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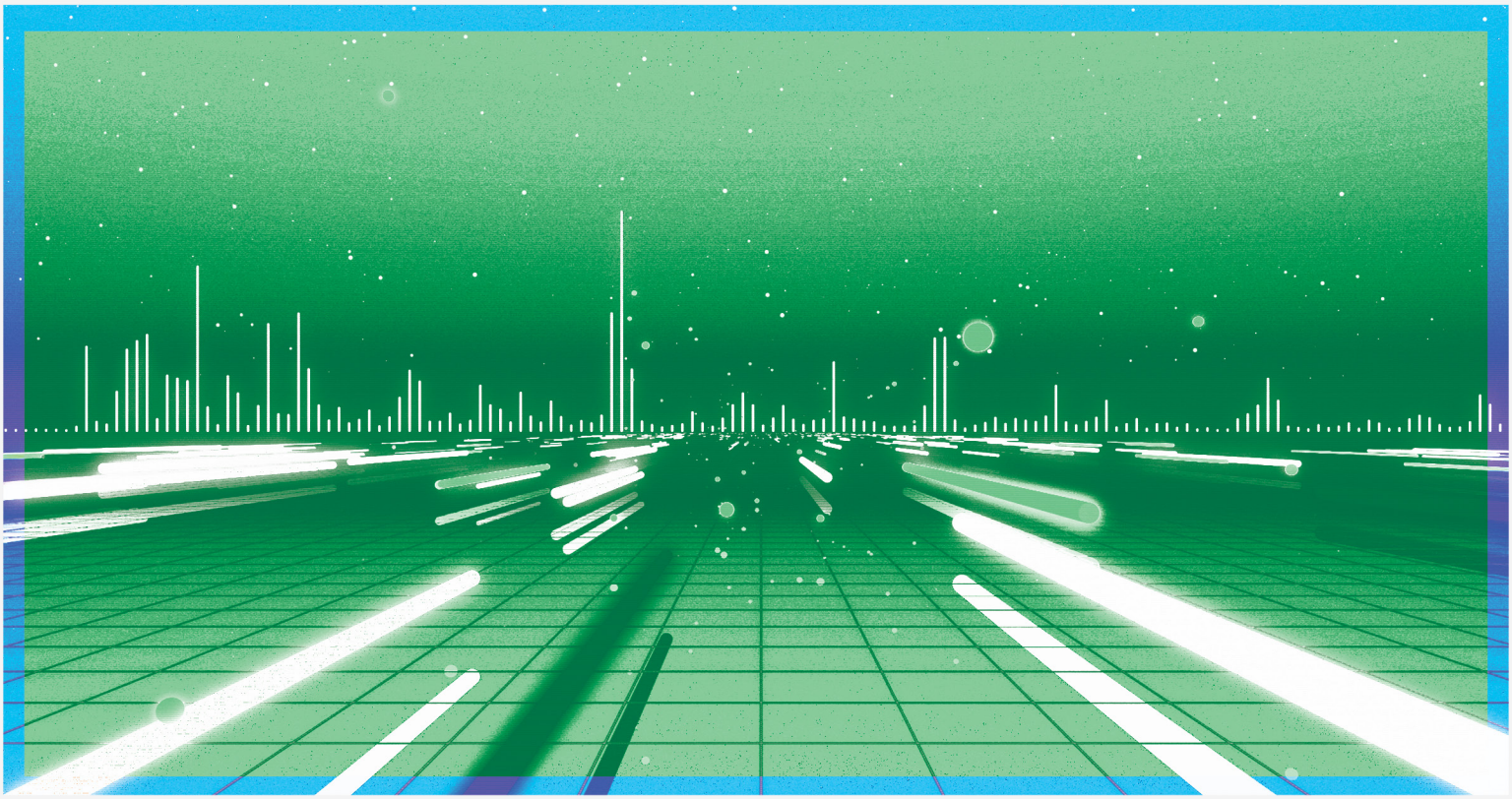
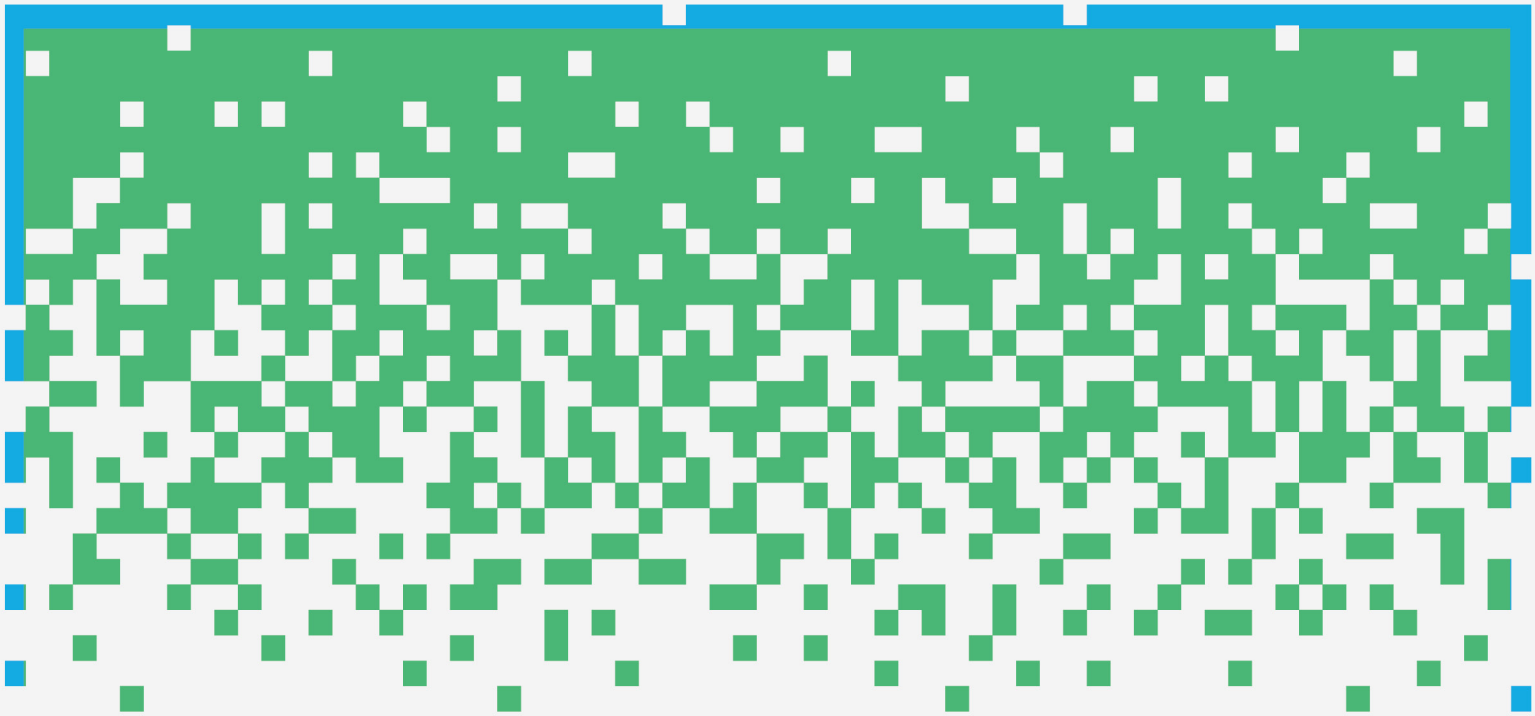


BLOCKCHAIN-BASED GAMING

A Primer



Blockchain-Based Gaming: A Primer

PUBLISH DATE 10/13/21

Introduction

The video gaming industry is evolving across several dimensions.

User experiences are transforming. In-person split-screen play has given way to massively distributed online games with global reach. Virtual and augmented reality primitives are immersing gamers in increasingly realistic alternative and borderless digital worlds.

Business models are evolving. Monetization through sales of physical games in-store has given way to free-to-play games monetized through in-game purchases and advertising. eSports tournaments and streaming services such as Twitch are giving gamers a "slice" of gaming industry revenues for the first time.

But a new trend is emerging.

Over ten years after the advent of Bitcoin, blockchain technology is being leveraged to redefine gaming experiences for developers and players alike. With innovations such as non-fungible tokens ("NFTs") and smart contracts, developers have new toolsets for crafting gaming experiences and their related economics.

With the introduction of blockchain technology come new existential questions. What are the incentive structures that align the interests of game developers, players, and spectators? Does the introduction of digital assets merely provide developers a new avenue for extracting rents from gamers? Or does it deliver gamers more enjoyable and more valuable gaming experiences?

All signs point to the most popular blockchain-based games today being proof of concepts that precede much higher levels and potentially widespread adoption of blockchain technology within the video gaming industry. Understanding how the technology is embedded into and impacting gaming experiences today can provide insights into how this nascent industry's future could evolve.

Blockchain-Based Gaming:
A Primer

Commissioned by

Forte Labs, Inc.

Forte Labs, Inc. - Forte is building economic technology for games. Its end-to-end platform enables the emergence of community economics, a system where the interests of game developers and players are aligned, leading to healthier, sustainable game communities. The team is composed of longtime industry members (Unity, ngmoco, Riot Games, Electronic Arts, Sony, and Rockstar Games, among others).

Forte is currently working with over thirty acclaimed game developers from across the industry to reimagine the economics of games. Partners include Jeff Tunnell, founder of Dynamix, the studio behind Starsiege: Tribes. Additionally, Gallium Studios - the game development company founded by Will Wright (creator of The Sims), recently partnered with Forte to launch a new blockchain and artificial intelligence-based game, Proxi. Previously announced developer partners include Hi-Rez Studios, Penrose, nWay, GC Turbo, Other Ocean, Kongregate, Magmic, and DECA Games.

Researched by

THE BLOCK Research

The Block Crypto, Inc. - The Block is an information services company founded in 2018. Its research arm, The Block Research, produces research content covering the digital assets, fintech and financial services industries.

