 2023; 4: 37–49. doi: 10.48550/arXiv.2212.13452
31. Laviola F, Iannuzzi A. Fundamental rights in the digital transformation between freedom and equality (Italian). Constitutional Law. 2023; 9–40.
32. Di Majo L. Art. 2 of the Constitution and the "Metaverse" (Italian). MEDIA LAWS. 2023. Available online: https://www.medialaws.eu/wp-content/uploads/2023/06/1-23-Di-Majo.pdf (accessed on 15 May 2024).
33. Rossi M, Ciletti M, Scarinci A, Toto GA. Learning through the metaverse and immersive reality: new inclusive perspectives (Italian). IUL Research. 2023; 4: 164–176. Doi: 10.57568/iulresearch.v4i7.419
34. Brittan H. The Problems With Immersive Advertising: In AR/VR, Nobody Knows You're An Ad. Standford Journal of Online Trust and Safety. 2021; 1: 1–14. doi: 10.54501/jots.v1i1.21
35. Choi Y, Kim YS. A study on satisfaction with virtual object manipulation in metaverse based on mixed reality. Journal of Positive School Psychology. 2022; 10282. Available online: https://www.journalppw.com/index.php/jpsp/article/view/6353 (accessed on 15 June 2024).
36. De Haas E, Huang Y, Bermejo C, et al. Towards Trustworthy Augmented Reality in The Metaverse Era: Probing Manipulative Designs in Virtual-Physical Commercial Platforms. IEEE. 2023. doi: 10.1109/VRW58643.2023.00232
37. Christodoulou K, Katelaris L, Themistocleous M, et al. NFTs and the metaverse revolution: Research perspectives and open challenges. Blockchains and the Token Economy: Theory and Practice. 2022; 139–178. doi: 10.1007/978-3-030-95108-5_6
38. Turdialiev MA. The legal issues of metaverse and perspectives of establishment of international financial center in metaverse. Oriental renaissance: Innovative, educational, natural and social sciences. 2022; 2: 239–249. Available online: https://dergipark.org.tr/en/pub/ljr/issue/82725/1419936 (accessed on 15 June 2024).
39. Ramos A. The metaverse, NFTS and IP rights: To regulate or not to regulate? Intellectual Property Forum: Journal of the Intellectual and Industrial Property Society of Australia and New Zealand. 2022. Available online: https://www.wipo.int/en/web/wipo-magazine/articles/the-metaverse-nfts-and-ip-rights-to-regulate-or-not-to-regulate-42603 (accessed on latest access: 15 June 2024).

40. Dwivedi YK, Hughes H, Wang Y. Metaverse marketing: How the metaverse will shape the future of consumer research and practice. Psychology & Marketing. 2023;40: 750–776.
41. Di Pierro M. What is the blockchain? Computing in Science & Engineering. 2017; 19: 92. doi: 10.1109/MCSE.2017.3421554
42. Porru S, Pinna A, Marchesi M, Tonelli R. Blockchain-oriented software engineering: Challenges and new directions. IEEE. 2017; 169. doi: 10.48550/arXiv.1702.05146
43. Serras C, Alturas B, Lapa T. Metaverse Technological Adoption: A Study of Processes, Behaviors and Attitudes. Metaverse Driven Intelligent Information Systems. 2024. doi: 10.1007/978-3-031-72418-3_17
44. Rajasekaran AS, Azees M, Al-Turjman F. A comprehensive survey on blockchain technology. Sustainable Energy Technologies and Assessments. 2022; 52(02039). doi: 10.1016/j.seta.2022.102039
45. Michael J, Cohn A, Butcher JR. Blockchain technology. 5th Texila World Conference for Scholars (TWCS). 2018; 1: 1-11. doi: 10.21522/TIJAR.2014.SE.19.02.Art003.
46. Yaga D, Mell P, Roby N, Scarfone K. Blockchain technology overview. arXiv preprint arXiv:190611078. 2019. doi: 10.48550/arXiv.1906.11078
47. Golosova J, Romanovs A. The advantages and disadvantages of the blockchain technology. IEEE. 2018. Available online: https://ieeexplore.ieee.org/document/8592253 (accessed on 15 May 2024).
48. Ammous S. Blockchain technology: What is it good for? Available at SSRN 2832751. 2016.
49. WIPO. Blockchain technologies and IP ecosystems: A WIPO white paper. 2022; 23. Available online: https://www.wipo.int/export/sites/www/cws/en/pdf/blockchain-for-ip-ecosystem-whitepaper.pdf (accessed on 15 May 2024).
