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UNDERSTANDING VIRTUAL DIGITAL ASSETS: WEB 3.0, BLOCKCHAIN, AND CRYPTO IN INDIA

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I. INTRODUCTION

In the context of the Internet, VDAs have become increasingly popular and significant, particularly with the advent of Web 3.0, which provides a secure and transparent way to create and maintain digital assets. The metaverse, a virtual world that exists inside the internet, is one of the most prominent platforms for VDAs, where people can interact with each other, create and trade goods, and even build entire virtual cities. Virtual land, a digital asset representing a piece of virtual real estate in the metaverse, is one of the most valuable assets, which can be bought, sold, and developed like real-world land. Investing in VDAs requires a certain level of technical knowledge, as owning and managing virtual assets requires familiarity with digital tools and platforms, as well as a rudimentary understanding of Web 3.0 and blockchain technology. In this chapter, the definition given by different sources including the Indian legislations about VDAs are covered and the web 3.0 technology that is working behind VDAs is explained.

II. MEANING

- **DIGITAL ASSETS**

The term Digital Asset has no common internationally accepted definition. A digital asset exists exclusively in digital form and has certain usage rights. Data without a distinct usage right is not considered an asset.

Anything that is made and saved digitally that is discoverable, identifiable, and valuable is considered a digital asset. They consist of text, photos, videos, and data. They can be used to produce value on a blockchain through tokenization, which was redefined in 2009 by blockchain technology and cryptocurrencies. An item needs to be able to transfer ownership through purchase, gifting, or other channels in addition to having the capacity to create value in order to qualify as an asset. It needs to be stored in a location where it may be easily accessed

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or discovered.

Digital assets took on an altogether new meaning in the 2010s as governments, investors, and the general public learned about blockchain technology and cryptocurrencies. Whether they were meant to be used as assets or not, cryptocurrencies were valued enough by the public to be added to the list of digital assets.

Digital assets include photos, documents, videos, books, audio/music, animations, illustrations, manuscripts, logos, metadata, content, social media accounts, gaming accounts, and newer blockchain-based assets like non-fungible tokens, crypto assets, tokens, central bank digital currencies and cryptocurrencies. Assets that do not use DLTs and block chain technology are not considered to be digital assets[1].

a) As per the Oxford Dictionary, Digital means "involving or relating to the use of computer technology."
b) As per IFRS (International Financial Reporting Standards), "An asset is a present economic resource controlled by the entity as a result of past events. An economic resource is a right that has the potential to produce economic benefits."

An Asset is a financial resource that is owned by a firm, country, or individual. Your company may own, develop, or profit from a wide variety of assets, including real estate, cash, office equipment, goodwill, investments, patents, inventories, and others. It is important to know that such resources are tangible or intangible that can be used to produce a positive economic value.

Thus, assets can be subdivided into two categories:

1. Tangible assets: includes a wide range of physical assets that can be transformed into cash, including tangible plants and machinery. Cash itself can be considered as an asset. Intangible assets: includes Goodwill, patents, and trademarks are examples of non-physical objects that contribute to the creation of positive economic value[2].

[1]Digital Asset: Meaning, Types, and Importance, reviewed by Amilcarchavarria, (Updated September 09, 2023), *available at:* https://www.investopedia.com/terms/d/digital-asset-framework.asp (last visited on Mar 27, 2024).
[2]Shreyan Srivastava, "Untangling the Mystery of Virtual Digital Assets", February 5, 2022, *available at*: https://vinodkothari.com/?p=38455 (last visited on Mar 27, 2024).

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III. DEFINITIONS

- **DIGITAL ASSETS**

a) Deloitte has defined digital assets as "cryptographically secured assets which exist only in a digital form, and typically maintained in a distributed ledger technology (DLT)"[3].

b) Commodity Futures Trading Commission (CFTC): "Digital asset is a broader term that encompasses additional applications, including ownership, transaction tracking, identity management, and smart contracts. A digital asset may express characteristics of a commodity or commodity derivative"[4].

Digital assets include, but are not limited to photos, videos, spreadsheets, design files, PDFs, graphics, cryptocurrencies that are stored in digital appliances such as laptops, personal computer, tablets, mobile phones, telecommunication devices that yield economic benefits to such company or individual.

There are three key elements that distinguish any single file as a digital asset. A digital asset should:

1. Be a digital file owned by an individual or company.
2. Provide economic worth to the individual or company.
3. Be searchable, discoverable, and accessible for use.

Basically, digital assets can be defined as anything that is created, exchanged, and stored in the digital world in such a way that it can be said to be an intangible asset.

- **VIRTUAL DIGITAL ASSETS OR VIRTUAL ASSETS**

All virtual digital assets are digital assets, but not all digital assets are virtual digital assets.

a. Virtual – Not real
b. Digital – Electronic means
c. Asset – something with value[5].

Not all digital assets fall under the FATF definition. For instance, assets that are issued or transferred to another person or exchanged for something else fall under the definition.

