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Non-Fungible Token (NFT)andDecentralized Finance

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ABSTRACT
The Non-Fungible Token (NFT) market is mushrooming inthe recent couple of years. The concept of NFT originally comes from atoken standard of Ethereum, aiming to distinguish each token with distinguishable signs. This type of tokens can be bound with virtual/digitalproperties as their unique identifications. With NFTs, all marked properties can be freely traded with customized values according to their ages,rarity, liquidity, etc. It has greatly stimulated the prosperity of the decentralized application (DApp) market. The blockchain and cryptoasset sector, since coming to the attention of the mainstreambusiness and financial markets during the bitcoin bull run of 2017, continues to accelerate and evolverapidly. Decentralized finance (DeFi), a new iteration of what was previously referred to as openfinance, has emerged as an innovative use case and service enabled by blockchain technology. Aswith any innovation or new tool, however, there remains a range of questions and considerations thatwill have to be addressed prior to wider adoption and utilization.However, the development of the NFT ecosystem is stillin its early stage, and the technologies of NFTs are pre-mature. Newcomers may get lost in their frenetic evolution due to the lack of systematicsummaries. In this technical report, we explore the NFT ecosystems inseveral aspects. We start with an overview of state-of-the-art NFT solutions, then provide their technical components, protocols, standardsand desired proprieties.This research attempts tocontextualize the development of DeFi, frame it within the blockchain and cryptoasset sector, andexplain potential obstacles and challenges to further development. Subsequent to this examination ofDeFi trends, challenges, and opportunities, a potential framework for further development andimplementation will be presented.

KEYWORDS: Blockchain · NFT · DApp · Smart contract, Decentralized finance

I. INTRODUCTION

Blockchain and cryptoassets have, and continue to, disrupt the financial servicessector and how both individuals and institutions access capital and other financial information. That said, therehas emerged a trend and direction that can be viewedas somewhat paradoxical to the original intent and idea of bitcoin andcryptocurrencies. As larger institutions, including large multinational organizationsand institutional investors allocate capital and personnel to the sector, this has ledto a pivot to more permissioned, private, otherwise more centralized blockchainoptions. Accompanying these investments has been the proliferation of new applications, as well as increased scrutiny and regulatory interest (Kharif, 2020a).These developments, although necessary for increased institutional adoption andacceptance of blockchain and cryptoassets, have led to some developers to buildout a new set of applications and services.Specifically, decentralized finance (DeFi) seems to represent a return more of a loosely organized operating structure and business model as opposed to the morecentralized options that have been proliferating the marketplace, and represents thepotential for truly decentralized finance What this paper attempts to do is as follows.Firstly, the research conducted within this piece will examine, analyze, and explainthe mechanics of DeFi as they connect to both blockchain technology as well ascurrent financial services. Secondly, and building on the fundamentals establishedin the first section of this research, certain accounting specific opportunities andchallenges will be presented and documented. This section will include accountingreporting and valuation issues, as well as a how these accounting issues can impactbusiness implementation. Lastly, and rounding out the research, a potentialframework for integrating physical assets with DeFi technology will be presented.

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Token Standards

The most prevailing token standard comes from ERC-20. It introduces theconcept of fungible tokens that can be issued on top of Ethereum once satisfyingthe requirements. The standard makes tokens the same as another one (in termsof both type and value). An arbitrary token is always equal to all the othertokens. This stimulates the hype of Initial Coin Offering (ICO) from 2015 topresent. A lot of public chains and various blockchain-based DApps.gainsufficient initial findings in this way. In contrast, ERC-721 introduces anon-fungible token standard that differs from the fungible token. This type oftoken is unique that can be distinguished from another token. Specifically, everyNFT has a uint256 variable called tokenId, and the pair of contract addressand uint256 tokenId is globally unique. Further, the tokenId can be used as aninput to generate special identifications such as images in the form of zombies or cartoon characters.

NFTs Desired Proprieties

NFT schemes are essentially decentralized applications ,and thus enjoy thebenefits/properties from their underlying public ledgers. We summarise the keyproperties as follows.

