

Web 2 vs. Web 3 Paths to the Metaverse: Who Is Leading? Who Should Lead?

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Abstract

Our research investigates two questions: Who is leading the metaverse? Who should lead? The questions are important because metaverse will have significant consequences for individuals, businesses, and society. We examined the current leaders of metaverse on two evolutionary paths, namely Web 2 and Web 3. Based on regulatory reports, corporate press releases, and patents, we found that only a handful of Web 2 companies are “all-in” on metaverse, and at least one of these enterprises, Meta, is on track to end up as a dominant platform provider. Based on market capitalization, user activity, and patents, only a handful of Web 3 communities are emerging. Despite the hype, we are still in the early days for metaverse on both evolutionary paths. As far as who should lead, we advocate for Web 3 because it benefits more users, content creators, and businesses. However, the future of metaverse is not deterministic and it will emerge from the choices we make today. We offer recommendations on how scholars and companies can support the Web 3 path to the metaverse.

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JEL Classifications: *G10, G30, G40, M21*

1. Introduction

Despite all the hype around metaverse and some of the inflated market size predictions—Citigroup thinks the metaverse will be a \$8 trillion to \$13 trillion market by 2030—there remains confusion about what it is and uncertainty about how it will come about (Lacity et al. 2023).

Pertaining to what metaverse is, there is debate as to whether the term “metaverse” is just a rebranded version of the virtual worlds that have been around for nearly two decades, such as Second Life or World of Warcraft, or if it is something new. As of 2023, we don’t know yet—a sentiment shared by Eric Schmidt, former Google CEO: “There’s not an agreement on what the metaverse is” (Sauer 2022).

We don’t even have agreement upon whether the term is singular or plural. Two prevailing approaches attempt to define “metaverse.” One approach has the minimal requirement of a metaverse as any virtual world, i.e., a computer-generated environment, so there are many metaverses here already (e.g., Merriam Webster Dictionary 2023). The other approach defines a single futuristic metaverse comprising a three-dimensional, immersive digital universe that seamlessly connects users to any virtual world (Ball 2021). The requirements for a single metaverse have not yet been achieved, such as interoperability, portability, and real-time rendering (Ball 2022). Gartner (2022) estimates that a single metaverse is more than 10 years away.

Metaverses (plural) are where we are today, with multiple virtual worlds that cannot yet interact with one another, let alone exchange value, or transport our avatars (digital representations of ourselves), virtual goods, and virtual money across worlds.

Currently, metaverses are evolving on two very different paths, namely Web 2 and Web 3 paths.

The Web 2 evolutionary path is led by companies seeking to be centralized platform providers. If they succeed, they will earn the lion’s share of profits, user privacy and autonomy will remain sidelined, and the current Web 2 surveillance capitalism business model will monetize user activity at unprecedented levels; potentially every hand gesture, eye movement, verbal utterance, bodily movement, place visited, and interaction with other avatars and objects will be monitored by the platform provider. We call it surveillance capitalism on steroids, and if one reads Meta’s “privacy” statement for its Quest headsets, this level of monitoring is already happening (Meta 2023a; Meta 2023b).

The Web 3 evolutionary path is led by communities and not-for-profit (NFP) foundations seeking to develop metaverse applications on decentralized architectures and governed by users and developers.

Decentralized architectures (e.g., blockchains) have some advantages over traditional centralized architectures. For

example, they are resilient to cybersecurity attacks because the attack surface is diffused across many locations. Cybersecurity gets stronger as more nodes are added to the network because hackers will need to attack more nodes. Another benefit is scalability—just add more machines to the network to increase computing power.

Another potential advantage of the Web 3 approach is decentralized governance via smart contracts and decentralized autonomous organizations (DAOs); users vote on decisions about the platform using governance tokens, which are cryptographically secured to prevent voter fraud (Ausustin et al. 2023; Lacity and Lupien 2022). However, DAOs are not a panacea: consensus among dispersed stakeholders can become difficult to achieve (Chen et al. 2020), and distributing voting power based on vested interest in a metaverse (i.e., wealth via virtual currency, land, etc.) can lead to re-centralization as a plutocracy (Goldberg and Schär 2023).

