1. INTRODUCTION

Digital assets are a new type of investment that includes electronic assets with ownership or use rights, such as cryptocurrencies, tokens, and digital collectibles.

These assets are secured by advanced encryption techniques using DLT (distributed ledger technology) or blockchain.

Digital assets are different from traditional investments and have been gaining popularity globally since 2009.

Digital assets offer greater diversification and higher expected returns, however, there are also higher risks associated with investing in digital assets.

This learning module provides an overview of digital asset investments, including key concepts and risks.

2. DISTRIBUTED LEDGER TECHNOLOGY

Distributed ledger technology (DLT)

Distributed ledger technology (DLT) – advancements in financial record keeping systems – offers efficient methods to generate, exchange and track ownership of financial assets on a peer-to-peer basis.

Potential **advantages** of DLT networks include:
- accuracy
- transparency
- secure record keeping
- speedy ownership transfer
- peer-to-peer interactions

Limitations:
- DLT consumes excessive amount of energy.
- DLT technology is not fully secure, there are some risks regarding data protection and privacy.

Three basic elements of a DLT network are:
i. Digital ledger
ii. A consensus mechanism
iii. Participant network

A **distributed ledger** is a digital database where transactions are recorded, stored and distributed among entities in a manner that each entity has a similar copy of digital data.

Consensus is a mechanism which ensures that entities (nodes) on the network verify the transactions and agree on the common state of the ledger. Two essential steps of consensus are:

- Transaction validation
- Agreement on ledger update

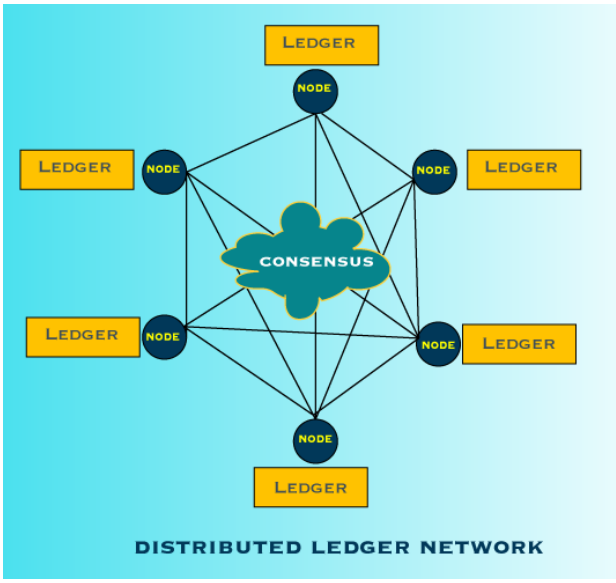
These steps ensure transparency and data accessibility to its participants on near-real time basis.

Participant network is a peer-to-peer network of nodes (participants).

DLT process uses **cryptography** to verify network participant identity for secure exchange of information among entities and to prevent third parties from accessing the information.

Smart contracts – self-executed computer programs based on some pre-specified and pre-agreed terms and conditions - are one of the most promising potential applications of DLT.

For example, automatic transfer of collateral when default occurs, automatic execution of contingent claims etc.



Blockchain acts as a digital ledger, sequentially recording information such as ownership changes across a series of blocks linked and secured cryptographically.

- Each block contains multiple transactions and a secure cryptographic hash to the previous block, maintaining the chain's integrity.
- The consensus mechanism ensures that all transactions are agreed upon by authorized network members, confirming the transaction's validity and its place within the blockchain's history.

The table below outlines the steps for adding a transaction to the blockchain.

Stage	***Description***
Initiation	Buyer and seller make a deal.
Block Creation	Transaction information is put into a new block and broadcast to the networks of computers (nodes).
Validation	Nodes in the network validate the transaction.
Verification	Pending transactions are gathered and verified and put together to form a new block of a predetermined size.
Linking	The new block is linked cryptographically to the previous one in the chain, guaranteeing chronological order and transaction integrity.
Completion	The transaction is added to the blockchain and the ledger is updated.

It is extremely difficult and expensive to manipulate data as it requires very high level of control and huge consumption of energy.

Proof of Work vs. Proof of Stake

Blockchains operate without a central authority, relying on consensus protocols to ensure trust and security among participants. These protocols determine how blocks, containing transaction information, are added to the chain and verified.

Two major types of consensus protocols exist:

a. Proof of Work (PoW)
b. Proof of Stake (PoS)

a) Proof of Work (PoW)

This protocol uses a computationally intensive process to validate transactions. Miners (nodes) compete to solve complex puzzles, and the successful miner gets to add the next block to the chain, earning rewards in the form of cryptocurrency.

