

# The Evolution of Gaming: Web3, NFTs, and the Future of Play

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## **Abstract**

This paper explores the evolution of the gaming industry, tracing its growth from its inception to modern times. It highlights key milestones, technological advancements, and trends that have shaped the industry. The paper also delves into the concept of Web3 and its potential impact on gaming, with a focus on Non-Fungible Tokens (NFTs) and their significance in the context of digital ownership. It discusses how NFTs empower players, promote interoperability, and introduce new economic incentives in gaming. The challenges and opportunities of this transformative shift are outlined. Additionally, the paper addresses regulatory and ethical considerations associated with NFTs in gaming, emphasizing the need for responsible innovation in this rapidly evolving industry.

## **Keywords**

Evolution, Gaming, Web3, NFTs, Non-fungible Tokens, Future, Composable NFTs, Regulation

## **1. Introduction**

The gaming world has seen tremendous growth since the inception of the first sets of games in the mid-90s. Fueled by the constant technological improvements, games have grown significantly from the early days of Tennis for Two to the advent of Massive Multiplayer Online Role-Playing Games (MMORPGs) and Augmented Reality experiences creating an Industry worth billions of dollars. The gaming industry now captures humans of all ages and demographics. The internet has also played a significant role in transforming the industry as many players can now connect online via different kinds of devices ranging from phones to PCs and tablets.

Technological advancements usually have a ripple effect on different industries, especially when it has to do with the internet. With the current rapid growth and focus in web3, an extension of the web as it's currently known, the gaming industry, as well as other industries such as entertainment, supply chain, fashion, and a host of others, are about to be swept by the web3 wave. Web3 represents a paradigm shift in the way we interact with the internet. Unlike the traditional web2 model, as it is currently known, web3 is characterized by decentralization, user control over data, and the utilization of blockchain technology [1]. Fungible and non-fungible tokens are products of blockchain technology and they have significant applications in gaming.

A non-fungible Token, as defined by Perez et al [2], is a “cryptographic asset on a blockchain containing unique identifying information and codes that separate them from one other”. Joshua et al simplify this by defining non-Fungible Tokens as a technological manner to keep track of ‘ownership’ of various digital or physical assets [3]. Having ownership at its core makes non-fungible tokens (NFTs) well-suited for web3 games.

NFTs create a player-centric economy, and ensure proof of authenticity and provenance while also promoting interoperability and cross-platform integration.

## 2. Historical Overview of Gaming

Adequately covering all games that have been released over the years will be like a man attempting to reach Mars in a SpaceX Falcon Heavy, at its current capacity, in only 1 month. As a result, we shall be mentioning only a few from different eras in the gaming industry.

Gaming can be traced back to the 1950s when Physicist William Higinbotham developed Tennis for Two [4]. In the following decade, Steve Russel, Martin Graetz, and Wayne Witanen, all students of Massachusetts Institute of Technology, developed Spacewar, making their work and that of Higinbotham the first interactive computer games [5], and not necessarily the first games ever created. This period could be said to have been the conceptualization era.

The video game industry began with Ralph Baer's "Brown Box" console that played table tennis in 1972. During this period, a team at Sanders Associate built the first commercial home console. Atari released Pong in 1972 while other games like Gran Trak and Gun Fight were released in 1974 and 1975 respectively. This was the start of the history of game consoles, and they operated on BASIC & C programming languages [6]. It is safe to call this the birth of the gaming industry.

Interest in gaming continued to increase by both gaming companies and gamers alike. This led to a spike from \$308MM in 1978 to \$2.8B in 1980 in the US alone [5]. With the widespread acceptance of home computers in the late 70s, gaming computers also began to gain mass adoption among gamers. This was due to the abundance of gaming consoles leading to the oversaturation of the market and the eventual recession hitting the US video game industry between 1982 and 1985[5].

There were different waves of gaming consoles. The popularity of the second generation of home consoles coincided with the emergence and growth of arcade gaming from 1976 to 1982. As a result, gamepads started to surpass traditional joysticks and keypads in preference. This paved the way for the third generation of home consoles, led by the introduction of 8-bit games, which propelled the Nintendo Entertainment System to global fame [7].

