Hyperownership: Beyond the Current State of Interaction with Digital Property

Amaury Trujillo
amaury.trujillo@iit.cnr.it
IIT-CNR
Pisa, Italy

ABSTRACT

The introduction of novel technology has oftentimes changed the concept of ownership. Non-fungible tokens are a recent example, as they allow a decentralized way to generate and verify proof of ownership via distributed ledger technology. Despite crucial uncertainties, these tokens have generated great enthusiasm for the future of digital property and its surrounding economy. In this regard, I think there is an untapped opportunity in applying a hyper-text approach to augment such highly structured ownership-based associations. To this end, in this work I propose hyperownership, based on the premises that property is the law of lists and ledgers, and that hypertext is an apt method to inquire such a ledger system. In spite of the significant risks and challenges to realize such a vision, I believe that it has great potential to transform the way with which we interact with digital property.

CCS CONCEPTS
• Human-centered computing → Hypertext / hypermedia.

KEYWORDS
digital ownership, distributed ledger technology, non-fungible tokens

ACM Reference Format:
Amaury Trujillo. 2022. Hyperownership: Beyond the Current State of Interaction with Digital Property. In Proceedings of the 33rd ACM Conference on Hypertext and Social Media (HT ’22), June 28–July 1, 2022, Barcelona, Spain. ACM, New York, NY, USA, 4 pages. https://doi.org/10.1145/3511095.3536373

1 INTRODUCTION

Ownership can be described, in very broad terms, as the set of exclusive rights over property, usually classified as tangible (e.g., real state, chattel) or intangible (e.g., intellectual property, digital objects). Such rights are universally recognized as fundamental [1], yet the very concept of ownership evolves over time, according to the mores of society and technological innovations of the place and moment. Ownership has in fact been intrinsically linked to information technology (in its broadest sense) from the very beginning of history, as attested by the small clay objects inscribed with proto-cuneiform dating back to 8000 BCE found in the Near East —called tokens— used to keep track of the number of animals owned [8, p. 22]. Millennia later, the printing press, another technological writing milestone, greatly eased the massive copying of books and also gave way to a new form of piracy of intellectual property [18, §1]. More recently, digital technology, which allows perfect copies of digital objects at near-zero cost, brought into question aspects of goods once considered to be central [22], such as rivalry (impossible simultaneous use) and scarcity (limited availability). Incidentally, such «fundamental shift from tactile to digital, physical to code, and hard to soft media» in ownership is also reflected by hypertext within the history of information technology, as described by Landow [21, pp. 29–41].

Moreover, present-day digital ecosystems—with most based on hypermedia— have heavily influenced our ownership experience. For instance, whereas traditional market models are based on ownership, the sharing economy is based on using and sharing products among each other, and is driven by consumer behavior (preference for convenience, low prices, sustainability), social networks and electronic markets, and mobile devices and electronic services [28]. Another example is the push towards a subscription model of digital goods and services, such as news, music, video, videogames, and apps. Nonetheless, not all changes in digital ownership are welcome, and much debate is being made regarding the rights of buyers, creators, and distributors of digital objects, and the loss of expected privileges associated with ownership [22]. Further, the increasing practice of license-only digital objects and the abuse of digital rights management (DRM) have given rise to harsh criticism against this "end of ownership" in the digital economy [27].

2 A NEW KIND OF DIGITAL OWNERSHIP

Discontent with diminishing digital property rights led many tech enthusiasts to seek alternative approaches. Arguably, one of the most interesting is the use of a non-fungible token (NFT) to certify the authenticity and ownership of tangible or intangible assets. An NFT is a unique identifier recorded using distributed ledger technology (DLT), which is based on decentralized immutable lists of records spread over a peer-to-peer network without the need of a trusted authority, with the most famous example being blockchain [30]. NFTs are a specific form of smart contracts, versatile transaction protocols that automatically execute, control, and document an agreement without the need of a trusted intermediary [3]. Amusingly enough, NFTs seem to carry on the ancient practice of using tokens to keep track of property, only this time via digital cryptographic hashes instead of inscriptions on clay.