- **Security through cost:** The high computational cost of mining makes it difficult and expensive to tamper with the blockchain. The security of the PoW protocol relies on the ***network's overall computing power***. Attackers would need to control a majority of the network's power to manipulate data.
- **Most Common Protocol:** PoW is the most widely used consensus protocol for digital assets like Bitcoin and Ethereum.

b) Proof of Stake (PoS)

This protocol relies on validators who stake their own cryptocurrency as collateral. These validators are responsible for validating transactions and adding blocks to the chain.

- **Security through Staking:** Validators who attempt to add invalid blocks risk losing their staked collateral, creating a disincentive for malicious activity.
- **Energy Efficiency:** PoS requires significantly less computational power than PoW, making it a more energy-efficient option.
- **Evolving Protocol:** While gaining popularity, PoS is still a relatively new protocol compared to PoW.

Permission and Permissionless Networks

DLT networks can be permissionless or permissioned.

Permissionless networks are open to new users. Participants can see all transactions and can perform all network functions.

In permissionless networks:

- *'no central authority'* is required to verify the transaction.
- all transactions are recorded on single database and each node stores a copy of that database.
- records are *immutable* i.e. once data has been entered to the blockchain no one can change it.
- trust is not a requirement between transacting party.

Bitcoin is a renowned model of open, permissionless network.

Permissioned networks are closed networks where activities of participants are well-defined. Only pre-approved participants are permitted to make changes. There may be varying levels of access to ledger from adding data to viewing transaction to viewing selecting details etc.

The table below shows the differences between permissioned and permissionless blockchains

FEATURE	PERMISSIONED BLOCKCHAIN	PERMISSIONLESS BLOCKCHAIN
MEMBERS	Limited number	Larger number
SPEED	Faster	Slower
COST	Cost-effective	Not cost-effective
DECENTRALIZATION	Partially decentralized	Decentralized
ACCESS	Limited membership	Unlimited membership
GOVERNANCE	Determined by a centralized organization	Decentralized and maintained by the members

Types of Digital Assets

Digital assets encompass electronic records used for transactions, including securities, currencies, real estate, or commodities.

Category	Type	Subtype
Digital Assets	1) Crypto-currencies	I. Bitcoin II. Altcoins a. Other Cryptocurrencies b. Stablecoins c. Memecoins III. Central Bank IV. Digital Currencies
	2) Tokens	I. Non-Fungible Tokens (NFTs) II. Security Tokens III. Utility Tokens IV. Governance Tokens

1. Cryptocurrencies

Cryptocurrencies, a common type of digital asset that enable near-real-time transactions without intermediaries, issued by individuals, companies, or organizations.

These assets can range from securities to real estate but are not backed by physical forms or central monetary authorities. Instead, they use ***decentralized ledger technology (DLT)*** to ensure secure transactions.

- There are various forms of cryptocurrencies, such as stablecoins and altcoins.
- They are known for having a cap on issuance to maintain value, but they also exhibit significant price volatility due to uncertain valuation fundamentals.
- Despite their unregulated nature, central banks are examining the potential of cryptocurrencies and the concept of ***Central Bank Digital Currencies (CBDCs),*** which would be digital equivalents of a nation's currency.

2. Tokens

Tokenization represents ownership rights to physical assets on a blockchain or distributed ledger, streamlining the transfer process by creating a single digital record of ownership.

Non-Fungible Tokens (NFTs): Unlike fungible tokens like cryptocurrencies (where each unit is identical), NFTs represent unique digital assets, like artwork, with certificates of authenticity stored on a blockchain

Security tokens digitize ownership rights for publicly traded securities, improving efficiency in post-trade processing, settlement, record-keeping, and custody by utilizing blockchain technology.

- **Initial Coin Offerings (ICOs)** are a form of security tokens where companies sell crypto-tokens to investors in exchange for money or another cryptocurrency, offering an alternative to traditional, regulated capital-raising methods like IPOs.

Utility tokens enable network services like payment and fees, compensating for network activities unlike security tokens that pay dividends.

Governance Tokens: Grant voting rights to holders, allowing them to participate in decision-making and influence the direction of permissionless blockchain networks.

Practice: Question-Set from the CFA Institute's Curriculum.

3. DIGITAL ASSET INVESTMENT FEATURES

The financial sector is seeing a surge in digital assets, particularly cryptocurrencies, which grew from 70 in 2013 to nearly 10,000 by early 2022.