- Verifiability. The NFT with its token metadata and its ownership can bepublicly verified.
- Transparent Execution. The activities of NFTs include minting, sellingand purchasing are publicly accessible.
- Availability. The NFT system never goes down. Alternatively, all the tokensand issued NFTs are always available to sell and buy.
- Tamper-resistance. The NFT metadata and its trading records are persistently stored and cannot be manipulated once the transactions are deemedas confirmed.
- Usability. Every NFT has the most up-to-date ownership information, whichis user-friendly and information-clearly.
- Atomicity. Trading NFTs can be completed in one atomic, consistent, isolated, and durable (ACID) transaction. The NFTs can run in the same sharedexecution state.
- Tradability. Every NFTs and its corresponding products can be arbitrarilytraded and exchanged.

DEFI CHARACTERISTICS & POTENTIAL

several of the core tenants of DeFi applications seem to, on the one hand, be a return and linkageback to the original idea and ideals of bitcoin itself. Specifically, DeFi protocols and projects enable lower cost, faster, and more efficient cross border payments and transactions, similar to how bitcoin was designed to facilitate remittances and other international transfers. While every DeFi project will be different, and will operate in a slightly different manner, there are several core characteristics that are common to virtually every project in the marketplace that are consistent with governance and operating a decentralized network (Hughes & Smith, 1991). Not presented as an exhaustive nor all-inclusive listing, these common characteristics should be used to form the basis for more robust and comprehensive analysis of said projects.While not a cure-all solution nor aguarantor of no additional issues, smart contracts do allow a certain level of automation to take place while also allowing some level of manual review to stilloccur. On the other hand, smart contracts and the increased errors that can resultfrom increased automation mitigates against solely relying on smart contracts andautomated execution (Morris, 2020).the potential and possible upside of DeFi applications and use casesexpand far beyond relatively straight forward crypto lending and crypto borrowingto more emerging concepts such as Universal Basis Income (UBI). Once considereda fringe or not terribly realistic idea or concept, the idea of UBI has more recentlymoved to the forefront of the macroeconomic conversation. Rounding out the discussion on the potential and upside of DeFi applications priorto returning to more operationally focused tasks and processes, the potential impactof flash loans and increased accessibility to credit and other financial resources isdifficult to overstate. Although theunderpinning idea of blockchain and bitcoin inparticular was how to enable greater accessibility at lower costs, DeFi mayultimately be how these aspirations become reality.

Clearly there are control and disclosure considerations that are connected toDeFi applications, and it is worth allocating some time to examine them (Bain,2020). Especially pertinent for DeFi application are the (worthwhile) concerns thatcan be raised with regards to Know-Your-Customer (KYC) and Anti-MoneyLaundering (AML) laws.Honing in on the specific issues that could curtail further investment and growth inthe space is also focused around the idea of interoperability. The intersection of thecrypto economy with the fiat economy is an issue that is worthy of additionalanalysis, and is one that is a factor at every decision point along the way. A commonrefrain among some blockchain and crypto skeptics is that there remains abifurcation between these two sets of economies, and the potential

damages thatcan occur should these gaps remain. In a practical sense what this results in is acryptoasset landscape and outlook that is separated and potentially broken off fromthe still much larger fiat based economy. One such example of how this integrationand overlap continues to expand is represented by the rapid growth in the nonfungible token (NFT) sector (Leising, 2021), which are yet another recent application and iteration of the blockchain and crypto economy.In addition to the regulations linked to customer knowledge and identification, theimportance of collateral and the ability to interoperate with that collateral isimportant. For example, if a DeFi organization both lends and operates in solelycertain types of cryptoassets, how will this entity have the ability to work with fiatbased banking institutions? Even seemingly simple issues as what accounting orbook-keeping software to use can quickly become an exceedingly complicatedissue when real world examples are brought to the table. Adding on to this issue isalso the importance of Federal Deposit Insurance Corporation (FDIC) coverage,i.e., how are the reserves secured?

Despite NFTs have a tremendous potential impact on the current decentralizedmarkets and the future business opportunities, the NFT technologies are stillin the very early stage. Some potential challenges are required to be carefullytackled, while some promising opportunities should be highlighted. Further, eventhough much literature on NFTs, from blogs, wikis, forum posts, codes andother sources, are available to the public, a systematic study is absent. This paper aims to draw attention to these questions insofar as observed and focuson summarising current NFT solutions. We provide a detailed analysis of itscore components, technology roadmap status, opportunities, and challenges. Thecontributions are provided as follows.