[3]Deloitte, "Market Manipulation in Digital Assets" Mar 2021, *available at:* https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Financial-Services/gx-design-market-manipulation-in-digital-assets-whitepaper-v2-1.pdf (last visited on Mar 27, 2024).
[4]Commodity Futures Trading Commission, "Digital Asset Primer" December 2020, *available at:* file:///C:/Users/Admin/Downloads/DigitalAssetsPrimer.pdf(last visited on Mar 27, 2024).
[5]Laushik polishetty, "Virtual Digital Assets and its views", published on July 25, 2023, *available at:* https://www.linkedin.com/pulse/virtual-digital-assets-its-views-kaushik-polisetty(last visited on Mar 27, 2024).

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a) The Financial Action Task Force (FATF) defined Virtual Assets also known as crypto assets as "A digital representation of value that can be digitally traded, or transferred, and can be used for payment or investment purposes". This FATF definition does not cover digital representations of fiat currency, securities, or other financial assets that are included elsewhere in its recommendations[6].

b) Income Tax Act, 1961 was amended after the introduction of the Finance Bill, 2022 leading to the insertion of following clause defining the term "Virtual Digital Asset".

Section 2(47A) "virtual digital asset" means

a) any information or code or number or token (not being Indian currency or foreign currency), generated through cryptographic means or otherwise, by whatever name called, providing a digital representation of value exchanged with or without consideration, with the promise or representation of having inherent value, or functions as a store of value or a unit of account including its use in any financial transaction or investment, but not limited to investment scheme; and can be transferred, stored or traded electronically;

b) A non-fungible token or any other token of similar nature, by whatever name called;

c) Any other digital asset, as the Central Government may, by notification in the Official

Gazette specify:

Provided that the Central Government may, by notification in the Official Gazette, exclude any digital asset from the definition of virtual digital asset subject to such conditions as may be specified therein.

Explanation. —For the purposes of this clause,

(a) "Non-fungible token" means such digital asset as the Central Government may, by notification in the Official Gazette, specify;

(b) the expressions "currency", "foreign currency" and "Indian currency" shall have the same meanings as respectively assigned to them in clauses (h), (m) and (q) of section 2 of the Foreign Exchange Management Act, 1999[7].

Thus, VDA have its existence in cyberspace (i.e.) cannot be converted into physical form, traded digitally and is intangible.

[6]Financial Action Task Force, "The FATF Recommendations" October 2021, *available at:* https://www.fatf-gafi.org/en/publications/Fatfrecommendations/Fatf-recommendations.html (last visited on Mar 27, 2024).
[7] Income Tax Act, 1961, (43 of 1961), S. 2(47).

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Draft Banning of Cryptocurrency & Regulation of Official Digital Currency Bill, 2019, prescribes following criteria which need to be met to qualify as a VDA:

- ✓ Any information or code or number or token,
- ✓ Generated through cryptographic means or otherwise,
- ✓ can be transferred, stored or traded electronically;
- ✓ providing a digital representation of value exchanged with or without consideration, with the promise or representation of having inherent value, or
- ✓ functions as a store of value or a unit of account (including its use in any financial transaction or investment, but not limited to investment scheme.

- **VIRTUAL CURRENCIES**

As per section-2(h) of the Foreign Exchange Management Act, 1999"Currency" includes all currency notes, postal notes, postal orders, money orders, cheques, drafts, travellers cheques, letters of credit, bills of exchange and promissory notes, credit cards or such other similar instruments, as may be notified by the Reserve Bank[8].

Section 2(q) of FEMA defines Indian currency as, "Indian currency" means currency which is expressed or drawn in Indian rupees but does not include special bank notes and special one rupee notes issued under section 28A of the Reserve Bank of India Act, 1934[9].

Section 2(m) of the FEMA defines foreign currency as "Foreign currency" means any currency other than Indian currency[10].

Virtual currencies not come under the definition of currencies by FEMA as well as not recognized by Reserve Bank of India and restricted its use[11].

Later in the case**,** Internet and Mobile Association of India v. Reserve Bank of India, ("IAMAI"),[12] the Supreme court held, the ban imposed by RBI on circular "prohibition of Virtual Currencies" was subsequently removed as it would deny rights under Article 19(1) (g)

[8] Foreign Exchange Management Act, 1999, (42 of 1999), s.2(h).
[9]Foreign Exchange Management Act, 1999, (42 of 1999), s.2(q).
[10]Foreign Exchange Management Act, 1999, (42 of 1999), s.2(m).
[11] Reserve Bank of India, "Prohibition of Virtual Currencies",Apr 2018, *available at:* https://rbi.org.in /scripts/NotificationUser.aspx?Mode=0&Id=11243(last visited on Mar 27, 2024).
[12](2020) 10 SCC 274.