As to “who” should lead the development of metaverse, we advocate for the Web 3 evolutionary path. Users, content creators, and businesses have much to gain from a decentralized evolutionary path to the metaverse. Users will have control of their digital identities, custody of their digital assets, the ability to monetize their own data, and the freedom to come and go and to buy and sell across virtual worlds in a privacy-preserving manner. Content creators can capture a larger share of profits from their creative works, and companies can compete in a free-market ecosystem based on open standards, rather than being dependent on, and vulnerable to, Web 2 platform providers’ policies and pricing (Cutolo et al. 2021).

Who is leading the metaverse? In this article, we analyze the progress made on both evolutionary paths.

Section 2 examines companies leading Web 2 efforts. We identify the US enterprises primed to dominate the metaverse based on data gathered from US Securities and Exchange Commission (SEC) Form 10-K reports and corporate press releases. Our analysis in this section focuses on US companies because of data availability. From our Web 2 analyses, we conclude that only a few US corporations are seriously committed to metaverse, with Meta being the current leader.

Section 3 examines NFP foundations and start-ups leading Web 3 efforts. We identify the top Web 3 metaverses based on the market capitalization of their native cryptocurrency and reviewed reports on user activity. From this analysis, we infer that market capitalization rates are inflated given the comparatively low number of active daily users.

Section 4 examines individuals and companies with the most US patents related to metaverse. This analysis highlights the Web 2 and Web 3 companies that have been awarded patents.

Section 5 shares the findings from our participant observation research by describing our experiences in Web 2 and Web 3 metaverses. Regardless of the evolutionary path, the metaverses accessed with virtual reality (VR) headsets are far richer than that accessed via a web browser, but there are more obstacles to gain access.

Section 6 summarizes our findings and outlines a path forward for Web 3. For Web 3 to flourish, we need much more investment and engagement from all stakeholders: consumers, creators, businesses, educators, researchers, governments, and nongovernment organizations (NGOs). At the core of Web 3 is the decentralization of control and the inclusion of all. Companies who invest in digital property and other assets, participate in standards efforts, host events, and sell digital goods and services in Web 3 metaverses will help establish and shape the ecosystem needed for Web 3 to prevail.

2. Web 2 analysis: Which US enterprises are leading?

To answer the question, we conducted analyses from two data sources: US SEC 10-K reports and corporate press releases. We chose 10-K reports because US companies are required to report any materially significant activities or threats that could affect future earnings or create significant risks. We chose corporate press releases to gauge a company’s interest in metaverse.

2.1. Web 2 metaverse leaders from SEC 10-Ks evidence

Form 10-K is a report the US SEC requires corporations to file annually. Some of the information a company is required to disclose in the 10-K includes details on the nature of its business, risk factors, financial data, organizational structure, subsidiaries, and management’s discussion and analysis about the financial and operational results. Because it is regulated by the SEC, audited by an independent auditor, and scrutinized by market participants—such as analysts and institutional investors—the 10-K is considered a credible report and source of information on the operations and financial performance of a firm (Lacity et al. 2022).

We extracted 10-K reports from January 2018 to May 2023 that mentioned the terms “metaverse” or “virtual world,” counted the number of corporations who mentioned them, and the number of times a corporation used them. We found modest results overall. Of the 46,001 10-K and related reports in the database spanning more than five years, only 202 reports mentioned one or both terms (see Figure 1).

The five companies with the most mentions of “metaverse” or “virtual worlds” in their 10-K reports were Ault Alliance (mentioned 158 times), GBT Technologies (156 times), Super League Gaming (113 times), Cinedigm (101 times), and Takung Art Company (101). Notably, Meta ranked 7th, with 54 mentions of the keywords from 2018 to 2023. We summarize what each of the top companies is saying to investors about their metaverse activities. Interestingly, all of

these companies describe their metaverse in terms of a “platform.”

