coinchange

NFT Landscape

RESEARCH REPORT

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  TradeZing is a live-streaming, social engagement, Web3 platform designed for Millennial and Gen-Z traders. The platform harnesses the power of community and content creation across stocks, cryptocurrency, NFTs, and the Metaverse to educate, elevate and entertain. To participate in the invite-only closed beta period, please sign-up at https://tradezing.com/

- XSolla is an international video game commerce company with a robust and powerful set of tools and services designed specifically for the gaming industry. The company's goal is to help video game publishers and developers succeed while putting their players first. As a leader in game commerce, they continue to solve the inherent complexities of global distribution, marketing, and new monetization avenues with NFTs, so their partners can grow audience, engagement, and revenue. Learn more at https://xsolla.com/

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FOREWORD

Coinchange, and its Research department are happy to share their second Research report on NFTs which will be a two-piece series. The first report is about the NFT landscape and insight on adoption and misconceptions. The second report is about NFT financialization and potential yield opportunity.Similarly to our first research report on rDeFi ([link here](#)), the approach taken has been both to educate Coinchange internal stakeholders as well as trying to provide a clear overview of the NFT sector and its ramifications. Through these research reports, we aim to shed light on sectors, protocols, and varied aspects of the crypto space in order to allow a broad spectrum of new, and existing participants to easily understand trends and the opportunities available.

As part of our continuous improvement process, feel free to share via email any research subject you would like to have covered by our team.

Also, we would gladly appreciate your feedback being sent to the following mail address: ccf.research.support@coinchange.io

EXECUTIVE
SUMMARY

The NFT landscape research has shown several key insights about the new NFT sector, mainly:

- NFT are finding they're utilities in different categories, from DeFi centric usage to Real-world usage enabling the digitalization of different sectors of the economy.

- NFTs' marketing image can be misleading, especially for collectibles where not all collections are created equal, and hence not all of them are immutable just because they are issued on the blockchain.

- Token standards for NFT have similarities and differences across chains, in the same way, that fungible tokens on a blockchain are rarely 100% compatible with another network.

- Marketplaces together with bridges might be the solution for a fully cross-chain NFT experience while ensuring the preservation of the NFT properties like royalties.

- Cross-chain NFT experience is only one part of the full picture, NFTs and regulation will soon come as NFTs are forcing the regulatory body to think about the implication of the digitalization of the economy and digital property.

INTRODUCTION

NFTs, otherwise known as "non-fungible tokens", are different from traditional cryptocurrencies as each token has unique properties. This is unlike traditional "fungible" assets like stocks, cash, or bitcoin and Ethereum, where all units are equally valued. They can be used to verify and prove ownership of digital assets like digital art, music recordings, digital pets, or even DeFi LP positions thanks to their unique characteristics. In addition, real-world physical assets like real estate have recently been starting to become tokenized as NFTs to be sold on exchanges because of the increased liquidity.

While traditional cryptocurrencies like Ethereum have exploded in popularity over the past couple of years, the popularity and valuations of NFTs have grown just as much, if not more, to approximately $23B USD in 2021. NFTs are coded as a variation of traditional smart contracts on several popular blockchains like Ethereum and Solana. This permits their ownership and purchase history to be tracked via looking at the blockchain. As the ownership is programmatic via smart contracts, NFTs have allowed for several new innovations such as artists being able to generate a fraction of revenue from all future sales, not just the initial one.

NFTs have introduced lots of interesting philosophical questions about the concept of ownership as they have increased in popularity. Why do pictures that can be "right-click saved" have any value at all? NFT supporters would argue that the act of collecting things isn't due to an object's inherent value. In fact, traditional collectibles like trading cards, and old comic books were produced for pennies' worth of ink and paper. Rare clothing items are often made from both the same materials and in the same factories as the more common varieties. Van Gogh's artwork is displayed in museums, but other artworks made with the same materials end up being sold in thrift shops.

Fungible tokens like bitcoin are all worth as much on a per unit basis as every other bitcoin token because they are not uniquely serialized. Meanwhile NFTs, by design, are all unique. The concept of "fungibility" refers to goods or assets that can be swapped interchangeably because they are all equally valuable. Cash is another great example as each bill of a specific denomination from a certain state can all be exchanged for the same value of goods or services.

Other items like concert tickets are non-fungible because each ticket represents access to a specific seat at a specific time at a specific venue on a specific date. Even if every ticket at a Raptors game cost the same price, they are not directly exchangeable as they all represent access to different locations in the venue, some of which are inherently more valuable or desirable than others. This is why we see certain NFT artworks in the same collection worth orders of magnitudes more than others.

In the first half of this report, the Coinchange Intelligence team will focus on a broad overview of NFTs by analyzing nine different use cases, the different approaches to NFT collection put in place to store the data and inherent problems, the various NFT token standards on different popular blockchains, and how NFTs could be regulated in the future.

NFT FUNCTIONS & USE CASES WITH

1. ART

NFTs allow artists and content creators a unique opportunity to monetize their wares. Artists no longer have to rely on galleries or auction houses to sell their art or gain a cult following of fans who want to purchase their work. Instead, the artist can now sell it directly to the consumer as an NFT, which also lets them keep more of the profits. In addition, artists can program in royalties for future sales so they will receive a cut whenever their art is sold to a new owner. This is an attractive feature as artists generally do not receive future proceeds after their art is first sold.

The surge in popularity of NFTs resulted in several creators gaining notoriety in the industry for both the quality of their work and the mind-blowing dollar value in sales. Some inferential NFT artists include Murat Pak, the team behind the infamous Archillect bot, whose Merge collection sold for $91.8M USD on the NiftyGateway platform during December of last year, and Beeple, whose EVERYDAYS: THE FIRST 5000 DAYS piece sold for over $69M USD through the world-famous Christie's Auction House in March 2021.

In addition, it's impossible to overlook YugaLabs, the team behind the ubiquitous Bored Ape Yacht Club collection, who purchased the ownership rights to the intellectual property of the Cryptopunk collection earlier this year.

