NFT Study Report

Part 1: Introduction and Use Cases

Introduction

The crypto industry has seen explosive growth over the last few years. One of the most dynamic sectors within the industry are non-fungible tokens or, in short, NFTs. Early adoptions include crypto art and collectibles. More recently, NFTs are increasingly used as membership cards or as a representation of items in blockchain games. In DeFi, some protocols use NFTs as liquidity provider tokens or as collateral for lending services. Other use cases include naming services, the management of intellectual property or the digital representation of physical assets such as real estate. More overlaps between the digital and the physical space and increasing integration into other blockchain solutions are likely.

While NFTs have existed for quite some time, it was not until the end of 2020 that they gained major traction. According to data from Dune Analytics, the weekly sales increased swiftly to 1.92 billion USD at its peak in August 2021.[1] It is worth noting that these figures only include sales on Ethereum. Other platforms are not yet covered.

Source: Dune Analytics

Given the explosive growth of sales, NFT marketplaces achieved record results. In August 2021 alone, the monthly sales on OpenSea surpassed 4 billion USD.

While the first NFTs were mainly issued on the Ethereum blockchain, NFTs are by no means limited to Ethereum. In fact, they can be issued on any programmable platform with some of them specializing on NFTs. Common blockchains that support NFTs are Liquid Network, Binance Smart Chain, Chiliz, Flow, Solana, and Tezos, just to name a few.

[1] https://dune.xyz/queries/131607/259119 (last viewed on March 1, 2022)

The latest investments into Dapper Labs and Sorare further indicate that the market will attract more investments in the future and will continue to grow. Dapper Labs raised 250 million USD at a 7.6 billion USD valuation and Sorare 680 million USD at a 4.3 billion USD valuation.

Since much is still in the flow, we are going to update our report and recommendations continuously. This report is based on the information available as of March 1, 2022, but some conditions may have changed since then, so please keep this in mind.

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1. Scope

In the first part of this report we are going to define NFTs comprehensively, provide a short overview of the dynamics of the NFT markets, and explain common use cases and potential future use cases. In part two we will analyze the technical implementation, and in part three outline legal and regulatory issues in various jurisdictions and provide possible solutions.

The targeted audiences of this document are developers, businesses, regulators, academia and more generally anyone looking to expand his/her knowledge on the topic.

2. Normative reference

This document has no normative reference.

3. Terms and definitions

This document uses the following terms as the shortcut for more complete wording provided as the definition. When the term appears within this document, it should be read as being replaced by the term.

3.1

NFT

An NFT (Non-Fungible Token) is a tokenized representation of an asset (or anything really) that provides some rights to the owner. It differs from other VAs used as currencies where fungibility is instead a very important and fundamental characteristic of the assets. An easy way to picture an NFT is a blockchain-based asset that has only one indivisible unit available and no possibility for further issuance in the future.

4. Abbreviations and symbols

In this document, the following abbreviations and symbols are used.

BGIN: Blockchain Governance Initiative Network
DAO: decentralized autonomous organization
NFT: Non-Fungeble Token
Satoshi: Unit of measurement equal to 1/1,000,000 bitcoin
VA: Virtual Asset

NOTE: All the abbreviations SHALL appear in this clause.

5. Overview

5.1 Non-Fungible Token (NFT) Explained

An NFT (Non-Fungible Token) is a tokenized representation of an asset (or anything really) that provides some rights to the owner. It differs from other VAs used as currencies where fungibility is instead a very important and fundamental characteristic of the assets. An easy way to picture an NFT is a blockchain-based asset that has only one indivisible unit available and no possibility for further issuance in the future. It is important to understand that an NFT is not an image, video, song, etc. itself; rather, an NFT is a means of proving ownership and authenticity, with each individual NFT representing an individual asset.

