

Property Law in the Digital Age: Challenges and Innovation

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Abstract:

This paper examines how traditional property law concepts are being reconceptualized to address the challenges of digital assets and environments. As property rights shift from tangible objects to code-based digital assets, fundamental tensions emerge between established legal frameworks and technological realities. Digital assets challenge core property assumptions of rivalry, excludability, and persistence, requiring courts and legislators to adapt centuries-old principles to novel contexts. The analysis explores how diverse legal systems respond to specific digital property types, including intellectual property in non-rivalrous environments, data ownership disputes, cryptocurrency classification, non-fungible tokens, and virtual real estate. Through examination of landmark judicial decisions, emerging legislation, platform governance mechanisms, and technical standards, the paper identifies promising pathways for reconciling traditional property functions with digital innovation. Drawing on comparative approaches from multiple jurisdictions, the research proposes a balanced framework that acknowledges the cultural significance of property institutions while adapting their implementation for digital contexts. The recommendations emphasize flexible, context-sensitive approaches that can maintain essential property functions such as resource allocation, coordination, security, and exchange facilitation, while accommodating the unique characteristics of digital environments.

Keywords: Digital Property, Cryptocurrency, Virtual Assets, Property Theory, Legal Adaptations.

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1. INTRODUCTION

In the past, property was more concretized, involving physical objects that could be owned, defined, and sold in the market. Property law is currently dealing with the exciting task of creating a new type of object that may be far from tangible items or pieces of land, written in code, located in a database, or on a blockchain. Bayer traces the current concepts like use, exclusion, possession, and transfer of property rights back to Wesley, who depicted them as a "stick."¹ The concepts do little to fit within the digital context since the space has engaged and can be independently accessed, copied, and distributed across numerous jurisdictions at nearly no cost.

As Joshua Fairfield accurately pointed out, property is a set of rules that regulates access and control over resources;² nevertheless, digital resources entirely overturn traditional property theory due to non-rivalry. As the ability to easily completely duplicate virtual items and allow multiple people worldwide to access them at once, prior understandings of physical property law break down as to how one can maintain control over or delimit access to an item.

This has significance in many sectors. The health sector is one of the most critical areas this transformation affects. IP regimes are pressurized as content is not only moving digital but also as blockchain technologies allow for the tokenization of the online platform's physical and digital assets, a new form of space supplemented and supplementing the tangible space, virtual objects, and subjects emerge with their real economic value.³ At the same time, data, a byproduct of using technologies, became a brand new category of tangible assets and a value worth fighting for.⁴ Digitalization in the context of property has implications that pose risks regarding legal worldwide systems. According to Balganes, property institutions and property law need to evolve in diverse ways, and they can do so only when such change is directed at preserving the normative goals of the institution of property in order for property to continue to remain relevant in society.⁵ This paper examines the evolving landscape of property law in the digital age by analyzing key challenges arising from digital properties and discussing emerging legal innovations addressing these issues. Section 2 provides conceptual foundations of property rights in digital contexts. Section 3 examines specific challenges across different digital property types, from intellectual property to virtual real estate and cryptocurrencies. Section 4 analyzes legal innovations responding to these challenges through case law, legislation, and regulatory approaches. Section 5 discusses normative considerations and policy recommendations, while Section 6 offers concluding

¹ Merrill, Thomas W., and Henry E. Smith. "What Happened to Property in Law and Economics?" *Yale Law Journal* 111, no. 2 (2001): 357-398.

² Fairfield, Joshua AT. *Owned: Property, privacy, and the new digital serfdom*. Cambridge University Press, 2017.

³ Lemley, Mark A. "IP in a World Without Scarcity." *New York University Law Review* 90, no. 2 (2015): 460-515.

⁴ Scassa, Teresa. "Data Ownership." *CIGI Papers* No. 187 (2018): 1-27.

⁵ Balganes, Shyamkrishna. "Property Along the Tort Spectrum: Trespass to Chattels and the Anglo-American Doctrinal Divergence." *Columbia Law Review* 107, no. 8 (2007): 1505-1546.

observations on future trajectories of property law in digital environments. By exploring this rapidly evolving intersection of property law and digital technology, this paper aims to contribute to the ongoing discourse on how legal systems can effectively adapt traditional property principles to provide appropriate protections and certainty in digital contexts.

