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What type of metaverse will we create?

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Abstract:

Our primary aims in this white paper are to educate readers on current views of the metaverse, its stage of maturity, identify which businesses are already exploring metaverse, and where it could be headed. We argue that a decentralized metaverse promotes greater privacy, security, equity, and inclusion, but the lack of economic incentives and business models for decentralized applications could result in continued centralization of ownership, control, and value if consumers and organizations don't choose a different path. The future of the internet is at stake, and everyone—consumers, creators, businesses, governments, and NGOs—should have a voice in shaping that future.

Keywords: Metaverse, virtual worlds, virtual reality, augmented reality, Web 2, Web 3

1. The state of metaverse

The future of metaverse is not deterministic, but rather it will emerge from the choices we make today.

In the previous 12 months, we've all heard a lot about 'metaverse'. Worldwide interest in metaverse escalated on two dates as evidenced by Google Trends (see Figure 1). The first date was October 24, 2021, around the time when 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.*"¹ The second date was February 20, 2022, shortly after Meta announced that its quarterly profits decreased by \$10.8 billion—the approximate amount it had spent on metaverse investments—plunging the stock by 22 percent in one day.²

Despite all hype around metaverse, there remains confusion about 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 Fall 2022, we don't know yet—a sentiment shared by Eric Schmidt, former Google CEO: "*There's not an agreement on what the metaverse is.*"³

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 a virtual world, i.e., a computer-generated environment, so there are many metaverses here already. The other approach defines a single futuristic metaverse comprised of a three-dimensional, immersive digital universe that seamlessly connects users to any virtual world. The requirements for a single metaverse have not yet been achieved, such

as interoperability, portability, and real-time rendering. Gartner estimates that a single metaverse is more than ten years away.⁴ 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. For this white paper, we use the term ‘proto-metaverses’ to describe today’s virtual worlds we can visit with an avatar. We use the singular term ‘metaverse’ to describe a futuristic version of a single, three-dimensional, virtual universe that connects many interoperable virtual worlds.

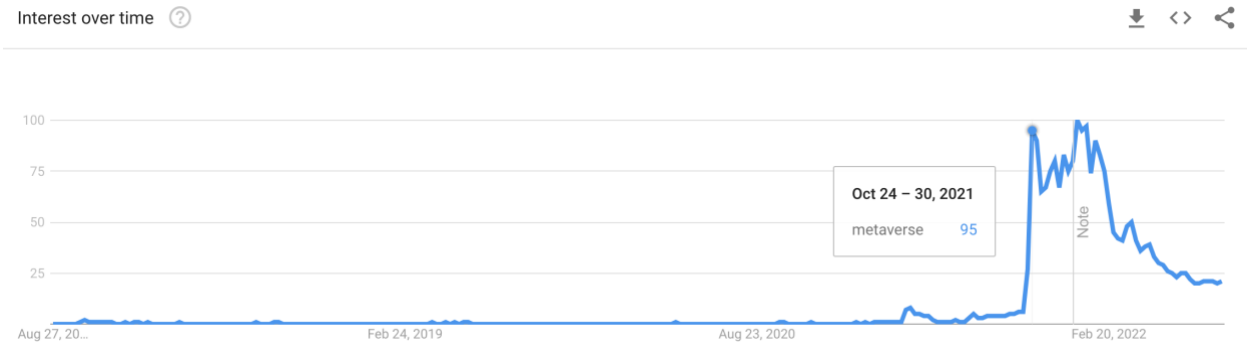


Figure 1: Google Trends’ 5-year history of worldwide searches for the term ‘metaverse’⁵

How to read the figure: The Y axis represents the relative interest over the five-year period. A value of 100 is the peak popularity for the term. A value of 50 means that the term is half as popular. A score of 0 means there was not enough data for this term.

Even though the definition and future of metaverse is unclear, many organizations are projecting significant economic opportunities. In the near term, Morgan Stanley estimates worldwide spending in proto-metaverses of \$12 billion in 2020, increasing to \$73 billion in 2024.⁶ Precedence Research estimates that the global metaverse market will be worth around \$1.6 trillion by 2030.⁷ Citigroup thinks the metaverse will be a \$8 trillion to \$13 trillion market by 2030, and that it may have five billion users.⁸

While many people are skeptical that the metaverse will be worth trillions of dollars within eight years, projections like these are causing board-room level discussions. McKinsey (2022) wrote: “No official definition yet exists for the metaverse, but companies can’t afford to wait until one does or the metaverse fully evolves to start experimenting and investing in it.”⁹ Even though no one agrees on what ‘a’ metaverse or ‘the’ metaverse is, there is a race to stake claims in current proto-metaverses. Companies are investing billions, applying for and obtaining patents, creating virtual events, branding merchandise, and paying high prices for virtual assets. For example, Tokens.com recently paid \$2.4 million for a virtual plot of land in Decentraland.¹⁰

1.1. What will metaverse do?

Let’s consider the consequences of a single, interoperable metaverse. We anticipate the metaverse, like previous internet-driven transformations, will disrupt and reshape the business, social, educational, political, and economic landscape of our world. It’s easy to imagine both utopian and dystopian consequences.

On the utopian side, millions of people might inexpensively gain access to work, education, healthcare, places, events, and ideas, leading to more inclusion. Future generations may earn most of their income and spend much of their money in the metaverse. New jobs will emerge, such as virtual real estate agents, virtual fashion designers, virtual security guards, virtual teachers, and others we cannot yet envision. In the metaverse, people with physical disabilities may gain mobility.¹¹ Emergent metaverse interface technologies—like haptics—may allow us to literally feel the virtual world around us, and bring us closer to the diverse and geographically dispersed people with whom we interact.

On the dystopian side, the negative consequences of addiction, cyberbullying, surveillance, cybersecurity breaches, and depersonalization in current virtual worlds could escalate in an immersive and persistent metaverse.¹² The digital divide—the difference between the digital ‘haves’ and ‘have-nots’ to access, use, and achieve economic benefit from digital technology—could widen without equal access to appropriate technology, networks, and training.¹³ Moreover, the potential for manipulating attitudes and behaviors in a metaverse is terrifying; we already know that fake news campaigns on social media have interfered with political elections. *The Independent* reported in that Brittany Kaiser, prior business development director of Cambridge Analytica, indicated that her former company influenced elections in at least 68 countries using the same disinformation tactics seen during the United States (US) presidential election and during the United Kingdom (UK) Brexit vote in 2016.¹⁴ How might our behavior be manipulated when we are immersed in the metaverse, and not just interacting through social media feeds?

1.2. How will the metaverse get there?

The degree to which we realize the above utopian or dystopian outcomes may depend upon the path we take to build the metaverse. Do we trust one or a few organizations to create, control and govern the access, digital assets, and transactions via privately-owned infrastructure and databases (Web 2) like we do with our social media platforms today? Or do we trust decentralized crowds to create and govern the access, digital assets, and transactions with publicly distributed infrastructure and databases, i.e., blockchains (Web 3) like we do with Bitcoin and Ethereum? Each path has positive and negative aspects (see Figure 2). We propose that Web 3 offers the best evolutionary path to create the underlying fabric of the metaverse to help ensure greater privacy, security, equity, and inclusion, via distributed infrastructure and databases. The next evolution of the internet—the metaverse—should offer a decentralized foundation with open standards upon which innovation can flourish. Established companies have an opportunity to lead the charge by adapting and extending their business models to leverage the benefits offered by the Web 3 approach. Startups have an opportunity to fill needs that emerged with Web 2 innovations that may go unmet in a Web 3 environment, and to create customer experiences to meet needs that we didn’t know we had.

The Web 2 evolutionary path. Our social media platforms are centrally owned and controlled because capitalism and behavioral economics work in their favor. Most users are accustomed to ‘free’ services from technology providers in exchange for the right to harvest and monetize their data. Shoshana Zuboff, Harvard Business School Professor, coined the term ‘*surveillance capitalism*’ to describe how companies use our data for the primary purpose of making a profit. She believes that surveillance capitalism is an existential threat to our human liberty, autonomy, and well-being.¹⁵ The threat of surveillance capitalism is much higher if the metaverse is controlled by one or a few companies. If we think social media platforms collect too much of our personal data and wield too much power today, imagine what personal data is collected in a metaverse—what we say, do, and look at; with what and with whom we interact; and what we create, sell, and buy. Metaverse

hardware could collect biometric data by scanning our irises, monitoring our circulatory and respiratory patterns, and capturing our voices and distinctive facial and body movements. We believe that a Web 2 metaverse will lead to greater surveillance capitalism.

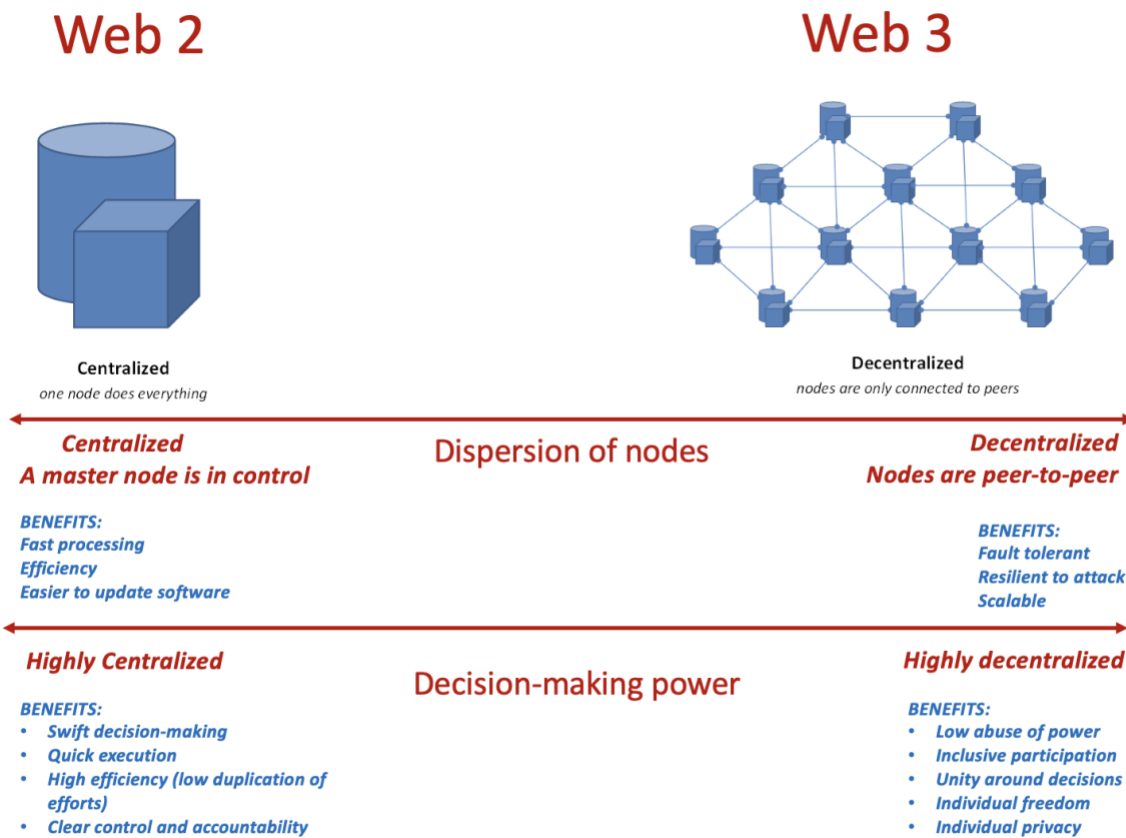


Figure 2: Possible evolutionary paths for the metaverse¹⁶

Another risk of the Web 2 path is that privately-owned, centralized databases are generally regarded as more susceptible to cybersecurity attacks, which are increasing in frequency and severity. For example, the 2020 SolarWinds attack cost governments and businesses nearly \$100 billion.¹⁷