5.2 Key difference to cryptocurrencies: Fungibility and Non-fungibility

The key difference between NFTs and other cryptocurrencies is the word “fungible”. Fungibility is a property of a good whose individual units are interchangeable, divisible, and indistinguishable (in value)[2]. Just as you can trade a $1 bill for another $1 bill, you can trade 1 bitcoin for 1 bitcoin; just as you can receive 100 pennies for $1, you can receive 10,000 payments of 10,000 satoshi for 1 bitcoin. Because NFTs are non-fungible, you cannot trade one for another without a gap in value. This is because, just like paintings and houses, the value of an NFT is subjective. By allowing a single or group of goods to possess individual identities, non-fungible tokens bring digital tokenization to many asset classes.

[2] https://www.investopedia.com/terms/f/fungibility.asp (last viewed on March 1, 2022)

5.3 “Ownership” in the virtual world

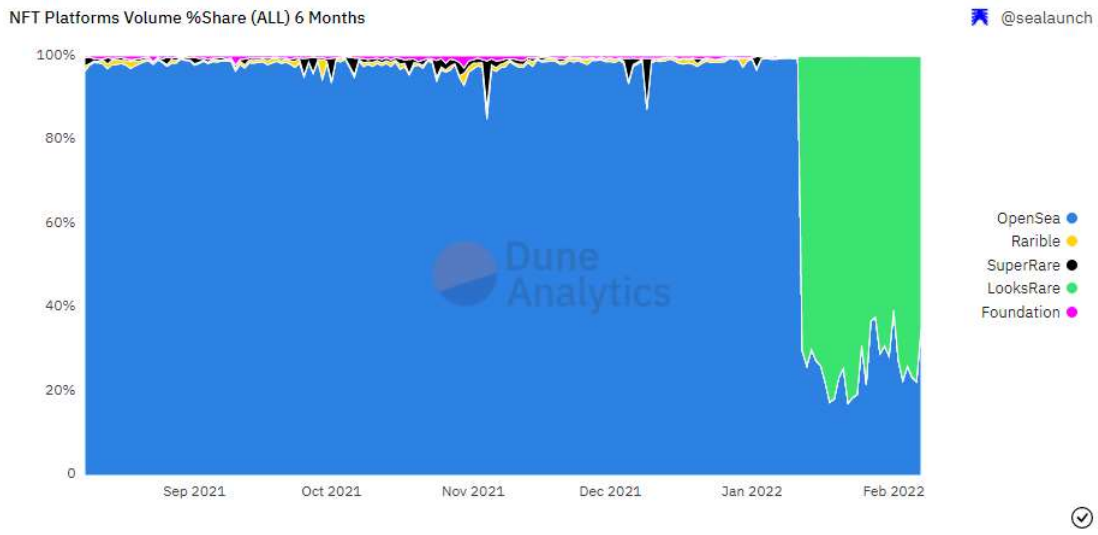
In the physical world, ownership is most commonly represented by obtention. To have means to own, with the exception of borrowing or leasing. While this system works fine in the real world, it is not possible to implement in the virtual world, where digital goods can be replicated with a simple right-click save-as. Non-fungible tokens allow for users to prove that a given asset is theirs and that it is exactly what they say it is.

NFTs provide significant utility to a variety of industries, and it is always important to understand exactly what you are receiving with the NFT. Some digital art NFTs are not just proof of ownership of the asset, but also give you special access to a community chat room, commercial and distribution rights, participation in a community DAO, etc. Because of this, different projects can fall into more than one category of NFTs.

5.4 Marketplaces for NFTs

NFTs are transacted on marketplaces where users around the world can list their NFTs and anyone can make an offer to purchase them. These marketplaces can be centralized, run by a company, or decentralized, run by a decentralized autonomous organization (DAO). At the time of writing, the leaders in NFT marketplaces are Opensea[3] and LooksRare[4], both Ethereum projects. Opensea is centralized and has historically been the dominant location for buying and selling NFTs; however, in January of 2022, LooksRare, a decentralized marketplace, captured a significant portion of Opensea’s trading volume. Currently, many of the risks associated with NFTs are being addressed by marketplaces, so the adoption of NFTs is heavily reliant on their continued development.