In the last couple of years, there has been a surge in public interest on NFTs due to the high-profile sale of certain digital assets [31], such as the sale for US$5.4M of the initial implementation source.
code of the World Wide Web by Tim-Berners Lee. Users and buyers of NFTs are allured by the promise of ownership, traceability, and financial gain [24]. And the high figures involved in much publicized sales have sparked a frenzy in the development of NFTs applications and ecosystems in different sectors, such as collectibles, sports, visual arts, and video games [25]. Even "traditional" social media have begun integrating NFTs. Twitter now can display special NFT profile pictures with a hexagonal shape present in the Ethereum blockchain (the most common DLT for NFTs), and Reddit has established a collaboration with OpenSea (the largest NFT marketplace) to sell unique animated avatars, called CryptoSnoos. Many more ideas are emerging around NFTs and DLT beyond finance, such as decentralized autonomous organizations (DAOs), a novel manner to codify and automatically manage governance via smart contracts without a central leadership [15]. Hence, due to the aforementioned commonalities with respect to information technology, I believe that using an hypertext approach to augment our capabilities on digital ownership based on DLT is a logical yet untapped opportunity.

3 ENVISIONING HYPEROWNERSHIP

Bitcoin, the first successful decentralized virtual currency, gave way to the idea of using DLT as a means to register property ownership. In particular, Fairfield [11] posited that property could be seen as a set of information describing who may do what, when, and with which resource: «property is the law of lists and ledgers». In this perspective, property does not consist in the thing itself, but in the packaging, tracking and transmission of data regarding ownership via information systems; thus, a property system has two key actions: store and communicate ownership information.

However, DLT has mainly focused on improving the latter action from the point of view of machines, neglecting the human element. For example, in a survey of DLT applications from the perspective of human-computer interaction (HCI), Eldsen et al. state that these «are currently overwhelmingly driven by a mix of engineering, investment and crypto-anarchist visions», and they express the need for more research on the human challenges of DLT, such as design for trust, algorithmic governance, influence on societal and individual values, ease of use for end users, and implications of publicly sharing one’s property data [9]. Glomann et al. further confirm the need of a human-centered approach given crucial DLT issues: high onboarding learnability; lack of design considerations for usability, efficiency, and accessibility; and design challenges in decentralized applications [12]. In this respect, I believe there is an unexploited opportunity in using a hypertext approach to tackle these issues, for as hypertext has been historically touted as a means to augment human intellect [32], by allowing a person to approach complex problems, to fulfill their comprehension needs, and to derive solutions to problems [10]. To seize such an opportunity, I think the view posited by Atzenbeck and Nürnberg [5] of a «hypertext method of inquiry, as way of viewing arbitrary systems», is particularly apt. In this view, hypertext shifts its focus from a particular set of technologies and techniques, to the more general explicit association of information. Hyperownership is thus a concept to augment human capabilities on digital ownership, by synthesizing these two ideas: property is the law of lists and ledgers, and hypertext is a method of inquiry of arbitrary systems.

Based on their form of structure from a hypertext perspective [5], NFTs are a first class structure, as by definition DLT records explicit relationships between resources and allows the association of metadata with a link for a given transaction. On top of these records, we could use a new representation to exploit the explicit ownership associations in new ways. For instance, we could use temporal bipartite graphs to represent the evolving relationships between the two main kinds of DLT entities: tokens (property) and their respective account (owner). Compared to their static and unipartite counterparts, temporal bipartite graphs model better the complexity and dynamism of real-world problems [7]. In this owner–property temporal bipartite graph, the state of ownership in a given moment could be computed from a derived static graph, i.e., a snapshot, in which each token is associated with at most one owner and each owner is associated with zero or more tokens. A second ownership-based useful representation could be a property–usage temporal bipartite graph, in which we model distinct usages of property tokens in a given context (e.g., profile picture in social media, an audio or video reproduction). In the snapshots of this graph, each property could be associated to zero or more usages. Finally, a third temporal bipartite graph, owner–usage could be derived from the first two. Further styling could be done through automatic context-aware hypermedia sculpting to remove irrelevant links based on context or manual calligraphic linking by users [13].

With such an approach, illustrated in Fig. 1, we could augment human capabilities to inquiry on ownership by: using novel HCI techniques to visualize and interact with digital property; leveraging recent advances in big graph mining [4] to discover interesting phenomena and gain insight into the dynamics of ownership; integrating existing knowledge graphs [17] to enrich the semantics of the ownership network and viceversa; creating novel non-linear narratives regarding the history of digital objects and the preferences of owner accounts; easing the exploration and recommendation of potentially interesting digital objects to buy, use, or admire; and much more.

