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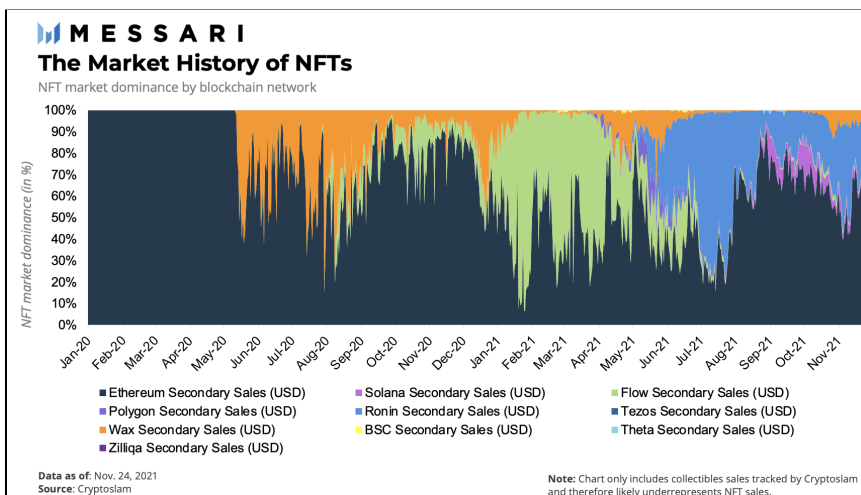
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NFT Market Overview

Non-fungible tokens (NFTs) are the equivalent of a serial number that can be used in a smart contract to verify the provenance and ownership of an asset (be it real world or digital). The serial number is encoded as an immutable, non-fungible property of the token along with the wallet address that minted the token. This provenance is how the authenticity of the NFT is confirmed, e.g. the NFT for Beeple's *First 5000 Days* is known to be authentic because it was minted from Beeple's wallet.¹



The earliest examples of NFTs were built on Ethereum with ERC-721 tokens, and today, Ethereum remains the dominant blockchain in the NFT market. Ethereum, however, has struggled to scale up to meet the explosive growth in the NFT market, and even after ERC-1155 was introduced to facilitate bulk NFT transactions, other Layer-1's, Layer-2's and sidechains have started gaining market share quickly.²

¹ While some people think NFT are immune to fraud, one anonymous white hat hacker proved otherwise by "[sleepminting](#)" a copy of Beeple's original digital art piece. Generally speaking, however, NFTs remain far less susceptible to fraud than the traditional art markets.

² <https://opensea.io/blog/guides/non-fungible-tokens/>

According to DappRadar, the NFT market generated over USD \$23 billion in sales in 2021 - an astounding jump from roughly USD \$100 million in the year prior.³ The actual number of sales may be higher because only sales facilitated through marketplaces can be reliably measured, leaving out direct, person-to-person (or rather wallet-to-wallet) sales. Conversely, wash sales and other forms of price manipulation could be artificially inflating sales estimates.

NFT Asset Segments

Most market observers segment the NFT market by the type of asset associated with the NFT. Art, collectibles, gaming and virtual worlds (aka the metaverse), sports, music and utility tokens are some of the most recognizable segments (although “utility” tokens is something of a catchall segment). Physical assets are another often mentioned segment but very few NFTs of this sort exist in the market today, as will be discussed later in the section on emerging segments.

It should also be noted that segmenting the NFT market by asset type can be highly subjective and does not necessarily provide for a mutually exclusive, collectively exhaustive (MECE) segmentation of the market.⁴ Although relative estimates of the size of each segment tend to be fairly consistent across sources, actual estimates can vary substantially without providing much in the way of additional insight into the market. A better approach for Chainlink to segment the market - based on the developer jobs-to-be-done - is proposed in the next section.

The largest consumer market segment as measured by USD sales in 2021 was collectibles. Collectibles are unique digital assets that are connected to some larger context and serve the consumer need for identity, community and social esteem. CryptoPunks and Bored Ape Yacht Club are the most recognizable collections in this segment, fetching extremely high price points from celebrities and brands for rare NFTs.⁵ The top 100 NFT collection alone are estimated to have a floor market cap of over USD \$16 billion.