[3] https://opensea.io/ (last viewed on March 1, 2022)
[4] https://looksrare.org/ (last viewed on March 1, 2022)



Source: Dune Analytics[5]

6. Use cases

6.1 Digital Art

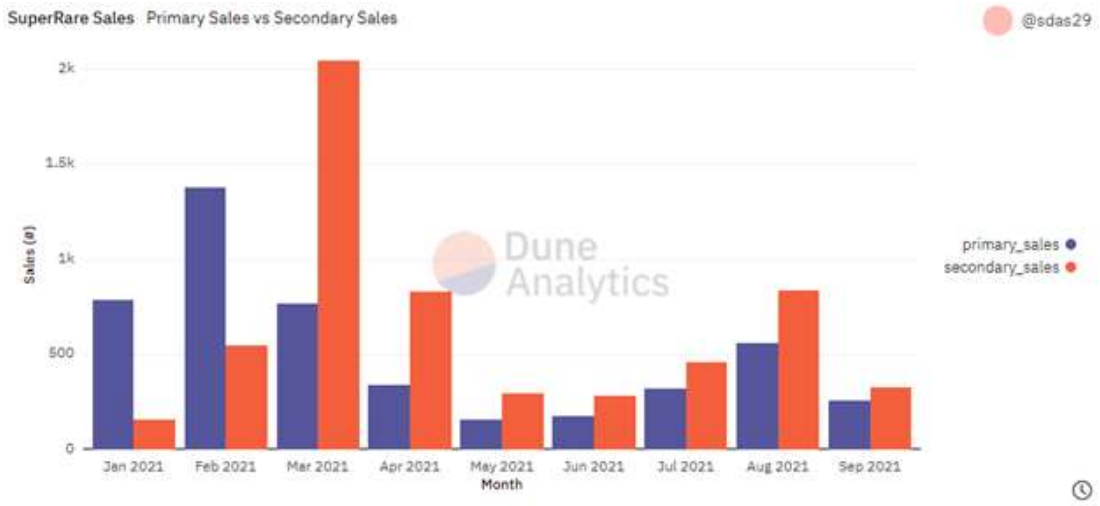
Despite increasing digitalization and a shift in public perception concerning digital goods, artists have found it difficult in the past to monetize their digital artworks. Like all other digital goods, artworks could easily be copied, and provenance was difficult – if not impossible – to track.

While NFTs do not prevent others from copying the digital files, they can be used to prove the artwork's authenticity, track its provenance, and indicate the rights an NFT represents permanently. Furthermore, unlike in the conventional art space, the data is publicly available on the blockchain and can therefore be accessed by anyone.

Under certain circumstances, NFTs further allow artists to participate not only in the initial sale but in all future sales via royalties. As such, they may provide a permanent source of income.

[5] https://dune.xyz/queries/362117/689607 (last viewed on March 1, 2022)

Crypto art caught the attention of the broader public when Christie's auctioned an NFT for 69 million USD in early 2021.[6] Since then, other auction houses such as Sotheby's and Poly Auction have started selling NFTs as well. The fact that sales by these auction houses have raised major eyebrows should not hinder the fact that most of the sales are still conducted in the crypto space. On SuperRare, another one of the leading platforms for crypto art, artists sold more than 1,381 NFTs in February 2021. Secondary sales reached their peak in March 2021, with 2,048 sales. Since then, the number of sales has decreased considerably but seems to trend upwards again. This is in line with other data from Dune Analytics, according to which the monthly crypto art volumes on various marketplaces collapsed from 60 million USD in March to 9 million USD in June. Today, the monthly volumes have stabilized around 45 million USD.[7]



Source: Dune Analytics[8]

