“The optimist thinks this is the best of all possible worlds. The pessimist fears it is true.”
— J. Robert Oppenheimer
THE COMPONENTS OF THIS WORLD

Blockchain and distributed ledgers

Digital Assets

Smart Contracts

Artificial Intelligence

Regulations and laws

- SROs – Self Regulatory Organizations
- Regulatory Bodies – SEC, FED, OCC, FINRA, CFTC, MiCA, AFME, MAS etc.
- Legislative bodies
- Law enforcement – AML, KYC, FinCEN, OFAC etc.

Geo- Politics

- Monetary policy and influence
- Reserve currency
- Rules of trade
**WHAT ARE DIGITAL ASSETS**

### Cryptocurrencies
- No centralized trust
- Volatile
- Easy cross-border movement
- Not clearly regulated
- (E.g.: Bitcoins, Ethereum etc.)

### Stable coins
- Pegged to fiat currency
- Regulatory implications unclear
- Can make DVP transactions easier on the chain

### Central bank digital currencies
- Issued by central banks
- Regulatory implications unclear
- Can make DVP transactions easier on the chain

### Tokenized securities
- Operational efficiencies
- Access to new markets (e.g., fractionalization)
- Reduction in risk
- Better Audit
- Cost of running two networks

### Digitally native securities
- Most cost-effective
- Can be well regulated
- Operational automation
- Disintermediation of central depository

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**COMPLEXITY OF CURRENT SYSTEMS**

**DIGITIZATION VS DIGITALIZATION**

Digitalization
- Data Governance
- Databases
- Messaging Systems
- Computation Algorithms
- Machine Learning

Digitization
- Digital Assets
  - Smart contracts
  - Programmable
  - Self-governing

Analog Channels

Digital Channels

Distributed Ledgers
Blockchain - A cryptographically linked set of blocks containing data which may represent transactions

Decentralized - There is no central trusted arbitrator to reconcile any disagreements, deceptions and differences between copies of the blockchain

Consensus - An algorithm that is used to reconcile such differences without the need for a central trusted arbitrator

The consensus mechanism needs to answer the following questions:

• Who can change the past, and how? (This is also known as immutability.)
• Who can change the future, and how? (This is also known as finality.)
• What is the cost to make such changes?
• How decentralized is the power to make such changes?
• Who will know if something has changed, and how will they know?
MINING

Mining is a type of consensus algorithm. The general principle of mining is to impose a cost for fraud (or mistakes). The cost should be high enough so that there is a disincentive to add incorrect or fraudulent blocks.

There are two common approaches for imposing the cost:

a) Proof or Work: This cost is external to the network. It is usually the cost of energy needed to solve difficult mathematical puzzles.

b) Proof of Stake: This cost is internal to the network. It is usually the loss of value of assets that a validator has to “stake”. The reasoning being that validators will refrain from fraudulent or sloppy work if it results in the loss of their assets.

Proof of work is extremely energy intensive; proof of stake is much less so. Bitcoin and Ethereum use proof of work, but Ethereum is in the process of changing to a proof of stake mechanism.
THE PROBLEM OF TURING COMPLETENESS

• A mathematical model for most practical computers and languages

• Most business applications need a Turing complete language

• Turing complete languages have a “halting problem” (they can get into infinite loops)

• Ethereum’s ability to execute a stored program, in a state machine called the Ethereum Virtual Machine, while reading and writing data to memory makes it a Turing-complete system

• Ethereum’s groundbreaking innovation is to combine the general-purpose computing architecture of a stored-program computer with a decentralized blockchain, thereby creating a distributed single-state (singleton) world computer. Ethereum programs run “everywhere,” yet produce a common state that is secured by the rules of consensus.

• To fix the halting problem Ethereum introduced “gas”

• DAPPs (Distributed Apps – Smart contract + interface)
SMART CONTRACTS

They’re not contracts and they’re not that smart, but they are:

A trusted, shared process
Potentially huge gains in operational efficiency.

A path to automation
Eliminating reconciliation and the attendant negotiations eliminates a LOT of friction.
DECENTRALIZED FINANCE

• Peer-to-peer financial services
• The terms of the financial contracts are coded in smart contracts
• Protocols – smart contracts that implements the rules of a particular financial product.
• Example: Aave – Allows users to provide liquidity and borrow assets based on smart contracts in the Aave network.

The promise
• Low barrier to entry for financial products (example: Fractionalization, Lending, Real estate etc.)
• Control of the rules of interaction is not monopolized by large institutions with capital to invest in infrastructure
• Instantaneous settlements (risk reduction)
• Greater security

Challenges
• Protocols are only as good as the smart contracts (code)
• Multiplication of scams. Example: “Rug pulls”
• Regulatory clarity
• Volatility
DIGITAL ASSET STRATEGIC CONSIDERATIONS FOR FINANCIAL INSTITUTIONS

Financial services will continue to enhance in-house digital asset capabilities in relation to digitally native securities and asset tokens.

Cryptocurrency custody capabilities will be needed to compliment this strategy.
CASE STUDY, NORTHERN TRUST, PRIVATE EQUITY

...a collaborative platform delivering increased efficiency, security and transparency.

LEGACY STRUCTURE

- Time consuming administrative processes
- Challenge to support Board best practice
- Lengthy and fragmented business activities

BLOCKCHAIN STRUCTURE

- Governance records on a single platform
- Real-time insight and transparency to all parties
- Compliant with legal and governance codes assisted by Smart contracts

= Entity has a full or partial copy of the fund register
CASE STUDY - NORTHERN TRUST AND BONDEVALUE - FRACTIONALIZATION

BondEvalue and Northern Trust Collaborate to Complete World’s First Blockchain-based Bond Trade – Press release, August 2020

• BondEvalue’s platform combines the power of distributed ledger technology (DLT) to enable enhanced transparency, liquidity and faster settlement, while making institutional grade investment opportunities available to new classes of investors.

• Northern Trust is providing securities services for the wholesale bonds and will support receipt of investments and payments of redemptions for the platform in a wide array of currencies. In what is believed to be a first for the industry, Northern Trust has built the market leading capability to communicate cash & securities settlement reporting directly to BondEvalue’s DLT platform via an application programming interface (API).
CASE STUDY - NORTHERN TRUST AND STANDARD CHARTERED – CRYPTO CUSTODY

Standard Chartered and Northern Trust Partner to Launch Zodia, a Cryptocurrency Custodian for Institutional Investors – Press Release, Dec 2020

- SC Ventures, the innovation and ventures unit of Standard Chartered, and Northern Trust, a leading provider of asset servicing, launched Zodia Custody, an institutional-grade custody solution for cryptocurrencies.

- Zodia combines the traditional custody principles and expertise of a bank with the agility of a fintech company to provide an infrastructure that meets the high standards and expectations of institutional investors through a platform that adapts to the changing needs of clients and the market.