But there are advantages to Web 2. Architecturally, centralized databases provide faster processing and easier software updates than decentralized architectures. Centralized governance models provide swifter decision-making, faster execution, lower duplication of effort, and clear accountability and control. Moreover, a business model of the Web 2 approach—users receiving valuable services for ‘free’, i.e., for the right of the provider to monetize their personal data—is still dominant. Prior attempts to build online communities, social networks, ad-free search engines, and similar services that offer greater privacy and security have generally failed to achieve success at scale.

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, and the freedom to come and go and to buy and sell across virtual worlds in a privacy-enhancing manner.

Content creators can capture the largest share of profits from their creative works, and businesses can compete in a free-market ecosystem based on standards of an open metaverse.

Decentralized architectures are resilient to cybersecurity attacks because the attack surface is diffused across many locations. In a typical decentralized architecture, the only way to infiltrate the network is to commandeer more than 50 percent of the processing power of nodes. Cybersecurity gets stronger as more nodes are added to the network because hackers will need to attack more nodes.^a Scalability is another benefit—just add more machines to the network to get more computing power. While architectural decentralization offers significant business value, the approach comes with downsides as well.^b Processing is slower compared to a centralized network because results need to be diffused and checked by the other nodes in the network, and changes to the system are slower because they require consensus across more stakeholders.

Decentralized governance reduces the potential for abuse of power and promotes inclusive participation in decision-making, unity around decisions, individual freedom, and privacy. On the other hand, decentralized governance can result in slower decisions, execution, and coordination. For example, software cannot be updated unless most nodes agree to adopt it—it takes a lot of coordination to make any changes.¹⁸ Another challenge for decentralized governance is the lack of a responsible party when ethical or legal issues arise—decentralized platforms require more complex, and potentially less satisfactory, methods for monitoring and moderating online content and behavior.¹⁹

The evolutionary path is not a simple binary choice of Web 2 *or* Web 3, as Web 2 proto-metaverses may exist in parallel or overlap with Web 3 architectures. For example, a Web 2 virtual world may interface with Web 3 blockchains to allow users to possess and utilize their digital assets. Our thesis, however, is that a Web 3 metaverse will more likely lead to the desired outcomes of privacy, equity, security, and inclusion than a Web 2 metaverse. While we believe a decentralized metaverse is the best architectural approach, a lack of economic models is a major impediment to Web 3—it’s hard to compete with free. 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.*”²⁰

As business professors, we believe businesses can have positive impacts on the development of a Web 3 metaverse, including help with open standards development; lobbying public officials for regulations that support privacy, equity, and inclusion; contributing to open-source software communities; investing in assets and hosting events in Web 3 proto-metaverses; organizing Web 3 hackathons to incentivize developers and content creators. Though businesses have many competing priorities and emerging technologies to consider, we believe every board room needs to ask the question: What type of metaverse will we help to create?

The remainder of this white paper takes a deeper dive into our conjectures and research findings (see ‘about the research’ at the end of the document). We first consider the various approaches to defining metaverse. Then, we take a deeper look at Web 2 vs. Web 3, including their histories and current Web 2 and Web 3 proto-

^a Caveat: this is a high-level description written for non-specialists. In actuality, the safety of the network also relies on n-versioning of software (i.e., the same logic programmed in different languages), node independence (i.e., operated by different parties) and a variety of hardware implementations. Further, while decentralized networks are more resilient to attacks, a successful attack that commandeers more than 50 percent of the nodes could have more severe consequences than a successful attack on a single organization.

^b Moreover, Brewer’s Theorem states that when some nodes are down in a distributed network, the network can either be designed to be available or consistent. In most blockchain networks, the choice is availability over consistency unless the community rallies to stop processing. So blockchains tolerate some short-term inconsistency to gain the benefits of availability.

metaverses. We outline business opportunities in Web 3, explore how businesses are thinking about metaverse today, and make recommendations for how everyone can actively contribute to creating a Web 3 metaverse.

2. What is metaverse?

Millions of people visit proto-metaverses daily, even though we don't have a perfect way to describe them. As stated above, there are two prevailing approaches to defining metaverse. Let's take a closer look at each approach.

2.1. Metaverses

Our most authoritative dictionaries define metaverse so generically that the term can apply to nearly any online computer-generated virtual world. The Oxford English Dictionary (OED), for example, first added the term 'metaverse' to its lexicon in 2008 and most recently updated its definition in March of 2022:

“A computer-generated environment within which users can interact with one another and their surroundings, a virtual world; (more generally) the notional environment in which users of networked computers interact.” — Oxford English Dictionary²¹

OED's etymology recognizes that the first use of the term metaverse came from Neal Stephenson's 1992 science fiction novel, *Snow Crash*. Stephenson first used the term in the sentence, “Hiro spends a lot of time in the Metaverse.” OED also notes that metaverse is a portmanteau of 'meta' (meaning beyond) and 'universe'.²²

The Merriam-Webster Dictionary only added 'metaverse' to its dictionary in September of 2022:

“A persistent virtual environment that allows access to and interoperability of multiple individual virtual realities.” — Merriam-Webster Dictionary²³

Alison McCauley—Web 3 keynote speaker, author, *Forbes*' contributor, and advisor—made a compelling case for a distinguishing feature of a metaverse versus a virtual world. She suggested that at a minimum, **a metaverse is a virtual world that we visit with an avatar**, i.e., with a digital representation of ourselves. Her distinction is important to understand. In this view, video conferencing (e.g., Zoom, WebEx, Skype) are virtual places but not metaverses because users appear as themselves in a video conference. While on our Zoom call, Alison commented, “We are in a virtual place—you are not actually in my living room, but in a computer-generated space that realistically appears as my living room.” Rene Magritte made a similar observation about representation in his famous painting (see Figure 3).

If one concedes that the distinguishing characteristic of a metaverse is a virtual world one visits with an avatar (see Figure 4 for some of our avatars), then metaverses are a rebranding of virtual worlds like Second Life (launched in 2003) and World of Warcraft (launched in 2004). Under this version of the definition, virtual reality (VR) headsets are not required to access a metaverse. Metaverses like Decentraland (open to the public in 2020) do not yet support VR headsets, but many consider it a metaverse.



"Ceci n'est pas une pipe" is French for "This is not a pipe". Magritte is making the point that the painting is not a pipe, but rather a representation of a pipe. Similarly, an avatar is a representation of ourselves.

Figure 3: Rene Magritte, "Ceci n'est pas une pipe", 1929

Image source: [https://uploads8.wikiart.org/images/rene-magritte/the-treachery-of-images-this-is-not-a-pipe-1948\(2\).jpg!Large.jpg](https://uploads8.wikiart.org/images/rene-magritte/the-treachery-of-images-this-is-not-a-pipe-1948(2).jpg!Large.jpg)

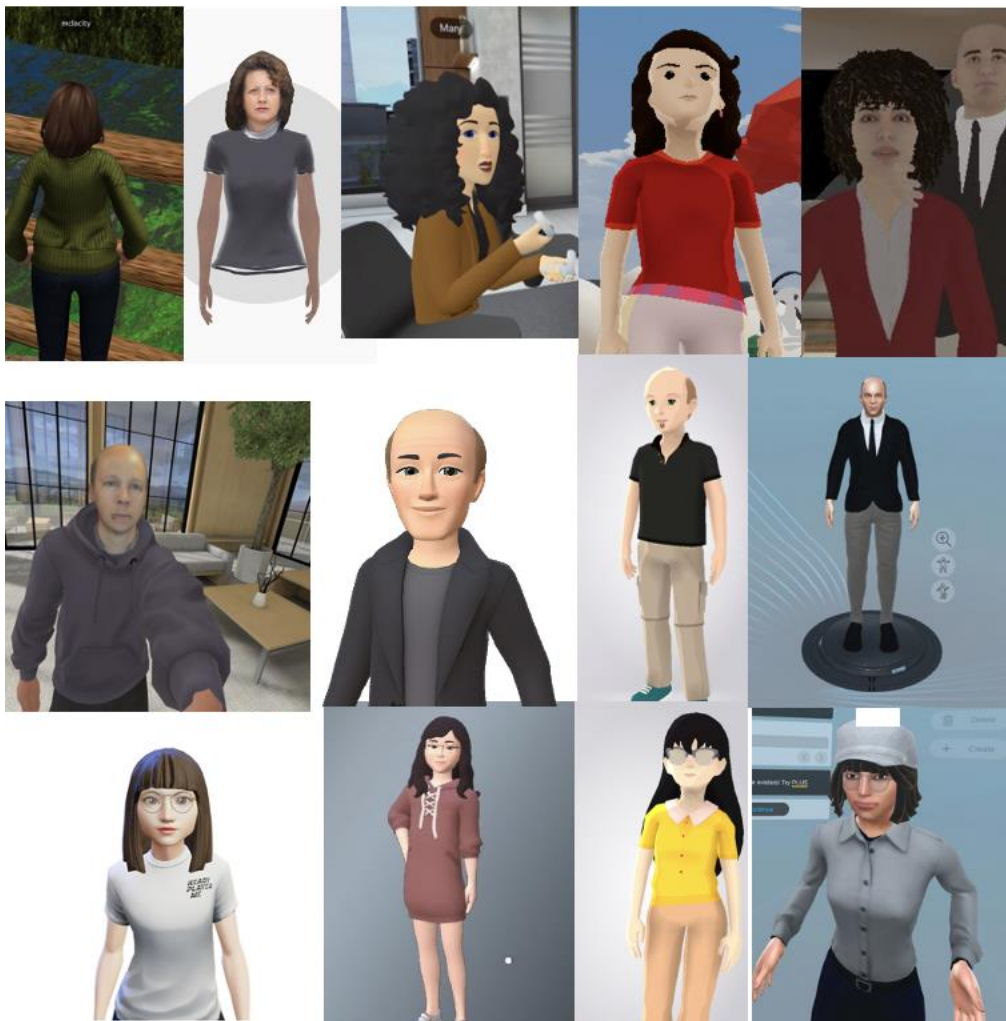


Figure 4: Sample avatars

(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

Other definitions minimally require VR headsets. For example, a recent *Forbes* article defined metaverse as:

“At its most basic level, the metaverse is a series of digital interactive worlds that are accessed through VR headsets. Users create avatars through which they move about and physically interact with others.” — Graig Paglieri, Forbes Technology Council²⁴

VR headsets undoubtedly make the user experience more immersive. For example, our team visited the VictoryXR Metaversity several times using our VR headsets; we felt completely immersed in the virtual campus spaces, such as the auditorium, chemistry labs, art galleries, and outdoor spaces (see Figure 5).