2. CONCEPTUAL FOUNDATIONS: PROPERTY RIGHTS IN DIGITAL CONTEXTS

2.1 Theoretical challenges to traditional property concepts

Traditional property theory has been constructed around certain foundational assumptions that digital assets directly challenge. Classical property frameworks typically presume rivalry in consumption, excludability through physical boundaries, and persistence of assets over time.⁶ Digital assets, however, can be non-rival (simultaneously used by multiple parties without degradation), difficult to exclude others from accessing, and potentially ephemeral or dependent on technological platforms for continued existence.⁷

As Lemley observes, "The economics of intellectual property are substantially different from the economics of traditional property."⁸ These differences become even more pronounced with purely digital assets. Information goods typically have high fixed costs of creation but near-zero marginal costs of reproduction and distribution, creating economic dynamics fundamentally different from those governing physical property markets.⁹

The conceptual framework of property as an "in rem" right, enforceable against the world at large, becomes problematic in digital environments where jurisdictional boundaries blur, enforcement mechanisms may be limited, and the very identification of the property's location presents challenges.¹⁰ As Smith notes, the information cost theory of property suggests that clear boundaries and standardized forms help reduce transaction costs in physical property systems, but these boundaries become significantly more complex to establish and maintain in digital contexts.¹¹

⁶ Waldron, Jeremy. *The Right to Private Property*. Oxford: Clarendon Press, 1988.

⁷ Benkler, Yochai. *The Wealth of Networks: How Social Production Transforms Markets and Freedom*. New Haven: Yale University Press, 2006.

⁸ Lemley, Mark A. "Property, Intellectual Property, and Free Riding." *Texas Law Review* 83, no. 4 (2005): 1031-1075.

⁹ Shapiro, Carl, and Hal R. Varian. *Information Rules: A Strategic Guide to the Network Economy*. Boston: Harvard Business School Press, 1999.

¹⁰ Merrill, Thomas W., and Henry E. Smith. "The Property/Contract Interface." *Columbia Law Review* 101, no. 4 (2001): 773-852.

¹¹ Smith, Henry E. "Property as the Law of Things." *Harvard Law Review* 125, no. 7 (2012): 1691-1726.

2.2 Reframing property for digital assets

Scholars have proposed various conceptual frameworks to address these challenges. Perzanowski and Schultz suggest that a "digital exhaustion" doctrine could help translate traditional property concepts like the first sale doctrine into digital contexts.¹² Fairfield advocates for viewing virtual property through the lens of emergent property systems that recognize new forms of rivalrous, persistent digital assets.¹³

Others propose more radical reconceptualizations. Wendy Gordon suggests that certain digital property rights might be better understood through relational models rather than traditional exclusion frameworks.¹⁴ Meanwhile, Shyamkrishna Balganesh proposes focusing on the particular normative goals that property institutions serve rather than attempting to apply rigid conceptual frameworks across contexts.¹⁵

These theoretical reconsiderations have practical implications. Courts and legislatures increasingly recognize that digital assets may constitute "property" for specific legal purposes while acknowledging that the scope and nature of those property rights might differ from traditional contexts. As the United Kingdom Jurisdiction Taskforce concluded in its legal statement on crypto assets; crypto assets "have all of the indicia of property" while acknowledging they are "not typical of most other things usually regarded as property."¹⁶

2.3 Unbundling digital property rights

A particularly useful approach to digital property may involve more explicit "unbundling" of the traditional property rights package. In digital contexts, the right to exclude might function differently from the right to use or the right to transfer. For example, cryptocurrency ownership involves control over private keys that allow transfer, but not necessarily the right to exclude others from viewing transaction data on a public blockchain.¹⁷

This unbundling becomes evident in emerging licensing and rights management systems. Smart contracts can enforce highly specific and conditional property rights that change dynamically based on use patterns, while non-fungible tokens might bundle certain rights (transfer, authentication) while excluding others traditionally associated with ownership (reproduction, modification).¹⁸

¹² Perzanowski, Aaron, and Jason Schultz. "Digital Exhaustion." *UCLA Law Review* 58, no. 4 (2011): 889-946.