DEFI ACCOUNTING CHALLENGES

An issue that spans crypto applications across the board is the volatility that iscommonly associated with, or linked to, cryptoassets of all kinds, as well as theimplications for this volatility on DeFi functionality and operations. Even arelatively simple DeFi transaction, crypto lending or borrowing, can be complicatedby the price volatility of an underlying asset. Considering that many of these DeFitransactions need to be collateralized in excess of the amounts borrowed – sometimes in excess of over 150% - any change in the price of the underlying cancause these covenants to be breached. Instead of simply requiring paperwork, however, a breach of these collateralization clauses can lead to the immediateliquidation of the smart contract itself.Debt covenants, and managing the risks associated with the potentialbreaching ofthese debt covenants are, of course, a routine part of any treasury or cash management function in an institution. The primary difference in the DeFi sector isthat this is driven by the potential volatility of the underlying asset serving ascollateral or otherwise equivalent basis for the loan or financing being provided.Even as DeFi applications and organization grow in scale, scope, and assets undermanagement (AUM), this embedded potential risk is something that has seeminglyflown under the radar.

Smartcontacts

Secondly, and circling back to the topic of smart contracts, these semi-autonomousblockchainapplications simultaneously allow organizations to operate in adecentralized manner, but also create risks. Benefits of smart contracts driving theoperations of an entity or firm are that integrating smart contracts into themanagement of a firm allows fewer manual touch points and opportunities fordelays and control breaches to occur. On the other side, however, increased automation and digitization of processes and protocols does introduce the potentialfor incomplete or erroneous processes simply being completed faster. In addition,there are also risks that can be introduced with regards to what specific individualshave access to, or control over, the underlying code that drives and manages thesmart contracts themselves.

STABLECOINS

To enable a robust conversation around DeFi it is integral to understand the roleand potential use cases for stablecoins in this emerging conversation. Developed asan alternative to decentralized stablecoins, the purported benefits of stablecoinsinclude, but are not limited to, the following. Many of the issues that are commonlyassociated with cryptocurrencies, but perhaps most pointedly the price volatilitycommonly linked to bitcoin and others, can be potentially offset or even resolvedvia the broader introduction of stablecoins (Kharif, 2019). Prior to any furtherdiscussion or conversation around the potential overlap of stablecoins for new and emerging blockchain applications such as DeFi it is important to break down andunderstand what exactly stablecoins are, and how they are differentiated fromexisting decentralized

cryptocurrenciesDrilling deeper into this concept, there are also several different types of stablecoinsthat can be utilized by any number of larger DeFi initiatives, which highlights the need for consistent and objective crypto taxonomy to be a part of any cryptoassetconversation (van der Merwe, 2021). For example, there are stablecoins that arepegged or connected specifically to one fiat currency such as the U.S. dollar, whichaccounts for the majority of stablecoins currently in the marketplace. In addition,there is the potential for some stablecoins to be connected, pegged, or tethered tosome external commodity such as gold, oil, or other external asset. There are alsoother options have entered into the marketplace that are stablecoins connected toother stablecoins, or have a value derived from a algorithmic formulation. In other words, these are stablecoins that are instruments or derivatives of othercryptocurrencies; this results in one cryptocurrency serving as the default reservecurrency for these other instruments

OPERATIONAL CHALLENGES

In addition to the blockchain and cryptoasset specific issues, there are alsooperational items that are unique to the DeFi sector and space. Specifically, and oneof the major issues that has been raised to date is that many blockchain applicationsare not always connected to existing financial markets, external assets, or othertraditional items. This continues to exist even as organizations debut and launchspecific funds and other financial market projects connected to DeFi during the 2021 bull run for crypto at large (Grelfield&Hajric, 2021). Although this hasbegun to be addressed via the rise of tokenized assets based on tangible and physicalassets, there is still another item that can potentially fly under the collective radarof financial services; the crypto dependency of the DeFi sector.To some market participants this might seem like a beneficial attribute of the entireDeFi concept and sector, but upon closer inspection this is a limiting factor thatcould provide a substantial headwind moving forward. While it is true that theblockchain and cryptoasset sector has expanded dramatically since bitcoin was firstintroduced in late 2008/early 2009, it is still dwarfed by the fiat-based commercialpayment system. Specifically, something that needs to be understood is that whileorganic solutions are indeed being developed and implemented in the marketplace,there is also reciprocating movement being delivered by incumbent institutions andregulators. These include, but are not limited to, the efforts and initiatives underwayat financial institutions such as JP Morgan, Visa, PayPal, and others; these shouldbe seen as yet another sign of blockchain and crypto maturation. That said, even though there are continuing advancements in product and service offerings, thereremains a significant obstacle; the lack of cash flow linked to cryptoassets.