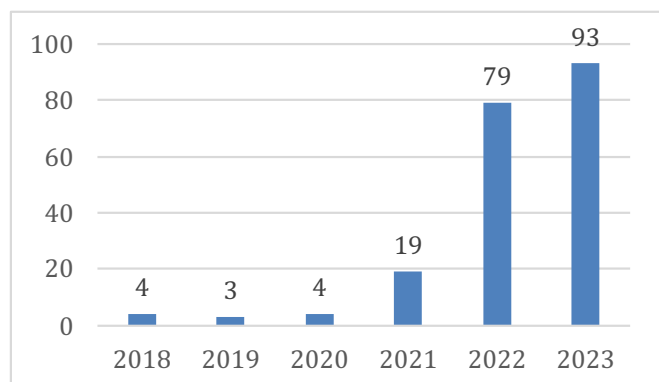


Figure 1. Number of US companies reporting metaverse/virtual world activities in 10-K reports.

Ault Alliance (stock ticker: AULT) is an electronics component company with many subsidiaries, including crane services, oil exploration, defense/aerospace, industrial, automotive, medical biopharma, consumer electronics, hotel operations, textiles, and a Bitcoin mining subsidiary. It earned \$61 million in revenue in 2022. In its 2023 10-K report, most of its mentions of metaverse pertained to its \$11.5 million investment in BitNile Metaverse Inc. (BNC), a decentralized platform for finance (DeFi). The report states, “BNC, an entity in the embryonic stage of development, represents a groundbreaking development in the online metaverse landscape, offering immersive, interconnected digital experiences that are inclusive, engaging, and dynamic. By integrating various elements such as virtual markets, real-world goods marketplaces, gaming, social activities, sweepstakes, gambling, and more, BNC aims to revolutionize the way people interact online... This unique integration establishes BNC as a pioneering platform in the metaverse industry, catering to diverse user interests and needs.”

GBT Technologies (GTCH) focuses on intelligent human body vitals devices, asset tracking IoT, and wireless mesh networks. Earning \$1.2 million in 2022, its 2023 10-K report discusses its joint ownership in Metaverse Kit Corporation. The report states, “The purpose of Metaverse Kit was to develop, maintain and support source codes for its proprietary technologies and comprehensive platform that combines a core virtual reality platform and an extended set of real-world functions to provide a metaverse experience initially within the area of sports and then expanding into virtual worlds of entertainment, live events, gaming, communications and other cross over product opportunities.”

Super League Gaming (SLGG)’s motto is, “We are the Rocketship to the metaverse.” Earning \$19.7 million in 2022, metaverse is its core business. From its 2023 10-K report, Super League Gaming describes itself as “the leading metaverse advertising platform,” “a leading publisher of games, monetization tools and content channels across

metaverse gaming platforms.” “Our strong and growing product-market fit currently reaches over 100 million monthly unique players in Roblox, Minecraft and Fortnite and generates over one billion monthly impressions.”

Cinedigm (CIDM) describes itself as “a leading independent distributor and aggregator of independent music, television, and other short form content rights distributed across digital, over-the-top (OTT), physical, and home and mobile entertainment platforms as well as a leading servicer of digital cinema assets on over 2,843 domestic and several international countries.” It earned \$56 million in revenue last year. From its 2022 10-K report, metaverse is mentioned in terms of its stock purchase in a leading Chinese Entertainment Company called “Metaverse.”

Takung Art Company (TKAT) reports that it “operates an electronic online platform located at <https://www.nftoeo.com/> for artists, art dealers and art investors to offer and trade in ownership over valuable artwork in the form of non-fungible token or NFT.” It earned \$3 million in revenue in 2022. Its 10-K report states that it owns Metaverse Digital Payment Co., a company based in Hong Kong.