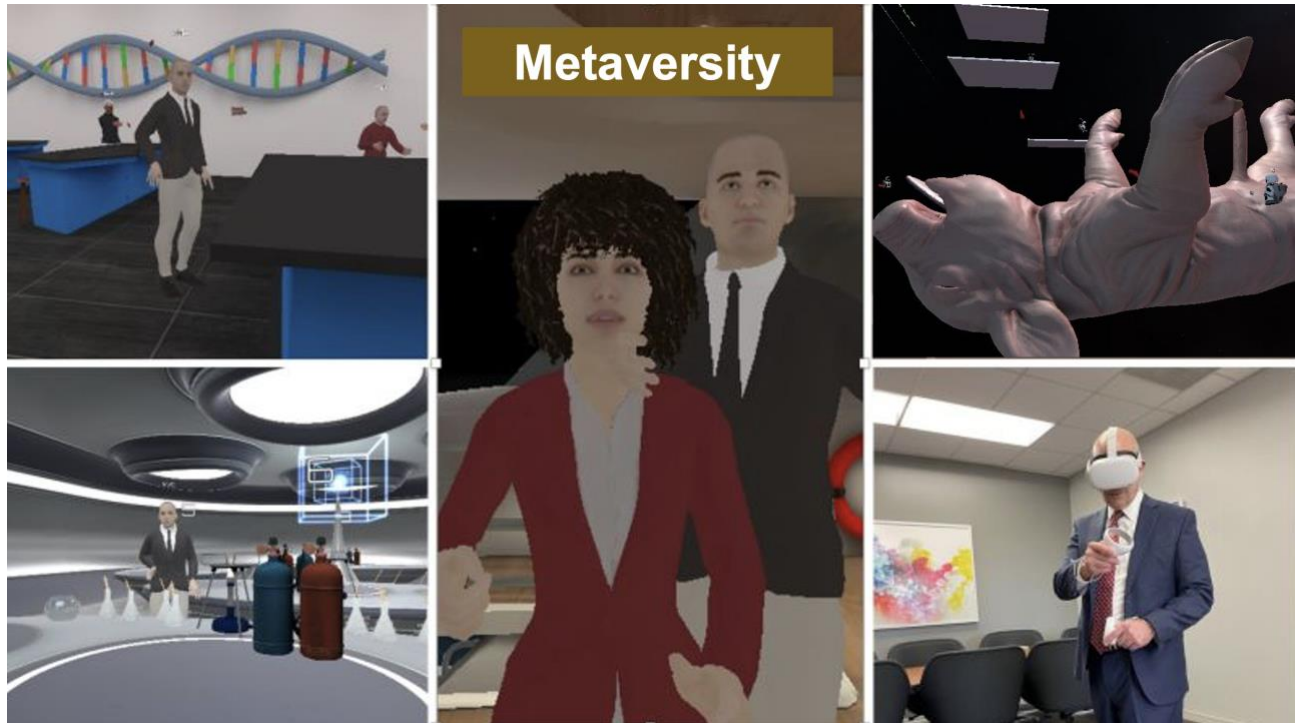


Figure 5: BCoE Research team visits Metaversity’s biology lab, chemistry lab, classroom, and dissected a three-dimensional pig from space.

If metaverses are virtual worlds visited via an avatar, regardless of whether a VR headset is a requirement, then metaverses are here already. However, today’s versions certainly have limitations. They are not interoperable—you need a separate avatar for each platform. Digital assets are not portable; for example, digital assets bought with Linden Dollars in Second Life cannot be ported over to Decentraland. General-purpose metaverse communities are still largely empty unless there is an announced event like a concert or fashion show; merely ‘dropping in’ to several metaverses left us wandering around searching for others, or for a reason to be there. The above definitions and perspectives describe what we refer to as proto-metaverses, but what about the notion of a unified technological infrastructure (like how we view “the world wide web” today) that provides the digital interoperability for the future of commerce, communication, competition, and collaboration, i.e., THE metaverse?

2.2. THE metaverse

Science fiction writers and technology futurists are more apt to refer to metaverse in the singular form—some future development of a single, interoperable internet of virtual places. Wikipedia’s definition of metaverse exemplifies this idea of ONE future metaverse:

“In futurism and science fiction, the metaverse is a hypothetical iteration of the Internet as a single, universal and immersive virtual world that is facilitated by the use of virtual reality (VR) and augmented reality (AR).” — Wikipedia²⁵

One highly cited definition comes from Matthew Ball, an angel investor, senior advisor to McKinsey, and author of the book, [The Metaverse and How it Will Revolutionize Everything](#). Ball defines metaverse in the singular form:

*“The metaverse is a massively scaled and interoperable network of **real-time rendered, 3D, virtual worlds** which can be experienced **synchronously and persistently** by an effectively **unlimited number of users** with an **individual sense of presence**, and with **continuity** of data, such as identity, history, entitlements, objects, communications, and payments.” — Matthew Ball²⁶*

Ball devotes an entire chapter in his book to unpack the definition, arguing why the metaverse is a ‘successor state’ of the internet—it’s not yet here. Table 1 summarizes the main requirements for Ball’s metaverse.

Attribute	Description
<i>Real-time rendered</i>	The process of generating images in real time. Currently, virtual worlds are pre-rendered, with options pre-selected. Real-time rendering would allow infinite possibilities for user choice and interaction, but requires an exponential jump in computational power.
<i>3D</i>	The realistic perception of three-dimensional (length, width, depth) space, rather than the traditional rendering of virtual environments in two dimensions (e.g., computer monitors, phone screens).
<i>Virtual worlds</i>	Computer-generated environments that are recognizable to their inhabitants and distinct from one another.
<i>Synchronous for an unlimited number of users</i>	The internet works by sending asynchronous feeds; at sufficiently high speed, we experience interactions as synchronous (e.g., video conference); the metaverse will need to do this at much greater scale. As Ball notes, Fortnite’s Travis Scott concert in 2020 was rendered across 250,000 copies—it was not truly synchronous for the 12.5 million attendees.
<i>Persistent</i>	The idea that objects and environments endure—their states are maintained, and their history is preserved, in the metaverse. By contrast, VR games are reset, as avatars die and come back to life; video calls end, and the virtual “room” disappears after everyone disconnects. A persistent metaverse would preserve the states of events and objects irrespective of any given user’s participation in the environment.
<i>Sense of presence</i>	Three-dimensional spaces create immersive user experiences via depth perception (vision), sound localization (hearing), touch, smell, and/or taste perception.
<i>Interoperable network</i>	Today, virtual worlds operate as islands. There are currently no standards for metaverse interoperability.

Table 1: Main attributes of the metaverse as described by Matthew Ball (2022) ²⁷

Note that Ball’s definition does not mention an avatar or VR headsets. Undoubtedly, we would connect to THE metaverse through some type of Internet of Things (IoT) hardware (see Figure 6). VR headsets are common today, providing depth perception and sound localization. One of the first IoT VR headsets was the Oculus

Rift, developed by Palmer Luckey after his project raised \$12.5 million through Kickstarter in 2012. Facebook bought Oculus in 2014 for \$2 billion. Other VR headset makers include HTC and Sony. In 2021, almost 9 million VR headsets were sold.²⁸

More wearable devices are under development to engage our other senses:

- **Haptic** hardware provides a sense of touch by applying vibrations or forces. Our mobile phones already alert us to messages by vibrating, but metaverse haptics are expanding to include fingertips, gloves, vests, and full body suits, as seen in popular movies such as *Ready Player One*.
- **Olfactory** headset attachments omit bursts of scent—commercial products are just coming to market.
- **Gustatory** devices simulate taste; current hardware simulates taste perception by spraying chemicals on a user’s tongue (not yet commercially available).

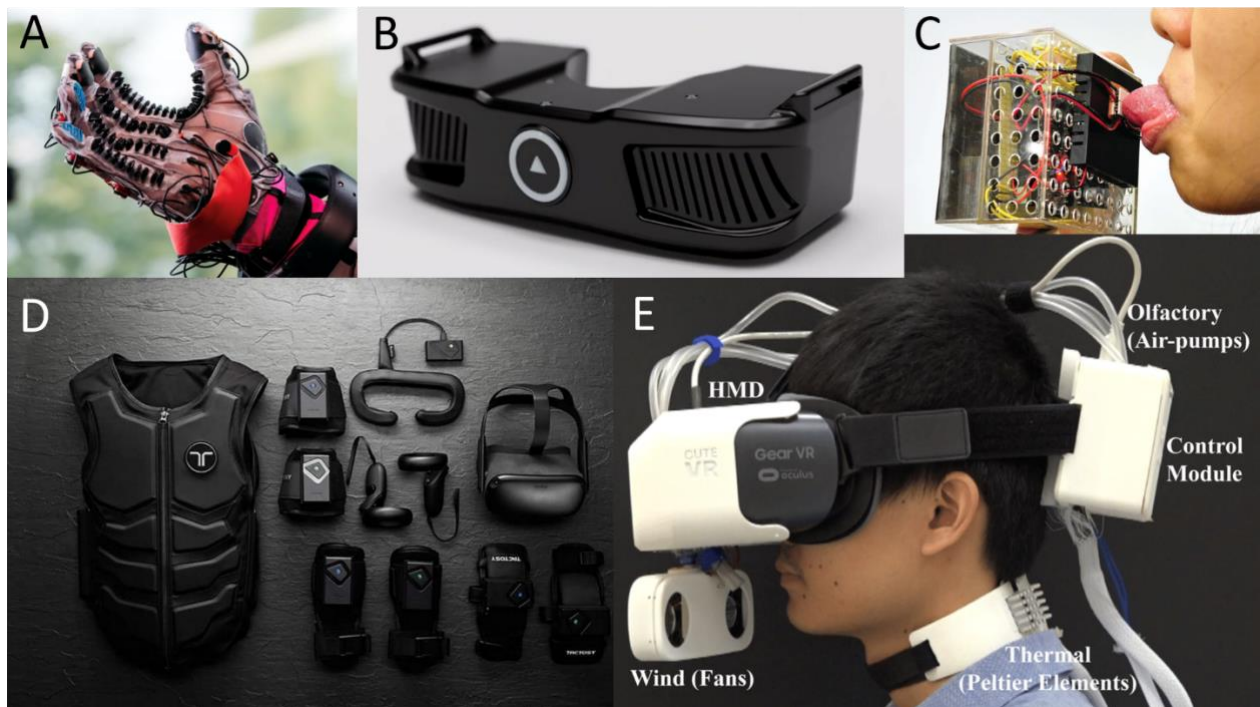


Figure 6: Wearable hardware devices stimulate the human senses of vision, sound, touch, smell, and taste