¹³ Fairfield, Joshua A.T. "Virtual Property." *Boston University Law Review* 85, no. 4 (2005): 1047-1102.

¹⁴ Gordon, Wendy J. "A Property Right in Self-Expression: Equality and Individualism in the Natural Law of Intellectual Property." *Yale Law Journal* 102, no. 7 (1993): 1533-1609.

¹⁵ Balganesh, Shyamkrishna. "Demystifying the Right to Exclude: Of Property, Inviolability, and Automatic Injunctions." *Harvard Journal of Law and Public Policy* 31, no. 2 (2008): 593-661.

¹⁶ UK Jurisdiction Taskforce. "Legal Statement on Cryptoassets and Smart Contracts." *The LawTech Delivery Panel* (2019): 1-46.

¹⁷ Swan, Melanie. *Blockchain: Blueprint for a New Economy*. Sebastopol: O'Reilly Media, 2015.

¹⁸ Wright, Aaron, and Primavera De Filippi. "Decentralized Blockchain Technology and the Rise of Lex Cryptographia." (2015): 1-58.

As Van Erp notes, "The digital revolution forces us to look differently at property law" by revealing that property rights have always been more contingent and context-dependent than often recognized.¹⁹ Digital contexts simply make these contingencies more visible and require more explicit articulation of which specific rights are included in any given property arrangement.

3. CHALLENGES ACROSS DIGITAL PROPERTY TYPES

3.1 Intellectual property in digital environments

Digital technologies have fundamentally disrupted intellectual property frameworks designed for tangible embodiments of creative works. Copyright law, in particular, faces challenges enforcing exclusive rights in environments where perfect digital copies can be created and distributed globally at minimal cost.²⁰ As Lessig observed early in the internet era, "While the law controls copying, technological developments have radically reduced the cost of copying," creating persistent enforcement challenges.²¹

These challenges have evolved beyond simple unauthorized reproduction to encompass text and data mining, AI training on copyrighted materials, and transformative digital remixes. Cases like *Authors Guild v. Google* and *Authors Guild v. HathiTrust* have grappled with how fair use doctrine applies to mass digitization projects,²² while emerging controversies surround AI systems trained on copyrighted materials without explicit permission.²³

Patent law similarly confronts difficulties with software patents, particularly regarding abstract ideas implemented through computer programs. Following cases like *Alice Corp. v. CLS Bank International*,²⁴ courts have struggled to delineate patentable software innovations from unpatentable abstract ideas. Meanwhile, trademark law confronts issues ranging from domain names and keyword advertising to virtual merchandise in metaverse environments.²⁵

3.2 Data as property

The status of data as property represents one of the most contested areas in digital property discourse. Personal data, which drives the digital economy, exists in a complex legal realm between privacy law, competition law, contract law, and property

¹⁹ Van Erp, Sjef. "Ownership of Digital Assets and the Numerus Clausus of Legal Objects." *European Property Law Journal* 9, no. 1 (2020): 1-35.

²⁰ Litman, Jessica. *Digital Copyright*. Amherst: Prometheus Books, 2001.

²¹ Lessig, Lawrence. *Code and Other Laws of Cyberspace*. New York: Basic Books, 1999, 124.

²² *Authors Guild v Google, Inc.*, 804 F.3d 202 (2d Cir. 2015); *Authors Guild v HathiTrust*, 755 F.3d 87 (2d Cir. 2014).

²³ Grimmelmann, James. "Copyright for Literate Robots." *Iowa Law Review* 101, no. 2 (2016): 657-681.

²⁴ *Alice Corp. v CLS Bank International*, 573 U.S. 208 (2014).