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of the Indian Constitution[13]. But the RBI remained doubtful and advised customers to exercise due diligence when dealing with VCs and regulations governing standards for Know Your Customer (KYC), Anti-Money Laundering (AML), Combating of Financing of Terrorism (CFT) and obligations of regulated entities under Prevention of Money Laundering Act, (PMLA), 2002. Additionally, entities regulated by RBI must ensure compliance with relevant provisions under Foreign Exchange Management Act (FEMA) for overseas remittances[14].Consequently, RBI has not provided any subsequent notification regarding the recognition of VCs as currency.

1. Department of Economic Affairs, 'Report of the Committee to propose specific actions to be taken in relation to Virtual Currencies' (2019), Ministry of Finance defined virtual currency as a "digital representation of value that can be digitally traded and functions as
    a) a medium of exchange;
    b) a unit of account; and/or
    c) a store of value; but does not have legal tender status".

Supreme court also adopted this definition in IAMAI case and stated VCs fulfills the criteria of digital representation of value and it can be exchanged, which is analogous to the definition of VDA under sub clause (a) of section 2(47A) of IT Act,1961.

Hence, VDA does not automatically include Indian currency or foreign currency according to the definition provided in the Foreign Exchange Management Act of 1999 (FEMA). Some of the VDA includes, Non-fungible tokens, Cryptocurrency, Tokens, Crypto Assets, Tokenized Assets, Security Tokens, Central Bank Digital Currencies.

- **CRYPTOCURRENCIES**

Cryptocurrency often called as crypto is a subset of virtual currency used as medium of exchange without central authority. It is based on algorithms and peer to peer networks, use cryptographic method for secure digital transaction. It is decentralized or distributed ledger technology, with underlying technology called Blockchain. Cryptocurrencies can be classified into crypto coins and crypo tokens.

[13]Megha Mittal, 'Crypto-Trading's Tryst with Destiny', 17 Mar 2020, *available at:* https://indiacorplaw.in/2020/03/crypto-tradings-tryst-with-destiny.html (last visited on Mar 27, 2024).
[14] Reserve Bank of India "Customer Due Diligence for transactions in Virtual Currencies (VC)", *available at*: https://rbi.org.in/scripts/NotificationUser.aspx?Mode=0&Id=12103(last visited on Mar 27, 2024).

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Cryptocoins: It is as like cryptocurrency native to its blockchain. Its main purpose includes 1) a store of value and 2) a medium of exchange. For example,

a) Bitcoin's blockchain coin is BTC
b) Ethereum's blockchain coin is ETH
c) The coins other than bitcoins called altcoins (alternative coins). Stablecoins, one of the virtual currencies, tied to an outside such as Euro and U.S.dollar is covered under FATF definition.

Crypto tokens: token can be created in addition to the blockchain's base layer native coin. It can be also be used to store digital art, smart contracts, and such depending on the blockchain network it's built on. Tokens can be fungible or non- fungible, where fungible token has the object of currencies but non- fungible tokens don't. Some common types of tokens include, utility token, non- fungible token, security token, governance token etc,[15].

- **NON- FUNGIBLE TOKENS (NFT)**

NFT can be defined as "a cryptographically unique, indivisible, irreplaceable and verifiable token that represents a given asset, be it digital, or physical, on a blockchain"[16].

NFT cannot be regarded as currency, so the Indian government added NFT in separate sub clause (b) of section 2(47A) of ITA, 1961 under the definition of "Asset". Each NFT have separate identification code, no two NFT were same as far now. United States Department of the Treasury noted that this creates an inconsistency with respect to the definition of VCs "since many 'tokens' at issue contain utility beyond that as a medium of exchange"[17].

- **CENTRAL BANK DIGITAL CURRENCY (CBDC)**

RBI defines CBDCs as "the legal tender issued by a central bank in a digital form. It is the same as a fiat currency and is exchangeable one-to-one with the fiat currency. Only its form is different"[18].As per the RBI, a legal tender is a "coin or a banknote that is legally tenderable for

[15]Blockchain Education, Cryptocurrency Coins vs Tokens: Key Differences Explained, 12 October 2023 *available at:* https://bitpay.com/blog/coins-vs-tokens/(last visited on Mar 27, 2024).
[16]Valeonti F and Et al., 'Crypto Collectibles, Museum Funding and Open GLAM: Challenges, Opportunities and the Potential of Non-Fungible Tokens (NFTs)' (2021), *available at:* https://www.mdpi.com/2076-3417/11/21/9931(last visited on Mar 27, 2024).
[17] Department of the Treasury, Federal Register Volume 85, No 122, 24 June 2020.
[18] Reserve Bank of India, 'Central Bank Digital Currency – Is This the Future of Money – T Rabi Sankar' (17 August 2021), *available at:* https://rbi.org.in/scripts/BS_ViewBulletin.aspx?Id=20438 (last visited on Mar 27, 2024).

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discharge of debt or obligation[19]. CBDCs are used as legal tender by the central bank.

FATF definition excludes Digital Currencies from its definition of virtual assets.

- **DIGITAL ASSETS VS VIRTUAL ASSETS VS CRYPTO ASSETS**

Digital assets, virtual assets, and crypto assets are terms used to describe different types of assets in the context of blockchain and distributed ledger technology.