With over 20 million transactions across both primary and secondary markets, the largest market segment by volume in 2021 was gaming and virtual worlds. In gaming, NFTs can be minted for in-game items that are oftentimes central to the game mechanics. In virtual worlds, NFTs represent parcels of land. The market leader in this segment is unequivocally Axie Infinity, which has spearheaded the play-to-earn revolution with over 1.4 million daily unique active wallets (UAW).

NFT Developer Segments

Chainlink is already playing an important role in the NFT value chain with its Verified Randomness Function (VRF). Randomness is a key ingredient for assigning NFT attributes in generative art, collectibles and gaming alike.⁶ What defines this market segment is not the underlying asset type but rather the developer’s need to randomly assign NFT attributes. The customer, from Chainlink’s perspective, is the developer, and the job-to-be-done is randomly assigning NFT attributes.

Over the past year, over 11 million NFTs were minted that could have benefited from Chainlink’s VRF, generating approximately USD \$13.5 million in revenue. While demand for Chainlink’s VRF will continue to

³ <https://dappradar.com/blog/2021-dapp-industry-report>

⁴ For example, Sorare is a fantasy soccer game that involves NFTs. As such, it could be considered part of both the gaming and the sports segments, although Sorare is very different from Autograph, which is also included in the sports segment but might actually be a better fit with collectibles.

⁵ Digital art from Art Blocks, which has experienced explosive growth recently, is also sometimes included in the collectibles category and illustrates the subjectivity of segmenting the market in this way.

⁶ <https://chain.link/education/nfts>

increase as the markets for generative art, collectibles and gaming NFTs grow, thinking in terms of other developer jobs-to-be-done with off-chain data can help to surface new opportunities for Chainlink to add value in the NFT market. Based on current market activity, there are two immediately addressable segments worth highlighting: NFT Financialization and NFT Commercial Use.

NFT Financial Services

With the rapid expansion of the NFT market, developers have started working on novel ways to facilitate NFT transactions beyond primary sales. The target customers for these Web 3 enabled solutions are investors interested in NFT-related financial services, such as lending and portfolio management. Collectively, this developer segment can be referred to as NFT Financial Services.











A conservative estimate of the size of this segment would focus on investment-grade NFTs, which excludes high velocity NFTs⁷ (e.g. in-game items) and NFTs with negligible secondary markets (e.g. ENS domains). This roughly equates to the art, collectibles and virtual land asset segments, which collectively represented around 2.2 million newly minted NFTs and USD \$12.3 billion in sales over the past year and are projected to grow at a compounded annual rate (CAGR) of roughly 20%.⁸ Based on the increasing number and value of these assets and developer activity, NFT Financial Services would be the most attractive near term growth and expansion opportunity for Chainlink to pursue.

Data Products

What developers in this segment share in common is a need for pricing data from diverse sources (i.e. data feeds) and pricing models that can be supported by Chainlink Keepers to essentially predict the most likely spot price for an NFT given its attributes and macro conditions. Pricing models - rather than just raw pricing data alone - are critical to properly handle the heterogeneity of the NFTs being bought and sold in market, e.g. is the NFT a 1/1 or 1/10000, who is the creator, does the NFT provide any other additional utility, etc., and to adjust for the risk factors discussed in the next section. The outputs of these pricing models would then be used by the smart contracts providing financial services to investors.

Data Sources

The best quality data will come from marketplaces and aggregators. Sales of art, collectibles and virtual land are still relatively concentrated across a small number of marketplaces, which should allow Chainlink to focus its business development efforts on the biggest players. Data on direct, secondary sales would be prohibitively difficult to acquire and verify but such sales are not likely to have a strong influence on pricing models anyways.