The five companies with the most mentions of metaverse in their 10-K reports all report revenues in terms of \$ millions and thus they may not have the impact of Meta, which ranked 7th on the list of 10-K reports with the most metaverse mentions. While recent press has criticized Meta’s lack of progress on metaverse, Meta is recognized as the leading Web 2 contender at this point because it has invested over \$10 billion in metaverse, more than any other company (Mac et al. 2022).

Meta Platforms (META): In October of 2021, Facebook’s CEO, Mark Zuckerberg, announced that Facebook was changing its name to Meta. In the video announcement, Zuckerberg said, “I believe the metaverse is the next chapter for the Internet.” (Facebook 2021).

Meta earned \$117 billion in revenue in 2023, which was a nearly 2 percent decline from its previous year. According to its 2023 10-K report, Meta is still committed to building the metaverse. Meta’s mission is “to give people the power to build community and bring the world closer together. All of our products, including our apps, share the vision of helping to bring the metaverse to life... Our vision for the metaverse does not center on any single product, but rather an entire ecosystem of experiences, devices, and new technologies. While the metaverse is in the very early stages of its development, we believe it will become the next computing platform and the future of social interaction.”

To summarize what we have learned from 10-K reports, very few US companies are investing in metaverse at a level significant enough to alert investors. The companies with the

most mentions of metaverse (or virtual world) are relatively small except for Meta. Irrespective of any media buzz, Meta's 10-K report shows that the company is deeply committed to its future as a metaverse platform, which will very likely build upon Meta's successful Web 2 model.

2.2. Web 2 metaverse leaders from corporate press announcements evidence

Official press releases are also an indicant of a company's interest in metaverse. We used the Nexis Uni database to identify public announcements related to "metaverse" or "virtual world" from five major news sources: Business Wire, EQS News, GlobeNewswire, London Stock Exchange Aggregated Regulator News Service, and PR Newswire. To narrow the search to focus on corporate press releases, we also use the keyword "ticker" to identify the publicly traded companies since Nexis Uni uses built-in classification to identify whether the news article mentioned any company or ticker in the text. We searched from January 2018 or May 2023. A total of 146 press releases mention "metaverse" or "virtual world" along with one or more publicly traded companies' tickers (see Figure 2). The press releases may have been issued by a company reporting on itself (e.g., Meta announcing its own news) or by a third party.

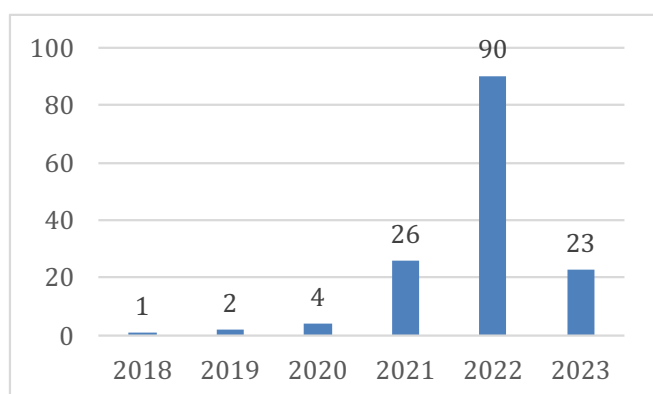


Figure 2. Number of US companies with corporate press releases on metaverse/virtual world (2023 data only up to May).

The five companies with the most mentions of "metaverse" or "virtual worlds" in corporate press releases were Vision Sensing Acquisition (mentioned in 16 releases), Meta (11 releases), Citigroup (7 releases), Aries I Acquisition (6 releases), and Atari (6 releases).

Vision Sensing Acquisition (VSAC) is a special purpose acquisition, or "blank check" company, meaning that it is publicly traded but has no business plan or operations. Corporate press announcements covered its partnership and \$103 million investment in Newsight, an Israeli-based company focused on depth camera sensors for machine vision, targeting metaverse, robotics, and Industry 4.0.

Meta Platforms (META) receives massive exposure in the popular press, but issues few formal press releases—only 5 before May 2023. Its press release in Q1 2023 results only mentions "metaverse" once and artificial intelligence (AI) three times.