1. **Digital Assets**

Digital assets are assets that exist in a digital form and are issued and transferred using distributed ledger or blockchain technology. These assets can represent a wide range of things, including financial instruments, digital collectibles, intellectual property, and more. Digital assets are stored and managed on a blockchain or distributed ledger, providing transparency, security, and immutability to their ownership and transfer.

2. **Virtual Assets**

Virtual assets are a subset of digital assets that are specifically issued and transferred using distributed ledger or blockchain technology. They can include virtual currencies, coins, tokens, and other digital representations of value. Virtual assets can be centralized or decentralized, convertible or non-convertible, and can be used for various purposes, such as payments, investments, or in-game assets. Virtual assets are stored and managed on blockchain networks, enabling secure and transparent transactions[20].

3. **Crypto Assets**

Crypto assets, short for cryptocurrency assets, refer to digital or virtual assets that are secured by cryptography and exist on blockchain networks. Cryptocurrencies like Bitcoin and Ethereum are examples of crypto assets. These assets are decentralized, meaning they are not controlled by any central authority, and transactions involving crypto assets are verified and recorded on a blockchain through consensus mechanisms. Crypto assets can be used for peer-to-peer transactions, investments, smart contracts, and various other applications within the

[19] Reserve Bank of India, 'FAQs' *available at:* https://m.rbi.org.in/scripts/FAQView.aspx?Id=136 (last visited on Mar 27, 2024).
[20] Washington state Department of financial institutions, Virtual Currency, Cryptocurrency, and Digital Assets Primer, *available at:* https://dfi.wa.gov/consumers/virtual-currency/primer(last visited on Mar 27, 2024).

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blockchain ecosystem[21].

As a result, digital assets encompass a broad category of assets stored and managed digitally, while virtual assets specifically refer to assets issued and transferred using blockchain or distributed ledger technology. Crypto assets are a subset of virtual assets that are secured by

IV. EVOLUTION OF CRYPTO IN INDIA

Though the regulations on crypto currencies are uncertain the transaction using bitcoins are increasing since 2020. The rise and usage of crypto from,

- **2008:** The crypto journey began with Satoshi Nakamoto publishing the white paper "Bitcoin: A Peer-to-Peer Electronic Cash System."
- **2010:** The first real-world crypto transaction occurred when 10,000 Bitcoin were exchanged for two pizzas, giving BTC its first cash value. New cryptocurrencies like Litecoin, Namecoin, and Swiftcoin started emerging.
- **2013:** Crypto investments increased, leading to the creation of Indian exchanges such as Zebpay, Pocket Bits, Coinsecure, Koinex, and Unocoin. The RBI issued a circular warning users about the security risks of virtual currencies.
- **2016–2018:** In 2017, the RBI and Finance Ministry released another warning stating that virtual currencies are not legal tender. In March 2018, the CBDT submitted a draft scheme to ban virtual currencies. One month later, the RBI issued a circular banning banks, NBFCs, and payment providers from dealing with cryptocurrencies or providing services to crypto exchanges. This caused a 99% drop in crypto exchanges and trading activity in India.
- **November 2018:** Nischal Shetty, founder of WazirX, started the #IndiaWantsCrypto campaign to push for positive crypto regulation. The campaign gained strong support from entrepreneurs and investors, leading to the announcement of a crypto bill in the February budget session. By July 2021, the campaign completed 1000 days, with thousands of crypto supporters participating.
- **March 2020:** The Supreme Court struck down the RBI crypto banking ban, declaring it unconstitutional. On January 29, 2021, the Indian government announced a plan to introduce a sovereign digital currency and proposed a ban on private cryptocurrencies.

[21]Blockchain and Distributed Ledger Technology (DLT), (Last Updated: 20 Apr, 2023) *available at:* https://www.geeksforgeeks.org/blockchain-and-distributed-ledger-technology-dlt/(last visited on Mar 27, 2024).

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- **2022:** In the Union Budget 2022, the Finance Minister announced that from April 1, 2022, income from the transfer of Virtual Digital Assets (VDAs) would be taxed at 30% plus surcharge and cess. No deductions are allowed except for the cost of acquisition. Losses from VDA transfers cannot be set off or carried forward. A 1% TDS applies to payments made for the transfer of VDAs. In the case of gifting a VDA, the recipient must pay the tax.

V. WEB 3.0 TECHNOLOGY

- **MEANING**

Web3, also known as Web 3.0, represents the third generation of the World Wide Web (WWW). It introduces significant changes and innovations compared to its predecessors. Web3 is a marketing term for uses of the World Wide Web that incorporate concepts such as decentralization, blockchain technologies, and token-based economics. Web 3 aims to create a more dynamic, decentralized, and user-centric web.

Specific Visions for Web3:

- Web 3.0 involves a direct immersion into the digital world. While the exact definition of Web3 remains somewhat hazy, it revolves around the idea of decentralization.
- Web3 often incorporates technologies like blockchain, AI, and machine learning.
- It envisions future where financial assets (in the form of tokens) are integrated into almost everything we do online.
- Decentralization, Ownership, Blockchain Integration, Cryptocurrencies and NFTs are some of the features of web 3 technology.