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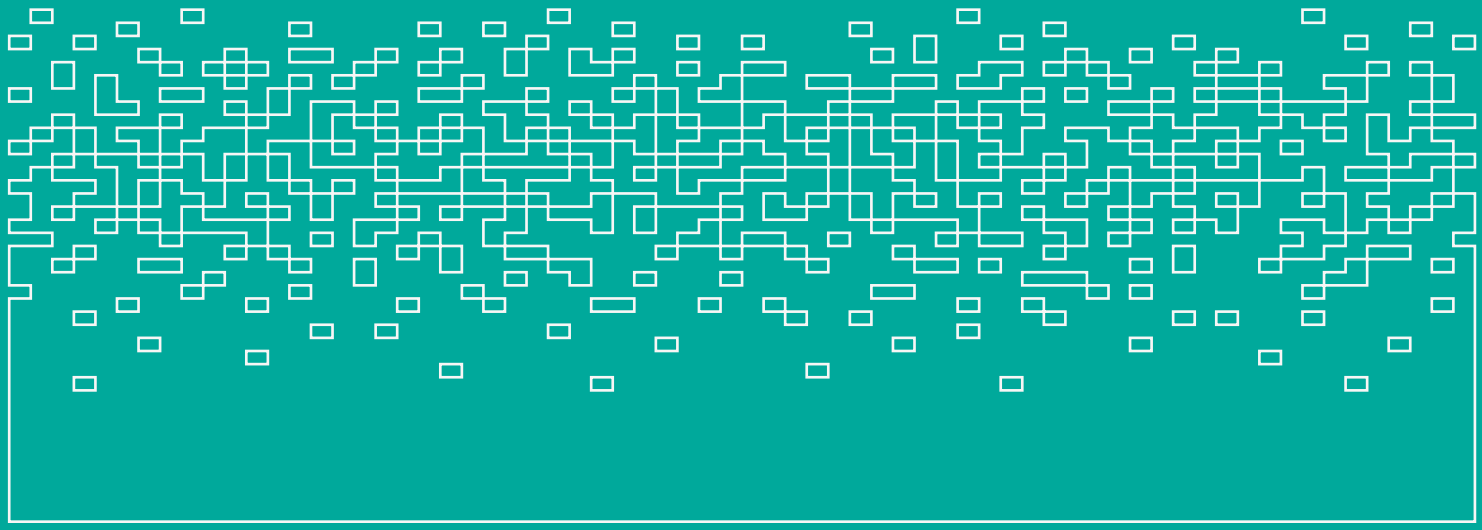
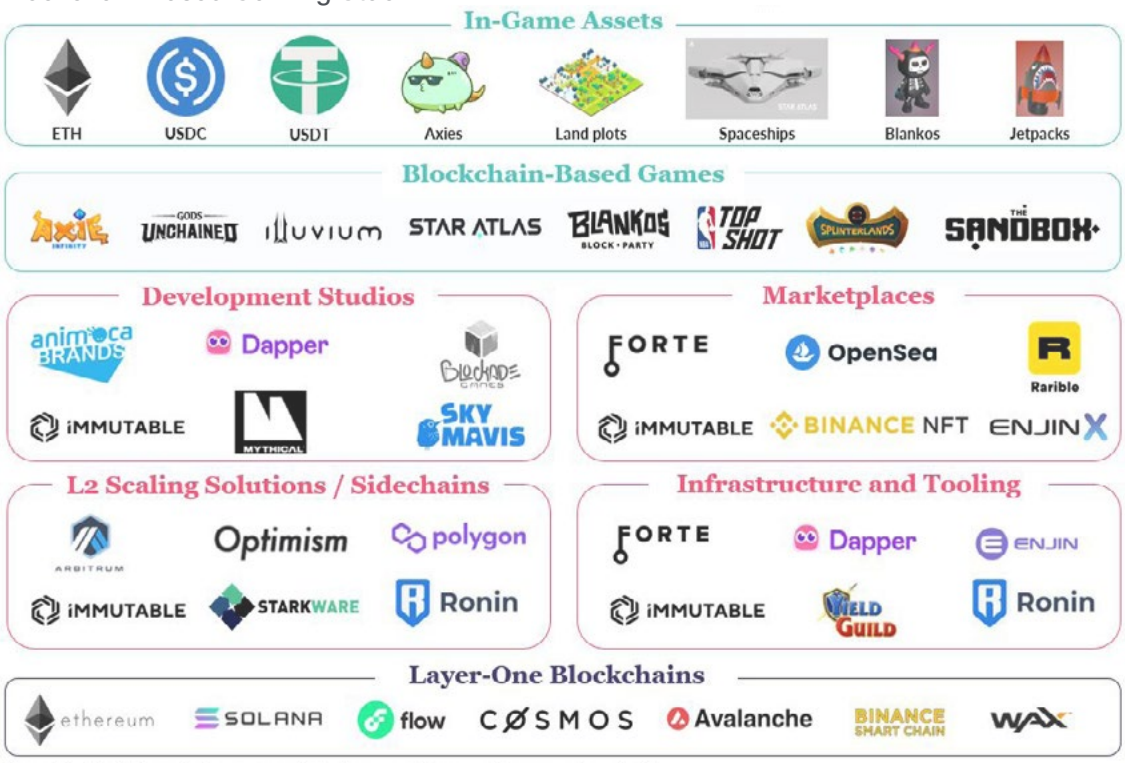


Blockchain-Based Games Defined

Blockchain-based games, unironically, can broadly be defined as gaming experiences that employ blockchain technology in one form or the other. To date, this use has been primarily centered on issuing and transferring in-game assets. These assets include NFTs that commonly represent in-game items and fungible tokens, which are used for in-game rewards, value transfer, and in some cases, grant holders governance rights.

The lines between what we call "blockchain-based games" and "traditional games" are slated to become increasingly blurry over the coming years as digital assets become more seamlessly integrated into gaming experiences and user experiences improve. Nonetheless, the different stakeholders in the blockchain-based gaming ecosystem today, which are outlined below, will likely remain constant.

Blockchain Based Gaming Stack



Source: The Block Research; Represents select industry participants and is not an exhaustive list.

Blockchain-Based Gaming Stack

Layer-One Blockchains enable the issuance and transfer of in-game assets such as NFTs and fungible tokens. They span general-purpose platforms such as Ethereum to platforms such as Flow and Wax that were explicitly designed for NFT issuance.

While these platforms are at the lowest level of the stack, their performance and security characteristics impact all of the stakeholders above them.

Gamers typically bear the transaction costs of minting in-game assets and transferring value on these Layer-1 platforms. Given the high transaction costs that have been persistent on Ethereum, the largest platform to date, many game development studios have opted to create their own blockchain solutions to rapidly grow user bases and avoid any potential scalability bottlenecks. Examples include Dapper Lab's launch of the Flow blockchain in response to congestion on Ethereum caused by its launch of CryptoKitties in late 2017. Additionally, Sky Mavis launched Ronin, which is an Ethereum sidechain solution that powers the economics behind Axie Infinity, the most widely adopted blockchain-based game seen to date.

In addition to these performance considerations, the decentralization of underlying blockchain platforms is an important consideration for gamers and developers alike. All else equal, platforms with higher degrees of decentralization provide better assurances of censorship resistance and ultimately higher levels of security for in-game value transfer.

Layer-2 Scaling Solutions and Sidechains typically aim to increase the scalability of Layer-1 platforms by taking transaction execution off of Layer-1 platforms and onto separate blockchains. They include rollup solutions, such as Arbitrum, which maximize their inheritance of the security of their underlying Layer-1 platform, to sidechains such as Ronin which have their own unique security mechanisms and thus more closely resemble independent Layer-1 platforms.

Infrastructure and Tooling Providers provide solutions that make it easy for game developers to incorporate blockchain technology into their games. These solutions include critical wallet infrastructure for storing and transferring in-game assets across platforms, fiat to crypto on-ramps and off-ramps, and risk management services such as Know Your Customer ("KYC") and Anti-Money Laundering ("AML") compliance solutions.

Developer Studios create and maintain front-end gaming software. In some instances, with a solution provider like Dapper Labs, these development studios directly integrate blockchain technology in their games. In other instances, developers work with an infrastructure and tooling provider such as Forte to provide these services.

Games and Apps span apps such as NBA Top Shot which are centered on collecting and trading cards, to virtual worlds such as Decentraland where land can be purchased, to games like Axie Infinity where gamers battle each other for prizes. Section 3 of this report provides an overview of the different types of blockchain-based games in the market today.

Marketplaces are where players mint, buy, and trade in-game items (primarily NFTs).

Blockchain-Based Assets include NFTs and fungible crypto assets used in gaming experiences. They are issued on top of Layer-1 platforms, Sidechains, and Layer-2 Scaling Solutions and can be transacted and traded on a peer-to-peer, global, and 24/7 basis.

TOKEN TAXONOMY

Fungible vs. Non-Fungible Assets

Much like traditional assets, blockchain-based assets employed in gaming can broadly be defined as either fungible or non-fungible.

Fungible assets are generally seen as interchangeable between one unit and another and are easily divisible into smaller fractions.

For example, a dollar bill is interchangeable with another dollar bill, and it can be broken down into cents which are also interchangeable. Likewise, one Bitcoin ("BTC") is generally accepted for another BTC and BTC is divisible into smaller units. The smallest unit of a BTC is called a "satoshi," which is equivalent to 1 / 100,000,000 of one BTC.

"For example, in the real world if you buy the Mona Lisa...your friend can make a copy of it. But there's an art expert who can come to verify that it's the original one...In the digital world, if you have an image and you make a copy of it, no one knows who has the original one. But now that's possible thanks to blockchain technology [and NFTs]"

Nikil Viswanathan · CEO at Alchemy

Non-fungible assets are unique and generally not seen as interchangeable or easily divisible.

For example, a house has attributes such as the plot of land it is built on, its prior history of inhabitants, and its date of construction that make it different from any other house. And while a house could theoretically be divided, it is generally seen as one unique asset. Likewise, the digital cat CryptoKitties pictured above are unique and not interchangeable on a 1:1 basis. They have different birthdays, different ancestries, and even different "cattributes" such as their eye shape and color.

What are NFTs actually?

While the difference between fungible and non-fungible assets can often be determined by physically inspecting them (i.e. two houses are not the same based on looking at them), NFTs enable verification of digital authenticity in a trust-minimized manner by leveraging blockchain technology. The quote above from Nikil Viswanathan does an excellent job of explaining this distinction.

If NFTs are ultimately representations of ownership, this naturally begs the question of: "do the objects they represent also reside on the blockchain?"

In almost all cases, the answer to this question is "no." Generally speaking, storing data directly on Ethereum and most other blockchains is not an optimal use of computational resources. For example, per the SSTORE opcode used to store data on Ethereum, it costs 20,000 gas (1/1,000,000 of one ETH) to store one byte of information on Ethereum. At $2500 per ETH, this would translate to ~$50k to store a 1-megabyte image on Ethereum. So, files themselves are not stored on the blockchain, but the metadata representing them is. The metadata, which is typically a URL where the actual files or raw media files are hosted, links an NFT to what it actually represents.

Accordingly, **"**blockchain-based records of authenticity" or, more colloquially, "digital ownership certificates" are good ways of contextualizing

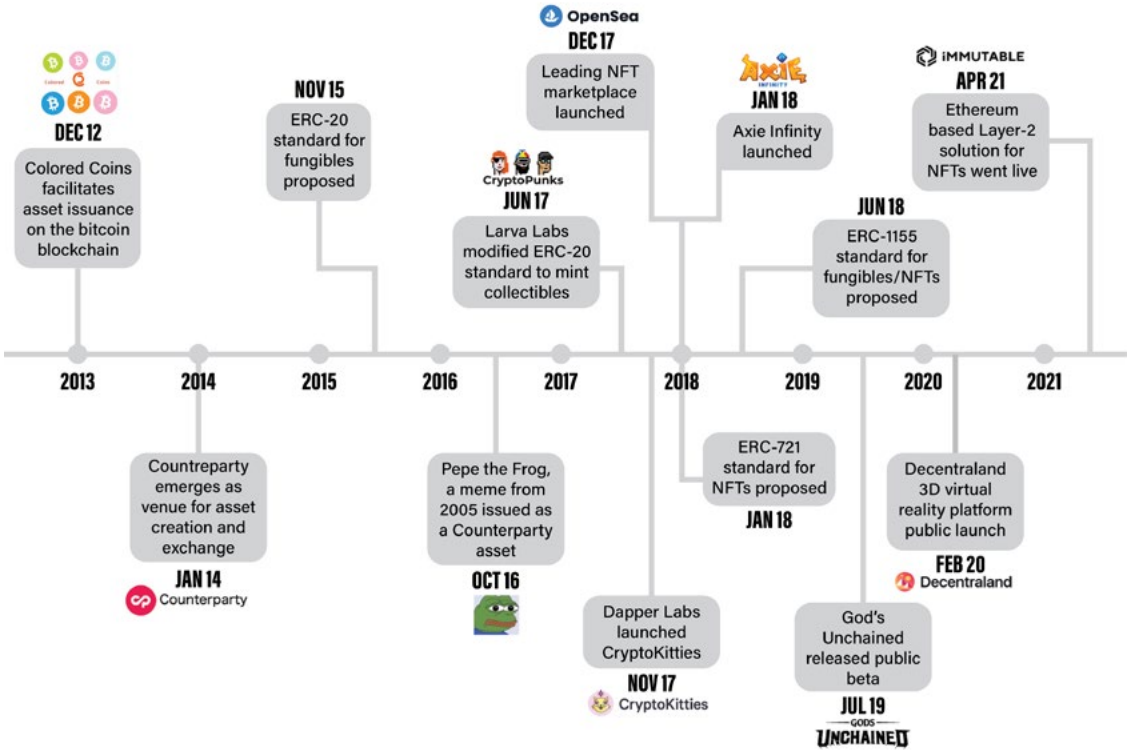
NFTs. While digital art, collectibles, and gaming assets have been some of the first assets represented by them, they are far from the last. NFTs can theoretically be used to confer ownership over anything.