(A) *Haptic glove by Meta²⁹* (B) *Olfactory attachment for VR headsets by OVR Technology³⁰*
 (C) *Taste simulator by researchers at National University of Singapore³¹* (D) *A full body haptic suite by bHaptic³²* (E) *Multi-sensory gear called Season Traveler³³*

These devices might seem clunky to wear today, but the history of laptops and phones suggests that mobile technologies will become more portable even as they become more powerful. Eventually, humans might access the metaverse through *microchip body implants*. Neural, cochlear, heart, and dermal implants are used for medical treatments—are body implants for work, play, and travel on the horizon?

At this early stage of development, many have sidestepped the difficulty of defining metaverse, and instead describe its *affordances*—what people can do and experience in a metaverse environment. Deloitte (2022), for example, describes four key experiences of a metaverse: embodied, immersive, social, and persistent.³⁴ **Embodiment** refers to a user’s perception that they control their virtual body (avatar) as their own biological body.³⁵ **Immersive** refers to a user’s perception that they are ‘in’ the virtual world, not merely observing it from the outside. As we have noted, IoT wearables increase the perception of immersion. **Social** means that virtual bodies can interact with other virtual bodies in meaningful ways. **Persistent** means that the virtual worlds continue to exist even when virtual bodies exit the virtual worlds.

We also note that many people include **augmented reality (AR)** as a key feature of the metaverse. Wikipedia, for example, includes AR in its definition of metaverse. Citigroup also includes AR as a key feature: “*We believe the Metaverse is the next generation of the internet—combining the physical and digital world in a persistent and immersive manner—and not purely a Virtual Reality world.*”³⁶

Augmented reality lays digital content over physical surroundings, allowing users to be in virtual and physical worlds simultaneously. Pokémon Go, released in 2016, is an example (see left side of Figure 7). In this game, the user downloads the mobile app, creates an avatar, and uses their mobile phone’s camera to overlay the virtual world on their physical surroundings. In addition to games, AR is used in businesses, e.g., for overlaying instructions onto a physical machine to assist workers (see right side of Figure 7). AR is anticipated to affect manufacturing, design, construction, retail, transportation, government, and professional services.³⁷



Figure 7: Augmented reality: Pokémon Go (left) and maintenance instructions (right)

Image credits:

(left) <https://9to5mac.com/2017/12/20/ar-pokemon-go-arkit/pokemon-go-arkit-5/>
(right) <https://www.i-scoop.eu/wp-content/uploads/2017/08/Augmented-reality-Industry-4.0-concept.jpg>

Even though the full vision of THE metaverse remains loosely defined and full realization is years away, we believe that the future is not deterministic; individuals and organizations do not just sit around and wait for the

future to happen, they actively create it. If THE metaverse comes to fruition, we hope that it manifests in a way that promotes and rewards innovation while enhancing individuals’ privacy, inclusion, and equity.

3.0. Who will control the metaverse? Web 2 vs Web 3

Since metaverses are applications that run atop the internet, it is appropriate to use the development of the internet to explain the development of metaverse. The internet is generally viewed as having four stages of development: Pre-web, Web 1, Web 2, and Web 3 (see Figure 8). With each stage of development, the internet provided more user affordances.

Early Internet (Pre-web). The internet traces its roots to ARPANET, a computer network designed by the United States Defense Advanced Research Projects Agency (DARPA) to share information and computing power among researchers. US universities were the first institutions to be connected to it in 1969. As more universities and government agencies connected, a standard way to identify machines and to send and receive messages emerged: Transmission Control Protocol/Internet Protocol (TCP/IP). Still today, every device connected to the internet has an IP address. TCP/IP works by taking a copy of a message from the sender, breaking the message into packets, and routing them to their destination where they are reassembled. For the first decades of its development, the internet wasn’t easily accessible or comprehensible to the average user.³⁸

	Early Internet	Web 1	Web 2	Web 3
Approximate dates	1960s – 1990	1991 to 2004	2004 to present	2009 to present
Key affordances:	<ul style="list-style-type: none"> Machine-to-machine connections 	<ul style="list-style-type: none"> Easy searching 	<ul style="list-style-type: none"> Easy searching Easy content generation Institutions facilitate value exchange 	<ul style="list-style-type: none"> Easy searching Easy content generation Peer-to-peer value exchange
Platform Governance	Centralized	Centralized	Centralized	Decentralized (Community controlled)
Identity model (access control)	Centralized: accounts and passwords	Centralized: accounts and passwords	Centralized and federated accounts and passwords	Decentralized (User controlled)
Digital asset control	Centralized	Centralized	Centralized	Decentralized (User controlled)
Proto-metaverse examples		<ul style="list-style-type: none"> Multi-User Dungeon (MUD) Multi-User Social Habitat (MUSH) 	<ul style="list-style-type: none"> Second Life Roblox Fortnite World of Warcraft Horizons Workroom 	<ul style="list-style-type: none"> Decentraland Somnium Voxels

Figure 8: The internet’s stages of development and example metaverses

Web 1: the read era. In 1990, Tim Berners-Lee developed HyperText Markup Language (HTML). His employer, CERN, launched the World Wide Web (WWW) a year later, marking the dawn of Web 1, the ‘read’ era, which occurred from approximately 1991 to 2004. Web browsers like Mosaic released in 1993, Netscape and Microsoft Explorer in 1994, and Google Chrome in 1998, made it easier to find information online. After the browsers, the centralized platforms came. Jeff Bezos founded Amazon in 1994 as an online bookstore. Although Amazon was not the first electronic commerce site, it heralded the coming explosion of business-to-

consumer (B2C) commerce.³⁹ eBay and Craigslist, both launched in 1995, popularized consumer-to-consumer (C2C) commerce, thus creating online marketplaces for people to buy and sell goods and services using centralized platforms. Netflix launched in 1997. Napster, released in 1999, launched a centralized platform for peer-to-peer file sharing. As more consumers gained confidence in transacting on the Web, online banking finally took off.

Multi-User Dungeons (MUDs) and Multi-User Social Habitats (MUSHes) of Web 1 were proto-metaverses—persistent virtual worlds in which people created avatars and constructed spaces and experiences, but everything was text-based (e.g., you could issue a command to ‘look at’ someone's avatar and you would get the text description that they had created).⁴⁰ Notably, the first commercially successful massively multiplayer online game, EverQuest, was released in 1999 and paved the way for future proto-metaverses.⁴¹

During Web 1, it was still difficult for the average person to create content.⁴²

Web 2: the read and write era. Social media, blogs, podcasts, and wikis characterize Web 2, known as the ‘read and write’ era. Major social media platforms emerged: MySpace in 2003; Facebook in 2005; YouTube in 2006; Twitter in 2007; Instagram in 2010; WeChat and Snapchat in 2011; and TikTok in 2016. Users could finally create content with ease on the internet. Web 2 also saw the popularization of early proto-metaverses in the form of online games such as World of Warcraft in 2004, and persistent and open social worlds such as Second Life in 2003.

The Web 2 era began around 2004 and continues today. In 2021, the consumer e-commerce market reached nearly \$5 trillion, and business-to-business e-commerce reached \$7.4 trillion.⁴³ Over 4.48 billion people worldwide use social media, representing 57 percent of the population. We generate 2.5 quintillion bytes of data every day!⁴⁴

Thus, the internet is being used to generate a massive amount of information and to transact a massive amount of economic activity. Though the internet is built on open standards and is, at its core, a decentralized ‘network of networks’, the innovative platforms that run on top of it (e.g., those noted above) have resulted in more centralized control and monetization by a small number of institutions.⁴⁵ The Internet Engineering Task Force (IETF) warns that the internet is continuously subjected to forces that encourage centralization. The IETF argues that centralization limits innovation, constrains competition, reduces availability, creates monoculture, and restricts access.⁴⁶ Besides acting as gatekeepers of our economic activities and identities via accounts and passwords, the dominant technology companies own and monetize our data. Many people believe that the internet should evolve to give power and control to users.

Next, we consider the implications of Web 2 for the metaverse.