The 1980s brought the emergence of gaming computers and early online gaming. Home computers like the Apple II and Commodore PET became popular. The video game crash of 1983 led to the rise of Japanese gaming companies like Nintendo and Sega [4].

The third generation of gaming consoles (1983-1995) saw the Nintendo Entertainment System (NES) dominating the market. It introduced the gamepad and featured games like The Legend of Zelda

The fourth generation (1987-2004) introduced 16-bit consoles like the Sega Genesis and Super Nintendo. Sonic the Hedgehog and Mario became iconic characters [5].

The 1990s ushered in innovations like 3D graphics, FPS games, and real-time strategy games. Violent video games like Mortal Kombat and Doom sparked concerns [4].

The fifth-generation consoles (1993-2006) included the Sega Saturn, Sony PlayStation, and Nintendo 64. Mobile phone gaming began to emerge with games like Snake.

The 2000s brought further innovations, including the rise of PC gaming and mods like Counter-Strike. The sixth-generation consoles (1998-2013) introduced the Dreamcast, PlayStation 2, GameCube, and Xbox.

Online gaming and Massively Multiplayer Online Role-playing Games (MMORPGs) gained popularity, with Xbox Live and Xbox's success with Halo 2. Mobile gaming flourished with titles like Angry Birds.

The seventh-generation consoles (2005-2013) included the Xbox 360, PS3, and Nintendo Wii. Online gaming and motion controls became prominent features.

The eighth generation (2012-present) started with the Nintendo 3DS, PS Vita, and Wii U, leading to the dominance of the PS4, Xbox One, and Nintendo Switch. Console exclusives were key to their success.

The next generation of gaming, represented by the PS5, Xbox Series X, and Xbox Series S, introduced cloud gaming services like Google Stadia and Amazon Luna. Graphical advancements and gaming monitors enhance the gaming experience.

Gaming has evolved significantly over the years, from simple simulations to complex, immersive experiences across a variety of platforms and technologies.

## **2.1 Online Gaming**

The real gaming revolution occurred with the introduction of LAN networks and, subsequently, the Internet, which enabled multiplayer gaming on a global scale [7]. Since the early 2000s, the gaming industry has witnessed significant progress, largely driven by the rapid expansion of Internet capabilities and advancements in computer processor technology. This technological growth has had a profound impact, consistently pushing the limits of what games, graphics, and consoles can achieve.

The cost-effectiveness of technology, coupled with the widespread availability of high-speed Internet, has made lightning-fast Internet access a common reality for a substantial portion of the global population, with over 5 billion individuals [9] now connected online. The reach of online gaming is substantial, as evidenced by data from Statista [10] Online gaming - Statistics & Facts report for 2023, indicating that at least 1.1 billion people with Internet access actively engage in video gaming.

Online multiplayer gaming, notably exemplified by titles like Call of Duty Modern Warfare, has grown to become an integral component of the gaming experience. In many instances, online gameplay surpasses the significance of offline objectives, revealing the transformative impact of Internet-enabled multiplayer interactions.

The rise of online first-person shooter games has also given rise to gaming communities, and organized groups of players who regularly participate in multiplayer gaming sessions [11]. These clans vary in size, structure, and objectives, ranging from small friend circles to large organizations with thousands of members. Various online platforms facilitate community activities, including competitive rankings, organizing battles, and arranging meet-ups.

Advancements in online gaming will automatically follow the trajectory set by protocols on the internet. We have seen read-only, and read-write eras since the birth of the internet. We are in a new dispensation that combines the initial two plus a new wave of data ownership, web3.

### 3. Web3 and the Rise of Web3 Games

Since it is still being developed, there has not been a universally accepted definition for web3 at this time. However, if web3 fully becomes a reality, then, it will be the successor of two previous generations of the web; web 1.0 and Web 2.0 [12]. It will merge the key components of the previous generations of the web with blockchain and other technologies, further facilitating an era of data ownership and decentralization.