Cryptopunks, among the most notable NFT art collections, and the project that inspired the modern CryptoArt movement, are a collection of 10,000 uniquely algorithmically generated 24x24 pixel pictures. As described on the creator's (Larvalabs) website, "No two are exactly alike, and each one of them can be officially owned by a single person on the Ethereum blockchain. Originally, they could be claimed for free by anybody with an Ethereum wallet, but all 10,000 were quickly claimed. Now they must be purchased from someone via the marketplace that's also embedded in the blockchain". Cryptopunk #5822 sold on February 12, 2022, for 8000 ETH, or roughly $23.7 Million USD.

2. MUSIC

Music is a very important area for NFTs because the current Web2 platforms pay out very little to musicians. Spotify for example currently distributes $1 USD to the artist for approximately 250 streams according to a 2020 report from Business Insider. Many new music NFT projects have been launched recently, including Arpeggi, Sound, and Royal. This allows fans to invest in music-related media such as songs and music videos the same way they would invest in physical art or rare collectibles. It opens up a whole new marketplace for fans and collectors, and a world of new possibilities for artists to monetize their content. In addition, owners of a particular musician's NFT could be given exclusive access to special content like behind-the-scenes footage.

Royal, for example, lets users purchase fractional royalties for a particular song or album as an NFT which can be sold on an exchange. As an artist gains more notoriety, the value of the NFT rises proportionally. Arpeggi Studio, as described on their site, is the first and only on-chain digital audio workstation (DAW). For the first time ever, musicians can compose and mint their songs as fully on-chain NFTs, allowing creators to take full advantage of blockchain technology.

3. ACCESS

Tickets are a logical use case for NFTs as they make the experience low friction and widely interoperable. It's easy to lose paper-based tickets, and they can easily get damaged when you get them wet or tear them. In addition, event organizers do not get enough security with paper-based tickets as they can be quickly faked.

Digital tickets based on QR codes seemed like a good solution for event organizers but not that effective for guests purchasing them. In addition, it's impossible to track customers or exchange data beyond the information that was provided to the event organizer. As a result, event organizers have no idea who is actually at their event. Because digital tickets in their current iteration are issued in a way that cannot be used for exchanges on the secondary market, you can neither change the name on the ticket nor control how many times the ticket will change hands. The lack of a standard exchange protocol incentivizes this type of fraud on the secondary market. NFTs allow for ticket liquidity to be centralized and identity to be attached to who is currently in possession   of the ticket.

A more native use case is digital access, where holders of an NFT gain access to a private discord server, video lessons, or events. Bored Ape Yacht Club, one of the most prolific and expensive art NFTs on the market, requires ownership of one of their NFTs for access to their exclusive and lavish boat parties.

4. GAME OBJECTS

Gamers currently spend about $150+B/year but users don't really own the majority of the objects they earn or own in-game, the company does. And the objects cannot interoperate and compose across games. As we've seen in the Decentralized Finance boom, interoperability and composability dramatically accelerate innovation. NFTs allow users to genuinely own the objects, flipping the polarity: games build around user-owned objects instead of users having to depend on the game.

Axie Infinity, inspired by Pokémon, is an NFT-based video game where you collect and battle your NFT monsters against each other. Getting started isn't easy or cheap and there's a much larger upfront investment needed than the average PlayStation or Xbox game. The upside, however, is that you own your Axie NFTs and can resell them on the secondary market, plus the game is "play-to-earn" which rewards you with crypto tokens that can be sold on an exchange.

Aavegotchi is a DeFi-enabled crypto-collectibles game developed by Pixelcraft Studios that allows players to stake their non-fungible token (NFT) avatars with interest-generating tokens and interact with the Aavegotchi metaverse. Aavegotchi combines both Decentralized Finance (DeFi) and NFTs to create a financially-incentivized gaming experience similar to Axie Infinity.

Xsolla's NFT Checkout is a product that lets game developers quickly and securely add NFTs to their game economy and give players the ability to purchase in-game items and other branded digital content using their method of choice. Whether it is with a Visa/Mastercard or with digital currencies. The payment checkout is local to the game so players can stay on the same UI and it easily integrates with already used payment methods.

Xsolla is an example of a fintech company furthering the adoption of NFT for game objects, pushing forward a higher level of engagement and ownership of the content from the developer to the users/players without requiring knowledge of blockchain technology on both ends. As an innovative leader in game commerce, they continue to solve the inherent complexities of global distribution, marketing, and monetization so their partners can grow audience, engagement, and revenue. Xsolla's expertise in technological innovation and business operations has created multiple products and solutions that help video game publishers and developers succeed while putting their players first.

5. REDEEMABLES

Unisocks was a whimsical pioneer of the model where a token could be redeemed for a physical good. This mechanism can be applied to lots of offline goods. For example, many high-end collectors of physical goods keep their collections in a vault. The infamous NFT artist Beeple mails users who purchase an actual digital frame that displays the loop of their NFT, encased in plastic and stickered with a holographic QR code that, when scanned, reveals the owner of the NFT. Many businesses are offering similar redeemables such as RelayX which issued a collection of 5000 physical reloadable crypto debit cards that are purchasable and tradeable via NFT token on their exchange.

6. IDENTITY

Currently NFTs are used to prove ownership of digital assets like videos, songs, tweets, artwork, virtual land, and collectibles. As for the future, companies like real estate firms are toying with the idea of using NFTs to verify physical assets. But these same concepts surrounding ownership can also be applied to people as identity can now be verified with an NFT. Goldfinch, a decentralized credit protocol for loans, recently announced their Unique Identity (UID) NFT, the first NFT for identity. Since the Goldfinch protocol opened in July 2021, 33,000 users have completed KYC ("know your customer") through the protocol. These users have minted their own UID NFT in the process and the NFT can be used to verify identity as the users have already completed KYC. Having an on-chain representation of personhood achieves two major goals: it opens DeFi to an entirely new set of real-world participants, notably companies and financial institutions who will be required to verify their identity each time they access a new DeFi protocol, and it greatly expands the design space for new features and mechanisms to be built on DeFi protocols.