Governance. Most of the proto-metaverses that operate today are Web 2 applications, meaning that they are centrally owned and governed by a company. Popular examples are Second Life (owned by Linden Lab), Fortnite (owned by Epic Games), Roblox (owned by Roblox Corporation), World of Warcraft (owned by Blizzard Entertainment), and Horizon (owned by Meta). If we include AR worlds as proto-metaverses, Pokémon Go is another example of a Web 2.0 application (owned by Niantic). Companies have the power to revoke access and to seize digital assets, and the responsibility to maintain safe and healthy environments. For example, Linden Labs deleted Woodbury University’s land from Second Life after users in the land behaved in a racist and harassing manner.⁴⁷

Identity model. With Web 1 and Web 2, companies control the user’s identity with a **centralized identity model**; users access the platforms with accounts and passwords. Even when users ‘delete’ an account, often all they have done is revoke their own access privileges, as it is up to the institutions to decide when an account is deleted from their databases. This also means that our credentials are not portable across platforms.⁴⁸ Increasingly, some organizations enable users to access multiple sites through a single account managed by companies such as Facebook, Google, Amazon, LinkedIn, and others, called the **federated identity model**. While the federated model reduces the number of accounts users need to manage, it creates larger attack surfaces. One of the reasons that the SolarWinds attack was so widespread was because hackers stole federated login credentials to access many systems. Federated accounts also increase institutional power over, and the ability to monetize, users’ data for the benefit of the managing company.⁴⁹

Digital asset control. With Web 2, digital assets like virtual plots of land, metaverse currency, and virtual goods and services are also centrally managed and controlled. Institutions can seize and delete assets at any time. Web 2 metaverse companies are likely to keep a large percentage of revenues from metaverse developers. Steam and Google Play keep 30 percent of revenues for apps developed by others; Roblox takes nearly 75 percent; Meta keeps 47.5 percent of developer revenues for Horizon Worlds.⁵⁰

Web 2 proto-metaverses include Second Life, Roblox, Fortnite, World of Warcraft, Horizons, and Metaversity. To the extent that the market offers many choices, users may not worry about an institution owning and controlling our favorite virtual world. But what if, as with social media platforms, only a few institutions evolve to control a vast majority of metaverse experiences? People will use metaverses for more than just games and socializing—metaverses will be places that we go to work, learn, access services (e.g., healthcare), exchange value, and access current news. People are particularly worried about Meta, formerly known as Facebook (see Figure 9).⁵¹ People point to Meta’s broken promise to Palmer Luckey—the creator of Oculus Headsets. When Meta bought Luckey’s company for \$2 billion in 2014, it promised not to introduce ads on Oculus headsets, but in 2021 did.⁵² Meta’s newer headsets, the Quest series, required a Facebook account until Meta was pressured to change that policy in 2022; now, Quest headsets require a Meta account. Meta collects data from its VR products about users’ physical features, navigation behavior, voice commands, and even physical movements. Meta also captures audio interactions on Horizon Worlds, indicating that the data is used to improve their products but claims it does not use this to monetize users’ data.⁵³

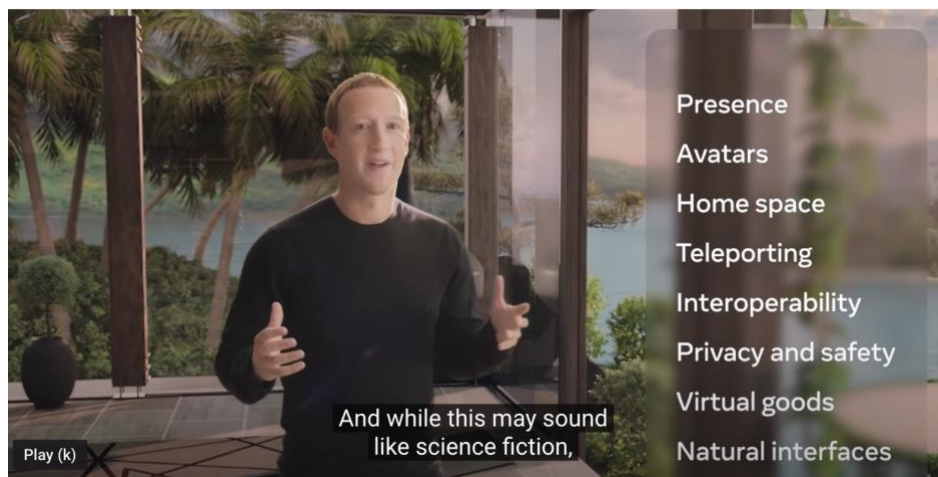


Figure 9: Mark Zuckerberg, CEO, announces rebranding of Facebook to Meta⁵⁴

Web 3: the read, write, and execute era. Web 3, currently in a formative stage, is characterized by decentralized and interoperable platforms supported through distributed technologies. By putting greater control in the hands of the user, it is referred to as the ‘read, write, and execute’ era. Users control their identities, credentials, and digital assets, and can monetize their own data and activities through digital currencies and distributed ledgers. Decentralized activities discourage abuses of power and, ideally, promote more inclusive participation and unity around decisions, and individual empowerment, freedom, and privacy.⁵⁵ As more of our modern social and economic activities happen online, decentralized activities will need a decentralized digital infrastructure, thus the creation of blockchain technologies.

Bitcoin was the first blockchain application, launched in 2009. The Bitcoin network allows users to send payments safely and directly to each other without a third party (e.g., credit card company) charging a fee to mediate the transaction. Bitcoin stores a record of each transaction on an immutable ledger (called a blockchain). The payments are made with a digital cryptocurrency called ‘bitcoins’—the first decentralized cryptocurrency. Today, and there are over 20,000 different cryptocurrencies, all fungible digital tokens where one token has equivalent value with another in its class. While many cryptocurrencies may never gain traction, the sheer number highlights the challenge of interoperability.

Since Bitcoin, innovations in consensus protocols, layer 2 solutions, and zero-knowledge proofs have made public blockchain networks more sustainable, scalable, and confidential.

Next, we consider the implications of Web 3 for the metaverse.

Governance. With Web 3, proto-metaverses are governed by a decentralized community. A smart contract is launched on a public blockchain network (e.g., Ethereum), and governance tokens are used to allocate voting rights. Governance tokens could be distributed to community supporters, by applying to a foundation set up by founders, or through capped purchases.

Identity model. Most Web 3 proto-metaverses do not require accounts—users can freely enter them, but with no sense of identity there can be no retained history. To retain history, a requirement for persistence, Web 3 proto-metaverses will need to use a decentralized identity model for self-sovereign identity (SSI). SSI aims to empower individuals to control their own identities and credentials, thus the term ‘self-sovereign.’ SSI replaces usernames and passwords with peer-to-peer relationships and provides verification of credentials within seconds. Blockchains play a role in SSI, primarily by becoming the public key infrastructure (PKI) for verifying that only authorized parties can create, hold, and verify credentials.⁵⁶

Digital asset control. There is a growing variety of digital asset types that enable Web 3. Most notably, non-fungible tokens (NFTs) represent unique digital assets. (Note: If you buy and sell NFTs on an exchange, you are transacting in a Web 2 model where a centralized party earns fees and controls your digital assets.) With Web 3, digital assets like virtual plots of land, goods, and services (e.g., an event access pass) are controlled by the user. The assets are bought with cryptocurrencies represented as fungible-tokens. Users possess and control the private keys associated with their NFTs and cryptocurrencies in digital wallets; the public keys associated with digital assets are stored on a blockchain. Blockchain platforms (e.g., Ethereum) verify and permanently store metaverse transactions on a distributed ledger.

Web 3 proto-metaverses including Decentraland, Somnium, and Cryptovoxels (see Table 2). There are also Web 3 proto-metaverses focused on gaming such as The Sandbox, Axie Infinity, Enjin, and Gala.⁵⁷ These

use decentralized architectures, and some metaverses—like Decentraland—have completely decentralized governance through a decentralized autonomous organization (DAO). Many have Web 2 linkages, such as selling NFTs through centralized marketplaces to conveniently buy and sell digital assets without needing to be inside the metaverse.

Metaverse	Platform	VR - enabled	Description	Fungible token market cap on 9/30/2022
Decentraland ICO in 2017	Ethereum	No	Decentraland set a maximum limit of 90,000 plots of virtual land, represented by ERC-721 NFTs, and bought with ERC-20 fungible tokens called MANA with a total money supply of 2.2 million, managed by a DAO. ⁵⁸ NFTs can be bought on OpenSea.	\$1.3 billion
Somnium Launched in 2018	Ethereum; Polygon; OpenSea	Yes	Somnium does not have a maximum number of plots of virtual land; Land is represented by ERC-721 NFTs and bought with ERC-20 fungible tokens called Space Cubes with a total money supply of 100 million or with other crypto on the OpenSea marketplace. Somnium uses Polygon to keep transaction costs low. ⁵⁹	\$17 million
Voxels Launched in 2018	Ethereum; OpenSea	Yes	Voxels has 7694 parcels of land of virtual land as of 9/30/2022, represented by ERC-721 NFTs and bought with ERC-20 fungible tokens called Voxies with a total money supply of 300 million. ⁶⁰	\$17 million

Table 2: Web 3.0 proto-metaverses

Based on our visits to Web 2 and Web 3 proto-metaverses 3, the Web 2 proto-metaverses we visited with VR headsets are more full-featured and aesthetically appealing than the current Web 3 virtual worlds—billions of dollars of investment do result in better quality software and more satisfying user experiences. For Web 3 to flourish, we need much more engagement and investment from all stakeholders: consumers, creators, businesses, governments, and 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, host events, and sell digital goods and services in Web 3 metaverses will help establish and shape the ecosystem needed for Web 3 to flourish.

4.0. Business opportunities in Web 3 proto-metaverses

Accenture advises that *“businesses can start identifying—and building—the Web3 and metaverse skills and capabilities they will need. Enterprises will need 3D artists, game designers and experts on the platforms on which they plan to build. Companies will need expertise in multiple blockchains and relationships with different consortiums. Because of the distributed nature of Web3, they must also find partners to go to market with.”*⁶¹

According to an analysis of 151 metaverse studies, most of which were VR applications, results show that organizations have achieved the following positive outcomes from metaverse adoption:

- Provide richer experiences (e.g., allow customers to try on virtual clothes before purchase)
- Improve teamwork and collaboration (e.g., greater sense of presence than videoconferencing)

- Increase training effectiveness (e.g., scenario-based training; simulation-based training)
- Reduce operational costs (e.g., less travel; digital prototypes are less expensive than physical prototypes)
- Deliver on sustainability goals (e.g., less carbon pollution from commuting)
- Increase safety and accessibility (e.g., such as in dangerous environments like mines and outer space; hazardous materials handling).⁶²

Businesses will have to consider new business models. For example, in a Web 3 metaverse, businesses might pay consumers directly with cryptocurrency for watching their ads, rather than paying the platform provider. Businesses will create new ways to attract users to virtual storefronts and other spaces, perhaps with exciting events. Business also need to consider how e-commerce business models translate to metaverse, for example:

Virtual-to-virtual commerce: These markets exist entirely in the virtual world. Users buy and sell virtual assets represented by NFTs, exchanging payment using cryptocurrencies. Transactions are stored on a distributed trust registry, typically a blockchain.

Virtual-to-physical commerce: These markets bridge virtual and physical worlds. Users order and pay for physical goods in a virtual world. The seller then ships the physical product to the buyer. The first virtual-to-physical commerce on a blockchain happened in 2010 on the Bitcoin network. Laszlo Hanyecz was an early Bitcoin enthusiast and developer of GPU mining. He wanted to prove that bitcoins had value by offering to pay 10,000 bitcoins to the first person who would deliver two Papa John’s pizzas to his door.⁶³ Someone took his offer, and the transaction is immortalized on the Bitcoin blockchain in block 57035 (see Figure 10). Based on the bitcoin’s value on 9/30/2022 (\$19,452.20), that’s \$194,522,000! Laszlo said the pizzas were great.