Decentralized Finance Cash Flow

An additional consideration that should be part of an evaluation of DeFi projects isthe importance of cash flow generation as a part of the initiative. Stocks and bondshave certain cash flows associated with them, and while these can certainly varyfrom instrument to instrument, the underlying fact remains the same. Investors,particularly the larger institutional investors that contribute significantly to marketliquidity and price discovery, expect and in some cases rely on cash flows to fulfillinvestment goals. To that end, to truly expand the concept of DeFi from a niche areato one more amendable to mainstream investors, these projects should also be linked to projects that – if not self-sustaining – at least generate some level of cashflow for investors.organizations have existed. Rewards points, membership rewards, and airline miles are mainstays of the retail and consumer economy; DeFi can and already isleveraging this familiarity. Commonly referred to as utility tokens, these coins andtokens can also play a role in financial market development, especially if they areissued and connected to tangible financial assets. Shares, represented by a coin ortoken, can represent a share in the management of an organization, and while everyindividual project will operate in its own distinct manner, there are several coreexamples that are relevant for any discussion around coin or token classification.

Tokenized

An emerging trend that is quickly expanding and developing in the DeFi space isthe idea and concept of tokenizing physical real-world assets. What this means willvary from project toproject, but the general process will include the followingcomponents. The specifics of this will be documented in more detail below, butgenerally are developed to allow assets holders to generate liquidity from existingassets. Drilling down into the tokenization process, and examining some of theissues linked to tokenizing assets in general, there are several core concepts andideas that are part of this process .The asset in question needs to be identified correctly, and this might be a moreextensive process than it might appear on the surface. To launch a DeFi operation,and to tokenize

certain properties and other physical assets there needs to be a clearcut ownership structure, which can be further complicated due to legal or jurisdictional issues (Mehboob, 2020).

Fraud Considerations

Any conversation around the proliferation of DeFi and associated applicationswould be incomplete without a conversation around the potential for fraud and otherunethical activity connected to the sector. Specifically, there are potentiallyworrying signs of a parallels connected to the previous ICO bubble that should beacknowledged as emerging factors in the DeFi sector. Perhaps most obviously isthe correlation that can be drawn between the hype and excitement that hadpreviously surrounded the ICO aspect of the cryptocurrency marketplace.Based in large part around the information asymmetry that still exists in the blockchain andcryptoasset sector, DeFi introduces an additional layer of decentralization to thisconversation. Seemingly an obvious point to make, this also creates numerous otheropportunities for fraud or other unethical activity to occur. These factors and trendsare also increasing the need for comprehensive audit and assurance standardsupdates and modifications (Ryan, 2021).

POTENTIAL FRAMEWORK FOR IMPLEMENTATION

To achieve broader and wider mainstream adoption it is necessary to develop andachieve more institutional usage it seems apparent that the development of aframework for implementation will be necessary. Constructing this bridge betweendifferent classes and types of financial systems is going to also require, potentially,the creation of new assets and asset reporting methodology. This also raises thefollowing question; what existing assets, if any, are an appropriate or wellconsidered fit for DeFi adoption and implementation? Taking a look at the expectations of coin and token holders, as well as some of the fundamentalcharacteristics of DeFi at large, there are several asset categories and characteristicsthat seem to make the most sense.