7. WEB 2 DATABASES

NFTs can be used to store data that are currently being held in centralized web2 databases, but in a decentralized manner. Some of these functions do not yet exist but would greatly improve the current web browsing experience, such as storing a particular user's viewing preferences for a specific website, or much more advanced things like a particular user's entire social graph. This would allow you to switch from one service to another seamlessly – and have full control of your own data, without having to re-add your existing network each time you install a new app like the web2 social media world of today.

The team behind AAVE recently released the Lens Protocol, a social graph on top of which developers can build decentralized social networks. Lens Protocol and its content are powered by dynamic NFTs, giving the power and control over content directly to the users, allowing for native content monetization.

8. REAL WORLD ASSETS

As the world is inevitably becoming more digital, NFTs offer a strong solution for tokenizing property rights and ownership in a way that can be referenced publicly (personal details remain hidden) on the blockchain. This concept allows the real-world asset to become digitized and stored, keeping in mind the security, legality, and storage of the asset. The ownership rights for everything, from real estate, to physical art, to even diamonds, is currently in the process of being digitized into NFTs. In addition, another benefit of NFTs is that they introduce much higher liquidity for these items when listed on exchanges, and will even allow fractional ownership for higher-priced items that would otherwise be inaccessible for most people to purchase themselves, with or without a bank loan.

Centrifuge, a decentralized, peer-to-peer lending platform for real-world assets, lists the following goals for tokenizing real-world assets (RWA) as user-mintable, privacy-enabled NFTs

- To mint an NFT that represents an off-chain asset consisting of structured data

- Allow anyone to mint the NFT who can provide a proof that they should be allowed to mint this NFT

- Proofs are validated on-chain against an "anchor registry" that holds the Merkle root hash of the off-chain document

- Thus, turning off-chain assets into on-chain assets, represented as an ERC-721 token.

9. UTILITY NFTS
(eg. Uniswap LP NFT, Armor Insurance NFT)

On Uniswap v3, liquidity provider (LP) positions are represented as NFTs (ERC-721 tokens) as opposed to the fungible ERC-20 tokens on Uniswap V1 and V2. Based on the pool and your chosen parameters selected on the liquidity-providing interface, a unique NFT will be minted representing your position in that specific pool. The owner of this NFT can modify or redeem the position. This NFT comes with a unique piece of on-chain generative art. Uniswap v3 NFTs are SVGs (Scalable Vector Graphic) generated entirely on-chain and derived from the properties of the underlying position.

These Uniswap NFTs can be traded/sold; however, this NFT represents an LP's ownership of their liquidity position. If you decide to sell your NFT for 1 ETH, which represents a liquidity position worth 100 ETH then the new owner of the NFT will have ownership of your provided LP tokens – they can withdraw your liquidity. During the early days of v3 liquidity provisioning, someone created a Uniswap v3 LP position worth 127,000 USD and accidentally or intentionally sold the NFT representing that liquidity for 1 ETH. This mechanism allows the creation of synthetic options based on the price range an LP will set its position into. Similarly, established DeFi insurance provider Armor Finance, has allowed users to buy a tokenized version of insurance coverage by issuing individual positions as ERC-721 NFTs which allows for the same liquidity benefits as the tokenized LP positions on Uniswap V3 as described above.
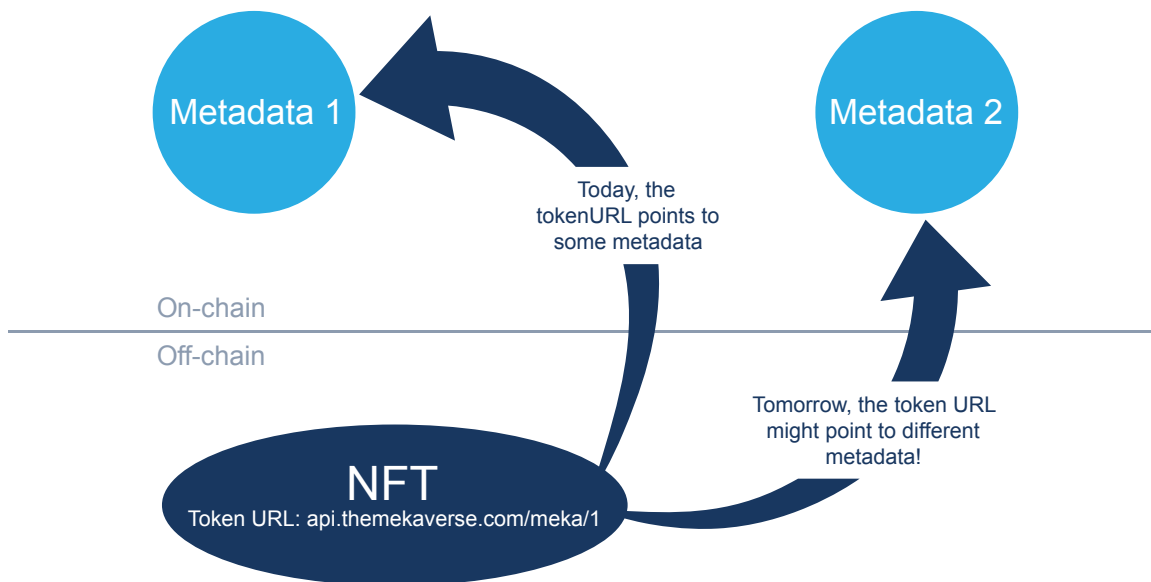
DATA STORAGE
PROBLEM
NFT AREN'T ALL IMMUTABLE.

The creation of an NFT can really be broken into two sections. First, there is the blockchain which handles the minting and accounting of the NFT. Most popular NFTs are built (coded) on the Ethereum network, and due to technical restrictions, the data cannot be stored on the Ethereum blockchain itself due to sky-high storage costs for the size of the metadata. As a result, various NFT collections have taken different approaches to the metadata storage problem while keeping the smart contract of the NFT on the Ethereum blockchain (or another network of choice). NFT metadata refer to the image together with all the unique trait that the NFT has.