In fall 2021, the first mainstream NFT trend caught on - social media profile pictures. Twitter, Instagram, Discord, etc. were all exposed to this new form of expression. Profile picture NFTs (also known as PFPs) are typically a unique combination of attributes assigned to a base image. For example, The Bored Ape Yacht Club is a collection of 10,000 digital monkeys, with each monkey having a different combination of hats, shirts, mouthes, etc. While this project may seem rather innocent, the cheapest Ape for sale is listed at 118[9] eth, or $317,652, as of January 31st, 2022. This is due to a variety of reasons, the main being that

[6] https://onlineonly.christies.com/s/first-open-beeple/beeple-b-1981-1/112924 (last viewed on March 1, 2022)
[7] https://dune.xyz/queries/11005/21861 (last viewed on March 1, 2022)
[8] https://dune.xyz/sdas29/crypto-art-data (last viewed on March 1, 2022)
[9] https://opensea.io/collection/boredapeyachtclub (last viewed on March 1, 2022)

having this monkey on your Twitter is a status symbol. Bored Ape owners are also given access to several member-only benefits. PFPs are an interesting use case of NFTs, but it can be expected that there will be more relevant use cases for the technology.

Key sectors: Art
Key Stakeholders: Digital artists, marketplaces, collectors, speculators

Main concerns: technical implementation and storage of artworks, intellectual property rights, legal issues concerning ownership, regulatory status (in some jurisdictions), low liquidity on secondary markets

Current market perception: Optimistic

Long term potential: High (but limited market opportunity)

6.2 Digital Goods

Similarly to the art use case, any assets can be represented by an NFT for some use cases; this can allow for interesting dynamics. For example, a centralized portal can create a system where the NFT gives special rights or benefits to the owner. This can create an independent and autonomous secondary market for example in the sector of video game based assets. This approach can provide to the developers a significant advantage in terms of reducing infrastructure investments to self-regulate and manage hosted items markets. The single most significant use so far of NFT in terms of numbers was in fact related to https://www.cryptokitties.co/.

Another sector that is primed to take advantage of digital goods as NFTs is the metaverse. The metaverse is just another word for the virtual world. Currently, there are a lot of uncertainties as to what the metaverse will look like and how exactly it will work. The 2 dominating metaverse projects, as of February 1st, 2022, are The Sandbox and Decentraland. Both allow for users to purchase digital land, represented as NFTs, upon which they can build unique user experiences. As previously mentioned, one current use for this digital land is NFT galleries, where users can showcase their assets and gain market exposure. With increasing attention and investment in the metaverse, many future use cases will likely

revolve around companies and customer experiences. For example, Adidas launched 30,000 NFTs with the promise of exclusive access to merchandise and "open metaverse land experiences"[10].

Key sectors: Video Games, B2C online services

Main concerns: Loss of control on secondary markets fees and related revenues, Added development cost and market research to predict user behavior in a free market environment

Current market perception: Neutral

Long term potential: Very high

6.3 Physical Goods

NFTs can also be a way to certify ownership of physical goods. In this case, the possible advantage is related to leveraging a permissionless ledger to store an information that can be (centrally) verified and possibly also use the keys owning the asset to create a pseudonymous identity system. The ability to use proven open source technologies can possibly be a significant advantage in this case but significant cultural and legal differences on the topic of ownership will likely be the biggest burden in terms of establishing long lasting international standards.

Non-fungible tokens allow for digital artists to capitalize on their work by making it scarce, available to everyone, and earn royalties on secondary sales. Physical art could truly benefit from this technology as well. The most significant problems with physical art transactions are high commissions taken by galleries, replicas and fakes, and limited exposure of the piece. Because many art galleries are located in upscale urban areas with pricey real estate, they have a lot of expenses to cover in selling the art. This causes galleries to take a 50%+[11] commission. Another expense to be covered is verification of authenticity done by a professional art authenticator, and while these individuals often go through years of training, they can be wrong. Lastly, because physical art is scarce by nature and can only exist in one place at a time, the market for a given piece is only as big as the market it is currently living in.