Citigroup (C) appeared in press releases pertaining to their projection that metaverse will be a \$8 trillion to \$13 trillion market by 2030 and that it may have 5 billion users (Citi 2022). One press release was about Citi's management of the Hiro Metaverse Acquisitions' (a "blank check" company) IPO.

Aries I Acquisition (RAM) is another "blank check" company. Founded by Thane Ritchie, Aries I invests in aerospace, quantum computing, AI, cybersecurity, metaverse, blockchain, and digital currencies.

Atari (PONGF) announced an NFT project with Brazilian pop culture artist Butcher Billy as part of its 50-year anniversary as a company. The collection of 2,600 unique NFTs is suggested to be worth \$500,000 to NFT holders. Atari also announced it is introducing a free metaverse experience.

3. Web 3 analysis: Which communities are leading?

Web 3 metaverses are based on token economics where users pay for virtual plots of land, services, and experiences (like live concerts or fashion shows) with the metaverse's native digital cryptocurrency. Within these virtual worlds, blockchain technologies create an immutable record of transactions upon which every user can rely.

To find the Web 3 leaders, we used CoinMarketCap.com. This site ranks the top metaverse cryptocurrencies by market capitalization. On May 29, 2023, CoinMarketCap reported the total market capitalization of Web 3 metaverses at \$13.8 billion. The top five metaverse tokens by market cap were Internet Computer (\$2.1 billion), ApeCoin (\$1.2 billion), The Sandbox (\$1 billion), Render Token (\$926 million), and Decentraland (\$894 million). Among these five, The Sandbox and Decentraland are the only ones with live virtual worlds your avatar can visit today. The other three are tokens that might be used in a future metaverse.

Internet Computer (token ticker: ICP) aims to be the world's decentralized internet. The white paper was released in April of 2022 by the DFINITY Team. The DFINITY Foundation is a Swiss-based NFP that coordinates the development of Internet Computer. So far, the Internet Computer community has launched a smart contracting language (Motoko), chain key cryptography, the Network Nervous System for blockchain governance, and has launched network nodes. It's not a metaverse destination yet, but communities could build a metaverse on top of it.

ApeCoin (APE) was launched on Ethereum by the APE Foundation in 2022. ApeCoin is a utility token and a

governance token for the ecosystem around the Bored Ape Yacht Club. The ecosystem has NFTs for 10,000 cartoon images of bored apes. It's not a metaverse, but because it has built such a strong community, some people think it will become a preferred token of the metaverse (Exposito 2022).

The Sandbox (SAND) was launched on Ethereum. It's a virtual world that allows users to create, buy, and sell digital assets in the form of a game. It uses a play-to-earn business model. According to CoinMarketCap, "By combining the powers of decentralized autonomous organizations (DAO) and non-fungible tokens (NFTs), the Sandbox creates a decentralized platform for a thriving gaming community." It has partnered with Tony Hawk, Snoop Dogg, Playboy, Paris Hilton, and other influencers to help sell its virtual plots of land. A total of 166,464 plots were created, and someone has paid \$450,000 to be Snoop Dogg's virtual neighbor (Irwin 2021)!

Render Token (RNDR), according to CoinMarketCap, "is a distributed GPU rendering network built on top of the Ethereum blockchain in 2017, aiming to connect artists and studios in need of GPU compute power with mining partners willing to rent their GPU capabilities out." Some people claim Render Token will become a dominant currency in the metaverse "because someone is going to need to render all those virtual worlds. With this Render Token distributed rendering network, we could see things being made faster for the Metaverse in a much more cost-effective manner. This is because Render Tokens would cost less than utilizing expensive cloud rendering infrastructure" (Sag 2017).

Decentraland (MANA) is a metaverse platform that was launched with smart contracts on Ethereum and is managed by a DAO. Its 90,000 plots of virtual land are represented by ERC-721 NFTs, can be bought on OpenSea with ERC-20 fungible tokens called MANA, with a total MANA supply of 2.2 million. Decentraland gained media attention when someone paid \$2.4 million for a virtual plot of land in 2021 (Howcroft 2021).