The smart contract is always decentralized since it's stored on-chain. In other words, the smart contract is stored by every full node in the Ethereum network, making it basically impossible to change or delete. But what about the NFT metadata? First, let's briefly cover how NFT metadata works. Each NFT in a collection is associated with a token URI (Unique Resource Identifier), which points to the NFT's metadata. This URI is stored on-chain, and typically cannot be changed. However, the content that the URI points to may be changed!

As a concrete example, the token URI for the first MekaVerse NFT is https://api.themekaverse.com/meka/1.

Metadata 1

Metadata 2

Today, the tokenURL points to some metadata

On-chain

Off-chain

Tomorrow, the token URL might point to different metadata!

NFT
Token URL: api.themekaverse.com/meka/1

The token URI matters because it determines whether or not an NFT's metadata can be changed or deleted based on where it is stored. For example, the MekaVerse team could change the metadata returned by https://api.themekaverse.com/meka/1 at any point in time. In other words, your MekaVerse NFT might have an image today—but it could easily be gone tomorrow or be a totally different image. This means that an NFT that was supposed to represent a specific piece of crypto art or maybe a game character can be altered without anyone knowing. This clearly shows that not all NFT collections are created equally and describing NFTs as immutable by essence is a false statement.

Let's look at the metadata for NFTs listed for sale on OpenSea, and analyze them with the following steps:

1. Click on any of the 'Collection Names' from the table below and then click on "Contract Address" to go to Etherscan, under details on the left side of the screen

2. Click "Read Contract" under the "Contract" tab on etherscan

3. Open the button "Token URI", enter the token ID in the box and hit Query. (Alternatively, you can look for the "Base URI" button which should display the root path where the metadata of the collection is stored)

4. The link to the metadata is displayed below

METADATA OF SOME POPULAR NFT COLLECTIONS:

Collection Name	Example Metadata URI For NFT in The Collection	Metadata Category (See explanation in next section of the report)
Bored Ape Yacht Club	ipfs://QmeSjSinHpPnmXmspMjwiXyN6zS4E9zccariGR3jxcaWtq/5465	**Decentralized & Immutable**
Cool Cats	https://api.coolcatsnft.com/cat/8411	**Centralized**
Meebits	https://meebits.larvalabs.com/meebit/13569	**Centralized**
Pudgy Penguins	https://ipfs.io/ipfs/QmWXJXRdExse2YHRY21Wvh4pjRxNRQcWVhcKw4DLVnqGqs/664/	**Decentralized**
Fox Fam	https://api.foxfam.io/fox/4305	**Centralized**
Winter Bears	https://winterbearsnft.com/api/3652	**Centralized**
MekaVerse	https://ipfs.io/ipfs/Qmcob1MaPTXUZt5MztHEgsYhrf7R6G7wV8hpcweL8nEfgU/meka/5223 / meka/5223 (As you can see, the token URI points to a different address a few months after the image above was created and MekaVerse no longer points to a central database but a decentralized IPFS database.)	**Decentralized**

While non-fungible tokens are as permanent as the blockchains they reside on, the persistence of the metadata linked to the NFT depends largely on the storage method used and varies widely between platforms, artists, and developers. See the below section on storage options, especially where decentralized storage is not the silver bullet when it comes to permanence of the metadata, together with an explanation of the different combinations of frozen and decentralized data.

STORAGE OPTIONS INCLUDE:

1. ON-CHAIN STORAGE
(eg. ETH - Cryptopunks,
NFTs built on BSV - Gopniks)

Most blockchains make a fantastic distributed ledger, but perform poorly when it comes to storage. As such, while on-chain storage is immutable and easy to access, it can be incredibly expensive. It cost over 73 million gas to upload the 10,000 crypto punks to the Ethereum blockchain, which at current gas price of 55 gwei would cost $11,242.

BSV (Bitcoin Satoshi Vision) allows for NFT token metadata to be stored on-chain through Run Protocol's jig feature. The jig can behave like ERC20 (fungible token) or ERC721 (non-fungible token).

A jig NFT on the RUN protocol can have many properties the creator establishes and the data associated with the jig is entirely stored on-chain. Jigs are interactive objects, meaning they have the ability to work with other Jigs and change over time. For example, a "player jig" can equip a "sword jig" increasing their attack power in a video game built on the BSV network. Jigs can also own other jigs so that you could have a "jig index" owning other "token jig" or "NFT jig". A jig could also be an egg that hatches over time into a digital pet like a dragon. Those pets could also have different attributes depending on what actions were taken on them in the past.

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2. DECENTRALIZED STORAGE
(eg. ETH - Most OpenSea featured collections)

Using a peer-to-peer file storage system such as IPFS together with FileCoin or Arweave allows for hosting files on multiple computers, reducing dependency on any single one. Moreover, this method uses content addressing, where the address of the data is actually a hash of the data itself, rather than using the location-based address method of the current traditional internet that has the inherent flaws described above.

Decentralized storage for NFTs is mostly handled through the Interplanetary File System, or IPFS, to create content-addressable hashes of data, also known as Content-Identifiers (CIDs). These CIDs act as both a way to retrieve the data and as a way to ensure the validity of the data. Those looking to retrieve data simply ask the IPFS network for the data that corresponds to a particular CID and then if any node on the network has that data, it will be returned back to the requester.

As the requester is retrieving the data, it is automatically rehashed on the requester's computer to make sure that the data matches back up with the original CID they asked for. This process ensures the data that's received is exactly what was asked for. If a malicious node tries to deliver false data, the resulting CID on the requester's end will be different, alerting the requester that they're receiving false data.

In a blog post on the official IPFS website, they point users to another website, NFT. storage where creators can store NFT data for free in a decentralized manner up to 32GB as per their FAQs.

Problems with decentralized storage:

IPFS can turn into regular centralized storage in practice if the data is only stored on one node as the rules of IPFS don't enforce replication. In addition, as described in the MekaVerse example above, the MetaData for an NFT can be changed well after the NFT is issued. As a result, while the digital item is correctly decentralized, it is not "immutable" which can have profound consequences if the item purchased is no longer the same after purchase.