50. European Blockchain Observatory and Forum. Demystifying Non-Fungible Tokens (NFTs). 2020. 4. Available online: https://blockchain-observatory.ec.europa.eu/document/download/3494c6fc-c61d-4193-b24a-28da803fc5fe_en?filename=DemystifyingNFTs_November+2021_2.pdf (accessed on 15 May 2024).
51. Bamakan H, Nezhadsistani N, Bodaghi O, Qu Q. Patents and intellectual property assets as non-fungible tokens; key technologies and challenges. Scientific Reports. 2022; 12: 1–13. doi: 10.1038/s41598-022-05920-6
52. Savelyev A. Copyright in the blockchain era: Promises and challenges. Computer law & security review. 2018; 34: 550–561.
53. Muciaccia N, Lopopolo S. First reflections on the relationship between NFT and IP (Italian). Journal Horizons of Commercial Law. 2022; 1–57.
54. Vulpiani G. Non fungible tokens, smart contracts and blockchain in art and fashion: crypto art and digital fashion (Italian). Cammino Diritto. 2021; 2.
55. Wang Q, Li R, Chen S. Non-fungible token (NFT): Overview, evaluation, opportunities and challenges. arXiv preprint arXiv:210507447. 2021.
56. Park A, Kietzmann J, Pitt L, Dabirian A. The evolution of nonfungible tokens: Complexity and novelty of NFT use-cases. IT Professional. 2022; 24: 9. doi: 10.1109/MITP.2021.3136055
57. European Innovation Council and SMEs Executive Agency. Intellectual Property in the Metaverse. Episode 1. 2022. Available online: https://intellectual-property-helpdesk.ec.europa.eu/news-events/news/intellectual-property-metaverse-episode-1-2022-02-25_en (accessed on 15 May 2024).
58. US District Court for the Southern District of New York. Nike Inc. v. StockX LLC, Case No. 22-cv-983. 2022. Available online: https://heitnerlegal.com/wp-content/uploads/Nike-v-StockX.pdf (accessed on 15 June 2024).
59. Howard M, Kahn J. Hermés International v. Mason Rothschild, 1:22-cv-00384. SDNY. Loeb&Loeab LLP. Available online: https://www.loeb.com/en/insights/publications/2023/06/hermes-international-v-rothschild (accessed on 14 May 2024).
60. Rogers v. Grimaldi, 875 F.2d 994, 999, 2d Cir. 1989. Available online: https://law.justia.com/cases/federal/district-courts/FSupp/695/112/2345732/ (accessed on 15 May 2024).
61. Goldbard LG, Binni NS. The First Amendment: Apparent Immunity from Trademark Infringement? Available online: https://www.stroock.com/uploads/firstamendmentapparentimmunityfromtrademarkinfringement.pdf (accessed on 15 May 2024).
62. Nice Classification, 11th Edition. 2022. Available online: https://www.wipo.int/classifications/nice/nclpub/en/fr/?basic_numbers=show&class_number=9&explanatory_notes=show&gors=&lang=en&menulang=en&mode=flat&notion=&pagination=no&version=20220101 (accessed on 15 May 2024).
63. EUIPO. Virtual goods, non-fungible tokens and the metaverse. 2022. Available online: https://euipo.europa.eu/ohimportal/en/news-newsflash/-/asset_publisher/JLOyNNwVxGDF/content/pt-virtual-goods-non-

fungible-tokens-and-the-metaverse (accessed on 15 May 2024).
64. EUIPO. Refusal of application for a European Union trademark (Article 7 and Article 42(2) EUTMR), application No. 018647205. Available online: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwib8YXWrJX-AhWhR_EDHU0SAUsQFnoECBgQAQ&url=https%3A%2F%2Feuipo.europa.eu%2Fcopla%2Ftrademark%2Fdata%2F018647205%2Fdownload%2FCLW%2FRFS%2F2023%2FEN%2F20230208_018647205.pdf%3Fapp%3Desearch%26casenum%3D018647205%26trTypeDoc%3DNA&usg=AOvVaw2lzTu5b5-Sbg1UTNYge88G (accessed on 15 May 2024).
65. Müller F. Remembering in the metaverse: Preservation, evaluation, and perception. University of Basel. 2012. Available online: https://edoc.unibas.ch/16452/1/diss_mueller_pdfa_final.pdf (accessed on 15 May 2024).
66. Hackl C. How brands can thrive in the direct to avatar economy. 2022. Available online: https://www.forbes.com/sites/cathyhackl/2021/01/29/how-brands-can-thrive-in-the-direct-to-avatar-economy/?sh=55434c50417c (accessed on 14 May 2024).