[10]https://www.adidas.com/into_the_metaverse (last viewed on March 1, 2022)
[11] https://greedhead.net/what-percentage-commission-do-art-galleries-take/ (last viewed on March 1, 2022)

Another reason for the integration of physical assets as NFTs is collateralization. The current process of securing loans through collateralizing physical assets is tedious. If one were to apply for a loan and put their house (of which the deed is represented by an NFT) up for collateral, the bank could simply lock the NFT until they receive their money back. If the person were to fail to pay the bank back, a smart contract would automatically execute and transfer the house to the bank.

All of the above problems can theoretically be solved by NFTs; however, the ability to attach an NFT to a physical object has yet to be solved. This is likely a problem that will require government intervention because there is off-chain trust involved. For example, buying an NFT of a painting requires you to trust that the previous owner will send you the piece upon the sale.

Key sectors: Real estate, Art, Notary

Main concerns: Complex legal/cultural landscape, slow innovation in legal processes, possibly limited benefits if different standards emerge

Current market perception: Cautious

Long term potential: Mid/High

7. Key Considerations

As non-fungible tokens are still a new technology, there are several considerations that investors, developers, regulators, and all other stakeholders need to pay attention to as the technology evolves. Parts 2 and 3 of this report will dive deeper into each consideration and what is being done to address them.

7.1 Authenticity

Because NFTs are just digital files, they can be reproduced as “fakes”. While anyone can find the NFTs trade history and the address that created the item, NFTs can be difficult to verify if you do not know the owner or the creator. “The problem is that authenticity is dependent on the seller being who they say they

are." (Pranksy)[12]. Because digital items are infinitely replicable, anyone can save a file they find online and mint an NFT linked to it. You can apply this same logic to a previously existing NFT. One can save the image associated with a given NFT and mint a new NFT tied to the same exact file. If someone were to buy the fake NFT, any utility associated with the real NFT would not be accessible.

Many creators have already been victims of this type of fraud. In late 2021, deceased artist Dan Howard's family heard that his art was being auctioned as NFTs on OpenSea. While OpenSea responded to the family by removing the auctions from the platform, more images of the art were listed a mere couple weeks later[13].

Inauthentic replicas are not a result of NFTs; the physical art space has been fighting this problem since inception. They have done so by monitoring the ownership record of the piece and employing expert authenticators, but these methods are far from perfect. In April of 2018, art historian Eric Forcada discovered that over half the paintings in a French gallery were fakes[14]. NFT exchanges have been working to fight this problem by verifying certain collections. In order to receive verification, the creators or members of the project's team have to submit an application to the exchanges. If accepted, the project receives an indication of authenticity, which proves a given NFT is what it claims to be.

7.2 Off Chain File Storage

One of the most referenced concerns regarding non-fungible tokens relates to the underlying file-storage system storing the NFT. Blockchains sell blocks to users who use the blocks to store data. With Ethereum[15], the most used blockchain for NFTs, the data inside these blocks is stored on all nodes running the network. Because of this, it is very expensive to store large data files. As of February 2022, the average Ethereum block stores 92,114 bytes of data, or 92.1 kilobytes[16]. This is of issue to NFTs because the files linked to the NFTs cannot be stored on the blockchain without paying a significant amount of money. For example, the Bored Ape Yacht Club image files take up about 161,000 bytes of storage each. Because it is too costly to store these files on the blockchain, many sellers store the files on a network outside of the blockchain and use a reference to the data in the NFT.