OpenSea developed the "freezing" mechanism, to fix this issue. As explained in a recent blog post, "The concept of "frozenness" is distinct from centralization. Even when they are stored in a decentralized manner, it's often still possible for the creator to make a transaction and change the metadata associated with an NFT. We call NFTs that have unchangeable metadata "frozen"." As a result, frozen NFTs are correctly decentralized and immutable.

In order to freeze an NFT on OpenSea, the creator of a collection can go to the respective "Edit" menu for that collection, and hit the "Freeze MetaData" toggle, as described in the above OpenSea blog post. The details section of a listing on OpenSea will then show Frozen under the MetaData section with a link to the item's URI on-chain.

Decentralized ➡️

Frozen ⬇️

Centralized	Decentralized
Centralized and immutable	Decentralized and immutable
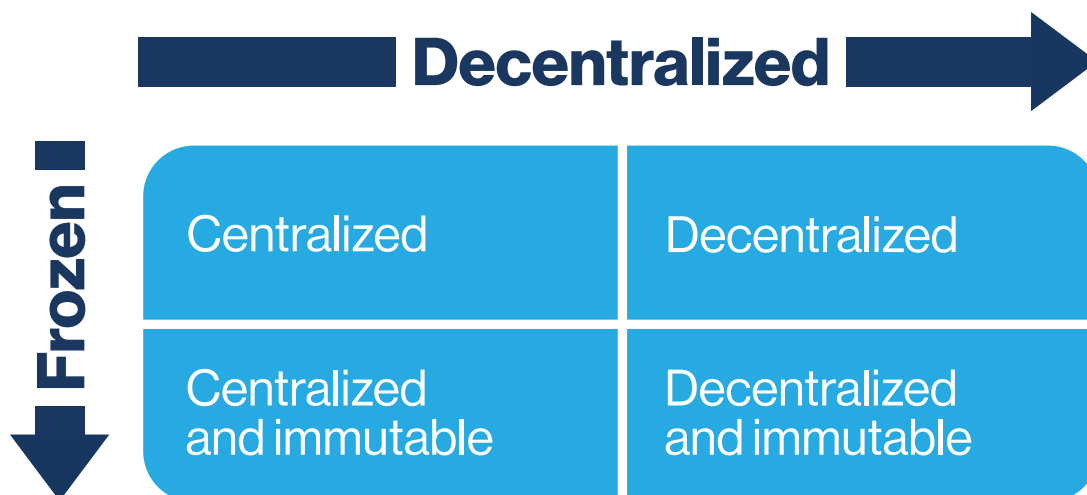
From the above table, Centralized (top-left quadrant) implies the metadata can be changed and the data is stored on a centralized server as explained in the next section in this report. Decentralized refers to the ability for the metadata to be changed but the data is stored on several decentralized servers simultaneously (eg IPFS - Filecoin, and ARWeave). Centralized and verifiable implies that the metadata is centrally stored as explained in the next section but it cannot be changed. A case for when this becomes a problem is explained below in the ClubNFT example. Decentralized and Immutable implies that the metadata is stored on several decentralized servers simultaneously and the metadata cannot be tampered with which is the ideal combination when buying digital art NFTs online.

In addition, using IPFS for data storage does not imply permanence: content hash addressing does not imply persistence as someone still needs to pay the bills. For example, Tezos NFT service Hic Et Nunc (HEN) left all the thousands of users of the ClubNFT community wondering where their NFTs were when they stopped paying for their IPFS nodes. The community contacted Infura directly and they started paying for the IPFS servers so the content wouldn't go down.

Fortunately, as the hash of the content was known, the users at least knew which exact pieces of content they needed to resurface, and the links didn't break. And since IPFS is not a private, centralized service, the community was able to just build mirror sites and reimplement the functionality of the site as soon as the IPFS node was back up. What happened with HEN was sort of a miracle, but the problem still exists: if a huge IPFS node goes down, chances are most of the content stored in that node is going to go down. Storage isn't free, someone ultimately needs to pay for that storage.

 As seen above, IPFS is not a silver bullet solution for storing NFT metadata. A node that retrieved a file can itself store the file to be used again in the future; but eventually, the storage space on IPFS will run low as demand increases. As a result, a process called Garbage Collection starts where the software automatically deletes files that it thinks are no longer needed unless they are "pinned", or in other words, labeled as "do not delete".

Files on IPFS can be pinned with a dedicated service provider like Piñata. These applications are free for small amounts of data but require a recurring paid subscription to pin all but the smallest files. As a result, if an NFT creator stops paying for the pinning service on IPFS the files will be deleted over time. In essence, this solution is fine for the short term, but not for the long term as there's no guaranteed permanence.

Arweave, a competing protocol to Filecoin, set out to resolve the above issues caused by IPFS platforms, by incentivizing nodes with the native protocol token, AR, as a reward for permanently storing the data. The formula used by Arweave for the fee calculation incentivizes the nodes to hold the data for well over 200 years. From the Arweave "yellow paper", the fee is calculated with the assumption of a rising AR price over time (in USD) while the price of physical storage continues to decrease simultaneously over time. On top of that, the Arweave team deliberately underestimated the decreasing cost of storage over the years in order to be even more conservative with their calculations for the AR token payout.

In addition, the Arweave file hosting nodes are periodically asked for a random piece of data from the entire Arweave protocol - that node gets awarded extra AR tokens if they can verify they are storing that random piece of data. As a result, every single file hosting node on the protocol benefits from holding a copy of the entire data stored on the Arweave network, achieving permanence of data.

It is impossible to know what proportion of NFTs are stored in a decentralized manner on Filecoin & IPFS or Arweave, as there are countless NFT projects which are not yet officially listed on any popular marketplace, so this problem is mostly limited to digital items for now. The problem of what proportion of NFT collections are stored in a truly decentralized manner is a good topic for a future research project for Coinchange Intelligence team.