MARKET	AVG. PRICE	TRADERS	VOLUME
1  LooksRare ETH	\$404.36k 20.32%	1,607 -5.91%	\$574.59M 16.79%
2  OpenSea ETH - Q Polygon	\$1.46k 6.45%	67,530 -15.89%	\$225.19M 10.34%
3  Magic Eden SOLANA	\$253.9 39.9%	24,607 -9.71%	\$7.98M 25.41%
4  CryptoPunks ETH	\$327.27k 59.26%	30 -70.67%	\$6.54M -65.38%
5  NBA Top Shot FLOW	\$49.46 14.37%	22,458 -15.67%	\$2.75M -12.74%
6  Axie Infinity ETH - Q RONIN	\$37.28 -50.91%	26,907 -6.73%	\$2.65M -7.7%
7  Mobox BSC	\$368.33 -5.71%	2,010 69.19%	\$1.2M 95.04%
8  Solart SOLANA	\$453.87 126.57%	2,221 -5.89%	\$791.1k 117.46%
9  AtomicMarket WAX	\$9.76 -0.77%	14,016 -5.74%	\$787.81k -5.39%
10  Decentraland ETH	\$42.76k 63.8%	26 -3.7%	\$727k 46.56%

Source: DappRadar <https://dappradar.com/nft/marketplaces>

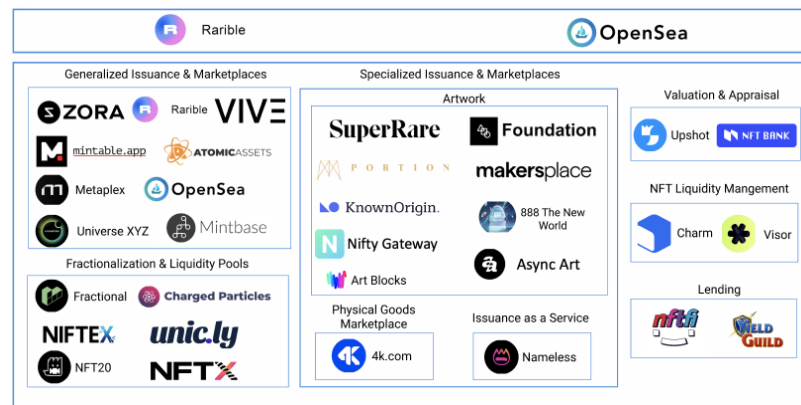
⁷ This is analogous to money velocity which is a measure of how often a unit of currency is used in a transaction; in the case of NFTs, it would be the frequency with which an NFT or class of NFTs are transferred. Low velocity implies NFTs are being held for longer periods as investments; high velocity implies NFTs are being exchanged for more utilitarian purposes. Investors might still be interested in high velocity NFTs for arbitrage opportunities but low velocity NFTs are necessarily less liquid and present more attractive assets for value retention and collateralization.

⁸ <https://nonfungible.com/market/history>

One of the challenges with data from all of these marketplaces will be wash sales and other forms of price manipulation. The underlying assets are also prone to bubbles as their popularity ebbs and flows, introducing the additional risk of a rapid collapse in the fair market value. NFT Financial Services developers need to account for all these risk factors in their pricing models.

Target Web 3 Protocols/Dapps

Within the NFT Financial Services segment, there are various customer personas to consider. There are the developers building solutions for fractional ownership of NFTs, such as Fractional, Unic.ly and NFTX (among others), who need reliable price information to make investment decisions and manage their portfolios and



liquidity pools.⁹ There are lenders, such as NFTFi and YieldGuild, who receive NFTs as collateral and need to know the value of that collateral relative to the loans being made. Finally, protocols such as Upshot and more diversified portfolio management service providers such as NFT Bank can be grouped together as appraisers who help investors to assess the fair market value of their holdings and to identify attractive new investment opportunities.

Source: Messari

<https://messari.io/article/the-nft-stack-exploring-the-nft-ecosystem>

NFT Commercial Use

Managing the commercial use of digital content - commonly referred to as digital rights management (DRM) - has been a challenge since the beginning of the internet. Content creators have had to rely heavily on intermediaries, such as publishers and content aggregators, to defend their intellectual property (IP) rights in exchange for a portion of the value generated by their content (i.e. revenues). NFTs, however, offer a new and better alternative: commercial use mediated through smart contracts.