Further complicating the distinction between NFTs and fungible crypto tokens is the idea of divisibility. While NFTs typically represent one verifiably unique object, ownership over them can be fractionalized into fungible tokens, which represent shares of an NFT. For example, even though each CryptoKitty is a verifiably unique asset represented as an NFT on the blockchain, it can be split into different shares represented by fungible tokens. These fungible tokens now become interchangeable and can also be further broken down into smaller shares.

What preceded the emergence of blockchain gaming?

The emergence and recent rise to popularity of NFTs were preceded by years of early experimentation and innovation. The emergence of blockchain-based collectibles, token standardization, and the birth of marketplaces are all important developments that preceded the implementation of NFTs in blockchain-based games.

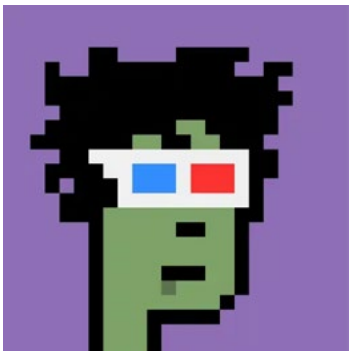
Major Events in NFT and Blockchain Gaming History



Collectibles

In March 2012, Colored Coins, a protocol facilitating the issuance of different assets (i.e., stocks, bonds, smart properties, precious metals, commodities) on the Bitcoin blockchain, was proposed. The first collectibles were issued on blockchain infrastructure approximately one year later with the launch of Counterparty, a similar platform to Colored Coins that added trading functionalities. Rare Pepe Memes, which are cartoon frogs, were some of the most popular collectibles to be issued on Counterparty.

Top CryptoPunk NFT Sales (Last 30 Days)



2,000 ETH
$6,641,920.00

450 ETH
$1,537,371.00

449 ETH
$1,277,494.80

360 ETH
$1,224,349.20

350 ETH
$1,074,507.00

350 ETH
$1,033,501.00

Source: NonFungible, Top Sales as of 10/7/2021.

In June 2017, Larva Labs, a collectibles development studio, introduced modifications to Ethereum's ERC-20 fungible token standard that enabled the team to attach unique identifiers to tokens. Using this modified standard, Larva Labs later minted 10,000 unique collectible and highly pixelated avatars, dubbed CryptoPunks as an experiment in proof of ownership. Approximately four years later, these CryptoPunk collectibles, which

were initially distributed for free, would become some of the most sought after digital collectibles and start selling for millions of dollars individually.

In November 2017, Dapper Labs, a technology company focused on NFTs, launched CryptoKitties, an Ethereum based game in which users can collect, trade, and breed digital cats while maintaining immutable ownership. To say that CryptoKitties was an early success would be an understatement. At one point, the game accounted for an estimated 25% of the total activity on Ethereum, according to developers Dapper Labs and marked a major event in the proliferation of NFTs.

Token Standardization

In late 2015, token standards emerged for the first time. Given that blockchain networks such as Ethereum are global in nature, coordination mechanisms are essential for building network effects. Token standards define certain attributes for blockchain tokens such as what types of tokens they represent (i.e. fungible or non-fungible), how they are transferred from one account to another, and also how metrics like the total supply of the token can be retrieved. The figure below outlines three of the most prominent token structures employed on the Ethereum: ERC-20, ERC-721, and ERC-1155.

Ethereum Token Standards Visualized

Source: The Block Research

In November 2015, the ERC-20 standard was proposed for the first time. This standard gave developers an “out of the box” solution for creating fungible tokens on the Ethereum network that could easily be traded for other tokens under the same standard. By adhering to this standard, tokens were easily supported by wallets such as Metamask and MyEtherWallet and quickly became adopted as a go-to solution for token issuers on Ethereum.

In January 2018, the ERC-721 standard was proposed. ERC-721 underpins the vast majority of NFTs that have been minted on Ethereum to date. ERC-721 tokens are unique and non-fungible. Accordingly, the value of two tokens belonging to the same contract can be different due to different previous owners, age, rank in an ecosystem, or a number of other attributes.

In June 2019, the ERC-1155 standard was proposed. ERC-1155 is a multi-token standard agnostic to token fungibility. It uses a single smart contract to represent multiple tokens (fungible and non-fungible), whereas ERC-20 and ERC-721 require the deployment of separate contracts for each token type or collection. The ERC-1155 standard has gained traction, particularly for games where users mint a large number of assets, such as The Sandbox. Given ERC-1155's use of a single smart contract for multiple classes of tokens, this standard allows for bundling of transactions and thus can reduce the typical fees paid on a Layer-1 by as much as 90%.

Exchange and Infrastructure

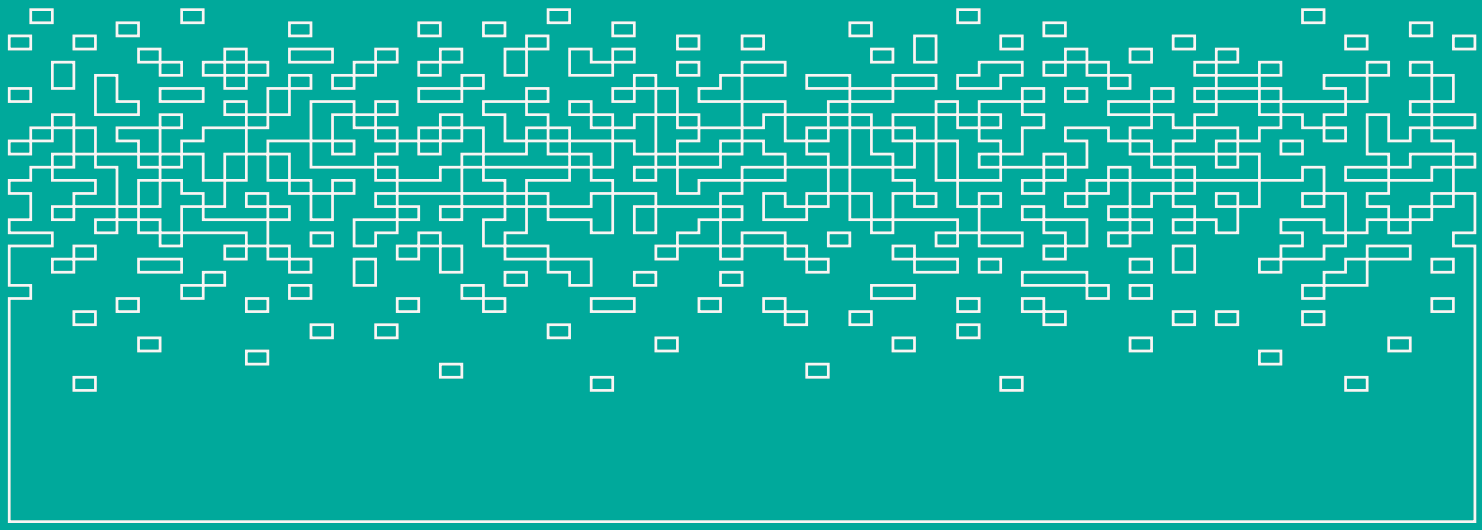
In December 2017, OpenSea, the world's largest NFT marketplace, launched. With the proliferation of NFTs that has occurred this year, OpenSea has seen traded value on its marketplace explode. The total traded volume of NFTs on its platform exceeded $3BN in August alone, up from ~$280MM in July.

In April 2021, Immutable, the company behind the card-based warfare game Gods Unchained, launched the first Ethereum Layer-2 scaling solution tailored for NFTs, Immutable X.

Blockchain Gaming

Blockchain-based gaming came onto the scene in early 2018 with the emergence of games such as Axie Infinity. Axie Infinity built on previous games such as CryptoKitties by adding more active gameplay such as battling and employed more complex in-game economics. In February 2020, Decentraland officially released its public platform. While Decentraland was originally created as early as 2015, it has gone through several iterations to transform into a virtual world where digital real estate sale prices have since increased markedly.

II Blockchain's Impact on the Gaming Industry



While the blockchain-based gaming industry is still in its nascent stages, a variety of different gaming types have emerged.

Unsurprisingly, these blockchain-based games are centered around many of the same core concepts prominent in traditional video games. For example, NBA Top Shot is building on the "collect and trade model" that has been prevalent in the baseball card and other collectible arenas for decades. Axie Infinity is building on the "breed and battle" game model that Pokémon pioneered in the 1990s. Sorare, a game where players buy and trade soccer player cards and build competing soccer teams, is building on the "draft and compete" model made popular by fantasy sports leagues. And finally, virtual worlds such as Decentraland and Somnium Space are placing gamers in alternative realities much like Second Life and The Sims.

Blockchain Based Gaming Landscape

Source: The Block Research; Represents select industry participants and is not an exhaustive list.

While many of these games fall into the same categories as widely distributed and played games today, the most important feature that distinguishes them from their traditional video game counterparts today is their use of blockchain-based bearer assets.

Asset Exchange

With the introduction of blockchain technology, in-game assets are native to permissionless, global blockchain platforms rather than closed-loop cloud or on-premise environments controlled by video game development companies. This puts users in direct ownership of their in-game items and grants them complete and irrevocable control over their use.

NFT marketplaces and digital asset exchanges are providing gamers previously unimagined venues for extracting value from in-game experiences by buying and trading these items on a 24/7, global basis.

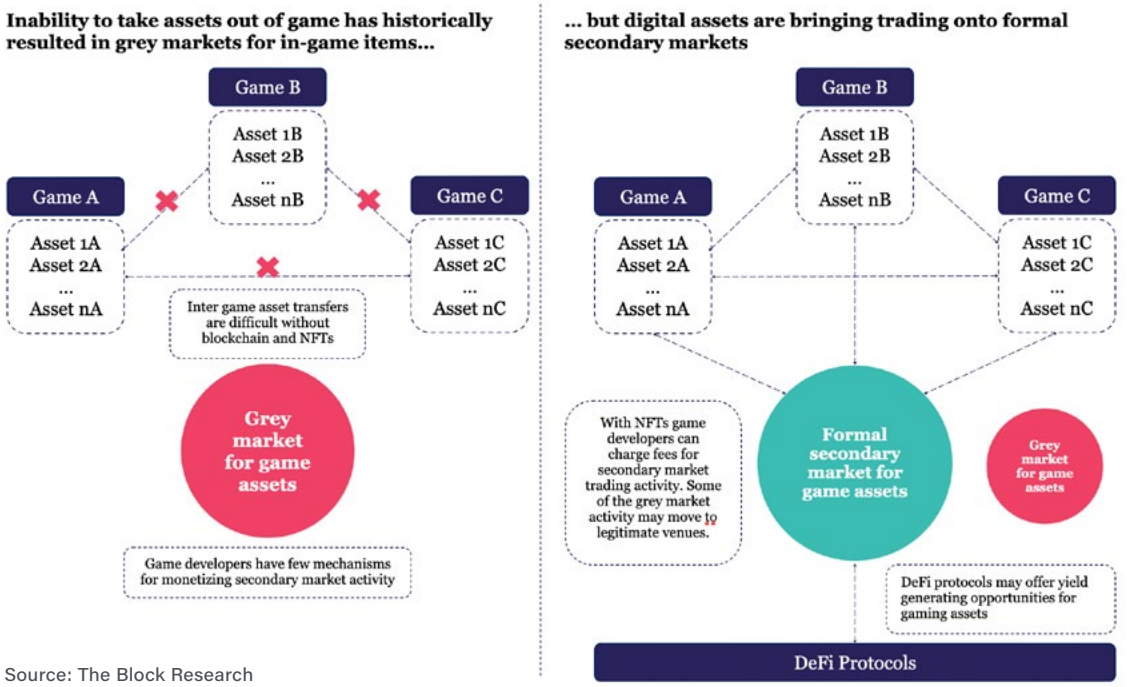
The Evolution of Seconday markets for Video Game Assets

Physical Trade-ins	Online Marketplaces 1.0	Online Marketplaces 2.0
▪ Trade in physical games in-store for cash or credits towards new games ▪ Trade ins typically receive significant discount to primary market purchase price ▪ Trade in opportunities limited to physical store footprint	▪ Trade in-game items on online marketplace such as Steam Community Market ▪ Limits on individual user wallet balance ($2,000) and maximum amount an item can be listed for ($1,800) on Steam Community Market ▪ Sale proceeds must be spent on Steam platform and cannot be withdrawn to external	▪ Trade in-game assets and NFTs on a peer-to-peer, global basis 24/7 ▪ Generate proceeds in liquid digital bearer assets which can be withdrawn from marketplaces ▪ Multiple platforms supported; Game assets eligible for use out of in-game experiences. ▪ Fungible in-game assets listed range of centralized and decentralized exchanges
GameStop	STEAM COMMUNITY MARKET	OpenSea

Source: The Block Research

The use of blockchain-based assets can also be beneficial for game developers. Under the current in-game item exchange framework, a practice known as “gold mining” has become prevalent. Gold mining entails players selling accounts or in-game currencies in grey markets or over-the-counter markets, limiting secondary market monetization opportunities for developers and making gamers vulnerable to fraud. With digital assets markets for in-game assets, game developers can gain insight into trading volumes of these assets and encode royalties into NFTs, such that with each subsequent sale, they receive a portion of the sales price as a royalty fee.