3. CENTRALIZED STORAGE
(eg. FLOW - NBA TopShot,
ETH - AXIE infinity)

Metadata and the underlying item may be stored on a centralized server or via a cloud solution like Amazon S3 or Google Cloud Storage. Centralized methods are affordable and fast, and many are routinely backed up so the risk of accidental loss is low. That said, the files may be taken down, whether the developer goes out of business or forgets to pay the hosting fees, or may be changed by the developer at any time. When this happens, the actual tokens will still exist but may point to a broken link or to different artwork, potentially causing the NFT to lose significant value. In fact, there are numerous examples of this happening, as was the case with Tron Dogs and NiftyMoji.

Centralized storage can be beneficial if handled with sufficient precaution and security measures. An example is Real-world assets that are being digitized as NFTs, their proof of ownership via government recordkeeping for tax and other liability purposes is still handled off-chain so this is not an immediate issue for now. It then allows the creation of their on-chain counterpart as NFT which points back to data stored off-chain with different verification and proof measures.

NFT TOKEN STANDARDS WITH DECENTRAL- IZED STORAGE:

From a technical perspective, NFTs on different blockchains are coded in different programming languages, and as a result, have different standards for the smart contract code and features themselves when it comes to generating a functional NFT. The first simplest difference would be what sets apart fungible and non-fungible tokens. A non-fungible token is simply a fungible token with a supply of one. In other words, it is unique and there are no other tokens like it.

Ethereum

On Ethereum, the largest smart contract blockchain and where the majority of NFT trading happens nowadays, the smart contract standard is called ERC (Ethereum Request for Comment). ERC-20, the most popular of them all, is the standard for fungible tokens built on Ethereum. ERC is an abbreviation for the rules that help developers use for coding a standard Ethereum-based token, and the "20" is the identification number for that specific type of code.

Most of the tokens on Ethereum with a supply greater than 1, AAVE and MPL for example, are coded in the ERC-20 standard. The rules and coding standards of the token must be followed in order for the token to have its intended functionality, like interacting with other tokens within the network. They can act as certificates, cryptocurrencies, or stocks. ERC-20 standard was the first token standard allowing the creation of fungible tokens on a blockchain, which has been reused with sometimes modifications across all the EVM compatible chains, where Binance Smart Chain has its BEP-20 standard, Polygon will have ERC-20 standard as well, Avalanche will have ARC-20 standard.

Ethereum has several other token standards for different types of tokens. ERC-721 is one of the free, open standards that describe how to build non-fungible or unique tokens on the Ethereum blockchain. While most tokens are fungible as described above (every token is the same as every other token), ERC-721 tokens are all unique. All of the NFT collections examined in the metadata table above are ERC-721 tokens.

ERC-998 is another non-fungible token standard that sets itself apart from the 721 discussed above by adding composability. In other words, multiple NFTs can be merged into a single NFT. The ERC-998 token standard can hold various Non-Fungible Tokens, like the ERC-721, and ERC-1155, in addition to fungible tokens like ERC-20. ERC-998 is currently implemented by AaveGotchi in a modified version of the original token standard.

ERC-1155 is a multi-token standard (fungible, non-fungible, and semi-fungible token) that allows users to register and control any number of fungible tokens and Non-Fungible Tokens in the same smart contract. This token standard was written primarily with gaming in mind. Fungible tokens, such as in-game currency, are often used to purchase NFTs, such as in-game items and other digital collectibles.

Polygon

It is an Ethereum Layer 2 scaling solution and supports the Ethereum ERC721 and ERC1155 token standards (via bridge) for NFTs.

Binance Smart Chain

uses the BEP-721 token standard for the creation of non-fungible tokens (NFTs). It's an extension of Ethereum's ERC-721, and thus compatible with the Ethereum Virtual Machine (EVM).

Solana

It does not have a specific NFT token standard - the NFTs on Solana are just ordinary SPL Tokens (Solana Program Library fungible token standard), whose supply is fixed to one with the metadata of the NFT attached. This makes the NFTs built on Solana very easy to deploy and transfer as there is no need to write or deploy unique smart contracts, and no need to call different transfer functions based on NFTs like Ethereum.

Tezos

Meanwhile, the Tezos smart contract platform has a single Token standard like Solana, called FA2, which can support a variety of token types, including fungible, non-fungible, and multi-asset contracts. FA2 gives developers the ability to create their own tokens and supports complex token interactions. In addition, FA2 supports a standard API for external wallets, games, and applications. FA2 tokens can include NFTs and other interactive, transmutable gaming items.

MARKETPLACES AND USE CASES
(Data as of March 1, 2022)

All tokens whether Non-fungible, Native or Fungible need a marketplace to be traded and exchanged to be able to find a price equilibrium. Such equilibrium is called the floor price for collections of art-related NFT. Below is a list of marketplaces across different networks and their main source of trading.

Blockchain	NFT Marketplace Name	NFT Marketplace Main Trading Source	Gross Volume ($) (30d) Via DappRadar	Transactions (30d) Via DappRadar	Users (30d) Via DappRadar
Ethereum	Opensea	Art	$3.48B	2.52M	467.44K
	Axie Marketplace	Video Games	$89.51M	6.28M	490.84K
	LooksRare	Art	$775M	95K	25.08K
Solana	Solanart	Art	$25.43M	422.11K	55.9K
	Solsea	Art	$2.22M	208.52K	29.62K
Polygon	Opensea	Art	$6.68	378	135
	PlayDapp Marketplace	Art	$777.16K	83.28K	7.63K
Tezos	objkt.com	Art	$9.26M	406.22K	27.46K
BNB Chain	AirNFTs	Art	$510.78K	24.17K	4.35K

All data is as of March 2022 as considered the most representative data set for the NFT market, considered the severely depressed market in June, July and August 2022.

We can see that marketplaces are for the most part trading art and collectibles. Hence arbitrage opportunities have opened up between marketplaces on the same network. Worth mentioning is that the act of trading digital property not only allows digital content to be exchanged but the properties and rights are also transferred to the buyer's address which becomes the owner. The most interesting property of NFT collectibles is the royalty that the issuers attach to them when created. The following section dives into more detail about NFT royalty and how they came to be.