Smart contracts are extremely well suited to managing royalty payments for the commercial use of digital content, and a number of pioneering developers are already trying to do just that for music, where the number of intermediaries involved can be surprisingly large and the structure of royalty payments are eye-wateringly complex.¹⁰ If successful, the solutions developed for music could also provide a template for others to follow with other forms of digital content; music is really just the beginning.¹¹

Traditional content consumption markets are the best proxy for sizing the NFT Commercial Use segment, and in 2021, music streaming generated around \$20 billion in revenue globally, while video streaming generated closer to \$50 billion. Most growth projections for streaming media and entertainment come in at 5-10% CAGR.¹²

Of course, it will take time for those traditional markets to adopt smart contracts and NFTs in a meaningful way, and it's hard to predict what that will really look like so these proxy measures of the NFT Commercial Use segment still need to be discounted to account for all that risk. Assuming 1-2% of the streaming market shift

⁹ <https://medium.com/@bdharris/an-overview-of-the-nft-fractionalization-landscape-83487874926b>

¹⁰ <https://www.indiemusicacademy.com/blog/music-royalties-explained>

¹¹ <https://www.rollingstone.com/pro/features/music-crypto-blockchain-nfts-guide-1116327/>

¹² <https://www.pwc.com/gx/en/news-room/press-releases/2021/global-entertainment-media-outlook-2021.html>

over to NFT based solutions over the near term, Commercial Use would be smaller than the NFT Financialization segment today, but over a longer time horizon, the NFT Commercial Use segment could be a much bigger opportunity for Chainlink.¹³

Data Products

Developers in the NFT Commercial Use segment need reliable information on the trigger events for royalty payments. Generally speaking, these are counts of streams, views, and impressions aggregated across content platforms. As with the NFT Financialization segment, additional off-chain computation supported by Chainlink Keepers could be used to calculate the actual royalty amounts due to the various rights holders (e.g. in the case of music, how much goes to the songwriter, how much goes to the recording artist(s), how much should be paid out for samples), in turn triggering smart contracts to make the payments.

Data Sources

Stream, view and impression counts would need to come from the platforms consumers use to find and access the content. For music and video content, the most important platforms include Spotify, Apple, Vevo, YouTube, Tencent, TikTok, and Amazon. The challenge with accessing these sources is that most of these Web 2.0 companies operate as walled gardens with considerable market power, and they might be resistant to sharing data or enabling anything that could threaten their vested interests in the status quo.

Nonetheless, as tech companies, these same content platforms also appreciate the strategic importance of disrupting your own business model before a new entrant can, and both TikTok and YouTube have already signaled their interest in participating in crypto - TikTok by way of a partnership with Audius¹⁴ and YouTube in less specific comments.¹⁵ An alternative to working directly with the platforms would be industry bodies that already help to aggregate much of this data for the same purposes, but of course, these are some of the very same entities developers are trying to disintermediate with smart contracts.

Another big hurdle to overcome will be encoding IP rights for back catalogs into smart contracts. In music especially, who gets paid for what can be very hard to untangle, and reliable metadata can be equally hard to find and access. Industry bodies involved in digital right management could be enticed to contribute data to oracle networks as part of a larger solution to these kinds of perennial industry challenges.

Target Web 3 Protocols/Dapps

Right now, most of the action in NFT Commercial Use is focused on music (for many of the reasons mentioned above) so music NFT platforms, such as Royal, Catalog and YellowHeart¹⁶, would be among the most promising opportunities to establish a beachhead. Additionally, Sound.xyz is targeting the market for music samples, and DistroToken is building a crawler to identify registered audio content on media platforms and recover royalties.

Chainlink could also work with Mirror.xyz and Brave to explore opportunities in publishing. Brave uses the Basic Attention Token (BAT) to reward publishers for impressions, and Brave might be able to enhance their value proposition with rewards for impressions outside the Brave browser. Livepeer could also potentially open up opportunities in video.¹⁷ All of these should be considered more experimental opportunities, subordinate in

¹³ Based on the previous market shifts over to streaming in music and video, the most likely time horizon would be 10-15 years.