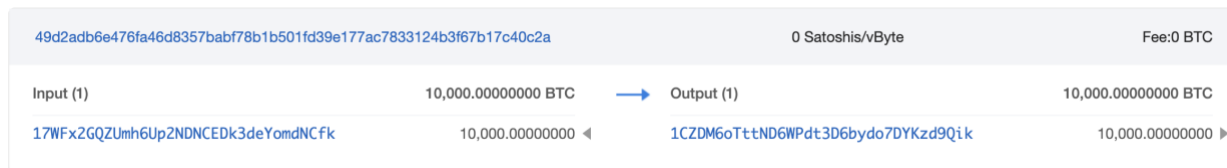


Figure 10: First virtual-to-physical purchase recorded on a blockchain
10,000 bitcoins were paid for two pizzas on May 22, 2010

The virtual-to-physical commerce market, like traditional e-commerce, has immense potential. Instead of searching for items like we do today on a web browser, we will explore products and services in a virtual world, put them in a virtual cart, and pay for them using our digital wallets.

Walmart began experimenting with the idea several years ago (see Figure 11). A 2017 prototype shows a Walmart virtual employee assisting a shopper. The shopper selects items to load into a virtual cart and pays for the items with Walmart Pay. Walmart ships the items to the shopper’s residence via a drone.⁶⁴ Brick and mortar retailers have a potential advantage in this market because they understand customers behavior in physical settings, which metaverse experiences—via presence and embodiment—seek to replicate and extend.

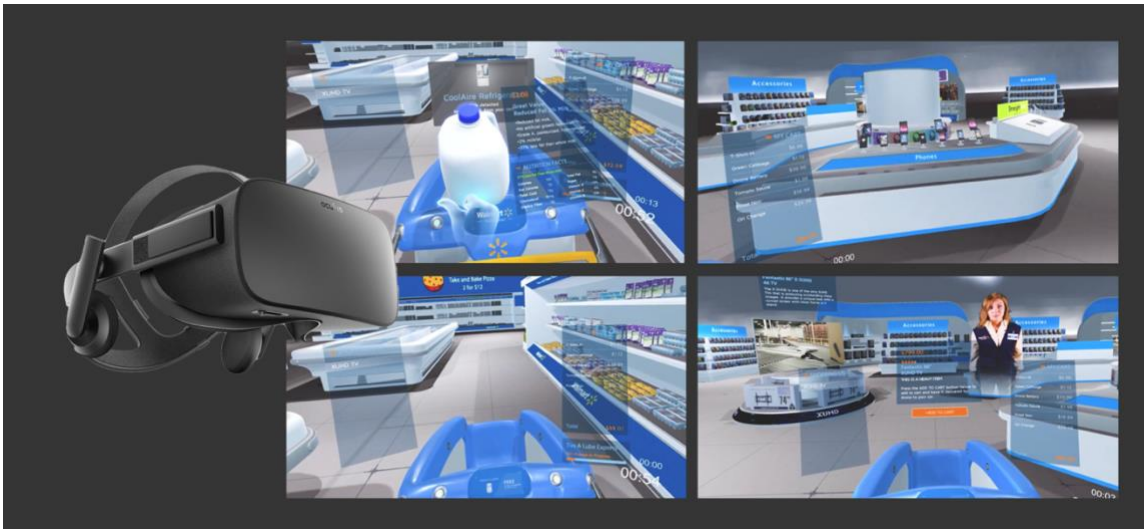


Figure 11: Virtual-to-physical commerce: 2017 exploration of virtual shopping

Source: <https://mutualmobile.com/work/walmart>

Physical-to-virtual commerce. Physical products come with tags that can be scanned to unlock virtual assets, like NFTs or fungible tokens. A classic example in the Web 2 world is Webkinz. Webkinz are physical stuffed animals that come with unique codes to unlock virtual versions of the animals that children can play with online (see Figure 12).



Figure 12: Physical-to-virtual commerce: Webkinz

Image credit: <https://i.ytimg.com/vi/LuAegm2pHgY/maxresdefault.jpg>

The Webkinz company was founded in 2005, and suffered some significant Web 2 perils, such as a 2020 data breach that compromised the login information for 23 million accounts.⁶⁵

5.0. How are US businesses exploring metaverse?

Our BCoE research team sought to answer the questions: which businesses are already exploring metaverse? Are they investing in Web 2 or Web 3 technologies? To answer the first question, the BCoE team conducted analyses from three data sources: US Securities and Exchange Commission (SEC) 10-K reports, corporate

press releases, and US patents. Overall, we found surprisingly little activity despite the hype and the market projections for a multi-trillion industry within the next decade.

It's not easy to answer the second question (Web 2 or Web 3). Most businesses seem to be experimenting within existing Web 2 proto-metaverses, in part because it is easier to comply with regulations and establish a legal agreement with a single platform owner. Similar to how many companies developed intranets before transacting on the internet, and are developing private blockchains before adopting public blockchains, we hope early investments in Web 2 proto-metaverses presage a move toward more open Web 3 metaverses.

5.1. For which US companies are metaverses already materially significant?

How seriously are US corporations taking metaverse? One place to find the answers to this question is Form 10-K, a report the US Securities and Exchange Commission (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 a credible source of information.⁶⁶ We extracted 10-K reports from the years 2017 to 2022 that mentioned the terms 'virtual world' or 'metaverse' and counted the number of corporations who mention them, and the number of times a corporation used them. We found modest results overall. *Of the 39,522 10-K reports in the database spanning five years, only 91 reports mentioned one or both terms* (see Figure 13).⁶⁷

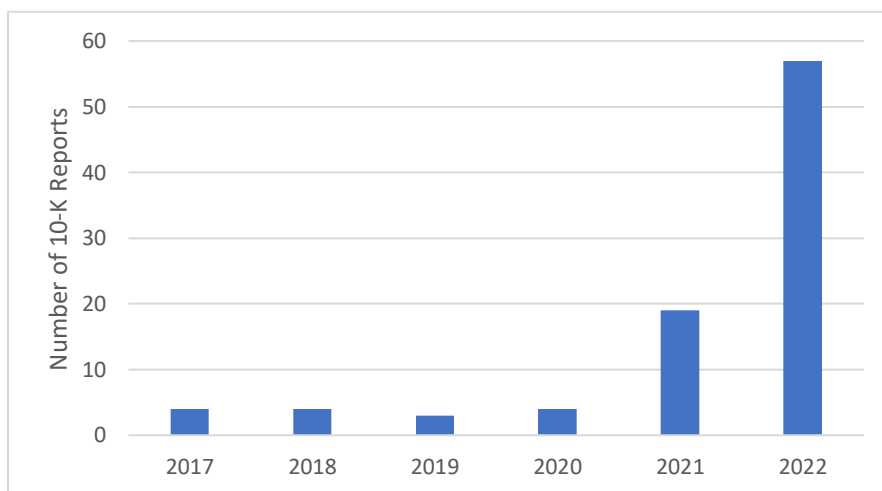


Figure 13: Number of 10-K reports that mention “virtual world” or “metaverse”

While most of corporations are quiet on virtual worlds and metaverses in their 10-K reports, early leaders are involved materially enough to alert investors, and the significance of these technologies is increasing over time. Figure 14 provides the top 10 US companies with most mentions of virtual world and metaverse in their five most recent 10-K reports.

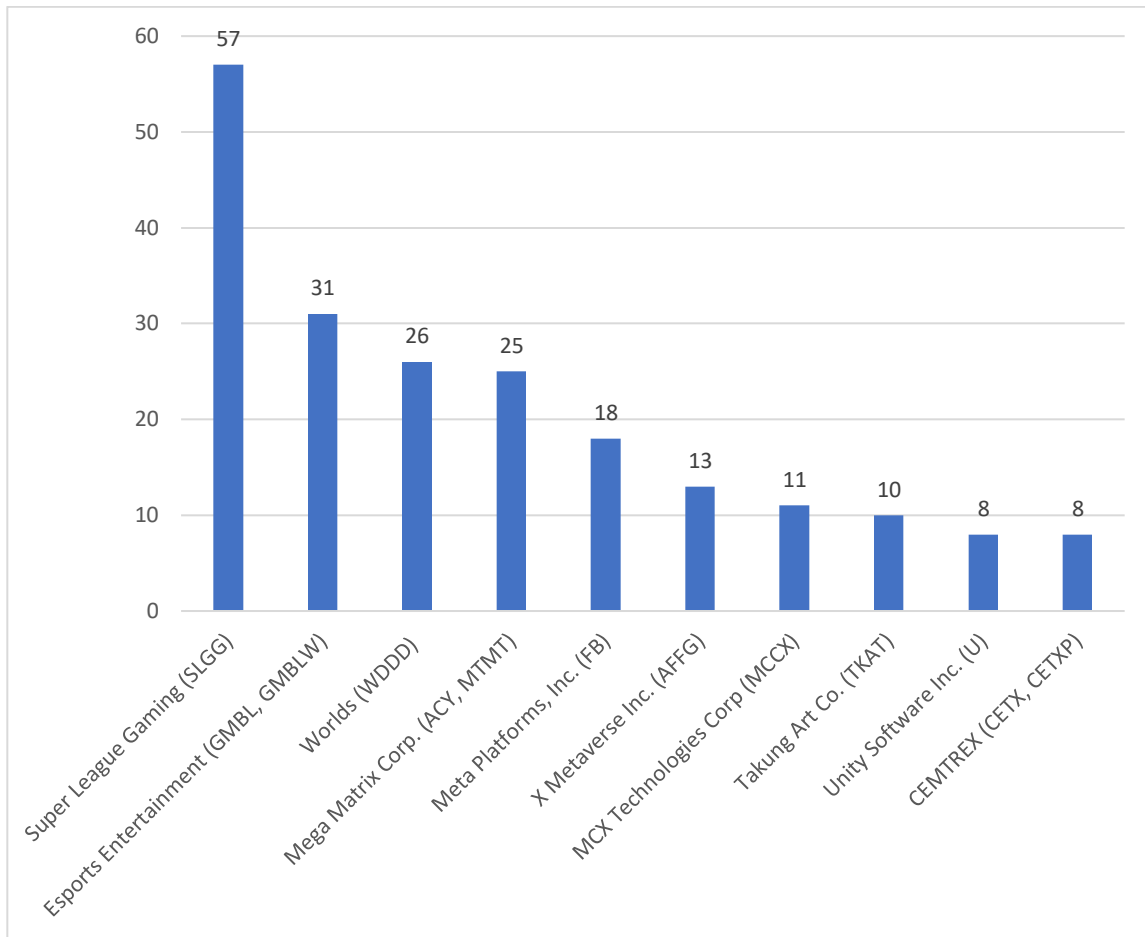


Figure 14: US companies with most mentions of virtual world and metaverse in five most recent 10-K reports