Blockchain is Facilitating Formal Secondary Markets for Gaming Assets



Source: The Block Research

In addition to increased monetization opportunities for developers, the tokenization of in-game assets opens up several other opportunities for gamers. Decentralized Finance ("DeFi") markets are one place where we have seen some users put their in-game assets to work. Platforms like Yield Guild Games facilitate borrowing and lending of in-game assets such that players who do not have the upfront capital required to purchase items can still participate in games by forfeiting a portion of their earnings to item lenders.

Business Model Implications

With the introduction of blockchain-based assets to video games comes the possibility for entirely new developer business models and gamer earning opportunities.

Up until ~2010, the most prevalent business model for the gaming industry was pay-to-play, whereby development studios and publishers generated revenue from upfront game sales and, in some cases, subscriptions. Collaborations with advertisers for in-game advertisements were few and far between. Gamers had little to no opportunity for capturing value from games outside of their enjoyment of the in-game experience.

Evolution of Video Gaming Business Models			
	Pay to Play (1970s ~)	Free to Play (2010s ~)	Blockchain Enabled (2020s ~)
Developer Revenue	▪ Upfront game purchases ▪ Monthly/annual subscription	▪ Freemium ▪ In-game item purchases ▪ Advertising	▪ Presale of game items or governance tokens ▪ Fees on secondary market trading activity
Gamer Monetization	▪ In-store trade-ins	▪ eSports tournaments ▪ Streaming (e.g. Twitch) & Endorsements	▪ Gameplay rewards / in-game tournaments ▪ Secondary market sales of in-game items and currencies
Driving Factors	▪ Sales primarily limited to physical store footprint ▪ Digital distribution methods limited	▪ Massive populations with internet access creates large distribution channel ▪ Rapid user onboarding through free to play revenue models	▪ Global, permissionless value transfer enabled by blockchain ▪ Rapid user onboarding through in-game, liquid rewards
Examples	FORZA, FIFA, grand theft auto, ASSASSIN'S CREED	FORTNITE, CALL OF DUTY WARZONE, ROBLOX, LEAGUE OF LEGENDS	AXIE INFINITY, GODS UNCHAINED, STAR ATLAS, SPLINTERLANDS

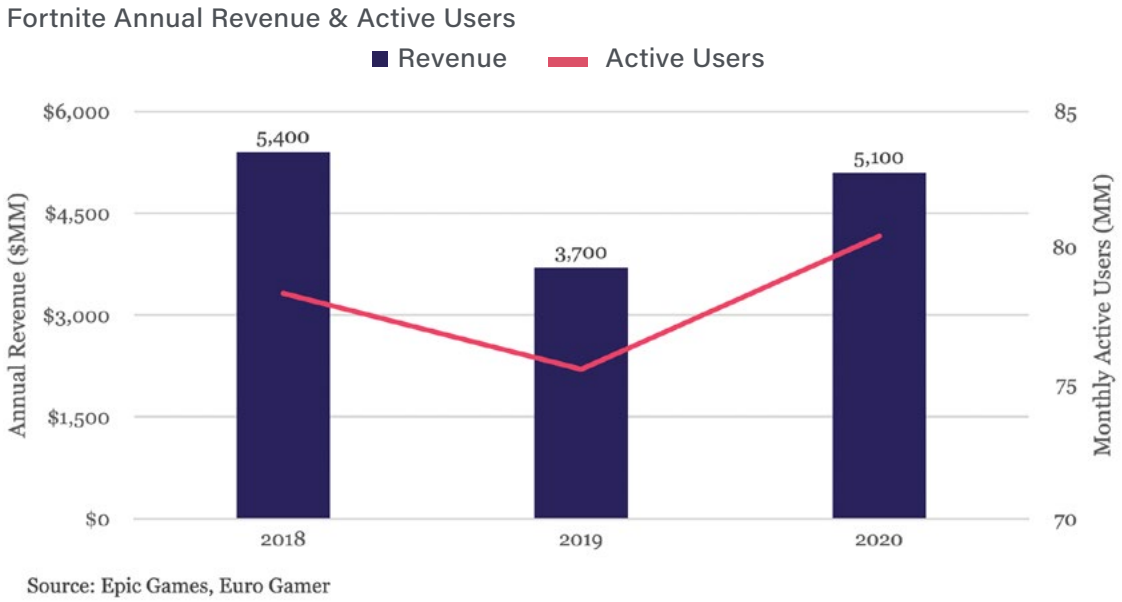
Source: The Block Research

"Free-to-play gaming, after all, was once considered a radical business model that at best would lead to lower revenues for a given game and at worst cannibalize the industry. Instead, it proved to be the best way to monetize and a core driver behind video gaming's cultural ascendance."

Matthew Ball · Managing Partner at EpyllionCo

With the advent of the free-to-play model in the 2010's, publishers began offering some games to players at no upfront cost. Under these models, in-game purchases (items and upgrades that enhance capabilities) and advertisements constitute the vast majority of revenue for publishing studios. Streaming services and e-sports have emerged as monetization levers for gamers, although they have only enabled the most elite gamers to reap the rewards.

Fortnite serves as a useful example of how successful some of these free-to-play business models have become. Having launched in July 2017, it generated over $5 billion in revenue in its first year of production. Additionally, the game went from zero users at the start of 2017 to ~80 million monthly active users by the following year. Wow!



Source: Epic Games, Euro Gamer

Blockchain-Enabled

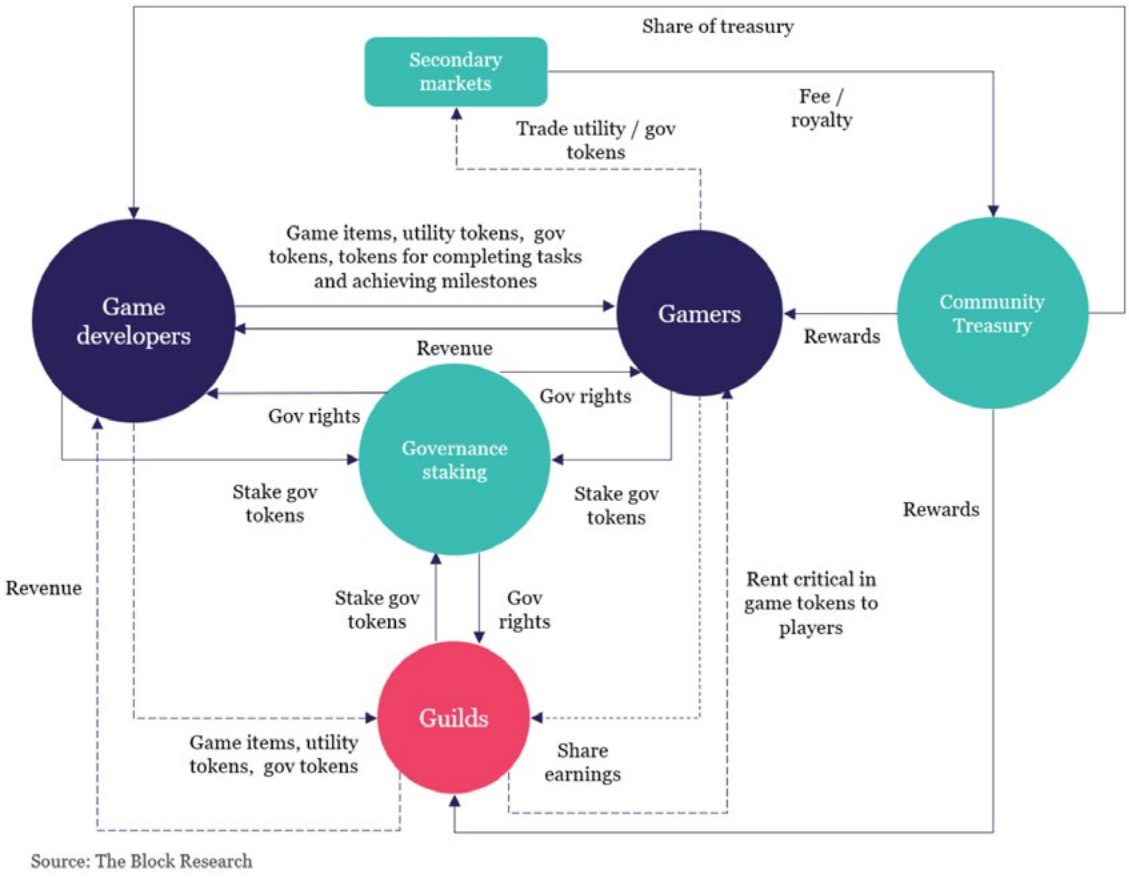
All signs point to the adoption of blockchain into gaming as a continuation of the free-to-play trend rather than a major paradigm shift. To date, the play-to-earn model whereby gamers are capable of earning in-game rewards in the form of blockchain tokens has been one of the more popular models employed by game developers.

But over time, the use of blockchain in gaming will likely span a variety of use cases outside of this play-to-earn model. Additionally, it is likely that the blockchain-enabled model will combine many elements from prior gaming models such as pay-to-play with upfront sales of tokens and free-to-play by allowing users to start playing with no upfront costs. For instance, games such as Axie Infinity, which is outlined in a case study later in this report, combine pay-to-play and play-to-earn elements.

In-Game Token Economics

A variety of games today employ complex blockchain token economics schema that determine which stakeholder(s) in a gaming ecosystem accrue value and at what point during a game's life cycle. Striking a balance between providing an enjoyable gaming experience and incentivizing participation from gamers and developers is slated to become an increasingly important consideration for gaming communities over the coming years.

General Model for Blockchain Gaming Economics



Source: The Block Research

While incentive structures of blockchain-based games are still in their early and, in many cases, experimental stages, the graphic above provides an overview of the many different moving parts that can compose a gaming ecosystem today.

The major stakeholders in these ecosystems and their interactions are as follows:

Game developers distribute or sell in-game items, in-game currencies, and governance tokens to gamers, thus generating revenue. These development studios also typically play a major role in the governance decisions of their respective gaming communities and retain large holdings of the game's governance tokens.

Gamers use in-game items during gaming experiences and, in some cases, earn in-game rewards tokens during gameplay. As gamers are in full control of their assets for these games, they have the opportunity to sell in-game items on secondary marketplaces which typically generates fees and royalties for a community treasury.

Guilds purchase in-game items and rent them out to game players in return for a share of the in-game rewards earned by gamers. As the prices of in-game items required for participating in some games have risen substantially, guilds are providing gamers who are unwilling or unable to source the required items opportunities to participate in gaming experiences.