- **WEB 1.0 VS.WEB 2.0 VS. WEB 3.0**

1. Web 1.0 (1990-2004)

During the early days of the web, it was primarily a collection of static websites owned by companies. Users had limited interaction, and content creation was minimal. These are some of the WebPages.

i. HTML (Hyper Text Markup Language): is the language used to format web pages.
ii. URI or URL (Uniform Resource Locator): Uniform Resource Identifier or Locator is a unique address used to identify any resource on the web.

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iii. HTTP: Hyper Text Transfer Protocol, which enables retrieval of connected materials from across the web[22].

2. Web 2.0 (after 2004)

Social media platforms emerged, allowing users to actively contribute content. Companies provided platforms for user-generated content and interactions. However, a few dominant companies controlled a disproportionate share of web traffic and value.

3. Web 3.0

Ethereum co-founder Gavin Wood coined the term "Web3" in 2014, referring to a "decentralized online ecosystem based on blockchain". In 2021, interest in Web3 surged, driven by cryptocurrency enthusiasts, high-profile technologists, and venture capital firms. Executives from venture capital firm Andreessen Horowitz even lobbied for Web3 as a potential solution to web regulation questions. The core idea of the web technology includes, Web1 was read-only, Web2 is read-write, and Web3 will be read-write-own.

To the point, Web3 represents a transformative vision for the internet—one that emphasizes ownership, decentralization, and user empowerment. As it continues to evolve, Web3 holds immense potential for reshaping our digital experiences[23].

VI. DISTRIBUTED LEDGER TECHNOLOGY

- **ORIGIN OF DLTS**

The origin of Distributed Ledger Technology (DLT) can be traced back to the publication of a white paper titled "Bitcoin – A Peer-to-Peer Electronic Cash System" in October 2008 by an unknown author using the name Satoshi Nakamoto[24]. This white paper is credited as the first theoretical framework of a DLT. In January 2009, the service described in the paper was launched, marking the practical implementation of the concepts outlined in the white paper. Cryptocurrencies like Bitcoin, which are a digital representation of value, are considered the

[22] World wide web foundation, history of web, *available at:* https://webfoundation.org/about/vision/history-of-the-web/(last visited on Mar 27, 2024).
[23]ChiradeepBasumallick,What is Web 3.0? Meaning, Features, and Benefits, November 29, 2022, *available at:* https://www.spiceworks.com/tech/tech-general/articles/what-is-web-three/#:~:text=Chiradeep%20BasuMallick%20Technical 20Writer,and%20a%20token%2Ddriven%20economy(last visited on Mar 27, 2024).
[24] Timothy M. Persons, GAO-19-704SP "Blockchain & Distributed Ledger Technologies", Sept 2019, *available at:* https://www.gao.gov/assets/gao-19-704sp.pdf(last visited on Mar 27, 2024).

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best-known use case for DLT[25]. Satoshi Nakamoto's white paper and the subsequent launch of the service laid the foundation for the development and adoption of DLT, particularly in the context of cryptocurrencies and blockchain technology.

- **CONCEPT OF DLTS**

Distributed ledger technology (DLT) is a decentralized record-keeping technology that enables the simultaneous access, validation, and updating of records across a network of nodes. It is a digital system for recording the transaction of assets that does not rely on central data store or administration functionality. Figure 1 provides a meaning of DLTs, which can be easily understandable.

Figure 1 This figure depicts about the Working of DLTs

Distributed Ledger Technology (DLT) is a decentralized record-keeping system where data is stored, validated, and updated simultaneously across multiple nodes in a peer-to-peer network. Each node maintains an identical copy of the ledger and uses consensus algorithms to agree on valid transactions, ensuring accuracy, security, and resilience without a central authority. DLT can record both static data, like registries, and dynamic data, such as financial transactions. Blockchain is the most common form of DLT, but other structures—such as directed acyclic graphs (DAGs) and hybrid models—also exist[26].

DLTs differ based on their data structures, consensus mechanisms (e.g., proof-of-work, proof-of-stake, DAG consensus), permission models (public or private), and whether they involve

[25] Kuhn, R, Yaga, D, Voas, J. "Rethinking distributed ledger technology", IEEE Computer, 52(2), 68-72. (2019), *available at:* https://csrc.nist.gov/CSRC/media/Projects/enhanced-distributed-ledgertechnology/documents/preprint- rethinking-dlt.pdf (last visited on Mar 27, 2024).
[26] Nick Barney, "Distrisbuted Ledger Technology", *available at:* https://www.techtarget.com/searchcio/definition/distributed-ledger, (last visited on Mar 27, 2024).

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mining. While blockchain typically uses SHA-256 (256-bit Secure Hash Algorithm) and supports mined or pre-mined cryptocurrencies, DAG-based systems offer faster, cheaper transactions. DLT has wide applications across government, finance, supply chains, entertainment, identity systems, and asset tracking[27]. Although still developing, DLT is expected to transform traditional centralized ledgers by enabling more transparent, efficient, and decentralized operations across sectors.