Let’s look at the five companies that most frequently mention the keywords:

Super League Gaming is headquartered in Santa Monica, California. The company’s motto is “We are the Rocketship to the metaverse.”⁶⁸ Popular games include Super League Arena, Minehut, Pixel Paradise, Frame Rate, Mine Ville, and Super League Arcade. It claims 1 billion monthly views across all social and digital platforms. Metaverse is its core business: “Super League Gaming, Inc., a leading gaming-centric creator and content platform, builds and operates networks of games, monetization tools and content channels across *metaverse gaming platforms* that empower developers, energize players, and entertain fans. Fueled by proprietary and patented technology systems, our platform includes access to vibrant in-game communities, an innovative *metaverse advertising platform*, a network of highly viewed channels and original shows on Instagram, TikTok, Snap, YouTube, and Twitch, cloud-based livestream production tools, and an award-winning esports invitational tournament series.”⁶⁹

Esports Entertainment is headquartered in Malta. Founded in Nevada in 2008, Esports Entertainment offers sports betting and the competitive playing of video games by amateur and professional teams. It has partnerships with the National Football League (NFL), National Hockey League (NHL), National Basketball League (NBA), Federation Internationale de Football Association (FIFA), and Indian Gaming Esports

Association. In its 2021 10-K report, Esports Entertainment referred multiple times to its service agreement with Metaverse Platforms, which included a loan.⁷⁰

Worlds is headquartered in Brookline, Massachusetts. It has proprietary technology to produce three-dimensional portals and web sites. “Our technology permits the development of virtual worlds which have broad applications.” Its main products are WorldsShaper, WorldsServer, WorldsBrowser, WorldsPlayer, and Worlds Gamma Libraries. In its 2020 10-K report, Worlds mentions *virtual worlds* seven times, but does not use the term ‘metaverse’.⁷¹

Mega Matrix is headquartered in Palo Alto, California. Mega Matrix emerged from bankruptcy in September 2021 with new investors and under new management. It’s a holding company with two subsidiaries: Mega Metaverse Corp. and JetFleet Holding Corp. Mega Metaverse’s mission is “to enable users to play and earn financial rewards in the *metaverse* through GameFi.” According to its 2021 10-K report, “Mega’s key plans going forward include: (i) NFT games with Mano as our first game, as well as other games to launch; and (ii) a marketplace where players and users can place their in-game NFT to sell or to trade for other digital assets. Mega’s proposed revenue model includes: (a) service fees for in-game NFT upgrade and new NFT creation, and (b) profit share for NFT sold or traded at alSpace marketplace.”⁷²

Meta Platforms (formerly Facebook) is headquartered in Menlo Park, California. The company’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.” Meta Platform’s 2021 10-K report reads, “Meta is moving beyond 2D screens toward immersive experiences like augmented and virtual reality to help build the *metaverse*, which we believe is the next evolution in social technology.”⁷³ The company acknowledges the risk is faces: “In 2021, we announced a shift in our business and product strategy to focus on helping to bring the *metaverse* to life. We expect this will be a complex, evolving, and long-term initiative that will involve the development of new and emerging technologies, continued investment in privacy, safety, and security efforts, and collaboration with other companies, developers, partners, and other participants. However, the metaverse may not develop in accordance with our expectations, and market acceptance of features, products, or services we build for the *metaverse* is uncertain.”⁷⁴

5.2. Corporate press releases on metaverse

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.’ Five major new sources were used: *Business Wire*, *EQS Newsfeed*, *GlobeNewswire*, *London Stock Exchange Aggregated Regulator News Service*, and *PR Newswire*. To narrow the search to focus on corporate press leases, 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. **A total of 126 press releases mention ‘metaverse’ or ‘virtual world’** along with one or more publicly traded companies. Out of those 126 press releases, 84 were released during the past six years (2017–2022) (see Figure 14).

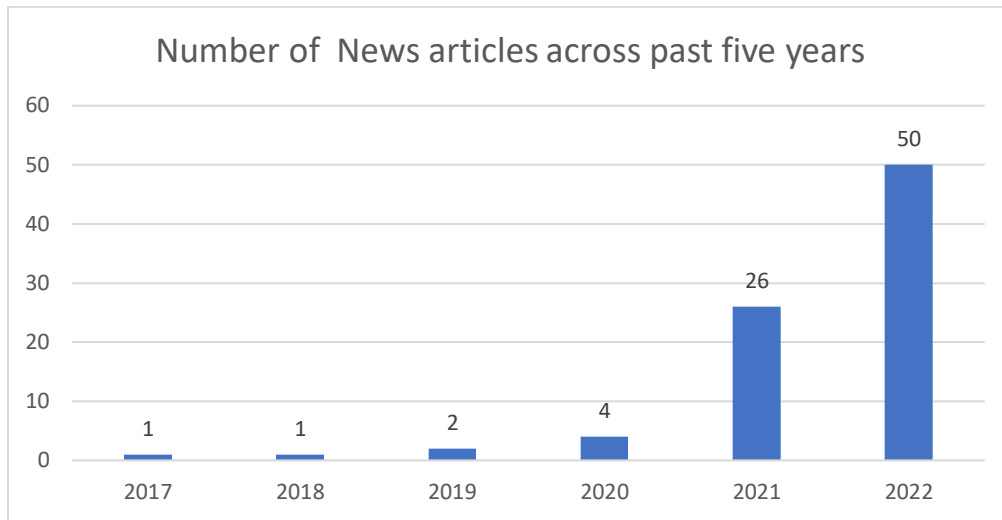


Figure 14: Number of press releases that mention ‘metaverse’ or ‘virtual world’ and a publicly traded company

Among the 84 public announcements, ‘metaverse’ was mentioned 286 times and ‘virtual world’ was mentioned 26 times in total. Figure 15 shows the frequencies of these two sets of keywords from 2017 until 2022. Metaverse has been frequently mentioned in the most recent two years.

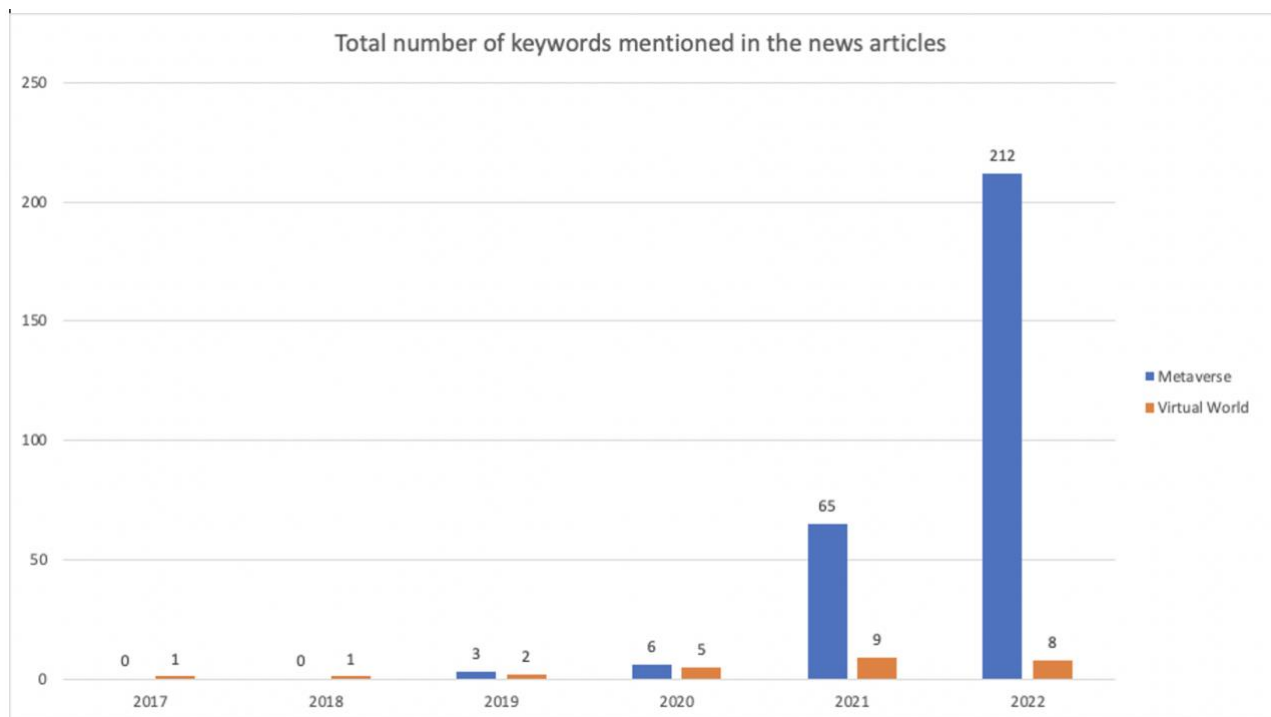


Figure 15: Number of keyword mentions of ‘metaverse’ or ‘virtual world’

Within the 84 press releases, 91 distinct publicly traded companies were mentioned. Meta Platforms, Aries I Acquisition, and CitiGroup were the three most frequently mentioned companies:

- **Meta Platforms** (formerly Facebook) issued some of its own corporate press releases, but other press releases also mentioned Meta Platforms, for example by companies entering the metaverse space.⁷⁵

- **Aries I Acquisition** was the second most frequently mentioned company in corporate press releases. It is a ‘blank check’ company, meaning that it is publicly traded but has no business plan or operations. Founded by Thane Ritchie, Aries I invests in aerospace, quantum computing, artificial intelligence, cybersecurity, and blockchain and digital currencies.⁷⁶
- **CitiGroup** was mentioned in press releases pertaining to corporate acquisitions, such as HITO Metaverse Acquisitions and PowerUp Acquisition’s IPO.

5.3. Metaverse patents

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 companies license their patents for free, so we do not make any assumptions about a company’s intentions based on patent data. Companies often seek patents as a pre-emptive move to prevent other individuals and companies from submitting patents and charging them fees (or suing them).⁷⁷ A 2013 study published in the *World Patent Information* journal found four reasons why companies license patents for free: cost cutting, profit-making, innovation catalyzing, and technology providing (see Figure 16).