Assets to serve as the basis for a DeFi based financial system should, before anyother considerations are taken into account, be relatively stable in value and notexperience large price swings and volatility. That is not to say that these assets musthold prices steady for an indefinite period; that is impossible. Rather, that wouldseem to point to assets such as real estate,infrastructure related assets, or intangibleassets relatively static in market valuation. Additional assets that might seem tomake sense are stablecoins that actually are stable in value, or some forms ofintangible assets that are either relatively static in value, or only subject to periodic
examinations.

In order for DeFi applications and the underlying assets become a larger part of theeconomic conversation, it is also going to be necessary for the fundamental businessand use cases to be transparent and understandable. To that end, and linking backto an earlier point, the assets themselves are going to need to be at least partiallyself-sustaining in order for this relatively new business model to operate asadvertised. In terms of the assets, however, there is also going to need to be aconversation and evaluation around how these assets are safeguarded. Clearly there are blockchain and crypto specific risks and control issues that need to be taken intoaccount, but even simply for the underlying asset itself, there are going to beadditional items that will need to reported and accounted for a DeFi project.

Policy Considerations

After analyzing the current state of the DeFi landscape, as well as the economicfactors that are driving this sector forward leads to the following question; what aresome of steps that can be implemented to help improve the potential success of sucha concept? Specifically, is there a framework or policy program that would be ableto be developed that could bring together the crypto economy and the fiat economy?While it is too early to state definitively how this merging will ultimately play out,there do appear to be several considerations that should form the basis for any suchframework.

A specific approach that can be taken is the implementation and proliferation ofsandbox environments. Sandboxes allow for the experimentation and developmentof innovative and non-conventional ways of doing business without having toremain in full compliance with a full suit of regulatory obligations. There arecertainly reasons why these rules and guidelines exist, but it is unreasonable toexpect that start-up organizations will be able to contend with them equally as wellas long-established incumbent entities.

NFT Interoperability (cross-chain). Existing NFT ecosystems are isolated from each other. Users once have selected one type of product can onlysell/buy/trade them within the same ecosystem/network. This is due to the

reason of its underlying blockchain platform. Interoperability and cross-chaincommunication are always the handicaps for the wide adoption of DApps.Based on the observations from [116], cross-chain communications can onlybe implemented with the help of external trusted parties. The decentralization property, in this way, has been inevitably lost to some extent. Butfortunately, most of the NFT-related projects adopt Ethereum as their underlying platform. This indicates that they share a similar data structureand can exchange under the same rules.

Updatable NFTs. Transitional blockchain updates their protocols throughthe soft forks (minor modifications that are compatible forwards) and hardforks (significant modifications that may conflict with previous protocols). A formal discussion has been provided in [75] stating the difficulties andtrade-offs when applying the updates to an existing blockchain. Despite thegeneric model, the new blockchain still has strict requirements such as tolerating specific adversarial behaviour and staying online during the updateprocess. NFT schemes closely rely on their underlying platforms and keepconsistent with them. Although the data are often stored in separate components (such as the IPFS file system), the most important logic and tokeIdare still recorded on-chain. Properly updating the system with improvementswill be a necessity.

II. CONCLUSIONS

DeFi and the entire ecosystem of blockchain based applications are clearly anemerging and fast growing aspect of the wider crypto economy. In order for thisinnovative use case to achieve wider and more mainstream adoption, however, thereare several considerations that need to be examined in more depth as well aspotentially resolved. Be it the operational challenges that will invariably arise as aresult of new technology applications, the regulatory landscape that continues to beambiguous, or the continuing accounting and taxation standards that need to be updated there are certainly still many potential roadblocks to full implementationand adoption of DeFi by market participants. This research and analysis should notbe viewed as an all-encompassing or solely authoritative guide to these issues.Rather, this research and the findings presented herein should be used as a startingpoint for more robust and rigorous debate.

Non-Fungible Token (NFT) is an emerging technology prevailing in the blockchainmarket. In this report, we explore the state-of-the-art NFT solutions which mayre-shape the market of digital/virtual assets going forward. We firstly analyzethe technical components and provide the design models and properties. Then,we evaluate the security of current NFTs systems and further discuss the opportunities and potential applications that adopt the NFT concept. Finally, weoutline existing research challenges that require to be solved before achievingmass-market penetration. We hope this report delivers timely analysis and summary of existing proposed solutions and projects, making it easier for newcomersto keep up with the current progress.

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