²⁵ Dogan, Stacey L., and Mark A. Lemley. "Trademarks and Consumer Search Costs on the Internet." *Houston Law Review* 41, no. 3 (2004): 777-838.

frameworks.²⁶ While individuals increasingly assert property-like claims over "their" data, businesses similarly claim ownership or control rights based on collection and processing investments.²⁷

The debate extends beyond personal data to machine-generated data, scientific databases, and aggregated datasets. As Drexel notes, introducing comprehensive property rights in data could create static monopolies in a field where innovation depends on data flow and accessibility.²⁸ Yet the absence of clear property rights may also create uncertainty that hinders data markets and investments.

Legal approaches to data property rights vary significantly by jurisdiction. The European Union Database Directive created a sui generis right for database makers who made substantial investments,²⁹ while the General Data Protection Regulation provides individuals with certain control rights over personal data without explicitly framing these as property rights.³⁰ In the United States, courts have generally rejected broad data ownership claims while recognizing more limited rights in specific contexts.³¹

3.3 Digital assets and cryptocurrencies

Cryptocurrencies and blockchain-based assets present novel property questions that challenge conventional categories. These assets combine characteristics of currencies, securities, commodities, and information products, creating regulatory classification challenges.³² Property law must address fundamental questions about the nature of "ownership" when it consists primarily of cryptographic control over digital tokens.³³ Courts have increasingly recognized cryptocurrencies as constituting property for specific legal purposes. In cases like *AA v Persons Unknown*,³⁴ English courts have treated Bitcoin as property for the purpose of granting proprietary injunctions. Similarly, in *Ruscoe v Cryptopia Ltd*,³⁵ the New Zealand High Court recognized cryptocurrency holdings as a species of intangible property held on trust for exchange customers.

²⁶ Schwartz, Paul M. "Property, Privacy, and Personal Data." *Harvard Law Review* 117, no. 7 (2004): 2056-2128.

²⁷ Jones, Charles I., and Christopher Tonetti. "Nonrivalry and the Economics of Data." *American Economic Review* 110, no. 9 (2020): 2819-2858.

²⁸ Drexel, Josef. "Designing Competitive Markets for Industrial Data: Between Propertisation and Access." *Journal of Intellectual Property, Information Technology and E-Commerce Law* 8, no. 4 (2017): 257-292.

²⁹ Directive 96/9/EC of the European Parliament and of the Council of 11 March 1996 on the legal protection of databases.

³⁰ Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data.

³¹ *Feist Publications, Inc. v. Rural Telephone Service Co.*, 499 U.S. 340 (1991).

³² Goforth, Carol R. "Securities Treatment of Tokenized Offerings Under U.S. Law." *Penn State Law Review* 46, no. 1 (2018): 85-153.

³³ Fox, David. "Cryptocurrencies in the Common Law of Property." In *Cryptocurrencies in Public and Private Law*, edited by David Fox and Sarah Green, 139-168. Oxford: Oxford University Press, 2019.

³⁴ *AA v Persons Unknown* [2019] EWHC 3556 (Comm).

³⁵ *Ruscoe v Cryptopia Ltd* (in Liquidation) [2020] NZHC 728.

Property law must also address novel issues arising from cryptocurrency characteristics, including forks (where blockchains split into competing versions), airdrops (where tokens are distributed to existing cryptocurrency holders), and staking arrangements (where tokens are temporarily committed to network security).³⁶ These features have no direct analogues in traditional property systems and require careful legal analysis regarding property status and rights allocation.

3.4 Non-Fungible Tokens (NFTs)

Non-fungible tokens represent a particularly complex digital property type that unbundles various rights traditionally associated with ownership. NFTs typically do not confer copyright ownership but rather specific rights defined by smart contracts and terms of service.³⁷ This creates potential disparities between perceived ownership rights and actual legal entitlements, as purchasers may believe they have acquired more comprehensive rights than legally provided.³⁸

Property questions surrounding NFTs include whether and how property rights in the token itself relate to any associated digital asset, the transferability of linked rights and licenses, and remedies available when platforms hosting NFT-linked content cease operations.³⁹ Cases like *Hermès International v. Rothschild* highlight emerging conflicts between intellectual property systems and NFT markets when tokens reference existing protected works or brands.⁴⁰