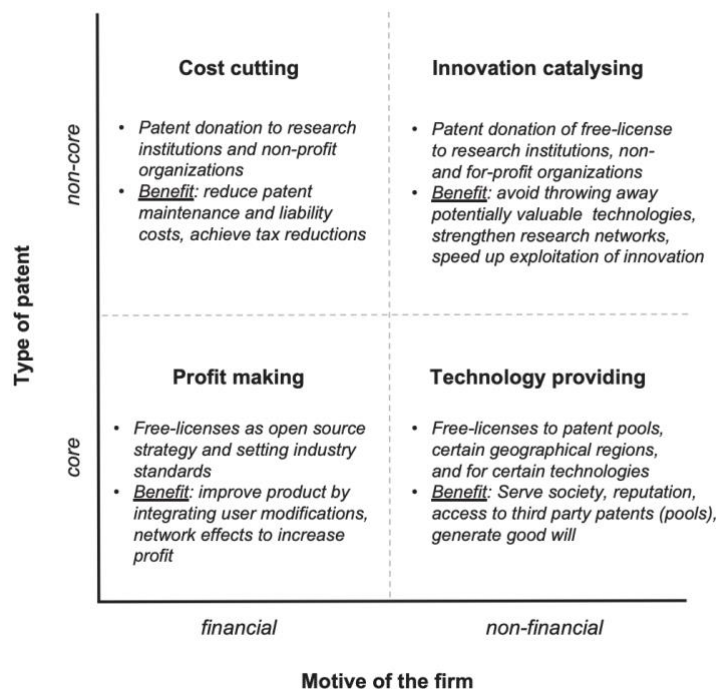


Figure 16: Four reasons why companies give away patents for free

Image credit: Nicole Ziegler, Oliver Gassmann, and Sascha Friesike (2013)⁷⁸

We searched the United States Patent and Trademark Office (USPTO) Patent Full-Text and Image Database to find issued (i.e., granted) patents and pending patent applications that related to metaverse.

5.3.1. Patents granted

From 2001 to present, a total of 175 patents were issued which mentioned the keyword ‘metaverse’ in the patent document. Figure 17 shows the 44 patents issued from year 2017 to 2021. No patent has been officially granted in 2022 as of this writing.

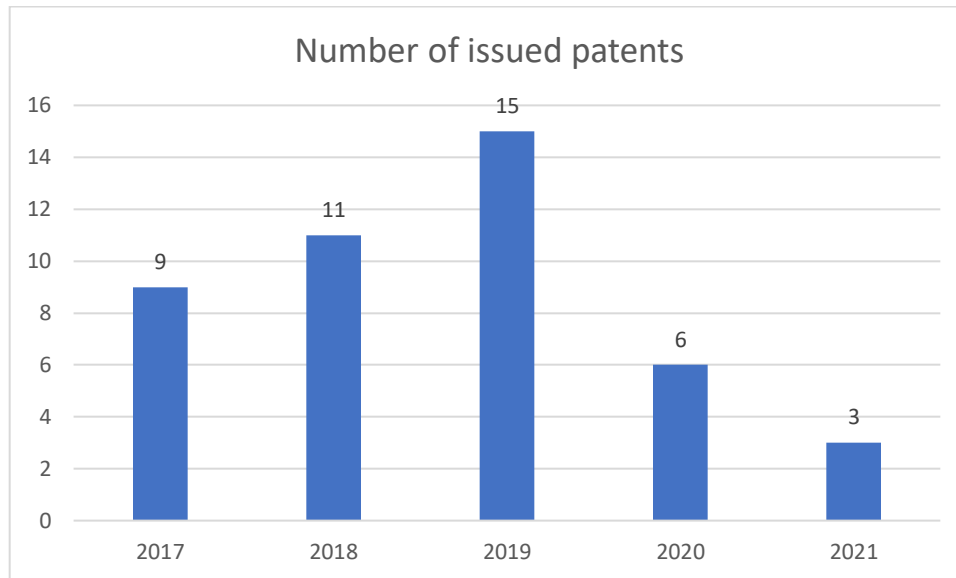


Figure 17: Number of US patents granted that contain the term ‘metaverse’

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’s novel, *Snow Crash*. The patent reads, “The novel *Snow Crash* 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).

As far as the greatest number of patents that mention metaverse, the top assignees are **Winklevoss IP (11 patents)**, **Patreon (7 patents)**, and **IBM (5 patents)**. Among the top three assignees, IBM’s patents are most directly related to metaverse; IBM uses the terms ‘virtual universe,’ ‘virtual world,’ and ‘metaverse’ synonymously. The Winklevoss 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 2017.⁷⁹ 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.⁸⁰

Readers may be surprised that Meta Platforms/Facebook is not among the companies that have patents issued on metaverse. The company has many patents, but its issued patents do not mention the specific keyword of ‘metaverse.’ Instead, Meta used terms like ‘virtual reality’ or ‘virtual environment’.

5.3.2. Patent applications

We found 241 patent applications that mention metaverse. Of those, 216 are assigned to one or more organizations.^{81,82} Figure 18 shows 92 patent applications filed in the past six years that mention metaverse. During this span (2017 to 2022), 41 organizations submitted patent applications that mention metaverse. **Samsung Electronics (14 applications), Roblox (5 applications), and IBM (5 applications)** have the greatest number of outstanding applications.

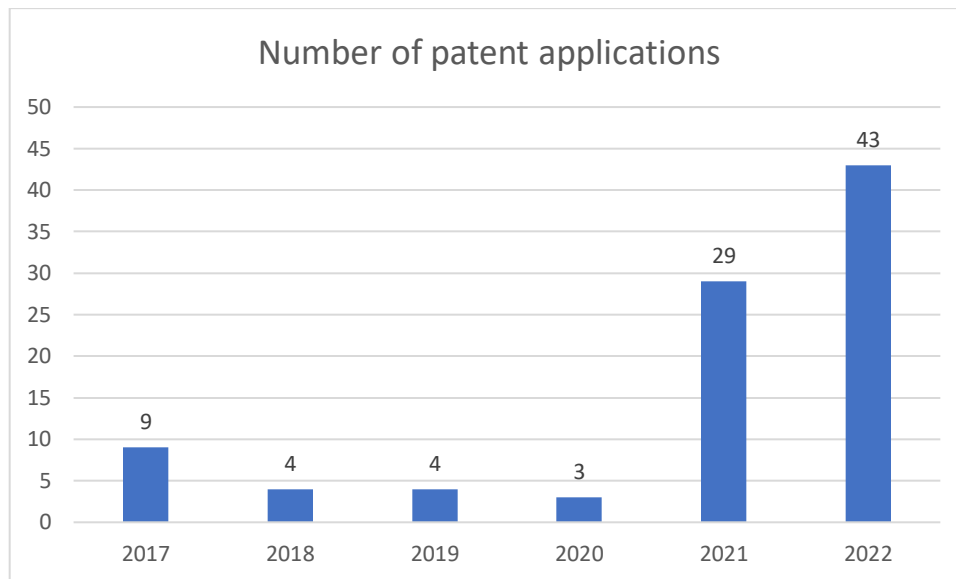


Figure 18: Number of US patent applications that contain the term ‘metaverse’

6.0. Conclusion

Experts and futurists are divided on whether the metaverse will deliver on its potential,⁸³ but it’s easy to envision that within a decade or two, many people could earn most of their income and spend much of their money in metaverses. There will be new jobs created. Universities will develop new curricula and offer remote learning in a metaverse.⁸⁴ We anticipate that the metaverse will irrevocably alter the business, social, educational, health, political, and economic landscape of our world.

What kind of metaverse will we create? The future of metaverse is not deterministic, but rather it will emerge from the choices we make today. We have argued that the optimal path forward is a Web 3-based public, decentralized metaverse platform that fosters user empowerment, privacy, security, equity, and inclusion.

We hope this white paper inspires people to learn about and to help shape a Web 3 metaverse. Today, we can support Web 3 proto-metaverses as community builders, investors in Web 3 digital assets, developers of content, and as consumers of digital goods and services. We need deep thinkers who understand behavioral economics to develop good economic business models to incentivize Web 3 innovation and adoption.

We call for more participation to help define the standards needed for Web 3, including standards for:

- 3D asset standards
- Avatar standards
- DeFi and payments standards
- Dispute resolution
- Diversity, equity, and inclusion
- Education and training
- Ethics, privacy, safety, and security
- Governance
- Intellectual property rights
- Self-sovereign identity and credentials
- Technical interoperability

Recently, metaverse standards making bodies have convened to meet this aim, and we hope readers are inspired to help (see Table 3).

Group	Launch Date	Mission	Key players
IEEE Metaverse Congress ⁸⁵	July 6, 2022	Webinar series Demystifying and Defining the Metaverse.	First speakers included industry leaders like Thomas Furness (“Grandfather of Virtual Reality”), Rev Lebedian (VP of Omniverse & Simulation Technology, NVIDIA) Yu Yuan, President Elect of IEEE Standards Association.
Metaverse Standards Forum ⁸⁶	June 2022	“The Forum will not create standards itself but will coordinate requirements and resources to foster the creation and evolution of standards within standards organizations working in relevant domains.”	Launched with 35 members, the Metaverse Standards Forum had over 600 principal members within four months.
Linux Foundation, Trust over IP (ToIP), AI & Metaverse Technology Task Force ⁸⁷	May 2022	“The TSWG AI & Metaverse Technology Task Force (AIM TF) is to complete a ToIP Recommendation for the ToIP community to address opportunities and challenges brought on by advances in AI, Metaverse and related technologies in relation to ToIP's mission of creating interoperable trust over the Internet.”	As of September 2022, 27 members

Table 3: Metaverse standards-making bodies

What kind of metaverse will we create? We can achieve the vision of individuals owning and monetizing their identities, credentials, and digital assets; of freely coming and going across virtual worlds; of securely executing transactions peer-to-peer with low transaction fees, of having a voice in the governance of the applications; and promoting the inclusion and dignity of all.

About the Blockchain Center of Excellence (BCoE)

The Blockchain Center of Excellence is housed in the Information Systems Department of the Sam M. Walton College of Business at the University of Arkansas. The BCoE was officially launched by Arkansas Gov. Asa Hutchinson on August 1, 2018. The center's vision is to make the Sam M. Walton College of Business a premier academic leader of research and education on blockchain-enabled technologies and digital ecosystems. The BCoE's case study series is one activity toward achieving that vision.

About the research. The Blockchain Center of Excellence research team visited a different proto-metaverse each week to get a sense of the user experience, including Web 2 and Web 3 virtual worlds. We interviewed experts to understand the opportunities and threats. We also wanted to understand its stage of maturity and how businesses are thinking about metaverse. Our team analyzed Securities and Exchange Commission (SEC) 10-K reports to determine how many and which companies consider metaverses as materially significant enough to alert investors. We examined corporate press releases and US patents (both issued and outstanding applications). The BCoE hosted a metaverse workshop for BCoE Executive Advisory board members. In this report, we share our findings, what we've learned so far, and recommend how businesses can help positively shape the future metaverse.

Disclosures:

Accenture, Walmart, and IBM are mentioned in this white paper, and they are members of the BCoE's executive advisory board.

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