The Sandbox and Decentraland are the only live metaverses among the top five. Despite high market capitalizations, their daily user activity is quite low. DappRadar reported in October of 2022 that each metaverse had fewer than 1,000 daily active users (Cohen 2022). In May of 2023, Sandbox had 4,610 unique active wallets and processed over 2,000 transactions worth \$4.73 million. Decentraland had 2,730 unique active wallets and processed over 35,000 transactions worth about \$25,000. Decentraland contests these numbers, suggesting that a better measure of user activity is unique visitors. Those numbers are still quite low with just 4,405 unique users for May 2023. Overall, the growth in user activity has been slow compared to other recent technological advances such as ChatGPT.

Not all Web 3 metaverse pioneers are associated with a specific cryptocurrency. For example, Lamina1 is building a

Layer 1 blockchain intended to provide infrastructure via interoperating tools and decentralized services for the open metaverse. It was co-founded by Neal Stephenson (who coined the term "metaverse" in 1992) and crypto pioneer Peter Vessenes. Lamina1's approach to a Web 3 metaverse is succinctly summarized by CEO Rebecca Barkin: "You can't architect a compelling experience backward from a desired financial outcome" (Stephenson 2023).

4. Web 2 and Web 3 metaverse leaders from US patent evidence

We chose US patents because they indicate which individuals and companies are developing intellectual property related to metaverse.

Individuals and companies seek patents to protect their intellectual property. While this protection may suggest that patent holders aim to create Web 2 metaverses by creating monopolies and by earning money from their intellectual property, some patent holders license their patents for free, so we do not make any assumptions about a patent holder's intentions based on patent data. Companies, for example, often seek patents as a preemptive move to prevent other individuals and companies from submitting patents and charging them fees (or suing them) (Guellec et al. 2010).

We searched the US Patent and Trademark Office (USPTO) Patent Full-Text and Image Database to find issued (i.e., granted) patents that related to "metaverse." (The patent database cannot be searched easily for compound terms like "virtual world.")

From 2001 to present, a total of 232 patents were issued which mentioned the keyword "metaverse" in the patent document. Figure 3 shows that 92 patents were issued from 2018 to 2022. (When we search the patent database on issued patents, they are pulled based on the publication filing date. There were no issued patents in 2023 yet because all the patents were filed before 2022.)

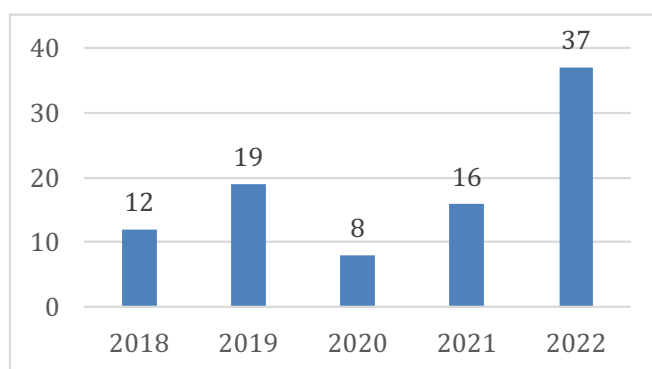


Figure 3. Number of US patents granted that mention "metaverse".

We were surprised that most patents that mention metaverse were granted more than six years ago. After reviewing the patents, the answer became clear: patent assignees were inspired by science fiction! For example, Kenneth Perlin and Athomas Goldberg were awarded the first US patent that mentions the word “metaverse” in 2001. Their invention is a method and a system for creating real-time, behavior-based animated actors. The patent mentions Neal Stephenson’s 1992 novel, *Snow Crash*: “The novel ... posits a ‘Metaverse’, a future version of the internet which appears to its participants as a quasi-physical world... The participants are represented by fully articulate human figures, or avatars whose body movements are computed automatically by the system. ‘Snow Crash’ touches on the importance of proper authoring tools for avatars, although it does not describe those tools. The present invention takes these notions further, in that it supports autonomous figures that do not directly represent any participant” (US Patent 6285380).