Governance mechanisms, while still in their early stages, are starting to emerge. With the advent of governance tokens, participants who hold and stake or “lock-up” their governance tokens can vote in changes and upgrades to the gaming experience and how treasury funds are allocated.

Case Study: Axie Infinity

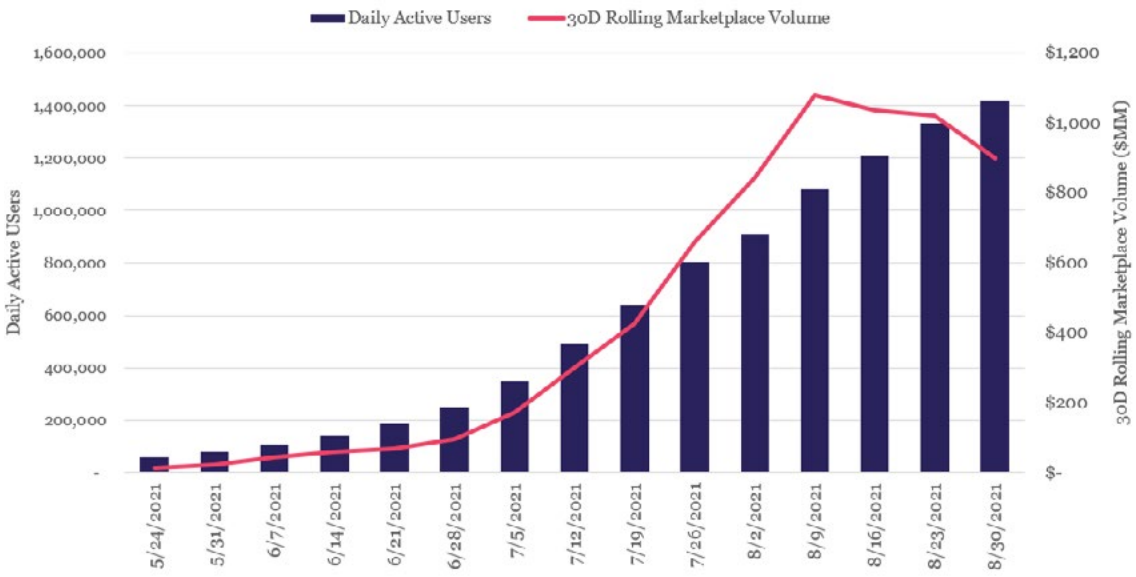
The majority of blockchain games today, at their core, borrow heavily from mechanisms seen in DeFi applications that explicitly incentivize usage of their products and services with financial rewards. Accordingly, the primary audience for many of these gaming applications is often financial actors and crypto enthusiasts - more likely to be interested in "yield farming" than in engaging in the game itself.

Axie Infinity, a "breed and battle" game inspired by Pokémon, represents one such example. The game was created in early 2018 by Sky Mavis, a Vietnam-based video game development company. Over the last four months, it has seen its total number of active users increase sixteenfold from ~60,000 in April to ~1.4MM by the end of August. Its NFT marketplace, where all non-fungible in-game items (Axies, Land Plots, etc.) are exchanged, has recently seen thirty-day rolling trading volumes surpass $1BN.

How Does Axie Infinity Work?

Starting at the base layer of the blockchain gaming stack presented in Part 1 of this report, Sky Mavis has employed a similar strategy to Dapper Labs, which created the Flow blockchain, in constructing its own blockchain called Ronin to power Axie Infinity.

Axie Infinity: DAUs and Marketplace Volume



Source: Axie Infinity; Data through 8/30/2021

Case Study: Axie Infinity

By constructing the Ronin blockchain, the Sky Mavis team has ultimately subsidized the normal costs borne by consumers (i.e., blockchain transaction fees for transferring and exchanging assets) to provide the most user-friendly experience and scale its community.

But, this move to a new chain also comes with trade-offs. The Ronin sidechain operates on a permissioned Proof of Authority ("PoA") sybil resistance mechanism, which differs from the permissionless Proof of Work ("PoW") and Proof of Stake ("PoS") mechanisms employed by many leading chains. Under Ronin's PoA sybil resistance model, all the entities participating in securing the network (i.e., validators) need to be authorized by Sky Mavis. Animoca Brands, Binance, Sparq, Nonfungible.com, Sky Mavis, and Ubisoft are some examples of entities that have validated the Ronin blockchain.

Given this permissioned validator set and the limited number of independent entities that participate in consensus, sidechains such as Ronin are more centralized than many leading Layer-1s and more prone to censorship. The Sky Mavis team has indicated that in the future, the platform will incorporate new elements from PoS and may also employ Layer-2 scaling solutions in an effort to increase the decentralization and security of the network over the longer term.

The major tokens that are issued on Ronin in conjunction with Axie gameplay are as follows:

Axie Infinity Blockchain Tokens Overview

	Axie Infinity Shard (AXS)	Smooth Love Potion (SLP)	Axies	Terra
Token Type	Fungible (ERC-20 Ronin Token)	Fungible (ERC-20 Ronin Token)	NFT (ERC-721 Ronin Token)	NFT (ERC-721 Ronin Token)
Usage	Governance token	In-game currency	In-game character	In-game digital real estate
How to acquire	Listed on 25+ crypto exchanges	Listed on 25+ crypto exchanges; In-game rewards	Listed on Axie NFT Marketplace	Listed on Axie NFT Marketplace
Price ($) (1)	$69.07	$0.09	$115.00	$10,990.00
Market Cap ($) (2)	$4.2BN	$184.2MM	$753.3MM	$184.3MM
Circulating / Total Supply (%)	*61MM* / 270MM (~23%)	*2.2BN*	*6.6MM*	*16,767* / 90,601 (~19%)

Source: The Block Research, Coinmarketcap, Axie Infinity Marketplace; (1) Price of in-game NFTs represents floor price of all listed NFTS. (2) NFT Market Capitalization is calculated as (Floor Price * Circulating Supply = Market Cap). Table does not include other miscellaneous in-game items which are tradable on Axie Marketplace. Data as of 9/23/2021.

Case Study: Axie Infinity

How are these assets employed in-game?

Axies are cartoon monsters with several different attributes such as in-game utility and rarity. Players need three Axies to participate in Axie Infinity.

Smooth Love Potion (SLP) is used for breeding new Axies and distributed as gameplay rewards. Once in possession of at least three Axies, gamers spend their SLP to breed new Axies which permanently removes them from circulation (i.e. burns SLP). The number of SLP burned per breeding depends on the breed count of parent Axies and ranges from 150 SLP to as high as 3,150 SLP. The more Axies that the player has already bred, the more SLP required for subsequent breeds.

Axie Infinity Shard (AXS) is primarily used today for breeding new Axies; 2 AXS are required per breed on top of any SLP required. In the future, AXS will be used to vote on upgrades to the ecosystem and give holders a say in how funds that are held in the game's treasury are managed.

Terra acts as the home and operation bases for Axies. It can be purchased, rented, and developed by players.

What opportunities and risks do these gaming models present?

Battling against computers (Adventure Mode), and engaging in player vs player battles (Arena Mode) are two of the more popular ways that gamers earn rewards, which are primarily denominated in SLP.

The tables below highlight some of the major drivers of the play-to-earn model that Axie Infinity has championed by distributing SLP rewards. How many hours per week a gamer plays, how much SLP is distributed in rewards, and perhaps, most importantly, the secondary market price of the SLP token are all factors that impact a gamer's earning potential.

Axie Infinity In-game Economics

Axie Infinity Economics (Hypothetical)[1]	
Axie Floor Price (A)	*$115.0*
Axie Required to Play (B)	*3*
Upfront Cost to Play (C = A*B)	**$345.00**
Hours played per week (D)	*10*
SLP earned / hour (E)	*40*
*SLP earned / week (F = D*E)*	*400*
SLP Price (G)	*$0.10*
Earnings Per Week (H = F*G)	**$40.00**
Annual Earnings (J = H*52)	**$2080.00**

Source: The Block Research; (1) Represents simplified hypothetical model. Actual performance could differ substantially, and this analysis does not represent a projection model. Factors not included that impact earnings include appreciation/depreciation of Axies purchased upfront, price fluctuations of SLP during the holding period, gains/losses associated with breeding new Axies, and any costs associated with borrowing Axies.

Weekly SLP Earnings Sensitivity (SLP)

SLP Earnings Per Hour \ Hours Played Per Week	2	4	6	8	10	12	14	16	18
0	0	0	0	0	0	0	0	0	0
10	20	40	60	80	100	120	140	160	180
20	40	80	120	160	200	240	280	320	360
30	60	120	180	240	300	360	420	480	540
40	80	160	240	320	400	480	560	640	720
50	100	200	300	400	500	600	700	800	900
60	120	240	360	480	600	720	840	960	1080
70	140	280	420	560	700	840	980	1120	1260
80	160	320	480	640	800	960	1120	1280	1440

Annual Earnings ($USD)

SLP Price ($USD) \ SLP Weekly Earnings	250	300	350	400	450	500	550	600	650
$0.000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$0.025	$ 325	$ 390	$ 455	$ 520	$ 585	$ 650	$ 715	$ 780	$ 845
$0.050	$ 650	$ 780	$ 910	$ 1,040	$ 1,170	$ 1,300	$ 1,430	$ 1,560	$ 1,690
$0.075	$ 975	$ 1,170	$ 1,365	$ 1,560	$ 1,755	$ 1,950	$ 2,145	$ 2,340	$ 2,535
$0.100	$ 1,300	$ 1,560	$ 1,820	$ 2,080	$ 2,340	$ 2,600	$ 2,860	$ 3,120	$ 3,380
$0.200	$ 2,600	$ 3,120	$ 3,640	$ 4,160	$ 4,680	$ 5,200	$ 5,720	$ 6,240	$ 6,760
$0.300	$ 3,900	$ 4,680	$ 5,460	$ 6,240	$ 7,020	$ 7,800	$ 8,580	$ 9,360	$ 10,140
$0.400	$ 5,200	$ 6,240	$ 7,280	$ 8,320	$ 9,360	$ 10,400	$ 11,440	$ 12,480	$ 13,520
$0.500	$ 6,500	$ 7,800	$ 9,100	$ 10,400	$ 11,700	$ 13,000	$ 14,300	$ 15,600	$ 16,900

Clearly, several other factors not included in this hypothetical analysis will determine the ultimate "all-in" earnings that a gamer can achieve by playing Axie Infinity.

- Significant appreciation or depreciation in the price of Axies, SLP, and other in-game assets could have a material impact on earnings
- How much SLP players are capable of earning per hour of gameplay is ultimately a function of how gamers spend their time in-game and can vary substantially
- How the in-game rewards distribution schedule evolves could materially impact earnings
- The quantity of Axies a player possesses also impacts how much SLP they are capable of earning. The more Axies that a gamer possesses, the higher earnings power they typically possess

Case Study: Axie Infinity

Based on the hypothetical model above, it is no surprise that the play-to-earn model has generated so much interest over the past months. Depending on the intersection of the variables included in the model, individuals playing Axie can generate material earnings that, in some cases, exceed their current levels of income. For example, according to data from the World Bank, The Philippines, which is where the majority (~60%) of Axie Infinity users have hailed from historically, has a GDP per capita of ~$3,300.