4 RISKS AND CHALLENGES

Due to the uncertainties surrounding NFTs, there are significant risks in undertaking the realization of hyperownership. For instance, despite the promise and eagerness of improved usage and financial control and financial by digital content creators, many are divided on the merits of NFTs [20]. Above all, crucial issues remain unanswered regarding the ownership of NFTs and the objects that they represent [23], such as a likely economic bubble, legal recognition, and the currently rising fraud and stealing in the community; as simply put by Joselit [19]: «The NFT is a social contract that values property over material experience. That contract can be broken.» Nevertheless, I think we should look beyond these hectic times and focus on the innovative technology and techniques of NFTs and DLT in general. After all, the hypertext community has already gone through a similar tumultuous technological period caused by hype and unwise investments, during the rise of the World Wide Web and subsequent dot-com bubble burst [35].

1https://www.bbc.com/news/technology-57666335
Many technical and ethical challenges must also be resolved to realize hyperownership. For instance, at the moment we have competing DLT and NFT community-driven standards, resulting in low cross-platform compatibility, albeit many initiatives are in course to remedy this [36]. In addition, DLT and related technologies present significant challenges in software engineering [34]. For instance, many DLT applications store assets on the InterPlanetary File System (IPFS), a distributed peer-to-peer hypermedia protocol aimed to be resilient and persistent [16], which entails a different development approach. In fact, given this shift in paradigm, many people call Web3 a potential decentralized and token-based iteration of the Web [33], albeit this has been decreed as a mere buzzword [26]. Still, Web3 tenets might represent the next step in hypermedia infrastructure, which began as monolithic systems, then client-server systems, later as open hypermedia systems (OHS), and currently as component-based OHS [6]. Hence, distributed and decentralized component-based OHS (using for instance IPFS for media storage) should be further explored. Another significant technical challenge concerns scalability, especially of a graph representation of DLT records which might manifest rapid exponential growth [2]. In this regard, the community on big graph processing systems is working towards adapting new distributed workloads, standard models, and suitable performance metrics to model complex real-world phenomena, with a keen eye towards the possibility of creating a Big Graph Memex [29], inspired by Bush’s original Memex concept. Hyperownership as described herein thus fits and builds upon such an ambitious vision.

Last but not least, ethical issues are also significant for hyperownership. Privacy, a main driver of DLT [14], is far from perfect, and as some of us can imagine, not everyone is keen in facilitating access to the information regarding what we own. Such issues are also present in hypertext, given that despite its potential to empower users and democratize access to information, it is susceptible to surveillance and manipulation [21, Ch. 8]. Indeed, both sculptural and calligraphic hypertext styles could be used to restrict access or to manipulate the narrative regarding the ownership of certain assets by certain individuals or groups. In fact, it could argued that both hypertext and DLT influence and are influenced by political motives, as respectively demonstrated by the OHS and DAOs. Hence, particularly attention should be paid to these sensitive issues in order to avoid abuse, intentional or not.

5 CONCLUSION
Once again, novel technology is changing the perception and experience of ownership, more so in an environment as intertwined as the digital economy. This change represents an opportunity for the development of novel hypertext ideas, such as hyperownership, to unravel and augment our relationship with digital property. Hence, I invite the hypertext community to look and take inspiration by the novel (yet ancient) token economy.