Web3 is the next evolution of the internet, characterized by decentralization, blockchain technology, and cryptocurrencies [13]. Unlike traditional Web2, where power and data are largely controlled by centralized entities, Web3 aims to give users more control over their data and digital assets. In the context of the gaming industry, Web3 introduces several fundamental principles and applications:

#### 3.1 Principles and Applications

- **Ownership and Control:** The concept common to the world of gaming before now had been in-game assets owned and controlled by the centralized authorities, particularly, gaming companies. However, with the integration of blockchain technology into games, players are now empowered to own their game characters.
- *Interoperability:* One of the key principles of Web3 is interoperability, which enables assets and data to move seamlessly between different games and platforms. Players can use their in-game assets across various games, creating a more interconnected gaming experience.
- *Transparency and Security:* Blockchain technology enhances transparency and security in gaming. Smart contracts ensure fair gameplay and transactions, reducing the risk of cheating and fraud.
- *Economic Incentives:* The ability to earn while having fun seems to be the biggest motivation for most web3 gamers. Web3 introduces token economies and incentivizes players to participate actively in gaming ecosystems. Players can earn tokens by contributing to the gaming community, playing, trading assets, or participating in governance decisions through decentralized autonomous organizations.

### 4. Non-Fungible Tokens (NFTs)

Peres et al. [2] defined an NFT as a “cryptographic asset on a blockchain containing unique identifying information and codes that separate them from one another”. In the context of Web3 gaming, NFTs are digital tokens that grant ownership of in-game assets, characters, skins, or other virtual items. Unlike cryptocurrencies such as Bitcoin or

Ethereum, which are fungible and interchangeable with one another, NFTs are non-fungible, meaning each token has distinct properties and cannot be exchanged on a one-to-one basis [18].

#### 4.1 Characteristics of NFTs

- *Uniqueness*: NFTs in Web3 gaming represent unique in-game assets or collectibles. Each NFT has distinct properties and attributes, making it different from other tokens. This uniqueness is often used to signify ownership of rare or valuable virtual items [18].
- *Indivisibility*: NFTs are indivisible and cannot be divided into smaller units. They are bought, sold, and owned as whole tokens, preserving the integrity and uniqueness of the in-game assets they represent. This characteristic best positions NFTs for fractionalization.
- *Ownership and Provenance*: NFTs provide verifiable ownership and provenance information for in-game assets. The blockchain records the ownership history and transaction details of each NFT, ensuring transparency and authenticity. Players can trace the origin and ownership of their virtual items.
- *Interoperability*: NFTs are typically built on blockchain standards like ERC-721 or ERC-1155, ensuring interoperability across different games, platforms, and marketplaces. Players can use their NFTs in various gaming contexts [27], creating a more interconnected gaming experience.
- *Digital Scarcity*: NFTs introduce digital scarcity by limiting the supply of unique tokens. Rare or limited-edition in-game items represented as NFTs can become highly valuable, encouraging players to seek out and trade these assets.
- *Programmability*: NFTs can be enhanced with smart contracts, allowing for programmable behaviors. For example, a smart contract can govern the transfer of ownership, enable royalties for creators on secondary sales, or unlock specific in-game features tied to the NFT.

#### 4.2 Underlying Blockchain Technology in Web3 Gaming

The use of NFTs in Web3 gaming relies on blockchain technology, with several key components and concepts:

- *Blockchain Ledger*: NFT data, including ownership records and metadata, is stored on a decentralized blockchain ledger. Ethereum is a popular choice for NFTs, but other blockchain platforms like Aptos, Polygon, and Binance Smart Chain are also used in gaming.
- *Smart Contracts*: Smart contracts define the rules and behaviors of NFTs in Web3 gaming. These contracts specify how NFTs are created, transferred, and interacted with. They can also govern royalties, item attributes, and in-game interactions tied to the NFT [3][15].
- *Digital Wallets*: Players use digital wallets to store, manage, and interact with their NFTs. These wallets are compatible with the blockchain on which the

NFTs were created and provide a secure means of buying, selling, and transferring NFTs. An improved version of these wallets helps players access all games from one passport-like wallet.