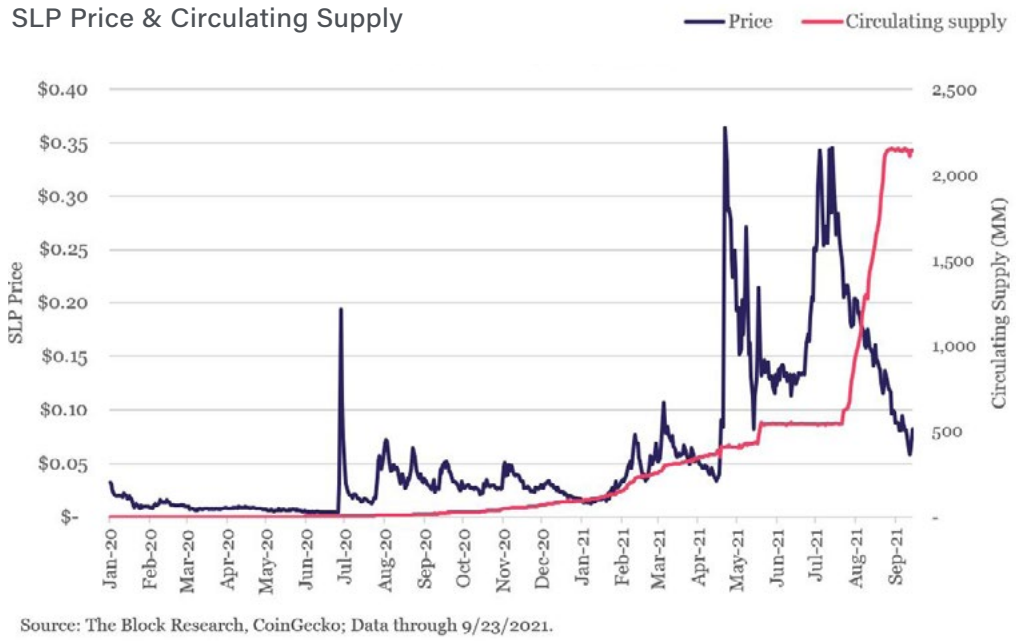
What are the risks?

Declines in the price of SLP are perhaps the most substantial risk to the economics of Axie's play-to-earn model as they directly impact the real value of earnings.

As the chart below shows, SLP prices have ranged substantially. On a year-to-date basis, SLP has traded at as low as $0.01 and as high as $0.36. Even more pronounced than these movements in price is the eye-popping rate of new issuance of SLP tokens. On a YTD basis, the total amount of SLP in circulation has increased by a factor of ~24x. While this rapid supply growth is not happening in a vacuum, as Axie's user base has also expanded dramatically, issuance of SLP rewards has far exceeded SLP burns. This rapid supply increase is likely one of the major drivers behind SLP's decline in price.

Accordingly, there is a degree of reflexivity inherent in game models like Axie Infinity. Rising SLP prices increase the real value of gamer earnings, incentivize more players to play, bolster demand for SLP, and can result in increased breeding that reduces the net issuance of SLP. This reflexivity also applies on the downside. Declining SLP prices reduce the real value of gamer earnings, reduce incentives for more players to play, reduce demand for SLP, and can result in more SLP inflation as Axie breeding slows and less SLP is burned.

Case Study: Axie Infinity



Source: The Block Research, CoinGecko; Data through 9/23/2021.

As evidenced by quotes below from the Axie Infinity website, the game's economics are far from set in stone. Monitoring how these economics evolve over the coming months and years will shed light on the resilience (or lack thereof) of some of these play-to-earn tokenomic models.

"Recently, the amount of SLP minted compared to the amount burned has been imbalanced....We may increase the amount of SLP required per breed in the future if burning and minting are still skewed towards excess SLP." Axie Infinity Website, August 9th, 2021

In some respects, the economics of the play-to-earn model hearkens back to longstanding concerns of pay-to-win in the gaming industry - where players with capital have significant advantages in a game over those who do not. Besides introducing potentially suboptimal player behavior, price volatility of in-game currencies also poses risks and uncertainty for users.

Irrespective of the uncertainties surrounding the economics of a game like Axie, the regulatory and compliance risks, which are later outlined in the "challenges for adoption" section of this report, are also material for play-to-earn games such as Axie Infinity.

Current State of Blockchain Gaming

Axie is just one of many blockchain-based games that have come onto the market. This next section presents some of the data related to other games and the market as a whole.

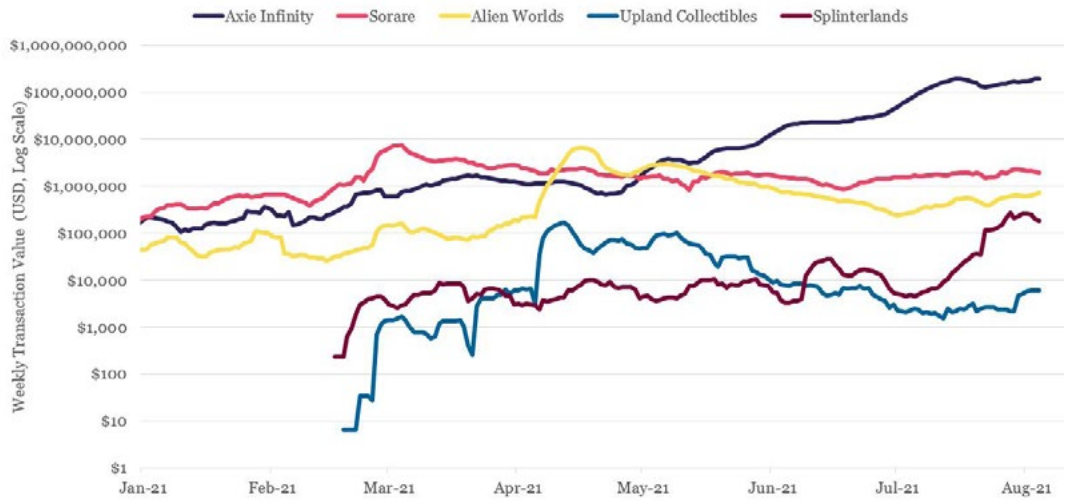
Blockchain Data

Based on data collected from DappRadar, blockchain-based games collectively had levels of usage commensurate with Decentralized Finance ("DeFi") applications and have seen total weekly users exceed 5MM.

Blockchain Gaming Users [(1)] vs DeFi, Exchanges, Others (Estimated)

Source: dAppRadar; (1) Weekly users represents unique active wallet addresses interacting with smart contracts related to each category. Data through 8/2/2021.

Weekly Transaction Value[(1)]

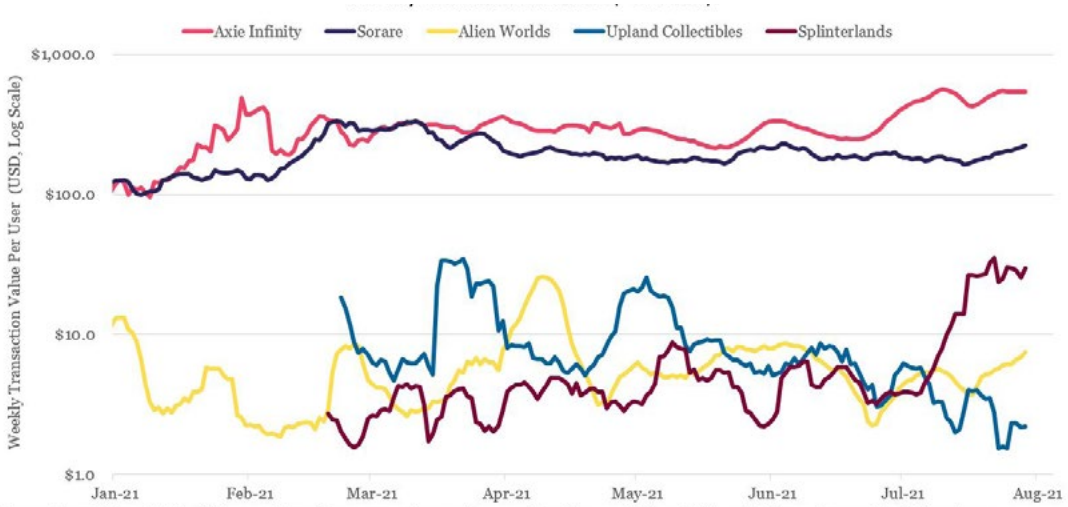


Source: CryptoSlam; (1) Weekly transaction value represents secondary market sales recorded on NFT marketplaces. Does not include primary market sales or trading of other fungible game tokens. Represents sales across select games. Data through 8/2/2021

Secondary market trading of in-game items provides another approximation of user engagement across different games. Above is the weekly secondary market trading volume of NFTs across a number of leading games: Axie Infinity, Sorare, Alien Worlds, Upland Collectibles and Splinterlands.

Indexing this weekly transaction value to the number of users for each of these games can provide insight into how much value users are transacting in-game. As displayed below, games such as Axie Infinity have seen users transact ~$600 of value tied to in-game items on a weekly basis followed by Sorare at ~$275.

Weekly Transaction Value Per User[1]



Source: CryptoSlam; (1) Weekly transaction value represents secondary market sales recorded on NFT marketplaces. Does not include primary market sales or trading of other fungible game tokens. Represents sales across select games. Data through 8/2/2021

Fundraising Data

Top companies focused on the blockchain gaming market have raised hundreds of millions of dollars in the past year. Many of these companies are backed by the leading venture capital firms, and several have reached "unicorn" status in 2021, with valuations exceeding $1BN.

Funding for blockchain-based gaming companies exploded in 2021. Individual funding rounds from companies such as Sorare ($680MM Series B), Dapper Labs ($305MM Series C, $250MM Series D) and Forte ($185MM Series A) in 2021 exceed aggregate blockchain-based gaming industry fundraising recorded in prior years.

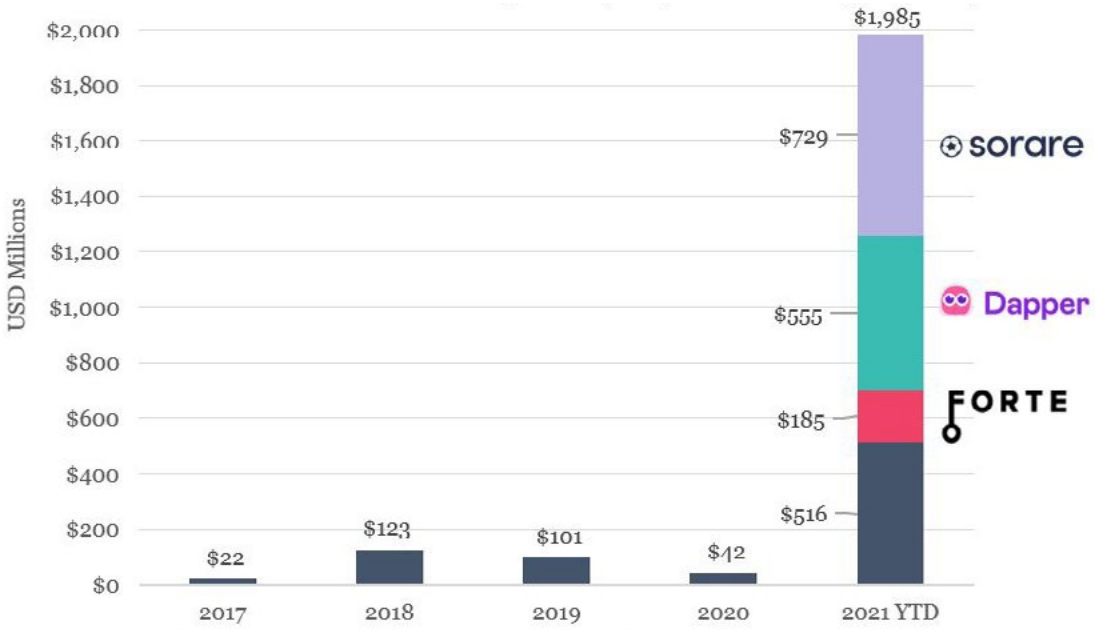
Blockchain Gaming Fundraising & Investors Overview[1]

Company	Segment	Funding ($MM)[2]	Valuation (date) ($MM)	Select Investors
sorare	Dev. Studio	$739.2	$4,300.0 (Sep-21)	a16z, USV, Polychain Capital
Dapper	Dev. Studio/ Infrastructure	$607.5	$7,600.0 (Sep-21)	Vayner/RSE, Dapper
FORTE	Infrastructure	$185.0	$1,000.0 (May-21)	Paradigm, FTX
animoca BRANDS	Dev. Studio	$180.6	$1,000.0 (Jul-21)	SoftBank, Battery
SKY MAVIS	Dev. Studio	$161.0	$2,800.0 (Oct-21)	Bond, Griffin Gaming Partners
OpenSea	Marketplace	$127.2	$1,500.0 (Jul-21)	1confirmation, Galaxy
GENIES	Dev. Studio	$117.0	*Undisclosed*	Benchmark, Coinbase Ventures
MYTHICAL GAMES	Infrastructure	$110.0	*Undisclosed*	Arrington XRP Capital
IMMUTABLE	Infrastructure	$77.6	*Undisclosed*	
ENJIN	Infrastructure	$61.9	*Undisclosed*	

Source: Crunchbase; (1) Represents select companies. (2) Funding represents cumulative funding. Data through 10/05/2021.