Kusumoto et al. earned the second US patent that mentions “metaverse” in 2005. The patent is for methods enabling users to create advertising/branding for their avatars, virtual spaces, and virtual objects. The authors also mention “metaverse” in the context of Stephenson’s novel (US Patent 6954728).

Among the top early patents awarded, IBM was awarded three patents prior to 2018 directly related to metaverse. IBM uses the terms “virtual universe,” “virtual world,” and “metaverse” synonymously. They were granted two more patents related to metaverse after 2018.

The top four companies as the original assignees with the most issued patents from January 2018 to May 2023 that mention metaverse are Winklevoss IP LLC (11 patents), Gemini IP LLC (7 patents), Patreon Inc (7 patents), and Umnai Ltd (4 patents). The following companies each have 3 issued patents during this timeframe: Katmai Tech, Starkeys LLC, Roblox, and Meta Platforms.

Patent research based on keywords requires additional analysis to understand what the company is really patenting. For example, the Winklevoss twins are well known in the Web 3 community, as well as from their legal battles with Mark Zuckerberg over the origins of Facebook (Mezrich 2019). The twins are co-founders of two top companies in our patent search, Winklevoss IP and Gemini IP.

Winklevoss IP’s 11 patents focus on digital assets and blockchains; the term “metaverse” comes up because their patents list examples of digital math-based assets, which include Metaverse ETP, a cryptocurrency launched in 2017. Gemini’s patents generally address how to use blockchain technologies to generate a stable digital asset.

Patreon is a Web 2 company that operates a platform for creators. Patreon’s seven patents pertain to membership platforms. Its patents come up in our search because they

frequently reference a New York Law School Review paper that has “metaverse” in the title.

Umnai developed an explainable model for tasks like motion detection in AI systems, like a metaverse.

Readers may be surprised that Meta Platforms does not have more patents. The company has many patents, but its issued patents do not mention frequently the specific keyword of “metaverse.” Instead, Meta used terms like “virtual reality” or “virtual environment.”

Looking at the evidence, both Web 2 and Web 3 companies are patent holders; Winklevoss and Gemini’s leaders, for example, are known advocates for Web 3 technologies, with a particular interest in stable coins. Other companies are considered to be Web 2 companies, including Patreon, IBM, Roblox, and Meta Platforms.

5. Web 2 vs. Web 3: Evidence from digital participant observation

We also spent time in several Web 2 and Web 3 metaverses to compare user experiences. Web 2 metaverses on our virtual road trip included Meta’s Horizon Workrooms, Second Life, Roblox, and Victory XR’s Engage platform. Web 3 metaverses we visited include Decentraland, Somnium, The Sandbox, Spatial, and Cryptovoxels. Some metaverses are only experienced with web browsers (e.g., Second Life and Decentraland), others are accessible only with VR headsets (e.g., Horizon Workrooms; Victory XR’s Engage platform), still others provide both web-based and VR-based options (e.g., Spatial). Figure 4 shows some of our avatars.

Overall, metaverse experiences were far richer with VR headsets because we felt a greater sense of presence. While still lagging behind modern video game experiences, VR graphics can be quite rich and beautiful. However, the setup to access the worlds via VR headsets took more work. For Web 2, this involved accounts and passwords to be established with the centralized platform provider, loading software on the headsets, creating an avatar, and using logon credentials to access the software. For Web 3, it involved downloading a digital wallet, loading the software on the VR headsets, and creating an avatar.

Our best user experience was in VictoryXR’s Metaversity platform because this platform has content relevant to our lives as educators. VictoryXR is a Web 2 content provider that builds virtual educational experiences on the ENGAGE platform and has already developed several college courses. For example, we learned about pig anatomy by climbing inside a virtual pig the size of a room; we used virtual Bunsen burners to perform chemistry experiments; and one of us took an oceanography class where her avatar walked into the ocean to interact with ocean species. According to Pitchbook, VictoryXR has received several rounds of venture capital

funding, the most recent of which was \$2.82 million. This level of funding is difficult to match in Web 3 communities.