3.5 Virtual real estate and in-game assets

Virtual environments create simulation-based "spaces" and "objects" that may have significant economic value despite their intangible nature. Property frameworks for these digital environments typically derive from a combination of contract law (through terms of service), technical controls implemented by platform providers, and emerging norms within user communities.⁴¹

The property status of virtual assets has faced judicial consideration in cases like *Bragg v. Linden Research*⁴² and *Marc Wobegone v Linden Research*,⁴³ which addressed property interests in virtual land and items within the Second Life platform. More recently, substantial investments in metaverse "land" through platforms like

³⁶ Walch, Angela. "The Path of the Blockchain Lexicon (and the Law)." *Review of Banking & Financial Law* 36, no. 2 (2017): 713-765.

³⁷ Levi, Stuart, and Alex Lipton. "An Introduction to Smart Contracts and Their Potential and Inherent Limitations." *Harvard Law School Forum on Corporate Governance* (2018).

³⁸ Quintais, João Pedro, Balázs Bodó, Stefan Giesen, and Alexandra Giannopoulou. "Blockchain and the Law: A Critical Evaluation." *Stanford Journal of Blockchain Law & Policy* 2, no. 1 (2019): 86-112.

³⁹ Werbach, Kevin, and Nicolas Cornell. "Contracts Ex Machina." *Duke Law Journal* 67, no. 2 (2017): 313-382.

⁴⁰ *Hermès International v Rothschild*, No. 22-cv-384 (JSR) (S.D.N.Y. Feb. 8, 2023).

⁴¹ Lastowka, Greg, and Dan Hunter. "The Laws of the Virtual Worlds." *California Law Review* 92, no. 1 (2004): 1-73.

⁴² *Bragg v Linden Research, Inc.*, 487 F. Supp. 2d 593 (E.D. Pa. 2007).

⁴³ *Marc Wobegone v Linden Research, Inc.*, No. 10-cv-01017 (E.D. Pa. filed Mar. 6, 2010).

Decentraland and The Sandbox have raised complex questions about the nature and persistence of property rights in these emerging virtual spaces.⁴⁴ Key challenges include determining appropriate property protection when platform providers modify or discontinue services, addressing conflicts between contractual terms and property expectations, and managing interoperability of assets across different virtual environments.⁴⁵ These issues have gained particular salience as virtual property transactions reach significant economic values, with some virtual land sales exceeding millions of dollars.⁴⁶

4. LEGAL INNOVATIONS AND RESPONSES

4.1 Judicial adaptations of property concepts

Courts have demonstrated remarkable adaptability in applying property frameworks to digital assets, often drawing on established legal principles while acknowledging the unique characteristics of digital properties. In the cryptocurrency context, several key decisions have established that digital assets can constitute property despite lacking physical form. The UK case *AA v Persons Unknown*⁴⁷ applied property principles to Bitcoin, enabling the granting of a proprietary injunction to recover assets acquired through ransomware.

In the same way, in *Ruscoe v Cryptopia Ltd*,⁴⁸ the New Zealand High Court examined the nature of cryptos' properties and held that they meet all the criteria given by Lord Wilberforce in *National Provincial Bank v Ainsworth*⁴⁹ they are definable, capable of identification by third parties, capable of being transferred by third parties, and have some degree of durational stability. This approach explained how several traditional property characteristics could be meaningfully applied to the new type of digital assets.

Note that courts also embraced different strategies in addressing concerns related to digital intellectual property. This drift indicates an evolution of the fair use doctrine in such cases as *Google LLC v Oracle America, Inc.*⁵⁰ demonstrates that there is a willingness by the judicial system to adopt concepts in the copyright laws to meet technological development by the US Supreme Court considering functionalities as well market consequences in the analysis of software's copyright.

⁴⁴ Fairfield, Joshua A.T. "Tokenized: The Law of Non-Fungible Tokens and Unique Digital Property." *Indiana Law Journal* 97, no. 4 (2022): 1261-1311.

⁴⁵ Cherry, Miriam. "A Typology of Virtual Work." *Georgia Law Review* 45, no. 4 (2011): 951-1013.

⁴⁶ Castronova, Edward. "Virtual Worlds: A First-Hand Account of Market and Society on the Cyberian Frontier." *CESifo Working Paper* No. 618 (2001).