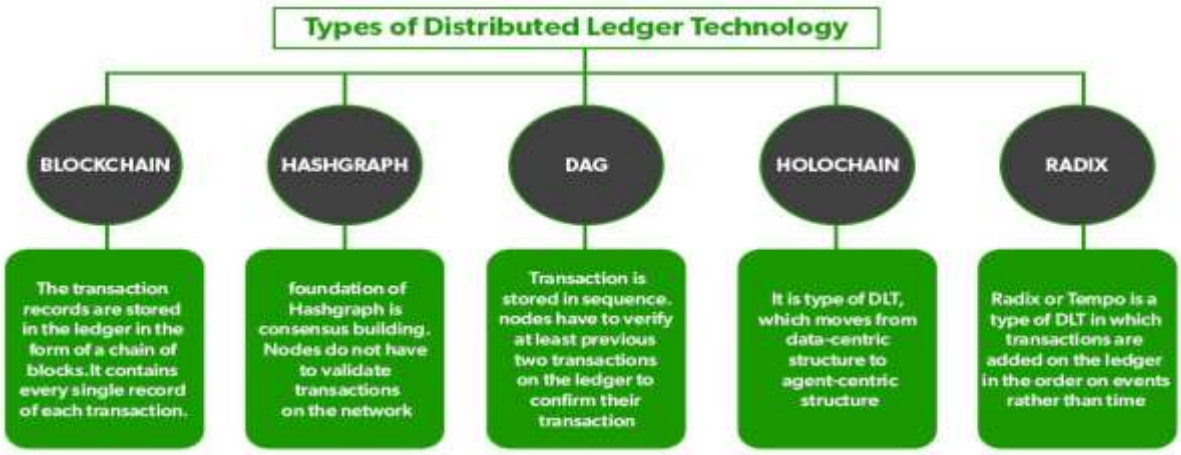

Figure 2Types of DLTs

- **DIFFERENCE BETWEEN DLTS AND BLOCKCHAIN TECHNOLOGY:**

Distributed Ledger Technology (DLT) is an umbrella term that refers to any system that relies on a shared database to process, record, and verify transactions in an open network. It is a form of record-keeping where several parties add records to a database, and everyone's copies are kept in sync. DLT can be used for various purposes, such as record management and process automation[28].A distributed ledger (DLL) is a database that maintains multiple copies of the same information in different locations. These copies can be updated on a regular basis. This means that anyone who can access the copy of the distributed ledger can verify the same information.

Maintaining integrity and availability is a key requirement for a distributed ledger. The following are the three fundamental requirements for a distributed ledger:

1. Consistency

[27] Christina Majaski, "Distributed Ledgers: Definition, How They're Used, and Potential", (Updated June 15, 2023), *available at:* https://www.investopedia.com/terms/d/distributed-ledgers.asp(last visited on Mar 27, 2024).
[28]Shaan Roy, "The Difference Between Blockchains& Distributed Ledger Technology", Feb 20, 2018, *available at:* https://towardsdatascience.com/the-difference-between-blockchains-distributed-ledger-technology-42715a0fa92 (last visited on Mar 27, 2024).

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2. Availability
3. Partition tolerance[29].

Blockchain, on the other hand, is a specific type of DLT that uses cryptography to control new units and is best viewed as a database with pseudonymous users. Each block in a blockchain contains information about every previous block, making it essentially impossible to alter records without changing each subsequent block as well. Blockchain is a decentralized distributed ledger, and its transparency, immutability, and security make it well-suited for recording events, managing records, processing transactions, tracing assets, and voting.

- **BENEFITS OF DLTS**

The benefits of Distributed Ledger Technology (DLT) include:

- **Decentralization:** No central authority; increases system resilience and reduces risk of widespread failures.
- **Security:** Strong cryptographic protection prevents tampering and removes the need for third-party intermediaries.
- **Transparency:** All participants can view transactions, reducing fraud and corruption through open ledger access.
- **Efficiency:** Automation lowers costs, reduces human error, eliminates intermediaries, and improves data quality.
- **Inclusivity:** Accessible to anyone with an internet connection, removing geographical and institutional barriers.
- **Wide applicability:** Useful across industries such as supply chain, healthcare, energy, news, and government (e.g., Target's ConsenSource for responsible sourcing).

These points highlight why DLT is a powerful, secure, and versatile technology for modern digital systems.

- **TECHNOLOGY THAT VDAs ADOPTS**

Virtual digital assets rely on both blockchain and other forms of distributed ledger technology (DLT). Blockchain, a specific type of DLT, records transactions in cryptographically linked blocks, enabling decentralized, secure, and tamper-evident transfers without a central authority. DLTs vary in their data structures (such as blockchains or DAGs), consensus mechanisms (like

[29]Ayush Abrol, "Blockchain technology vs Distributed Ledger Technology", *available at:* https://www.blockchain-council.org/blockchain/blockchain-vs-distributed-ledger-technology/(last visited on Mar 27, 2024).