Figure 4 The authors' avatars.

(Top): Mary Lacity's avatars in *Second Life*, *Spatial*, *Horizon Workrooms*, *Decentraland*, and *VictoryXR Metaversity*; (middle): Jeff Mullins' avatars in *Spatial*, *Horizon Workrooms*, *Decentraland*, and *VictoryXR Metaversity*; (bottom) Le Kuai's avatars in *Spatial*, *Meta Horizon*, *Decentraland*, and *Engage*

Overall, we found both Web 2 and Web 3 metaverses to be mostly empty spaces. We were often the only avatars wandering around the different lands once we left the initial "welcome" centers. The only time virtual worlds were busy was when they were associated with well-advertised events, like fashion shows and concerts. While this is currently the case for "open" metaverses, other virtual worlds that can be loosely defined as metaverses (e.g., Roblox, VRChat), and our best user experience in Engage, suggest that compelling experiences will drive metaverse growth.

6. Discussion and path ahead

There is considerable hype around the concept of metaverse. Based on our data and experiences on both Web 2 companies and Web 3 communities, we question the size of metaverse market estimations. Precedence Research (2022) estimated that the global metaverse market will be worth around \$1.6 trillion by 2030. Citi (2022) thinks the metaverse will be a \$8 trillion to \$13 trillion market by 2030, and that it may have five billion users. In contrast to these large numbers, HfS Research estimated the market opportunity to be \$2.45 billion (HfS Research 2023).

The HfS Research estimate seems more accurate to us given the limited number of Web 2 companies focused on metaverse and the limited user activity in Web 3 metaverses we found in our research.

Our primary aim in this article was to compare Web 2 and Web 3 paths to the metaverse to identify who is leading. We acknowledge that our research has several limitations. First, our 10-K report, corporate press releases, and patents only investigated US-based organizations. Second, we have not considered other sources that might inform the analysis, such as venture capital investment. We encourage colleagues to replicate and extend investigations for companies in other jurisdictions; many non-US-based companies and governments are investing in metaverse.

While acknowledging our study's limitations, we do believe that our findings are important and have implications for the future.

Web 2 has an inherent financial advantage because investors have a clear path to returns with platform business models. In contrast, Web 3 is counting on token economics to drive investment. As Forbes contributor Alison McCauley writes, "Web 3 communities are still looking for business models that reduce the cost of decentralization, which inherently shifts the expense of the network to the people who use it" (McCauley 2022).

Moreover, many people are still new to Web 3; the previous Web 3 descriptions in this study are filled with technical terminology many investors and consumers do not understand, such as blockchains, crypto, smart contracts, NFTs, DAOs, cryptography, consensus, and digital wallets. The educational challenges ahead for Web 3 metaverse are significant. As professors, we encourage more faculty to teach metaverse and Web 3 courses (e.g., Rinn et al. 2023; Themistocleous et al. 2023; Triantoro and Jackson 2022).

For companies, most will not want to be beholden to a platform provider. Thus we encourage more companies to participate in standards-making bodies focused on an open metaverse, including IEEE Metaverse Congress, Metaverse Standards Forum, Linux Foundation, and Trust over IP (ToIP) AI & Metaverse Technology Task Force.

We join other researchers who advocate for Web 3 research (e.g., Ausustin et al. 2023; Beck et al. 2018; Lumineau et al. 2020). We support the vision of individuals owning and monetizing their identities, credentials, and digital assets; of freely coming and going across virtual worlds; of securely executing peer-to-peer transactions with low transaction fees; of having a voice in the governance of the applications; and of promoting the inclusion and dignity of all (Lacity et al. 2023). We also support the calls by other scholars for ethical guidelines (Smith et al. 2023).

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