This growth is drawing the attention of institutional investors seeking high returns, leading financial service providers to expand their offerings to meet the rising demand for digital assets.

1. Distinguishing Characteristics of Digital Assets

Similarities:

- Both digital and traditional assets utilize indirect investment mechanisms such as exchange-traded funds (ETFs) and hedge funds.

Differences: Digital and traditional assets have significant differences.

1. **Differences in Inherent Value**
   Traditional assets have an inherent value linked to underlying assets or expected cash flow, while digital assets lack an inherent value and rely on the likelihood of appreciation, perceived scarcity and the potential for future transfer of value.

2. **Different Transaction Validation Methods**
   Traditional assets are recorded on private ledgers by central intermediaries, while digital assets are recorded on a decentralized ledger with advanced algorithms, encryption, and permissioned or permissionless networks.

3. **Different Uses as a Medium of Exchange**
   Traditional financial assets are typically traded in widely accepted currencies. Digital assets like cryptocurrencies can act as an alternative to fiat currencies for online transactions within specific ecosystems such as Web3 but have limited mainstream acceptance due to high transaction costs and legal challenges.

4. **Distinctions in Legal and Regulatory Protection**
   Traditional assets are highly regulated and well-defined, while digital assets lack established standards and legal status, making them speculative, disadvantaged in the legal framework, and vulnerable to fraud and market manipulation.

2. Investible Digital Assets

The digital asset landscape is booming, with various cryptocurrencies optimized for various purposes.

1. **Bitcoin (BTC or XBT)** Bitcoin is a peer-to-peer network launched to secure payments and serves as both a medium of exchange and a store of value. It is the most popular and widely traded cryptocurrency, influencing the creation of new digital assets.

2. **Altcoins:** Alternative cryptocurrencies, like Ether, utilize similar technology but offer broader functionalities. Ether, for example, is programmable, enabling the creation of applications on its blockchain.

3. **Stablecoins:** These cryptocurrencies aim for price stability by being pegged to real-world assets like fiat currencies or precious metals. They aim to reduce volatility and facilitate cross-border transactions.

   1. **Smart stablecoins:** Use algorithms to manage asset supply.

   2. **Asset-backed tokens:** Tokenized versions of real-world assets (e.g., USD, gold) for crypto wallets.

   Note: Stablecoins cannot be exchanged for fiat money and lack legal or regulatory backing.

4. **Meme Coins:** These are cryptocurrencies inspired by internet jokes, with early investors potentially profiting significantly due to their fast rise and fall in value.

Practice: Question-Set from the CFA Institute's Curriculum.

4. DIGITAL ASSET INVESTMENT FORMS

Digital asset investments can be made directly on the blockchain or indirectly through exchange-traded products and hedge funds.

1) **Direct Ownership** requires a **"***cryptocurrency wallet***"** to store public and private keys needed to access the asset.

Types of Cryptocurrency Exchanges

a) **Centralized exchanges (CEXs):** Most common, offer transparent pricing, volume and liquidity, but contradict Bitcoin's decentralized ideology.
   - Prone to security risks (frauds) due to centralized servers.
   - May be regulated depending on jurisdiction.

b) **Decentralized exchanges (DEXs):** Mimic blockchain's decentralized protocol (operate similarly to Bitcoin).
   - Offer greater security therefore are more difficult to attack.
   - Lack of centralized control pose regulatory challenges which may lead to illegal activity.

2) **Indirect Ownership** is achieved through exchange-traded products and hedge funds.

1. Direct Digital Asset Investment Forms

Direct investments in digital assets like cryptocurrencies are made on exchanges and recorded permanently on the blockchain. These exchanges often operate 24/7, enabling continuous trading. However, several risks are involved:

i. **Increased Fraud Risk:** Popularity attracts scams like fake ICOs (Initial Coin Offerings), pump and dump schemes, and attempts to steal wallet credentials.

ii. **Loss of Access:** Crypto wallets require unique passkeys. Losing them means losing access to the funds forever. Around 20% of Bitcoins are estimated to be lost or inaccessible.

iii. **Price Manipulation:** Smaller currencies might be controlled by a few large holders ("whales") who can manipulate prices.

2. Indirect Digital Asset Investment Forms

Investors have several options for gaining indirect exposure to digital assets:

Cryptocurrency Coin Trusts:

- Invest in trusts holding large amounts of cryptocurrency over-the-counter (OTC), similar to closed-end funds.
- No need for a digital wallet or encryption keys.
- May have high fees and trade at a premium/discount to their value.