- *Metadata:* Metadata associated with NFTs contains additional information [3] about the in-game item, such as its name, description, image, and attributes. This metadata is often stored off-chain and linked to the NFT via its unique identifier.
- *Marketplaces:* NFT marketplaces in Web3 gaming serve as platforms for players to mint (create) and trade NFTs. Creators can list their in-game assets, and players can discover, purchase, and sell these NFTs in these marketplaces.
- *Integration:* Game developers integrate NFT functionality into their games, allowing players to interact with and utilize NFTs within the gaming experience. This integration can include custom item showcases, trading mechanics, and in-game bonuses tied to NFT ownership.

## 5 Challenges and Opportunities in the Web3 and NFT Gaming Paradigm

As the gaming industry goes deeper into the Web3 and NFT era, it is faced with a spectrum of challenges and opportunities that could reshape the very essence of gameplay and digital asset ownership. These dual forces are at the forefront of a revolution that holds immense promise yet requires careful consideration of its implications.

### 5.1 Challenges

- *Scalability and Blockchain Congestion:* The integration of NFTs and Web3 technologies can place considerable strain on existing blockchain networks. Scalability concerns and congestion issues may result in slower transaction times and increased gas fees [6][19]. Game developers and blockchain architects must collaborate to mitigate these challenges. Some L1s like Aptos [14] and L2s like Polygon are built to solve this challenge.
- *Regulatory Uncertainty:* The regulations surrounding NFTs and blockchain technology remain dynamic and often unclear. Governments worldwide are still in the process of defining and regulating these novel digital assets. The gaming industry must navigate evolving compliance requirements and be prepared to adapt to changing regulations [19].
- *Environmental Impact:* The energy-intensive nature of blockchain mining, particularly in proof-of-work systems, raises environmental concerns [16]. As the gaming community becomes more conscious of sustainability, addressing the carbon footprint of blockchain technology will be vital to maintaining a positive image. Again, there are more proof-of-stake chains emerging, including Tezos, Aptos [14], and relatively recently, Ethereum was moved from proof-of-work to proof-of-stake.

## 5.2 Opportunities

- *Play-to-Earn Ecosystems:* Web3 gaming introduces the concept of play-to-earn, where players can actively participate in token-based economies. This revolutionary shift enables gamers to not only enjoy their favorite titles but also earn tangible rewards, blurring the line between leisure and livelihood. Note that Play-to-earn in this paper is an umbrella name for all forms of earning methods in web3.
- *Empowering Player Ownership:* Through NFTs and blockchain technology, players gain true ownership of in-game assets [6]. This empowerment enhances player engagement and loyalty, as gamers can now monetize their skills and assets across various gaming experiences.
- *Decentralized Autonomous Organizations (DAOs):* The rise of DAOs within the gaming community offers players the opportunity to influence game development, voting on decisions ranging from in-game features to governance matters [24]. DAOs foster a sense of community and democratize the gaming ecosystem, including development.
- *Cross-Platform Interoperability:* The principles of Web3 promote interoperability [23], allowing in-game assets to transcend individual titles and platforms. This interconnectedness enriches the gaming experience, enabling players to use their assets across a diverse range of games.

## 6 The Future of Play: Implications and Speculations

*The gaming world is at a turning point, getting ready for some big changes thanks to Web3 tech and Non-Fungible Tokens (NFTs). Picture it like this: we're looking ahead, and there's a mix of exciting possibilities and things we're not so sure about.*

### 6.1 Long-term Impact on Gaming:

Web3 and NFTs are all geared up to change the gaming world in some really major ways. Although it's tough to say exactly how much they'll shake things up, a few key effects are crystal clear:

- *A New Gaming Economy:* Web3 gaming introduces a player-centric economy where gamers can truly own and trade in-game assets [17][20]. This reimagining of ownership fosters a sense of attachment to digital possessions, transforming gaming from a pastime to a potentially lucrative endeavor.
- *Cross-Platform Play and Interoperability:* With the principles of Web3 at its core, gaming experiences become more interconnected. The concept of cross-platform interoperability will allow players to take their NFT-backed assets from one game to another seamlessly. This interconnectedness will redefine player engagement and potentially lower barriers to entry for new players.
- *Incentivized Participation:* The introduction of token economies in Web3 gaming incentivizes active participation. Gamers may be rewarded not only for winning matches but also for contributing to the broader gaming community, fostering a sense of camaraderie and shared success.