NFT ROYALTIES
Manifold Smart Contract Spec

One unique feature native to NFTs is the ability to distribute royalties during the resale of the content. For example, Beeple's "Crossroads" NFT piece was resold on the Nifty Gateway NFT marketplace for $6.6 million in February 2021, over 100 times the original listing price. In the traditional art world, Beeple would not receive any commission for his work past the original sale. The smart contract allowed him to net a 10% royalty from the resale transaction, as the code can facilitate and enforce the terms and conditions of transactions.

For years, users turned to marketplaces like OpenSea to mint their NFTs. Unfortunately, the marketplace's third-party smart contract did not give the artist the spotlight they deserved. Some older NFTs built on Ethereum were not encoded with the above linked ETH EIP-2981 smart contract spec, and marketplaces do not know how much of the resale value to hold back as royalty for the original artist and where to send those funds. Manifold.XYZ, an NFT minting platform, tries to solve this problem in two ways - first by enabling artists to mint their own NFT, ready to be listed on various popular Ethereum marketplaces, while maintaining creative ownership and taking care of on-chain history through their Manifold smart contract specification.

Second, we must consider that there are several NFT royalty specifications including EIP-2981, Manifold, and Rarible, which all provide a royalty amount and recipient address for each NFT; however, they have slightly different smart contract implementations. As a result, marketplaces have a hard time adhering to all the various royalty specs. In addition, older non-fungible tokens minted on third-party marketplaces with royalties set up off-chain with a specific platform, don't have their royalty configurations set up on-chain to take advantage of listings on different marketplaces.

As a result, Manifold partnered with various reputable marketplaces such as Rarible, SuperRare, OpenSea, NiftyGateway, and Coinbase NFT to build the Royalty Registry, to make it easy for marketplaces to use the appropriate on-chain royalty configurations, and to make it possible for contracts that did not originally support on-chain royalties to add them. As described on the Royalty Registry website, "We all believe that it's important to ensure creators get their fair share of every sale."

Since NFTs are in relative infancy, their trading happens for the most part in the blockchain they've been issued on and can't really be traded for NFT on another chain, even more complexities arise when talking about royalty registry of collection on different chains. Such a situation leads to the following section where we look at if NFT can be ported over to another network in the same way that fungible tokens (ERC-20 and the likes) have been. We look in more detail at the infrastructure that can enable such operations.

NFT AND CROSS-CHAIN ECOSYSTEM

As all NFTs are required to pick a token standard to be built upon, the creator ends up limiting their unique digital content to a single network in the process. For example, all NFTs minted using the ERC-20 or ERC-721 token standards mentioned above are native to the Ethereum blockchain, meaning that they can be sent to Ethereum addresses thus almost resembling a close environment.

Additionally, if an NFT marketplace does not support a certain blockchain, then content hosted on that unsupported network cannot be sold on that platform. To put this problem into more context, Magic Eden, one of the leading NFT marketplaces on the Solana network, traded roughly 1.3M SOL worth of volume in the past seven days ($115.5M USD as of May 2, 2022), cannot host CryptoPunks for sale as they are not built on the Solana network.

OpenSea is tackling this issue by slowly integrating NFTs from other networks on their platform; however, it is unreasonable to expect every single NFT marketplace to support NFT projects from every other network. However, we could envision a near future where marketplaces could leverage bridge infrastructure to allow cross-chain NFT trading rather than developing connections to each blockchain. Hence leading to the second approach which has recently gained momentum involves bridging NFT from one network to the other. Blockchain bridges themselves are networks that allow users to port their digital assets, both fungible and non-fungible, from one blockchain to another.

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Wormhole, for example, is a bridge between Solana and Ethereum network. It allows the user to move their Solana NFT built on the SPL standard to the Ethereum network to be sold on a marketplace that only lists Ethereum NFTs such as LooksRare. The Wormhole protocol locks your non-fungible token on the blockchain of origin by placing it in a "vault", and then proceeds to mint a wrapped version of that very same non-fungible token on the target network using the ERC-721 standard. The process is reversible - a user can unwrap their NFT and bring it back to its original blockchain. Wormhole, in this case, unlocks the original non-fungible token and simultaneously burns the wrapped one. This process ensures that the NFT maintains its one-of-one value proposition.

NFT bridges like Wormhole possess their own set of risks, including errors in the smart contract code. This can result in the protocol being exploited by malicious parties, or the bridge itself malfunctioning. The end-user suffers in the process by losing access to their valuable NFT tokens. In addition, another potential risk vector is censorship, where the team behind a bridge protocol can theoretically prevent you from transferring a specific NFT project to another network. The bridge network itself could also collude to steal funds from users who trusted the network.

Ternoa is another blockchain project that attempts to solve the interoperability problem by building on Polkadot, a protocol that connects several specialized blockchains (like Ternoa) into a single, combined network. This interoperability is the key to Ternoa's success, helping it to communicate with other blockchains specializing in certain data protocols.

Ternoa's goal is to allow individuals and companies to transfer their personal data and files, stored on the blockchain as NFTs, to their trusted ones in a decentralized and permissionless manner without any intermediaries. The protocol's "Time Capsule" feature lets users create literal time capsules, which have specific access conditions for a predetermined future date, set by their respective creators. In addition, the Ternoa protocol forwards the files stored in time capsule NFTs to decentralized storage blockchains like Arweave and Sia for backup, while keeping a copy of the files on its own data storage network.

The concept of blockchain interoperability between various protocols is especially important when it comes to NFT Financialization, which is the focus of the second part of this research report series.

As NFTs are poised to find their way both in Decentralized Finance as well as Traditional Finance we can't overlook their compatibility together with their adaptation to regulation and potentially inversely, how regulators and the economy will adapt to them. We explore such ideas in the next section.