¹⁴ <https://www.coindesk.com/business/2021/08/16/tiktok-picks-streaming-service-audius-to-power-new-sounds-library/>

¹⁵ <https://decrypt.co/91179/youtube-ceo-hints-at-nft-integration-in-letter-to-creators>

¹⁶ Yellowheart could also provide a foothold for the Ticketing & Access NFT use case, should a validated need for off-chain data from oracles emerge as the market continues to evolve.

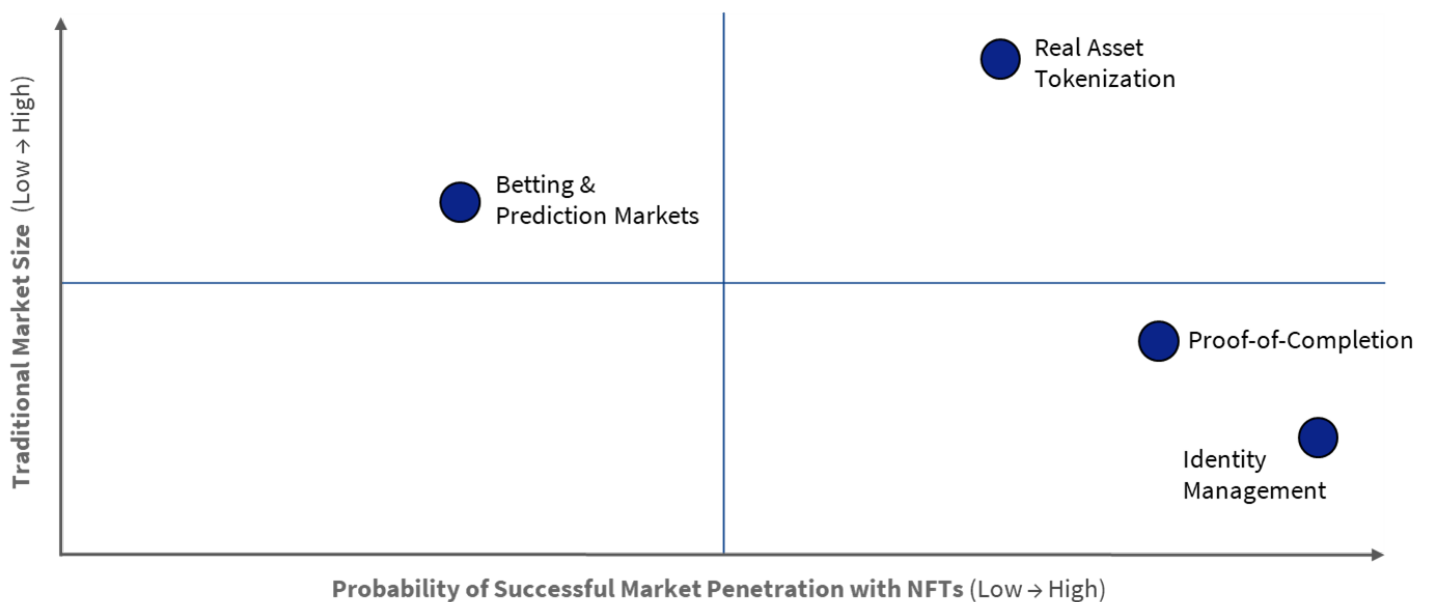
¹⁷ <https://messari.io/article/the-state-of-livepeer>

priority to music because commercial use solutions for music seem to have the most traction in the current market.

Emerging Segments

Outside of the market segments already discussed, there are a lot of other talked about NFT use cases that today remain aspirational in nature.¹⁸ Tokenizing real assets with NFTs, for example, has generated a lot of excitement but very little in the way of actual solutions so far. While such use cases may one day become very large and lucrative segments of the market, they require a lot more [customer development](#) before a significant investment of resources from Chainlink can be justified.

With all that in mind, there are still few use cases worth mentioning where Chainlink's oracle network could play an important role.¹⁹ To size each of these emerging segments, the size of the traditional markets can be weighted by the probability of successfully transitioning those markets over to NFT enabled solutions.