REFERENCES
[1] Bram Akkermans. 2018. A comparative overview of European, US and South African constitutional property law. European Property Law Journal 7, 1 (2018), 158–183.
[2] Ken Alabi. 2017. Digital blockchain networks appear to be following Metcalfe’s Law. Electronic Commerce Research and Applications 24 (2017), 23–29.
[3] Andreas M Antonopoulos and Gavin Wood. 2018. Mastering ethereum: building smart contracts and dapps. O’Reilly Media.
[4] Sabeur Aridhi and Engelbert Meepos Nguifo. 2016. Big graph mining: Frameworks and techniques. Big Data Research 6 (2016), 1–10.
[5] Claude Atzenbeck and Peter J Nürnberg. 2019. Hypermedia as method. In Proceedings of the 30th ACM Conference on Hypertext and Social Media. 29–38.
[6] Claude Atzenbeck, Thomas Schedel, Manolis Tzagarakis, Daniel Rofiner, and Lucas Mages. 2017. Revisiting hypertext infrastructure. In Proceedings of the 28th ACM Conference on Hypertext and Social Media. 35–44.
[7] Xiaoshuang Chen, Kai Wang, Xuanmin Lin, Wenjie Zhang, Lu Qin, and Ying Zhang. 2021. Efficiently answering reachability and path queries on temporal bipartite graphs. Proceedings of the VLDB Endowment (2021).
[8] Peter T Daniels and William Bright. 1996. The world’s writing systems. Oxford University Press on Demand.
[9] Chris Eldred, Arthi Manohar, Jo Briggs, Mike Harding, Chris Speed, and John Vines. 2018. Making sense of blockchain applications: A typology for HCI. In Proceedings of the 2018 chi conference on human factors in computing systems. 1–14.
[10] Douglas C Engelbart. 1962. Augmenting human intellect: A conceptual framework. Menlo Park, CA: SRI International.
[11] Joshua AT Fairfield. 2014. BitProperty. S. Cal. L. Rev. 88 (2014), 805.
[12] Leonard Glömann, Maximilian Schmid, and Nika Kitajewa. 2019. Improving the hyperlink experience of the Memex system. In Proceedings of the 28th ACM Conference on Hypertext and Social Media. 608–616.
[13] Charlie Gargood, Verity Hunt, Mark J Weal, and David E Millard. 2016. Patterns of sculptural hypertext in location based narratives. In Proceedings of the 27th ACM Conference on Hypertext and Social Media. 61–70.
[14] Muneeb Ul Hassan, Mubashir Hussain Rehmani, and Junjun Chen. 2019. Privacy preservation in blockchain based IoT systems: Integration issues, prospects, challenges, and future research directions. Future Generation Computer Systems 97 (2019), 512–529.
[15] Sâmier Hassan and Priyavera De Filippi. 2021. Decentralized Autonomous Organizations. Internet Policy Review 10, 2 (2021), 1–10.
[16] Huawei Huang, Jianru Lin, Baichuan Zheng, Zibin Zheng, and Jing Bian. 2020. When blockchain meets distributed file systems: An overview, challenges, and open issues. IEEE Access 8 (2020), 50574–50586.
[17] Shaoxiong Ji, Shirui Pan, Erik Cambria, Pekka Marttinen, and S Yu Philip. 2021. A survey on knowledge graphs: Representation, acquisition, and applications. IEEE Transactions on Neural Networks and Learning Systems (2021).

[18] Adrian Johns. 2010. Piracy: The intellectual property wars from Gutenberg to Gates. University of Chicago Press.

[19] David Joselit. 2021. NFTs, or The Readymade Reversed. October 175 (2021), 3–4.

[20] Logan Kugler. 2021. Non-fungible tokens and the future of art. Commun. ACM 64, 9 (2021), 19–20.

[21] George P Landow. 2006. Hypertext 3.0: Critical theory and new media in an era of globalization. JHU Press.

[22] Joseph P Liu. 2000. Owning digital copies: Copyright law and the incidents of copy ownership. WM. & Mary L. Rev. 42 (2000), 1245.

[23] Henry Lydiate. 2021. Crypto Art Business. Art Monthly 447 (2021), 44–44.

[24] Simon Mackenzie and Dianza Beccina. 2021. NFTs: Digital things and their criminal lives. Crime, Media, Culture (2021), 17416590211039797.

[25] Matthieu Nadini, Laura Alessandretti, Flavio Di Giacinto, Mauro Martino, Luca Maria Aeiolo, and Andrea Baronchelli. 2021. Mapping the NFT revolution: market trends, trade networks, and visual features. Scientific reports 11, 1 (2021), 1–11.

[26] Annalee Newitz. 2022. Web3 is a fantasy, but it can still hurt you. New Scientist 253, 3376 (2022), 28.

[27] Aaron Perzanowski and Jason Schultz. 2016. The end of ownership: Personal property in the digital economy. NFT Press.

[28] Thomas Puschmann and Rainer Alt. 2016. Sharing economy. Business & Information Systems Engineering 58, 1 (2016), 93–99.

[29] Sherif Sakr, Angela Bonifati, Hannes Voigt, Alexandru Iosup, Khaled Ammar, Renzo Angles, Walid Aref, Marcelo Arenas, Maciej Besta, Peter A Boncz, et al. 2021. The future is big graphs: a community view on graph processing systems. Commun. ACM 64, 9 (2021), 62–71.