⁴⁷ *AA v Persons Unknown* [2019] EWHC 3556 (Comm).

⁴⁸ *Ruscoe v Cryptopia Ltd* (in Liquidation) [2020] NZHC 728.

⁴⁹ *National Provincial Bank v Ainsworth* [1965] AC 1175.

⁵⁰ *Google LLC v Oracle America, Inc.*, 141 S. Ct. 1183 (2021).

4.2 Legislative and regulatory frameworks

This paper attempts to document the current legislative approaches or measures being adopted to address some of these challenges and reveal some level of convergence among the legislatures across the globe. The European Union has been more proactive in creating comprehensive digital property frameworks: the Digital Content Directive,⁵¹ which sets up consumer rights about digital goods, and the Markets in Crypto-Assets (MiCA) Regulation.⁵²

The various issues involving digital property have been handled differently by the states in the United States. Most states adopted the Revised Uniform Fiduciary Access to Digital Assets Act (RUFADAA),⁵³ describing the legal ways for the fiduciaries to access the decedent's or incapacitated person's electronic assets. Wyoming has passed perhaps the most progressive legislation that protects the direct property rights of the interests in digital assets and provides an ecosystem for banks to offer qualified custodial facilities.⁵⁴

Several jurisdictions have also started developing specific legislation dealing with virtual property. South Korea's Game Industry Promotion Act limits virtual item property rights,⁵⁵ while China's civil code has incorporated provisions that may be relevant to protecting virtual property.⁵⁶

4.3 Contractual innovations and platform governance

Much digital property governance occurs through private ordering rather than formal legal frameworks. Platform terms of service effectively establish property regimes for virtual assets, while licensing agreements define the scope of permissible use for digital content.⁵⁷ These contractual frameworks increasingly incorporate sophisticated mechanisms like smart contracts that automatically execute and enforce property transfers and restrictions.⁵⁸

Digital rights management systems and technological protection measures represent another innovation that shapes property rights in digital contexts. These technologies can enforce property-like restrictions beyond what law formally requires or

⁵¹ Directive (EU) 2019/770 of the European Parliament and of the Council of 20 May 2019 on certain aspects concerning contracts for the supply of digital content and digital services.

⁵² Regulation (EU) 2023/1114 of the European Parliament and of the Council of 31 May 2023 on markets in crypto-assets.

⁵³ Uniform Law Commission. "Revised Uniform Fiduciary Access to Digital Assets Act" (2015).

⁵⁴ Wyoming Senate File 0125, Digital Assets-Existing Law (2019).

⁵⁵ Game Industry Promotion Act, Act No. 14839 (South Korea, 2017).

⁵⁶ Civil Code of the People's Republic of China, adopted at the Third Session of the Thirteenth National People's Congress on May 28, 2020.

⁵⁷ Kim, Nancy S. "The Software Licensing Dilemma." *Brigham Young University Law Review* 2008, no. 4 (2008): 1103-1162.

⁵⁸ Levy, Karen EC "Book-Smart, Not Street-Smart: Blockchain-Based Smart Contracts and The Social Workings of Law." *Engaging Science, Technology, and Society* 3 (2017): 1-15.

recognizes, creating what Radin calls "machine rule" that may supplement or even supplant traditional legal governance.⁵⁹

Platform governance systems have also evolved sophisticated dispute resolution mechanisms for digital property conflicts. eBay's resolution center, domain name dispute resolution under Internet Corporation for Assigned Names and Numbers (ICANN) procedures, and smart contract-based arbitration systems represent private governance innovations that address digital property disputes outside traditional court systems.⁶⁰

4.4 Standards and interoperability initiatives

Emerging technical standards and protocols increasingly shape digital property systems by enabling interoperability and persistence across platforms. In the cryptocurrency space, token standards like ERC-20 and ERC-721 establish technical frameworks that enable property-like characteristics to be embedded in blockchain assets.⁶¹ These standards facilitate the creation of digital property markets by ensuring assets can be consistently identified, transferred, and authenticated. Similar standardization efforts appear in other digital domains. The Publishing Link Specification standardizes e-book ownership records,⁶² while initiatives like the Metaverse Standards Forum work to establish interoperability standards for virtual assets across platforms.⁶³ These technical standards effectively create infrastructure that enables more robust digital property systems by addressing identification, persistence, and transferability challenges.