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Proof-of-Work and Proof-of-Stake), and permission models (public or private). Together, these technologies verify, execute, and record digital asset transactions securely. In essence, while all blockchains are DLTs, not all DLTs are blockchains, and virtual digital assets make use of both[30].

VII. BLOCKCHAIN TECHNOLOGY

Blockchain technology is a foundational component of virtual digital assets, offering a decentralized, secure, and transparent system for recording and managing transactions. As a form of distributed ledger technology, blockchain ensures data integrity and immutability by storing transactions in cryptographically linked blocks. This eliminates the need for intermediaries, reduces fraud risks, and enables secure creation, transfer, and verification of digital assets such as cryptocurrencies, NFTs, and tokens[31].

Blockchain also supports smart contracts, which automatically execute terms written into code, increasing the efficiency and reliability of virtual asset transactions. It facilitates tokenization, allowing real-world assets to be digitally represented and managed more effectively. Originating from Satoshi Nakamoto's 2008 Bitcoin white paper, blockchain introduced a system where transaction blocks contain timestamps, nonces, and cryptographic hashes, creating a permanent and tamper-resistant ledger. Designed to replace trust-based payment systems with cryptographic proof, blockchain allows two parties to transact directly without relying on financial institutions, making fraud and transaction reversal computationally impractical. Overall, blockchain revolutionizes digital asset exchange by providing a secure, trustless, and transparent ecosystem[32].

Blockchain was first popularized with the bitcoin, Cryptocurrency and gained popularity for its exceptional capacity to create a shared economy and establish the basis for the current digital currency market. Blockchain has been regarded as a revolutionary method for maintaining privacy and security[33].

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[30] K&L Gates, Industry Focus, "Digital Assets, Blockchain Technology And Cryptocurrencies", *available at:*https://www.klgates.com/Digital-Assets-Blockchain-Technology-and-Virtual-Currencies#LangCode=en-US (last visited on Mar 27, 2024).
[31] *Ibid*
[32] Digital Assets and Blockchain Technology, *available at:* https://www.hklaw.com/en/services/practices/technology-and-cybersecurity/digital-assets-and-blockchain-technology (last visited on Mar 27, 2024).
[33]Thien Huynh-The, Thippa Reddy Gadekallu, et.al.,Blockchain for the metaverse: A Review 14 February 2023, pg no. 4-5, *available at:* https://www.sciencedirect.com/science/article/pii/S0167739X23000493?ref=pdf_download&fr=RR&rr=86a66061f9548a02 -2 (last visited on Mar 27, 2024).

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- **HOW BLOCKCHAIN TECHNOLOGY WORKS**

While the underlying mechanisms of blockchain are intricate, we will provide a concise overview of the process in the following steps. Blockchain software has the capability to automate most of these steps:

Step 1 – Recording the transaction

A blockchain transaction is when a physical asset or digital asset is exchanged between two parties within the blockchain network. It is documented as a data block and may include the following details:

- Parties involved in the transaction
- Transaction specifics
- Date and time of the transaction
- Location of the transaction
- Purpose of the transaction
- Quantity of assets exchanged
- Number of pre-conditions met during the transaction

Step 2 – Establishing consensus

For a recorded transaction to be deemed valid, a majority of participants within the distributed blockchain network must reach a consensus. The rules of agreement can vary depending on the network type, but they are typically defined at the network's inception.

Step 3 – Linking the blocks

Once consensus is achieved, the blockchain incorporates the transactions into blocks, which can be likened to the pages of a ledger book. Additionally, a cryptographic hash is appended to each new block. This hash serves as a chain that connects the blocks together. If the contents of a block are intentionally or unintentionally altered, the hash value changes, enabling the detection of data tampering.

Consequently, the blocks and chains are securely linked, preventing any modifications. Each subsequent block reinforces the verification of the preceding block and, consequently, the entire blockchain. This can be compared to stacking wooden blocks to construct a tower. Blocks can only be added on top, and removing a block from the middle would cause the entire tower to collapse.

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Step 4 – Distributing the ledger

The system disseminates the most recent version of the central ledger to all participants[34].

- **TYPES OF BLOCKCHAIN TECHNOLOGY**

The types of blockchain networks include Public Blockchain, Private Blockchain, Consortium Blockchain, and Hybrid Blockchain[35].

- **Public Blockchain**
  - Open to everyone for participation and transactions.
  - Decentralized and trustable due to algorithms detecting fraud.
  - Offers security, anonymity, and decentralization.
  - Examples include Bitcoin and Ethereum.
- **Private Blockchain**
  - Permissioned and managed by a single entity.
  - Restricted access, partially decentralized.
  - Provides higher privacy and stability.
  - Used by enterprises for specific needs like data confidentiality.
  - Examples include Ripple, exchange platform is a private blockchain for businesses,
- **Consortium Blockchain**
  - Controlled by multiple entities, each operating a network node.
  - Participants have permissions to view specific data.
  - Often referred to as Distributed Ledger Technology (DLT).
  - Used in industries like finance, insurance, and food distribution.
  - Global Shipping Business Network Consortium (GSBNC) is a non-profit blockchain consortium focused on digitizing the shipping industry and increasing cooperation among maritime operators.
- **Hybrid Blockchain**
  - Combines elements of both public and private blockchains.
  - Offers flexibility in terms of control and transparency.