67. Floridi L. Metaverse: A matter of experience. Philosophy & Technology. 2022; 35(73). doi: 10.2139/ssrn.4121411.
68. Falk TH, Le LB, Morandotti R. The Internet of Senses: A Position Paper on the Challenges and Opportunities of Multisensory Immersive Experiences for the Metaverse. IEEE. 2022; 139–144. doi: 10.1109/MetroXRAINE54828.2022.9967586
69. Mariusz M. Study—Metaverse. 2023; 119. Available online: https://www.europarl.europa.eu/RegData/etudes/STUD/2023/751222/IPOL_STU(2023)751222_EN.pdf (accessed on 15 May 2024).
70. European Commission. Communication from the Commission to the European Parliament, the Council, The European Economic and Social Committee and the Committee of the Regions, on Europe's Media in the Digital Decade: An Action Plan to Support Recovery and Transformation. 2020. 784 final. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0784 (accessed on 15 May 2024).
71. European Parliament. Hearing on Regulatory Challenges of the Metaverse. 2023. Available online: https://www.europarl.europa.eu/committees/en/hearing-on-regulatory-challenges-of-the-/product-details/20230420CHE11607 (accessed on 15 May 2024).
72. European Parliament. Initiative on virtual worlds, such as the metaverse. Available online: The opinion is available here: https://www.eesc.europa.eu/en/our-work/opinions-information-reports/opinions/initiative-virtual-worlds-such-metaverse (accessed on 15 May 2024).
73. Bently L, Sherman B. Intellectual Property Law. Oxford University Press; 2022.
74. Pila J, Torremans P. European Intellectual Property Law. Oxford University Press; 2019.
75. Grosse H, Metzger, A. Intellectual Property Ordering beyond Borders. Cambridge Intellectual Property and Information Law, Cambridge University Press; 2022.
76. Vanzetti A, Di Cataldo V, Spolidoro MS. Handbook of Industrial Law (original language: Italian). 9 edn. Giuffrè. 2021; 173.
77. INTA. White Paper Trademarks in the Metaverse. 2023; 26. Available online: https://www.inta.org/perspectives/inta-research/trademarks-in-the-metaverse-white-paper/ (accessed on 15 May 2024).
78. Weiser PJ. Regulating Interoperability: Lessons from AT&T, Microsoft, and Beyond. Antitrust LJ. 2009; 76: 271. Available online: https://scholar.law.colorado.edu/faculty-articles/454 (accessed on 15 May 2024).
79. Wertheimer HW. The principle of territoriality in the trademark law of the common market countries. International & Comparative Law Quarterly. 1967; 16: 630–662. Available online: https://www.cambridge.org/core/journals/international-and-comparative-law-quarterly/article/abs/principle-of-territoriality-in-the-trademark-law-of-the-common-market-countries/F281B0C8535284F2C651D1559E80CCE6#article (accessed on 15 May 2024).
80. Peukert A. Territoriality and extra-territoriality in intellectual property law, Beyond Territoriality. Brill Nijhoff. 2012; 189-228.
81. Dinwoodie GB. Trademarks and territory: Detaching trademark law from the nation-state. Hous L Rev. 2004; 41: 885.
82. Kenney M, Bearson D, Zysman J. The Platform Economy Matures: Pervasive Power, Private Regulation, and Dependent Entrepreneurs. SSRN Electronic Journal. 2019. 47. doi: 10.2139/ssrn.3497974
83. Correani A, De Massis A, Frattini F, et al. Implementing a digital strategy: Learning from the experience of three digital transformation projects. California management review. 2020; 62; 37–56.
84. INTA. White Paper Trademarks in the Metaverse. 2020; 23. Available online: https://www.inta.org/wp-

content/uploads/public-files/perspectives/industry-research/METAVERSE_REPORT-070323.pdf (accessed on 15 May 2024).

85. Dick E. Public policy for the metaverse: Key takeaways from the 2021 AR/VR policy conference. 2021. Available online: https://d1bcsfjk95uj19.cloudfront.net/sites/default/files/2021-arvr-policy-conference-report.pdf (accessed on 15 May 2024).
86. Dionisio JDN, Burns III WG, Gilbert R. 3D Virtual worlds and the metaverse: Current status and future possibilities. ACM Comput Surv. 2013; 45.
87. Bosworth A, Clegg N. Building the metaverse responsibly. Meta. 2021; 27: 2. Available online: https://about.fb.com/news/2021/09/building-the-metaverse-responsibly/ (accessed on 15 May 2024).
88. Balis J. How brands can enter the metaverse. HBR Online. 2022; 1–6. Available online: https://hbr.org/2022/01/how-brands-can-enter-the-metaverse (accessed on 15 May 2024).