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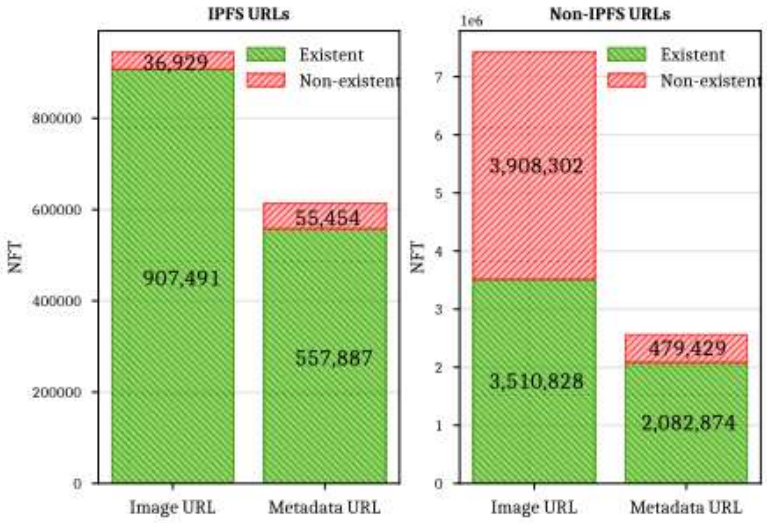
[12] https://www.theguardian.com/technology/2021/sep/01/collector-buys-fake-banksy-nft-for-244000 (last viewed on March 1, 2022)
[13]https://www.reuters.com/article/usa-tech-art/booming-nft-art-market-plagued-by-mind-blowing-fraud-idUSKBN2JS0YJ (last viewed on March 1, 2022)
[14] https://www.theguardian.com/world/2018/apr/30/french-museum-discovers-half-collection-fakes (last viewed on March 1, 2022)
[15] https://ethereum.org/en/ (last viewed on March 1, 2022)
[16] https://ycharts.com/indicators/ethereum_average_block_size (last viewed on March 1, 2022)

As explained in the overview section, NFTs are a unit of data. Contained in this unit of data is metadata. Metadata is data that provides context[17]. For non-fungible tokens, the metadata is a description of the asset of which the NFT represents. For example, the metadata of Bored Ape #3749[18] reads: "{"image":"ipfs://QmQpxqZ6hPnx8ofapPVgbg9JAh7S9oh3fNYvWwU7okdCU8","attributes":[{"trait_type":"Mouth","value":"Small Grin"},{"trait_type":"Hat","value":"Sea Captain's Hat"},{"trait_type":"Eyes","value":"Laser Eyes"},{"trait_type":"Clothes","value":"Black T"},{"trait_type":"Background","value":"Yellow"},{"trait_type":"Fur","value":"Solid Gold"}]}[19]".

The first part of the metadata is a pointer to where the image is stored. The InterPlanetary File System (IPFS) is a distributed system for storing and accessing files, websites, applications, and data[20]. The metadata contains a 46-character hash that points to the associated file stored in the IPFS. In plainer terms, an NFT does not contain the image itself, but a link to where the image is stored.

The link between the NFT and the asset is incredibly important for the token to stay relevant. When this link is broken, often referred to as the "Broken Link Problem", the underlying asset of which the NFT represents ownership is gone. It is of great importance that one checks the storage means and location of a given NFT before purchasing. The IPFS is known as one of the most trusted means of storing files and has greatly outperformed other storage solutions. The figure below examines "broken" NFTs on OpenSea and compares those using IPFS to those using other solutions.

[17] https://www.merriam-webster.com/dictionary/metadata (last viewed on March 1, 2022)
[18] https://opensea.io/assets/0xbc4ca0eda7647a8ab7c2061c2e118a18a936f13d/3749 (last viewed on March 1, 2022)
[19] https://opensea.mypinata.cloud/ipfs/QmeSjSinHpPnmXmspMjwiXyN6zS4E9zccariGR3jxcaWtq/3749
[20] https://docs.ipfs.io/concepts/what-is-ipfs/ (last viewed on March 1, 2022)



Source: Understanding Security Risks in the NFT Ecosystem[21]