5. NORMATIVE CONSIDERATIONS AND POLICY RECOMMENDATIONS

5.1 Balancing innovation and protection

Digital property frameworks must balance innovation incentives with appropriate protection levels. Overly rigid property regimes may impede digital innovation by creating excessive transaction costs and anticommons problems,⁶⁴ while insufficient protection may undermine investment and market development. As Lemley notes, "The rhetoric of property is commonly employed in the intellectual property context to support a theory of absolute protection...[but] treating intellectual property as ordinary property is a mistake."⁶⁵ This observation applies equally to many digital property contexts.

⁵⁹ Radin, Margaret Jane. "Regulation by Contract, Regulation by Machine." *Journal of Institutional and Theoretical Economics* 160, no. 1 (2004): 142-156.

⁶⁰ Katsh, Ethan, and Orna Rabinovich-Einy. *Digital Justice: Technology and the Internet of Disputes*. New York: Oxford University Press, 2017.

⁶¹ Entriken, William, Dieter Shirley, Jacob Evans, and Nastassia Sachs. "ERC-721 Non-Fungible Token Standard." *Ethereum Improvement Proposals*, no. 721 (2018).

⁶² International Digital Publishing Forum. "EPUB Publications 3.0.1" (2014).

⁶³ Metaverse Standards Forum. "Establishing the Foundations for Open Metaverse Interoperability" (2022).

⁶⁴ Heller, Michael A. "The Tragedy of the Anticommons: Property in the Transition from Marx to Markets." *Harvard Law Review* 111, no. 3 (1998): 621-688.

⁶⁵ Lemley, Mark A. "Property, Intellectual Property, and Free Riding." *Texas Law Review* 83, no. 4 (2005): 1031-1075.

A balanced approach might involve tailored property protections that vary based on asset type and context rather than applying uniform property models across all digital domains. For instance, strong property protections may be appropriate for personal cryptocurrencies but problematic for data resources that benefit from broader access and use.⁶⁶

5.2 Addressing digital divides and equity concerns

Ensuring equity considerations gain attention, digital property systems trigger appropriate equity attention points. It is worrisome that as property rights are extended to cover objects in cyberspace, they may manifest novel aleatory properties based on possession, technological access and literacy to embrace new forms of inequality.⁶⁷ Given that new forms of valuable virtual properties and cryptocurrencies are emerging, property inequality will likely be true to intensifying more standard inequalities associated with technological access to objects and other material resources.

Governments should determine how these approaches are presented to various populations and, if necessary, enhance the protection of the property in question to vulnerable groups. These may cover rules and policies on consumer protection on investment, raising awareness and knowledge about digital property among the population, and measures preventing new property development from excluding disadvantaged groups.⁶⁸

5.3 Jurisdictional challenges and harmonization efforts

Cryptocurrencies and virtual property exist on international networks, crossing the boundaries of jurisdiction that may lead to conflicts of laws regarding property.⁶⁹ International standardization becomes imperative to bring legal clarity and minimize risks associated with compliance within the global digital markets.

Actions like the United Nations Commission on International Trade Law (UNCITRAL) Model Law on Electronic Transferable Records are significant in achieving the most incredible consistency in digital property amongst different jurisdictions.⁷⁰ Regional frameworks like the EU digital single market also make efforts to minimize fragmentation in digital property laws.⁷¹ In the future, much emphasis should be laid on fewer differences in the fundamental principles of digital property laws and mutual recognition of such laws, but at the same time, adequate discretion should be maintained to accommodate jurisdiction differences.

⁶⁶ Frischmann, Brett M. "An Economic Theory of Infrastructure and Commons Management." *Minnesota Law Review* 89, no. 4 (2005): 917-1030.

⁶⁷ Hargittai, Eszter. "Digital Na(t)ives? Variation in Internet Skills and Uses among Members of the 'Net Generation'." *Sociological Inquiry* 80, no. 1 (2010): 92-113.