## 6.2 Shaping Player Behaviors:

Web3 and NFTs hold the potential to transform player behaviors in several ways:

- *Ownership and Investment:* Players may adopt a more investment-oriented mindset, carefully curating their collections of NFTs and seeking rare and valuable assets. This shift may encourage long-term engagement and loyalty to games that support asset ownership.
- *Earning While Playing:* The play-to-earn model, enabled by NFTs, may motivate players to invest more time and effort in their gaming pursuits. This could lead to increased skill development and competition.
- *Community Building:* Decentralized Autonomous Organizations (DAOs) within gaming communities will empower players to have a say in the direction of their favorite titles. This sense of agency could foster a stronger bond between players and developers.

## 6.3 Game Design and Business Models:

The integration of Web3 and NFTs will inevitably influence the game design and business models [17]:

- *Player-Centric Game Design:* Developers may need to adapt to a player-centric model where in-game assets are crucial. Games may evolve to include customizable, NFT-backed characters, skins, and items, offering players greater control over their in-game experiences.
- *Dynamic Economies:* Game economies may become dynamic and responsive, driven by player demand and market forces. Developers must balance the supply and demand of in-game assets to maintain fairness and engagement.
- *New Revenue Streams:* Traditional revenue models such as one-time purchases and microtransactions may coexist with NFT-based revenue streams. Developers can monetize the creation, sale, and trading of NFTs [17], creating new revenue possibilities.

## 6.4 Composable NFTs:

Composability is the concept of creating complex systems or structures by combining smaller, modular components or elements. It has significant relevance in the context of NFTs and games, particularly in blockchain-based gaming ecosystems.

Let's take Ethereum tokens for instance. The ERC-998 token, similar to ERC-721, is non-fungible but has composability features, allowing users to organize assets into complex hierarchies and trade them under single ownership. It represents multiple digital collectibles/assets, including ERC-20 and ERC-721 tokens, enabling tokens to own or be owned by others. Essentially, it bundles various digital assets, such as NFTs, ERC-20 tokens, and more, offering new use cases like batch transfers [21][22]. For instance, you can merge 5 or more ERC-721 [21] tokens into a parent token, simplifying the process of selling them as a single lot.



Using this concept, game developers can create modular elements, such as characters, assets, or game mechanics, as NFTs. These NFTs can be easily combined to form a new character, or avatar, or integrated into various games. Composable NFTs will bring a totally different perspective to gaming.

## 7. Regulatory and Ethical Considerations

*The integration of Non-Fungible Tokens (NFTs) and blockchain technology into the gaming ecosystem is a transformative development that not only presents opportunities but also raises important regulatory and ethical questions. As these technologies gain prominence, it becomes imperative to assess the regulatory aspects and contemplate the ethical challenges they may bring forth.*

### 7.1 Regulatory Aspects:

- *Defining NFTs:* At the heart of the regulatory challenge lies the need to define NFTs clearly. Regulatory bodies must determine whether NFTs should be classified as digital assets, securities, or something entirely new. The classification can have profound implications for taxation, investor protection, and market oversight.
- *Consumer Protection:* As NFTs gain popularity, there is a growing concern about consumer protection. Regulatory authorities need to ensure that marketplaces and developers provide transparent information about NFTs and associated risks. This may include disclosures about the potential for asset devaluation and the non-guaranteed resale value of NFTs.
- *Anti-Money Laundering (AML) and Know Your Customer (KYC):* To combat money laundering and illicit activities [26], regulatory agencies may require NFT marketplaces to implement AML and KYC procedures. This could involve verifying the identities of buyers and sellers involved in high-value transactions.
- *Taxation:* Taxation policies around NFTs are evolving. Some jurisdictions may consider NFT transactions as taxable events, impacting both buyers and sellers. The tax implications [26] of NFT ownership and trading need to be clarified by regulatory bodies.
- *Intellectual Property (IP) Rights:* NFTs often involve the sale and transfer of digital assets that may include copyrighted content. Regulatory frameworks must address how NFTs intersect with intellectual property rights, ensuring that creators and copyright holders are adequately protected.