Real Asset Tokenization

Today, one of the few examples of tokenized real assets is 4k, but the 4k protocol depends critically on custodial possession of the actual physical goods (in this case, luxury items) to mint NFT equivalents.²⁰ If an oracle network could be used instead to verify the provenance, ownership and possession of real assets in a decentralized way, the tokenization opportunities would be measured in the trillions of USD. Tax, title and insurance data could be used to tokenize real estate; near field communication ((NFC) and the internet-of-things (IoT) could be used to tokenize all manner of commodities. The regulatory uncertainty that surrounds crypto tempers the probability of successful penetration into these traditional markets but the probability remains on the highside nonetheless.

¹⁸ <https://blog.ether.cards/building-dynamic-nfts-on-ether-cards-using-chainlink/>

¹⁹ Some exciting NFT use cases, such as ticketing where NFTs could help to address the problem of scalping, have been excluded here because how such smart contracts might need to use off-chain data from oracles remains unclear (perhaps at the point of redemption).

²⁰ <https://www.coindesk.com/business/2021/07/20/rolexes-in-defi-nft-marketplace-4k-raises-3m-to-combine-nfts-and-luxury-goods/>

Betting and Prediction Markets

Betting and prediction markets are another great fit with NFTs and smart contracts. Bets could be minted as NFTs; oracles would then verify whether the bet or prediction was correct; and smart contracts would automatically pay out winning bets. By some estimates, there are over 1.6 billion gamblers globally who might be interested in placing bets with NFTs, and all those gamblers equate to over USD \$500 billion in annual revenues, with roughly USD \$80 billion of that coming from online gambling. Suffice it to say, this is another very large traditional market that could eventually shift over to NFTs.²¹ Were it not for the regulatory barriers to entry in major markets like the US, this segment would probably already be large enough to merit attention, but after adjusting for the regulatory risk, Real Asset Tokenization remains a more attractive opportunity.

Proof-of-Completion

NFTs are a novel way to prove that you have completed some sort of task or requirement, such as attending a class or completing an online course, and it is easy to imagine how this could evolve into using NFTs to manage licensing, certifications and even diplomas. Higher education generated almost USD \$78 billion in worldwide revenue in 2020 and is expected to grow by 10% compounded annually in coming years.²² This emerging segment would be smaller than Real Asset Tokenization or Betting and Prediction Markets, but with the COVID pandemic accelerating trends in virtual learning, the probability of successfully shifting the market over to NFTs seems higher.

Identity Management

The Ethereum Naming Service (ENS) and Unstoppable Domains mint NFTs to represent public keys in an easier to remember (and say) human-readable format - the Web 3 equivalent to DNS. These NFTs can represent a lot more than a website though. NFTs could become your universal Web 3 username, stored in your crypto wallet and used in place of social sign-ons to access dapps, with Chainlink oracles using public records to verify you are who you say you are (as a more scalable alternative to [BrightID](#)'s current solution). Decentralized identity verification and management could also one day provide a solution to know your customer (KYC) requirements. The clear need for decentralized identity management solutions to enable a Web 3 future makes it highly probable that this will become a legitimate segment of the NFT market, but that segment is likely to be much smaller, both in terms of transaction volume and USD equivalent value, than the other segments already discussed. For reference, Verisign estimates the total number of registered top level domains to be just over 350 million.²³

Conclusion

The challenge for Chainlink in the NFT market will be to distill a vast and rapidly expanding universe of use cases down to just a few strategic priorities. Jobs-to-be-done provides a good framework for segmenting the market that focuses on Chainlink's actual customers: smart contract developers. Chainlink's VRF is already serving the NFT Minting segment well, and the next big growth opportunities will come from the NFT Financial Services and NFT Commercial Use segments.

²¹ <https://gamblingngo.com/guides/gambling-stats-facts/>

²² <https://www.marketwatch.com/press-release/worldwide-higher-education-market-size-forecast>

²³ https://www.verisign.com/en_US/domain-names/dnib/index.xhtml