[34] What is blockchain technology? *available at:* https://aws.amazon.com/what-is/blockchain/?aws-products-all.sort-by=item.additionalFields.productNameLowercase&aws-products-all.sort-order=asc(last visited on Mar 27, 2024).
[35]Making sense of bitcoin, cryptocurrency and blockchain, *available at:* https://www.pwc.com/us/en/industries/financial-services/fintech/bitcoin-blockchain-cryptocurrency.html (last visited on Mar 27, 2024).

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- Can cater to various use cases by blending features of public and private blockchains.
- Blockchain networks rely on smart contracts to enable public members to verify that private transactions have taken place.
- For instance, hybrid blockchains allow public members to access digital currency while maintaining private ownership of bank-owned currency.

These different types of blockchain networks vary in terms of decentralization, accessibility, security, and privacy, catering to diverse needs across industries and applications[36].

- **CONSENSUS MECHANISM**

The Blockchain Technology has two consensus mechanism, which includes Proof of Work and Proof of Stake.

1. Proof Of Work

Proof of Work (PoW) is the most widely used consensus algorithm in cryptocurrencies and is essential for verifying transactions and adding new blocks to a blockchain. The idea was first proposed by Cynthia Dwork, Moni Naor, and Satoshi Nakamoto in 1993, and the term "proof of work" was later introduced in a 1999 paper by Markus Jakobsson and Ari Juels. Satoshi Nakamoto applied PoW in the Bitcoin protocol in 2008, making it popular in blockchain systems.

In PoW, miners use computer hardware to solve difficult mathematical puzzles. The miner who solves the puzzle first gets to create the next block and then broadcasts it to the network. Other nodes check and confirm the block's accuracy, and only after this confirmation is the block officially added to the blockchain.

Although PoW provides strong security and decentralization, it is limited in speed and scalability because solving these puzzles requires a large amount of energy. Despite this drawback, PoW remains highly secure. This is because attacking a PoW blockchain would require enormous computing power, hardware, and electricity—costs so high that it becomes nearly impossible for a malicious actor to take over the network. Thus, PoW plays a crucial role in maintaining the trustless, secure, and decentralized nature of blockchain networks.

[36]A beginner's guide to the different types of blockchain networks, *available at:* https://cointelegraph.com/learn/a-beginners-guide-to-the-different-types-of-blockchain-networks(last visited on Mar 27, 2024).

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2. Proof Of Stake

Proof of Stake (PoS) is a consensus mechanism introduced as an alternative to the energy-heavy Proof of Work (PoW) system. The idea was first discussed on the BitcoinTalk forum on July 11, 2011. In 2012, Sunny King and Scott Nadal formally proposed PoS to address the excessive energy consumption of PoW mining. Peercoin, launched in 2012, became the first working PoS cryptocurrency, followed by others such as Algorand, Cardano, Nxt, Solana, Polkadot, and Blackcoin. In 2022, Ethereum—the second-largest cryptocurrency—transitioned from PoW to PoS.

In PoS blockchains, validators replace miners. Instead of using large amounts of computing power, validators "stake" their tokens to earn the chance to validate transactions and create new blocks. If validators behave dishonestly or make serious errors, they can lose their staked tokens through a penalty system called slashing. PoS lowers the barrier to becoming a validator, although participants still need to stake a certain amount of cryptocurrency. Importantly, PoS consumes far less electricity than PoW, making it much more environmentally sustainable.

An enhanced version called Delegated Proof of Stake (DPoS) allows network users to vote for delegates who then validate blocks on their behalf. This system aims to be more decentralized and fair compared to basic PoS. Ethereum's move to PoS—known as Ethereum 2.0—demonstrates the growing popularity of this model. Overall, PoS provides a more energy-efficient, sustainable, and accessible method for securing blockchain networks, making it a favored consensus mechanism for many modern cryptocurrencies[37].

VIII. CONCLUSION

In this virtual world, it is essential to research and equip oneself with the necessary knowledge before investing in VDAs, considering factors like the potential returns on investment, the location of the virtual land within the metaverse, the quality of the land, and the overall demand for that piece of virtual real estate. This chapter covered the overview of VDAs, its definition, meaning etc. The DLTs and blockchain technology was discussed in detail to bring awareness about how VDAs transactions are done.

[37] Gemini Crypto - Types of Blockchain: PoW, PoS, Private, and DLT, *available at:* https://www.gemini.com/cryptopedia/blockchain-types-pow-pos-private (last visited on Mar 27, 2024).