### 7.2 Ethical Dilemmas:

- *Environmental Concerns:* The energy-intensive nature of blockchain mining, especially in proof-of-work systems, raises ethical concerns related to carbon emissions [25]. The environmental impact of blockchain technology must be addressed as the gaming community becomes increasingly eco-conscious.
- *Asset Devaluation:* Ethical dilemmas arise when players invest in NFTs with the expectation of long-term value, only to see the market fluctuate

dramatically. The risk of asset devaluation can lead to dissatisfaction and disillusionment among gamers.

- *Accessibility and Inclusivity:* The barrier to entry for some Web3 gaming ecosystems, particularly those reliant on high-value NFTs, can be exclusionary. This raises ethical concerns about accessibility and inclusivity in gaming communities, potentially creating disparities between players based on their economic capacity. The introduction of fractional NFTs could solve this.
- *Scalping and Speculation:* The speculative nature of NFT trading has given rise to scalping practices, where individuals purchase desirable NFTs with the intent of selling them at a significant markup. This practice can result in unfair pricing and ethical conflicts.
- *Digital Asset Ownership:* The concept of digital asset ownership, while empowering players, can also raise ethical questions about virtual property rights. Disputes over ownership and property rights in virtual worlds may require ethical frameworks for resolution.

### **7.3 Balancing Innovation and Responsibility:**

In navigating the regulatory and ethical considerations of Web3 gaming and NFTs, it is essential to strike a balance between fostering innovation and upholding responsibility. The gaming industry, in collaboration with regulatory bodies and ethical watchdogs, must take proactive measures to:

- Develop clear regulatory guidelines that protect consumers while allowing for technological advancement.
- Promote environmental sustainability by exploring blockchain solutions that minimize energy consumption.
- Ensure that the benefits of NFTs and blockchain technology are accessible to a wide range of players, addressing inclusivity and fairness concerns.
- Establish ethical frameworks for addressing asset devaluation and property rights disputes, promoting transparency and fairness.

As gaming evolves, addressing regulatory and ethical considerations will be a pivotal step in realizing the full potential of Web3 gaming and NFT integration, ensuring that innovation aligns with ethical principles and societal values.

## **8. The Potential Future Trajectory of Gaming**

As we engage in forward-looking analysis regarding the gaming industry's trajectory in the context of the Web3 and NFT era, several compelling insights become evident [19]:

- *Diverse Gaming Economies:* We envision a world where gaming economies are diverse, with traditional revenue models coexisting with NFT-based ecosystems. Players will have the option to participate in token-based economies, creating new opportunities for both leisure and livelihood.
- *Innovative Game Design:* Game developers will embrace player-centric design, offering customizable NFT-backed characters, items, and skins.

Games will become dynamic ecosystems where players have a stake in their development. Asset composability will also go a long way here.

- *Environmental Consciousness*: The gaming community will become increasingly eco-conscious, pushing for blockchain solutions that reduce energy consumption. Sustainability will be a core consideration in future Web3 gaming.
- *Player Empowerment*: The concept of true asset ownership will empower players to shape their virtual worlds, blurring the lines between creators and consumers. Composable NFTs will enable players to craft unique experiences.
- *Regulation and Ethical Frameworks*: As the industry matures, regulatory bodies will refine guidelines to protect consumers and ensure fairness. Ethical frameworks will evolve to address asset devaluation, inclusivity, and property rights disputes.

## 9. Conclusion

In summary, this academic paper delves into the transformative impact of Web3 technology and Non-Fungible Tokens (NFTs) on the gaming industry. It explores the shift towards genuine ownership of in-game assets, cross-platform interoperability, and player-centric economies. Despite acknowledging challenges like speculation and scalability, the paper envisions a future with diverse gaming economies, innovative design, and a strong focus on environmental sustainability. It underscores the necessity of developing ethical and regulatory frameworks to ensure fairness and inclusivity in this rapidly evolving gaming landscape. Overall, the paper provides a comprehensive analysis of the potential implications and opportunities presented by the integration of Web3 and NFTs in gaming.

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