[30] Lana Swartz. 2017. Blockchain dreams: Imagining techno-economic alternatives after Bitcoin. Another economy is possible: Culture and economy in a time of crisis 1 (2017).

[31] Amaury Trujillo. 2022. The surge of non-fungible tokens and its implications for digital ownership from an Internet governance perspective. Rivista italiana di informatica e diritto 4, 1 (2022).

[32] Andries van Dam. 2019. Reflections on a Half-Century of Hypertext. In Proceedings of the 30th ACM Conference on Hypertext and Social Media. 3–4.

[33] Shermin Voshmgir. 2020. Token Economy: How the Web3 reinvents the Internet. Vol. 2. Token Kitchen.

[34] Florian Wessling and Volker Gruhn. 2018. Engineering software architectures of blockchain-oriented applications. In 2018 IEEE International Conference on Software Architecture Companion (ICSA-C). IEEE, 45–46.

[35] Peter Robert Wheale and Laura Heredia Amin. 2003. Bursting the dot. com” bubble: a case study in investor behaviour. Technology Analysis & Strategic Management 15, 1 (2003), 117–136.

[36] Idongesit Williams. 2020. Cross-chain blockchain networks, compatibility standards, and interoperability standards. The case of european blockchain services infrastructure. In Cross-Industry Use of Blockchain Technology and Opportunities for the Future. IGI global, 150–165.
Visual-Meta Appendix

The data below is what we call Visual-Meta. It is an approach to add information about a document to the document itself, on the same level of the content (in style of BibTeX).

It is very important to make clear that Visual-Meta is an approach more than a specific format and that it is based on wrappers. Anyone can make a custom wrapper for custom metadata and append it by specifying what it contains; for example @dublin-core or @rdfs.

The way we have encoded this data, and which we recommend you do for your own documents, is as follows:

When listing the names of the authors, they should be in the format 'last name', a comma, followed by 'first name' then 'middle name' whilst delimiting discrete authors with 'and' between author names, like this: Shakespeare, William and Engelbart, Douglas C.

Dates should be ISO 8601 compliant.

Every citable document will have an ID which we call 'vm-id'. It starts with the date and time the document's metadata/Visual-Meta was 'created' (in UTC), then max first 10 characters of document title.

To parse the Visual-Meta, reader software looks for Visual-Meta in the PDF by scanning the document from the end, for the tag @visual-meta-end. If this is found, the software then looks for @visual-meta-start and uses the data found between these tags. This was written September 2021. More information is available from https://visual-meta.info for as long as we can maintain the domain.

@{visual-meta-start}
@{visual-meta-header-start}
@{visual-meta}{version = {1.1},
generator = {ACM Hypertext 21},
organisation = {Association for Computing Machinery}, }
@{visual-meta-header-end}
@{visual-meta-bibtex-self-citation-start}
@{inproceedings{10.1145/3511095.3536373,
author = {Trujillo, Amaury},
title = {Hyperownership: Beyond the Current State of Interaction with Digital Property},
year = {2022},
isbn = {978-1-4503-9233-4},
publisher = {Association for Computing Machinery},
address = {New York, NY, USA},
url = {https://doi.org/10.1145/3511095.3536373},
doi = {10.1145/3511095.3536373},
abstract = {The introduction of novel technology has oftentimes changed the concept of ownership. Non-fungible tokens are a recent example, as they allow a decentralized way to generate and verify proof of ownership via distributed ledger technology. Despite crucial uncertainties, these tokens have generated great enthusiasm for the future of digital property and its surrounding economy. In this regard, I think there is an untapped opportunity in applying a hypertext approach to augment such highly structured ownership-based associations. To this end, in this work I propose hyperownership, based on the premises that property is the law of lists and ledgers, and that hypertext is an apt method to inquiry such a ledger system. In spite of the significant risks and challenges to realize such a vision, I believe that it has great potential to transform the way with which we interact with digital property.},
numpages = {4},
keywords = {digital ownership, distributed ledger technology, non-fungible tokens},
location = {Barcelona, Spain},
series = {HT '22},
vm-id = {10.1145/3511095.3536373}} }
@{visual-meta-bibtex-self-citation-end}
@{visual-meta-end}