Given the lag between fundraises and new product launches, all signs point to 2022 and 2023 being watershed years for deployments of blockchain-based games.

Blockchain Based Gaming Company Fundraising History



Source: The Block Research, Crunchbase, Pitchbook; Data through 10/04/2021.

Challenges for Adoption

User Experience

Getting started on most blockchain-based games is a cumbersome experience to say the least. It requires significant effort from users, familiarity with wallet services and password management, upfront expenses, and perhaps, most importantly, patience and persistence on the part of gamers. For example, here are some of the typical steps that a player has to go through before playing a game such as Axie Infinity:

1. Set up an Ethereum wallet such as Metamask and securely store the seed phrase (backup password) safely
2. Purchase ETH with traditional currency on a centralized exchange and send it to Metamask, which incurs a fee or, depending on which country the user is based in, purchase ETH via Metamask's credit card solution
3. Create a wallet on the game's customized chain or Layer-2 scaling solution and once again store the seed phrase safely
4. Create an account on the game's website using the wallet
5. Link an email ID to the game account
6. Send ETH or the game token to the game's wallet which incurs a transaction fee
7. Download the game if necessary
8. Purchase necessary in-game items

Additionally, once players complete these steps, the quality of the actual gaming experience (depth of gameplay/strategy, graphics, complexity, etc.) that awaits them on the other side is far more rudimentary than that of more established traditional games. Bridging the gap between the user experience of blockchain games today and traditional games will require innovation on several fronts.

Distribution

According to estimates from gaming research company Newzoo, ~2.8BN gamers play games on mobile phones compared to ~1.4BN on PC and ~0.9BN on consoles. Centralized control over mobile distribution platforms, namely the Play Store (Android) and App Store (iOS), could pose a challenge for the peer-to-peer and user centric vision of blockchain-based games.

For example, Apple has historically charged development studios a ~30% distribution fee on primary sales of game assets. This has resulted in long-standing disputes with game developers such as Epic Games over the fairness and legality of such practices. However, Apple recently settled a long-standing class action lawsuit with US app developers. Following the settlement, developers will be allowed to promote alternative payment options via email to gamers, thus potentially circumventing the hefty commissions charged by the app store.

Developments in mobile game distribution like these will be important to track over the coming years. Blockchain-based games ultimately aim to give developers and gamers full control over in-game experiences and economics, which stands in stark contrast to the platform-controlled nature of mobile gaming today.

Multi-chain interoperability

The fragmented state of the blockchain ecosystem today poses a challenge to the seamless interoperability envisioned by the metaverse. To date, dozens of different Layer-1 platforms, sidechains, and Layer-2 scaling solutions that are cultivating their own respective blockchain-based ecosystems have emerged.

Cross-chain blockchain bridges, which enable users to port assets from one blockchain over to another, are the biggest example of what interoperability at the base layer looks like today. While these solutions are increasing interoperability, they are constructed on an ad-hoc chain by chain basis and require significant effort from users to transport assets across chains.

The development of more generalized cross-chain communication protocols, such as Layer-1 Platform Cosmos's Inter Blockchain Communication ("IBC'") protocol, bears watching over the coming years. Often analogized to the TCP/IP protocol of the internet, IBC is developed to enable not only cross-chain token transfers but other features such as cross-ledger voting and account delegation. These features could push the pace of interoperability in the multi-chain ecosystem forward and alleviate today's frictions.

Nonetheless, a truly interoperable blockchain base layer remains a distant reality at this point.

Regulatory and Legal Compliance

Blockchain-based video game developers and users are subject to the same patchwork of laws and regulations that govern activity for all operators in the digital assets industry. And depending on the specifics of the individual games, they may also be subject to gambling laws and other gaming specific regulations. Complying with these comprehensive and fragmented regulatory regimes and laws will require significant action and resources from blockchain gaming communities.

Money Transmission Laws

Game developer studios that offer the ability to purchase in-game currencies, and other digital goods are likely to be subject to money transmission regulations.

Domestically, the Financial Crimes Enforcement Network (FinCEN), a bureau of the United States Department of the Treasury, administers the Bank Secrecy Act ("BSA") which aims to prevent money laundering and terrorist financing. The BSA requires operators, including those engaged in creating, obtaining, distributing, exchanging, accepting, or transmitting virtual currencies to take a number of precautions such as implementing Know Your Customer ("KYC") and anti-money laundering ("AML") policies.

While FinCEN has not yet indicated whether certain NFT market participants (e.g., creators, sellers, dealers, marketplace operators) are or may become subject to AML requirements, regulatory scrutiny of NFTs appears likely. At the international level, the Financial Action Task Force (FATF), an inter-governmental watchdog that establishes AML standards, issued updated guidance on virtual assets in March 2021 that could apply to NFTs. In this update, the FATF expanded the scope of what it considers virtual assets from "assets that are fungible" to "assets that are convertible and interchangeable."

At the State level, definitions for what constitutes a money transmitter vary on a case-by-case basis. Generally speaking, when businesses fall under a state's definition of "Money Services Business", they are required to obtain a money transmitter license ("MTL") from that individual state.

Securities regulations

Game development companies that are involved in issuing In-game tokens whether fungible or non-fungible could come under securities regulations depending on the circumstances of their token offerings and distributions.

In the United States, securities transactions are regulated by the Securities and Exchange Commission ("SEC"). Whether certain blockchain-based assets fall under the purview of the SEC is usually decided by applying The Howey Test, which determines whether a transaction constitutes an investment contract. Generally speaking, if users pay money to acquire tokens (which represent ownership of digital items or governance rights) with an expectation of profit which may be derived based on efforts of third parties, then these tokens could be construed as investment contracts and their issuers would be subject to securities laws.

Tax Compliance

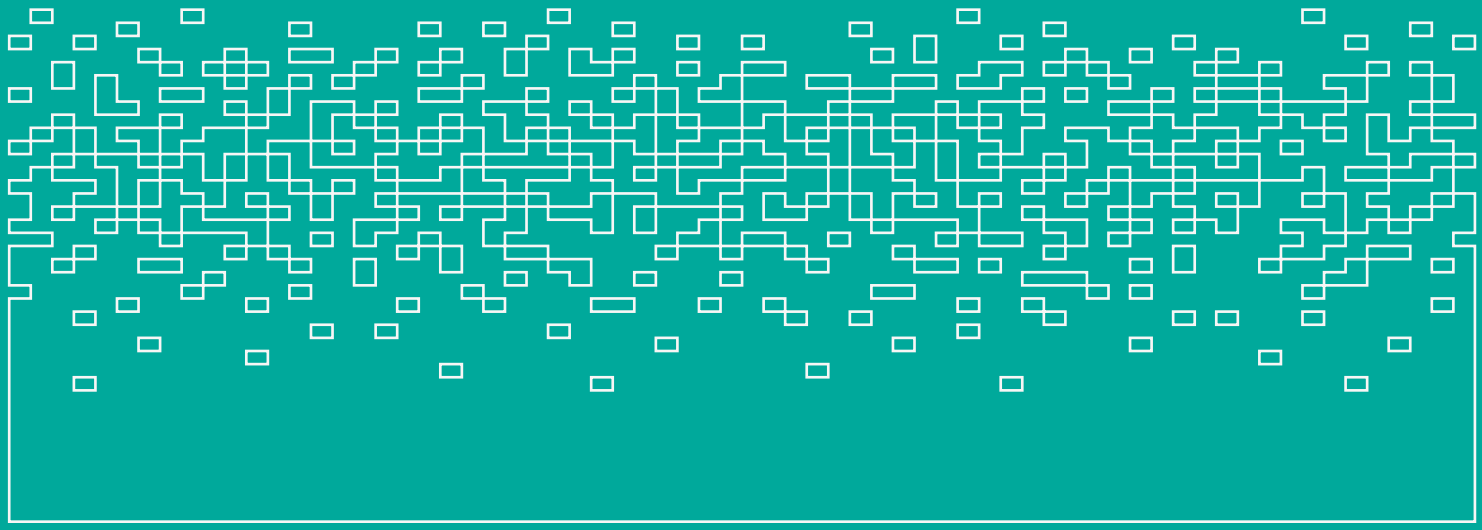
In 2014, the United States Internal Revenue Service ("IRS") issued a notice that digital assets ("virtual currencies") are treated as property for federal income tax purposes. Accordingly, all transactions, regardless of their size, are subject to capital gains tax.

To date, the IRS has not taken a formal stance on the tax treatment of NFTs. It is possible that NFTs could receive the same tax treatment as virtual currencies. Alternatively, NFTs could receive similar tax treatment to collectibles such as stamps, antiques, or trading cards, and be taxed at the collectibles tax rate, which is significantly higher than the long-term capital gains rate at 28%.

Given the large number of transactions made in gaming experiences and their relatively low value compared to other financial use cases, compliance with tax policy could be a significant challenge for gamers and development studios alike.

Blockchain-Based Gaming:
A Primer

III Beyond Gaming



Defining "The Metaverse"

Blockchain gaming and “The Metaverse” are terms that frequently appear in the same sentences. But what do we really mean when we refer to the metaverse? And where does blockchain-based reside within it?

Defining the metaverse is challenging. In one sense, it’s already here. With each passing day, people are spending more and more of their waking hours online. New forms of digital media, entertainment, and immersive user experiences are increasing the sheer number and depth of the digital experiences that humans have on a daily basis.

But in another sense, it’s a distant reality. Traditional open-world gaming examples such as Minecraft and blockchain-enabled digital worlds such as Decentraland are a far cry from the immersive digital worlds imagined in movies like Ready Player One and The Matrix.