Cryptocurrency Futures Contracts:

- Contracts to buy/sell a set amount of cryptocurrency at a specific future price.
- Settled in cash, not actual cryptocurrency exchange.
- High inherent leverage, less developed markets, and greater volatility compared to established markets.

Cryptocurrency ETFs:

- Track the performance of digital assets using cash and derivatives, not direct investment.
- Offer diversification and potentially lower fees than trusts, but may not perfectly replicate the underlying asset.

Cryptocurrency stocks

- Provide exposure to digital assets through publicly traded digital exchanges, payment providers accepting cryptocurrencies, corporations investing in or mining cryptocurrencies, and corporations developing products or services for blockchain networks.

Hedge Funds

- Offer various strategies, including discretionary, long/short, quantitative, and multi-strategy, for indirect digital asset investment.
- Some hedge funds actively mine Bitcoin to boost returns.

3. Digital Forms of Investment for Non-Digital Assets

Investors can participate in digital investments based on non-digital assets, providing value through asset-backed tokens:

Asset-Backed Tokens are digital tokens representing ownership of physical or financial assets like gold, real estate, or stocks. These tokens offer several advantages:

- Increased liquidity through fractional ownership (splitting an asset into smaller pieces for multiple investors).
- Transparent and permanent record of ownership.
- Lower transaction and record-keeping costs.

Financial regulators classify asset-backed tokens as securities because of the ownership interest in the underlying asset.

Asset-backed tokens are typically issued on smart contract platforms, such as Ethereum, which allow for decentralized transactions

Decentralized Finance (DeFi) is a movement that seeks to design, combine, and develop various open-source financial applications as building blocks for sophisticated financial products and services.
DeFi is a marketplace for **dApps**.

- **Decentralized applications (dApps)** are applications built on blockchain designed for various financial functions, including exchange, value storage, asset tokenization, and ownership transfer.
- **Smart contracts** embedded in dApps handle traditional financial activities like lending, trading, investment, settlement, payment, and transfer in a decentralized and instantaneous manner.

Practice: Question-Set from the CFA Institute's Curriculum.

5. DIGITAL ASSET INVESTMENT RISK, RETURN, AND DIVERSIFICATION

Digital assets like Bitcoin and Ethereum have seen significant growth since their introduction, partly driven by the emergence of traditional investment options like exchange-traded products and hedge funds.

However, due to their volatility and market uncertainty, many investors consider ***cryptocurrencies*** to be alternative investments rather than traditional financial assets.

1. Digital Asset Investment Risks and Returns

Investing in cryptocurrencies presents a unique set of challenges and opportunities, characterized by reliance on asset appreciation, market-driven prices, significant volatility, and ongoing regulatory and legal uncertainties.

- **Limited Underlying Value:** Digital assets like Bitcoin rely solely on price appreciation, not cash flow.
- **Heavy Price Dependence on Demand:** Scarcity drives prices as supply is limited (e.g., Bitcoin has a cap of 21 million coins).
- **High Volatility:** Despite some decrease, Bitcoin's volatility remains significantly higher than traditional assets.
- **Uncertain Investment Potential:** Other cryptocurrencies exhibit similar patterns to Bitcoin, increasing uncertainty.
- **Lack of Legal Protection:** Currently, there is no legal protection for using cryptocurrencies as a medium of exchange.
- **Regulatory Uncertainty:** Regulations are evolving, and digital assets are currently regulated as commodities in the US with pending regulations in the EU.
- **Fraud and Criminal Activity:** Fraud is prevalent among buyers, sellers, issuers, and marketers of digital assets.

Example: Bitcoin's price went from $0.05 in 2010 to a high of $68,789 in 2021 before crashing to $17,709 in 2022, highlighting the high returns and volatility associated with digital assets.

2. Diversification Benefits of Digital Asset Investments

Cryptocurrencies provide ***diversification*** benefits due to their ***low correlations*** with traditional asset class returns.

Their prices are influenced by factors such as market adoption, network effects, technological advancement, regulatory development, speculation, and general market risk appetite.

This speculative nature and different value drivers result in low correlations with traditional investment assets.

However, it's noteworthy that cryptocurrency's correlation with traditional assets is increasing, casting uncertainty on their long-term diversification benefits.

Practice: Question-Set from the CFA Institute's Curriculum.

Practice: End-of-Chapter Questions from the CFA Institute's Curriculum and Questions from the FinQuiz Question B.