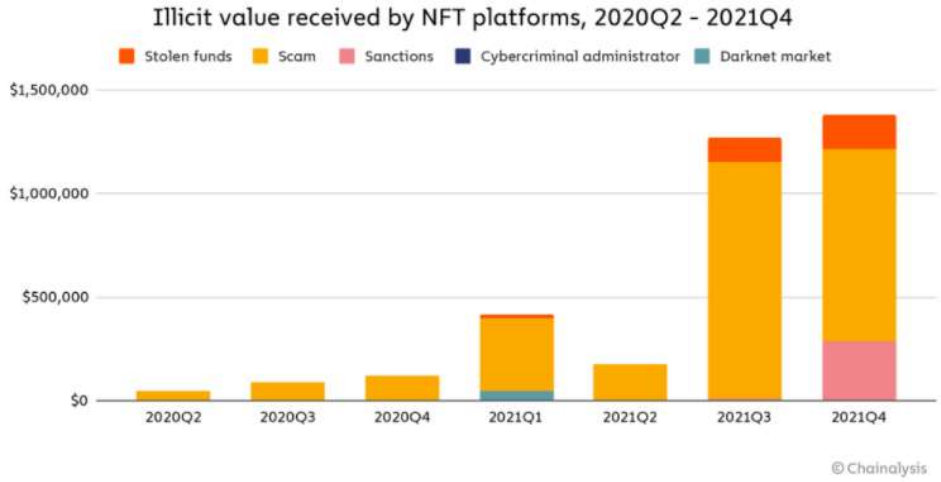
7.3 Money Laundering

The art market has always been used by criminals for money laundering, and NFTs seem to be the next step in illegal monetary transactions. The US Treasury identified 6 qualities of the high-value art market that make it enticing for money laundering: high-value, opaque nature, subjective valuation, transportability, law enforcement's difficulty in monitoring transports, and the use of third-party intermediaries to keep clients anonymous[22]. All 6 of these qualities apply to non-fungible tokens, with the most notable being transportability. On top of these 6, NFTs possess the ability to self-launder. Self-laundering is where criminals create an NFT themselves with one address and then buy the NFT with a different address. The NFT is then sold to the open market in exchange for clean funds.

Another reason NFTs are subject to money laundering is the structure of transactions in the market. With physical art, one entrusts a gallery to sell their art to the highest bidder. In this type of transaction, the gallery is responsible for ensuring an unproblematic and fully legal exchange in order to maintain their reputation. With NFTs and centralized/decentralized exchanges, the transactions are handled not only by the marketplace, but also by the seller of the NFT. This seller has no obligation to ensure the legitimacy of the exchange.

[21] https://arxiv.org/abs/2111.08893 (last viewed on March 1, 2022)
[22] https://home.treasury.gov/system/files/136/Treasury_Study_WoA.pdf (last viewed on March 1, 2022)

The third quarter of 2021 saw a jump in illicit addresses sending value to NFT marketplaces, from less than 250,000 USD in Q2 to over 1 million USD in Q3[25]. This number continued to rise in the fourth quarter. While these increases are significant, the overall activity represents a fraction of the 8.6 billion USD[23] in cryptocurrencies that were used for money laundering in 2021.



Source: Chainalysis[25]

7.4 Wash Trading

Similar to the concept of self-laundering is a type of transaction called a wash trade. An NFT transaction is made up of two parties: the seller and the buyer. These parties are not represented by physical people, but rather unique public key identifiers that point to a wallet on the network. One can own as many of these wallets as they would like. This means that one can sell an NFT to their own address, with the only loss of value in the network fee. This is a problem because NFT sellers can make their token appear much more valuable than it truly is. If a user were to mint an NFT with one address, sell it to their second address for 100 eth, and then list it on a marketplace for 5 eth, an inexperienced buyer could think they are purchasing a valuable NFT for a big discount.

One way to monitor wash trading is to find addresses that purchase an NFT from an address that it has received cryptocurrency from. If an address sends another address 0.5 eth, and then the receiving address purchases an NFT from the sending address, it is highly likely that one person owns both addresses. Chainalysis identified 262[24] users who sold an NFT to a self-financed address more than 25 times. An

[23] https://go.chainalysis.com/2022-Crypto-Crime-Report.html (last viewed on March 1, 2022)
[24] https://go.chainalysis.com/2022-Crypto-Crime-Report.html (last viewed on March 1, 2022)

interesting part of this find was that the net profit of these trades, amount made from resale to unsuspected buyers minus the amount paid for gas fees, was positive for less than half of the 262 users. However, the 110 sellers that made profit made over 8.5 million USD, while the other 152 only lost about 400,000 USD.