While there is no universally agreed-on definition of the metaverse, the definitions provided by thought leaders in the gaming and investing industry provide useful context:

“Realtime 3D social medium where people can create and engage in shared experiences as equal participants in an economy with societal impact.” Tim Sweeney · CEO at Epic Games

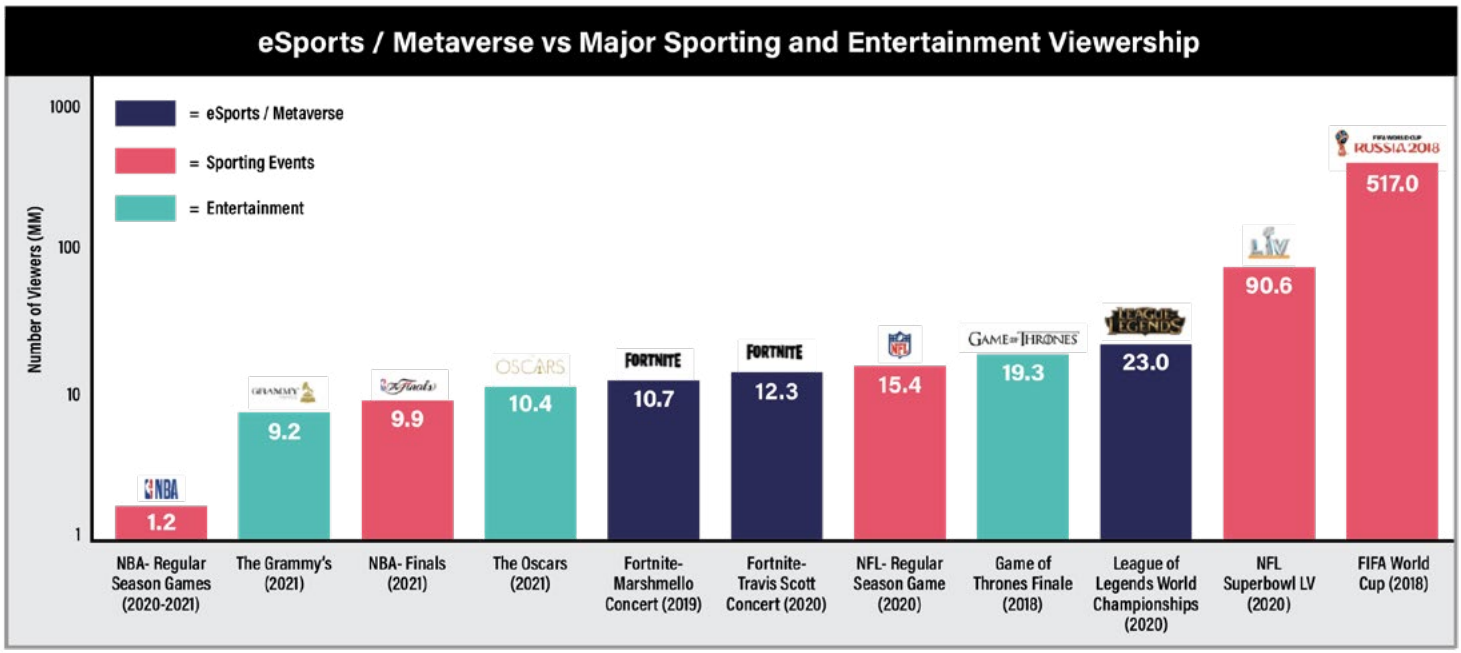
“A persistent, infinitely scaling virtual space with its own economy and identity system.” Jonathan Lai · Partner at a16z

“A sort of successor state to the mobile internet…[There] will be no clean ‘Before Metaverse’ and ‘After Metaverse’. Instead, it will slowly emerge over time as different products, services and capabilities integrate and meld together.” Matthew Ball · Venture Capitalist at Epyllion Co, Makers Fund

Given blockchain gaming’s use of peer-to-peer value transfer across shared public blockchain infrastructure, saying that it has “metaverse tendencies” today is probably the best way of describing its positioning against these broader trends.

Metaverse Trends Today

While the fully realized version of the metaverse is years away and challenging to envision, several trends today shed light on how it is emerging. Examining attendance at eSports competitions and virtual gatherings is one way of quantifying its rise.



Source: The Block Research, ESPN, Nielsen, CNBC, Forbes, The Verge, BBC, Hollywood Reporter, WSJ, FIFA

The massive crowds that the League of Legends draws for its World Championships demonstrate just how mainstream digitally native events have already become. Likewise, large gatherings in fully digital environments with shared experiences and interactions represent some of the most apparent metaverse-like events today.

For example, virtual concerts have drawn massive crowds and delivered highly immersive experiences. In April 2020, American rapper Travis Scott drew a crowd of over 12 million (~100x the size of the largest NFL stadium) to a virtual concert hosted in Fortnite. For several days leading up to the concert, Fortnite players could see a stage being constructed at the beach concert venue, Sweaty Sands Beach, and the event kicked off with a pre-show where players battled it out before Scott came on. During the show, players flew around the planet beneath a gargantuan digital rep-

resentation of Scott that turned into a cyborg at one point during the concert. When the song "Highest in the Room" came on, the crowd was submerged underwater, along with a giant spaceman.

With the introduction of blockchain technology, signs of an even more immersive experience are becoming apparent.

Metapalooza, a fully virtual event that took place in January 2021, is perhaps one of the clearest examples of the metaverse "firing on all cylinders". It involved participants donning VR headsets, a live art marketplace selling fractionalized NFTs, and a live DJ. It also had active participation from attendees in a scavenger hunt where they answered questions and performed tasks to find items hidden around the virtual museum.

The main attraction at Metapalooza was a live auction of art pieces put on by Metapurse, a venture capital firm. Metapurse purchased 20 art pieces created by Beeple, the American digital artist whose digital artwork called "Everydays - The First 5000 Days" sold for a record $69 million at Christie's auction house. Additionally, the company bought premium land plots in three virtual venues Decentraland, Somnium Space, and Cryptovoxels, and constructed virtual museums to display the art pieces.

Ownership of these 20 art pieces and the virtual art museums were bundled into an NFT called B.20 which was then fractionalized into 10 million tokens. 25% of these tokens sold out in a matter of seconds in a live auction hosted at the event.

DJ 3LAU, an American DJ and electronic music producer, played music throughout the event while interacting with fans through Discord. The event also had speakers like the artist Beeple himself, Jason Bailey, art analyst and co-founder of ClubNFT, Duncan Cock Foster, the co-founder of Nifty Gateway.

Catalysts for Adoption

Infrastructure Providers

While big-budget development studios are undoubtedly considering implementing blockchain into their games, several challenges persist. Managing wallet infrastructure, account recovery services, regulatory uncertainties and reputational risks surrounding the practices of some of today's blockchain gaming models are all key considerations for large game studios and enterprises building applications for a mass market audience.

Reducing the friction that comes with implementing blockchain technology for both gamers and developers is a natural catalyst for the adoption of blockchain gaming. Infrastructure providers are obfuscating many of the challenges that come with blockchain technology (wallet services, compliance services, etc.) to make it easier for game developers to build out blockchain-based games or potentially incorporate blockchain technology into their existing gaming platforms.

For example, Forte is a blockchain game development platform licensed to mint currencies and NFTs in compliance with banking secrecy, money transmittal, anti-money laundering, and other regulations in the U.S. and other select jurisdictions. The Forte platform helps publishers and game developers establish regulated user accounts that allow players to hold stored value, purchase and trade digital assets, or transfer funds, depending on the mechanics of a particular online marketplace, game, or virtual world.

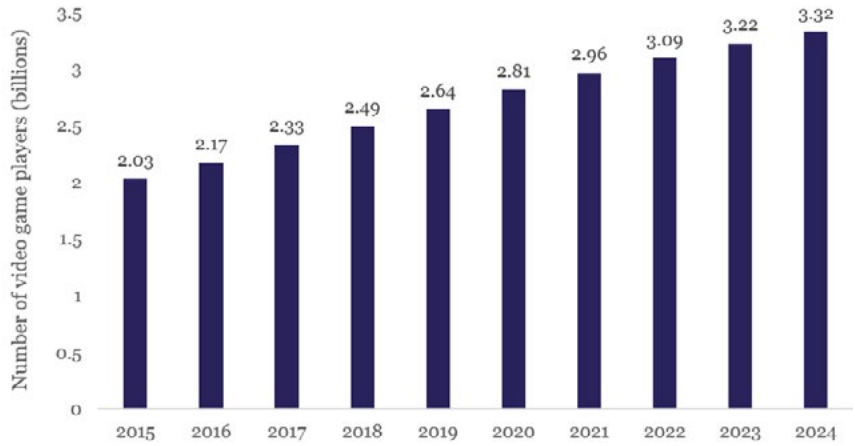
"We set out to create a platform that makes it easy for game developers of any size, including the world's largest publishers, to incorporate blockchain technology into their games, to enable players to own digital goods and currencies, and trade with each other, have true property rights and, create thriving economies that both players and publishers can benefit from," Josh Williams · CEO at Forte

Gaming Market Size

Gaming already has a massive userbase that is projected to surpass ~3BN video game players in 2022. According to data from DappRadar, there are an estimated 1,000 blockchain-based games that have emerged to date

which represents a very small portion of the over 1 million individual video games that exist today according to research from GamingShift. Accordingly, even small levels of adoption of blockchain technology on a percentage basis, could represent massive growth in users from current levels.

Estimated Number of Video Game Players



< 1,000
Blockchain Enabled Games

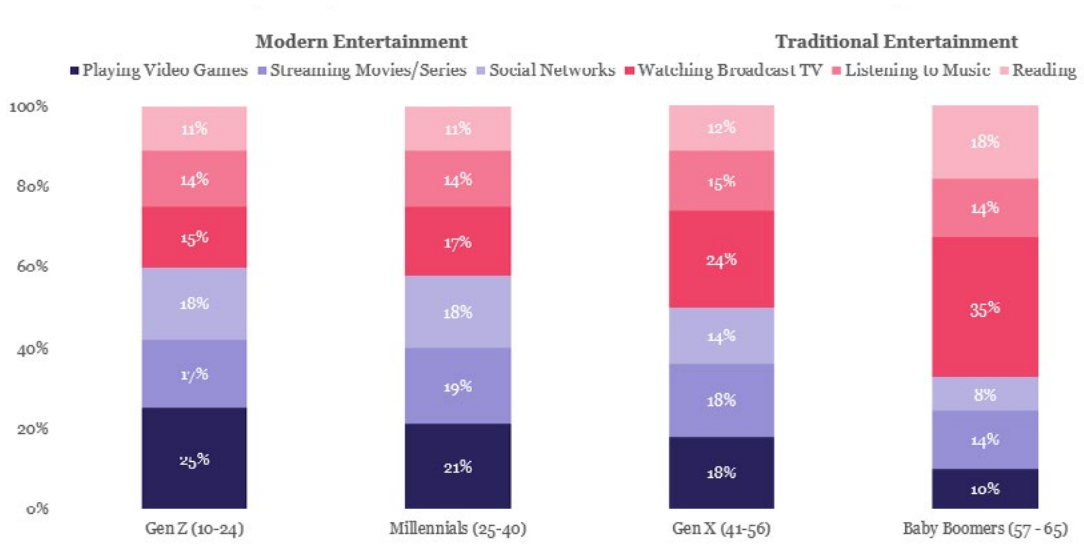
1,000,000+
Estimated total video games

Source: Newzoo, DappRadar, GamingShift

Generational Tailwinds

"Boomers thought "good service" meant white-glove high touch service. Gen Z thinks "good service" means not having to interact with a human at all." - Ari Paul · BlockTower Capital

Time Spent By Different Generations Across Entertainment Categories



Source: NewZoo; Representative sample of online population aged 10-65/10-50. Sample Size = 72,068. Survey conducted during January – April 2021.

The pace of adoption of blockchain-based gaming and more broadly, the growth of the metaverse will be driven by younger generations. As the chart above shows, Millennials and Gen Z are by far the largest consumers of video gaming and more broadly, modern “metaverse-like” forms of entertainment.

Younger generations’ familiarity with digital mediums and moreover, their willingness and desire to experiment with new technologies such as blockchain technology are underappreciated factors that could catalyze the adoption of blockchain gaming.

Conclusion

From giving users full control over their in-game assets to enabling new in-game incentive structures, blockchain technology is giving gaming communities a new set of tools for augmenting and improving digital experiences.

As the blockchain gaming industry is still in its infant stages, it is challenging to predict how the technology could ultimately be implemented across gaming and game-like experiences. Analyzing the tokenomic structures underpinning play-to-earn games such as Axie Infinity highlights some of the recent drivers of adoption, but also the risks and uncertainties inherent in some blockchain-based gaming models today.

Saying that blockchain-based gaming has "metaverse tendencies" is probably the best way of positioning it amongst broader trends towards immersive digital experiences that place users at the center. Although the metaverse remains an amorphous concept, the examples of digitally native and shared cultural experiences presented in this report highlight how it is starting to take shape.

Despite the rapid growth of blockchain-based gaming and the broader proliferation of NFTs in 2021, the blockchain-based gaming industry faces a number of challenges to adoption. From rudimentary in-game experiences, to clunky and time-consuming onboarding processes, to lack of interoperability solutions, realizing the full vision of the metaverse will require innovation on several fronts and, most importantly, time.

Nonetheless, at ~3BN users, the gaming industry already has a massive, tech-savvy, and highly engaged community. Successfully integrating blockchain technology into one or a handful of today's top games could represent a massive increase in adoption. And based on the explosion of funding in the industry this year, all signs point to deployments of new blockchain-based games picking up substantially over the coming years.