⁶⁸ Nakamura, Lisa. *Digitizing Race: Visual Cultures of the Internet*. Minneapolis: University of Minnesota Press, 2008.

⁶⁹ Michaels, Ralf. "Territorial Jurisdiction After Territoriality." In *Globalisation and Jurisdiction*, edited by Piet Jan Slot and Mielle Bulterman, 105-130. Leiden: Kluwer Law International, 2004.

⁷⁰ UNCITRAL. "UNCITRAL Model Law on Electronic Transferable Records" (2017).

⁷¹ European Commission. "A Digital Single Market Strategy for Europe." COM(2015) 192 final (2015).

5.4 Future-proofing digital property frameworks

The law of property has to devise strategies that effectively accommodate future technological changes rather than proceeding from the assumption that present technologies are unchanging.⁷² Fairfield recommends that such functional concepts and principles should not rely on specific technologies but should be based on technologies. Regulatory sandboxes and experimental legal zones provide opportunities to test innovative property approaches before wider implementation.⁷³ These controlled environments allow regulators to observe how property frameworks function with emerging technologies and adjust approaches based on practical experience rather than theoretical predictions.

6. CONCLUSION

Property law in the digital age faces a fundamental tension between stability and adaptation. As a legal institution designed to provide certainty and secure expectations, property law naturally resists rapid change. Yet digital technologies continue to evolve at an accelerating pace, creating persistent pressure for legal adaptation.⁷⁴ Several trajectories seem likely in this evolving landscape. First, we can expect increasing unbundling and customization of property rights in digital contexts, with more explicit articulation of specific entitlements rather than reliance on broad ownership concepts.⁷⁵ Second, property governance will likely involve more complex interactions between formal law, technical standards, and platform rules than traditional property systems.⁷⁶ Third, the boundaries between property and other legal frameworks, particularly contract and privacy law, will continue to blur in digital contexts.⁷⁷

Despite these changes, core property functions remain relevant. Digital property systems still serve to allocate resources, coordinate usage, provide security, and establish frameworks for exchange, traditional functions of property institutions.⁷⁸ The challenge lies in adapting the specific mechanisms through which these functions are accomplished to match the characteristics of digital resources and environments. As Fairfield concludes, "Property is not solely a legal institution; it is a social institution backed by law."⁷⁹ This observation highlights perhaps the most significant challenge for digital property frameworks: aligning formal legal rules with evolving social understandings and

⁷² Fairfield, Joshua AT. "BitProperty." *Southern California Law Review* 88, no. 4 (2015): 805-874.

⁷³ Allen, Hilary J. "Regulatory Sandboxes." *George Washington Law Review* 87, no. 3 (2019): 579-645.

⁷⁴ Cohen, Julie E. *Between Truth and Power: The Legal Constructions of Informational Capitalism*. New York: Oxford University Press, 2019.

⁷⁵ Bell, Abraham, and Gideon Parchomovsky. "Reconfiguring Property in Three Dimensions." *University of Chicago Law Review* 75, no. 3 (2008): 1015-1070.

⁷⁶ Pasquale, Frank. *The Black Box Society: The Secret Algorithms That Control Money and Information*. Cambridge: Harvard University Press, 2015.

⁷⁷ Cohen, Julie E. "Property and the Construction of the Information Economy: A Neo-Polanyian Ontology." In *Governing Access to Essential Resources*, edited by Katharina Pistor and Olivier De Schutter, 56-90. New York: Columbia University Press, 2015.

⁷⁸ Rose, Carol M. "Property as the Keystone Right?" *Notre Dame Law Review* 71, no. 3 (1996): 329-369.

⁷⁹ Fairfield, Joshua A.T. *Owned: Property, Privacy, and the New Digital Serfdom*. Cambridge: Cambridge University Press, 2017, 35.

expectations about digital resources. As individuals increasingly perceive digital assets as "their property" despite technical or legal complexities, property law must develop frameworks that reasonably align with these expectations while providing necessary clarity and protection in an increasingly digital world.