7.5 Regulatory and Tax Implications

As non-fungible tokens are a very unique asset-class, many are wondering how governments will view them. Regulators did not begin to truly address cryptocurrencies until 2021, and because of this they have a lot to catch up on. Regulation guidelines for NFTs will likely follow that of cryptocurrencies due to the substantially higher amount of cryptocurrency transactions. It is unlikely that NFTs can be grouped in with cryptocurrencies due to their ability to provide various types of utility.

So what classification will NFTs fall into? In order for an asset to be classified as a security, the investor must expect a return on their investment. In recognizing this, an NFT of a professional baseball player hitting a homerun will likely not be classified as a security; however, if a musician releases NFTs to fund the production of their album, while promising a percent of the royalties received by the album, it is likely that the NFT will have to be classified as a security.

Another classification that NFTs could be considered is commodities. The US Commodities Futures Trading Commission (CFTC) have indicated that digital currencies like Bitcoin and Ethereum are commodities under the US Commodity Exchange Act of 1936[25]. Because non-fungible tokens are unique and non exchangeable, it is unlikely that they will follow in this classification.

Aside from their classification, non-fungible tokens have other legal considerations, such as intellectual property (IP) rights. With most NFTs, some or all of the IP rights are kept by the creator. In certain scenarios, the NFT's smart contract may define certain parameters under which the owners of the NFT can profit off the reproduction and/or distribution of the asset. For example, a popular project called CryptoKitties allows for the commercialization of the NFTs such that "Commercial Use does not result in you earning more than One Hundred Thousand Dollars (100,000 USD) in gross revenue each year."[26] An

[25] https://www.law.cornell.edu/uscode/text/7/chapter-1 (last viewed on March 1, 2022)
[26] https://www.cryptokitties.co/terms-of-use (last viewed on March 1, 2022)

understanding of an individual NFT's IP rights is very important as more and more commercial opportunities develop.

7.6 Fractionalization

One type of NFTs that are almost certain to be classified as a security are fractionalized NFTs (F-NFTs). Whereas standard ERC-721 NFTs can only have one owner, F-NFTs are tokenized fractions of NFTs that allow multiple people to invest in the same NFT. Essentially, fractionalized NFTs use one or more NFTs as collateral to create ERC-20 tokens (referred to as "shards" of the NFT) that mirror their fractional value of the NFT; the market cap of the ERC-20 tokens is tied to the value of the NFT(s) that back them. F-NFTs will be most useful in tokenizing high-value assets, such as commercial real estate. By fractionalizing these assets, anyone can gain exposure to illiquid and heavily-barriered assets. F-NFTs also bring more liquidity to asset classes, such as real estate, that have been illiquid since conception. Because F-NFTs will mainly be used to expose people to new investment vehicles, they are due for more significant regulations than standard NFTs.

7. Conclusions

NFT's are a quickly growing and constantly evolving phenomenon that surely deserves attention. Major corporations including Twitter and Adobe are integrating tools supporting NFT's on their platforms and the dedicated marketplaces are growing by the day. Even though NFTs have drafted significant amounts of buzz, there are still significant gaps in research and data. It is important to remember that, as with any new technology or investment vehicles, change is inevitable. The NFT market today will likely look completely different in a couple years. Please be cautious in any NFT purchases.

In the second part of the Study Report we will dig deeper into the technical aspects of the different NFT implementations and explore emerging standards.

All the parts of this report can be considered as "living documents" to be refreshed periodically with updated information and insights from the community as this new intriguing niche of the industry develops.

Appendix A – Acknowledgement

(Informative)

(Note) The views expressed in this report are based on the personal views of the authors and not the views of the organizations to which they belong. Affiliations below are as of March 1, 2022.

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