NFT REGULATION

As a new technological and financial innovation, the American Securities Exchange Commission (SEC) has not yet developed the appropriate framework to regulate NFTs. However, Hester Peirce, the current SEC Commissioner, said that financial regulation is inevitable and NFTs will be regulated as securities in a recent interview with CoinDesk.

She mentioned that fractionalization, and crowdfunding by proxy, is where people need to be careful, especially if tokenizing an NFT implies ownership rights or governance voting rights. Peirce said, "I think as people have learned, our definition of security is quite broad, and so people need to be thinking about potential places where NFTs might run into a securities regulatory regime."

Similarly, the EU's Draft Regulation on Markets in Cryptoassets, MiCA, does not mention anything specifically regarding NFTs, and as a result, we cannot assume that these digitally owned items are excluded from the document's scope.

What might regulation for NFTs look like? Well, we can start our analysis with the NFT versions of tangible, real-world assets, like real estate which already has established securities frameworks. As a result, it would be safe to assume that the digital versions will have very similar regulations. Braden Perry, a former CFTC enforcement attorney, told Blockworks in a recent interview, that real estate has a "huge upside potential" when it comes to NFTs and smart contracts, but the US regulatory environment "lags innovation" to support it.

Propy is a real estate transaction automation platform that, just last year, made headlines for selling an apartment in Ukraine as an NFT, the world's first digitally transferred property. Although there isn't an existing regulatory framework, the firm is taking all the legal steps required to ensure that the protocol is fully regulatory compliant.

In addition, their site mentions the following legal steps the firm took to ensure that their first property-as-NFT auction last year was compliant, "The ownership of the property was actually held and recorded in Ukraine as a US LLC. The auction winner became the owner of the NFT that gives the rights to the LLC, with Arrington signing proprietary-developed legal papers for NFTs to transfer ownership to all future buyers. Propy developed the smart contracts, the legal framework that is suitable for the US market and will soon launch a real estate NFT auction platform for the upcoming NFTs."

Just last month, Propy made headlines again for selling ownership rights of an apartment in Tampa, Florida as an NFT for the USD equivalent of 210 ETH. Natalia Karayaneva, CEO & Co-Founder of Propy said, "At Propy, we have developed all the necessary smart contracts and a compatible legal framework that allows tokenizing any real estate property in the United States. NFT sales reached $4 billion in December 2021, and real-world assets will soon represent a significant portion of that market".

So, not only are firms dabbling in NFTs taking the steps to meet regulatory and compliance guidelines, quotes like the following from former CFTC enforcement attorney Branden Perry, make it obvious that regulators understand the technology and its benefits, "The [real estate] title process is ideally suited for streamlined and protected recordings on a blockchain," Perry said. "But the regulatory system is still new, and there are a lot of questions regarding the government's role in crypto."

Centrifuge, a peer-to-peer lending platform, where lenders can offer collateral to a various number of funds that are digitizing real-world assets around the world as NFTs, has created thorough documentation about their legally compliant process, and what steps users need to take to create NFTs in the correct manner so there are no legal issues.

Now when it comes to the less tangible, digital assets that are yet to have any regulatory framework, platforms like fractional.art, introduce a whole new series of questions for the Government about how NFTs fit into existing securities regulations. As mentioned by SEC Commissioner Hester Peirce above, fractionalization, and crowdfunding by proxy, are areas where users need to be very careful because the concept appears to be eerily similar to stocks as part-ownership of a company or real estate.

Another area where both NFT purchases and platforms need to be careful about regulation is airdrops. Several NFTs, in order to incentivize demand for their digital items, have introduced airdrops to holders of those NFTs. LooksRare, a competing platform for OpenSea, rewarded users who transacted on the OpenSea platform, with free LOOKS tokens based on the number and volume of transactions they completed on OpenSea, as a marketing method to try to gain market share.

Airdrops, while legal, are still a regulatory grey zone as there have not been established guidelines created on taxes. Users are awarded them for free without their consent, and become responsible for the taxes against their will, as a result. From a recent Forbes article about Airdrop taxes, "According to past unsolicited property tax rulings (Technical Advice Memorandum 8109003 and 8109004) and the details provided in the Rev. Rul. 2019-24, surprised airdrops like the $ENS token is likely taxed at the time the taxpayer gains dominion & control over the asset. In simple terms, this means at the time you claim the token and have the ability to transfer, exchange or sell the coin. The amount of ordinary income to be reported is the fair market value at the time you gain dominion and control. This amount would be subject to ordinary income taxes (10% - 37%) based on your income tax bracket."

Digital ownership of items is a new and inevitable frontier for the crypto economy. With the speed of innovation and change in the crypto space running way ahead of regulation setters, it is likely that by the time MiCA - or any other regulatory body - provides guidance on NFTs and related projects, then the NFT landscape will already be significantly different from what we see today. So it's a moving target: one with which regulators will continue to struggle to keep pace.

CONCLUSION

The NFT landscape has been growing at a staggering pace and although still in infancy, are poised to challenge the status quo on how we do things in traditional finance while enabling better and potentially more efficient digitalization of the economy. As with everything in the crypto space, Doing Your Own Research by reading reports, such as this one, allows new investors to navigate the quick claim that more mainstream crypto media will portray about NFTs while also allowing faster adoption of these new technologies. The NFT sector is already working on having NFT being seamlessly cross-chain, which ultimately is key for the Metaverse to truly take hold, encompassing a multitude of protocols with their communities across a multitude of networks.

Moreover, the innovation in the NFT space together with the ramifications for specific industries like Gaming, Art, Real Estate (both digital and brick & mortar) are something to keep an eye on as more transformation of those industries might take place thanks to NFTs.

Such a rapid innovation pace has forced the regulators to inform themselves about the ramifications that it would have, which some regulators already understand and are in support of. Nonetheless the actual law and framework still need to be created while hopefully not killing the innovation while nascent.

At last, the advent of NFT and their rapid evolution has led to their financialization, similar to fine art which in the traditional market can be used as a capital asset. This sector of the NFT market - NFT Financialization - is further explored in the second report of this series which builds upon the insights from the present report.