

CIO Insights Reflections: A deeper look – demystifying Distributed Ledger Technology

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Distributed Ledger Technology at a glance

Overview

We had a first look at Distributed Ledger Technology (predominantly blockchain) & Cryptocurrencies in late 2017. This report aims to dig one level deeper and provide a comprehensive assessment of both the potential and the associated risks of this emerging technology which could have an impact on a wide variety of areas:

Governance & law | economic & social structures | financial products & services | identity & personal management | sustainability

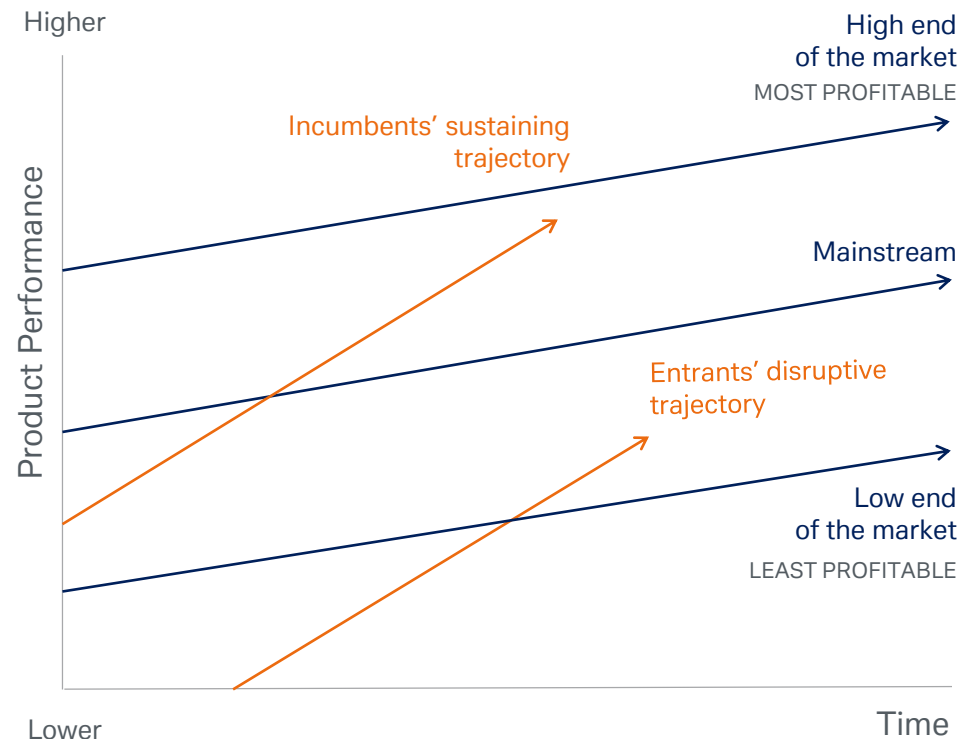
- ① The **pace of adoption** of Distributed Ledger Technology (DLT) into a **wide variety** of use cases within the financial system signals the beginning of a new era and it could be seen as introducing a **new era for the internet** in terms of economic and financial relationships, leading to **time savings of 75%** when resolving financial disputes.
- ② Currently there is a **socioeconomic shift going on** and the foundations for the application of the blockchain technology is being created by a mix of **established companies** and **start ups** that have attracted major talent from the financial industry. Distributed Ledger Technology may become pervasive in **5 to 10 years**. We will see some solutions going live this year.
- ③ **Collaboration** across industries is key in order to harvest the promised efficiency of blockchain. Blockchain has created a **window of opportunity** to question current market processes and allows the use of emerging tech to create better and more efficient solutions which could lead to **savings of \$15-20 billion in the financial services industry** by 2022. **10% of the global GDP information** might be stored on DLT by 2025.
- ④ Blockchain **is still an emerging technology** and there are **challenges** (legal, regulatory, technology, standardisation) to **overcome** before it can go mainstream. From the regulatory point of view it is **very important** that new rules do not restrict the technology itself, but are focused on the respective use cases.
- ⑤ Blockchain will **not be a panacea** for all of our problems if processes, rules, requirements, data structures and policies are not **adjusted and standardized**. Failure to do this will just prolong the issues that exist today.
- ⑥ **Productivity gains** due to harmonization of existing asymmetric information profiles as there are no needs for intermediaries.

Source: Deloitte, IBM, World Economic Forum, Deutsche Bank AG

What is disruptive innovation?

Before we take a deeper look at Distributed Ledger Technology, we should pause and think about what turns a development into disruptive innovation.

“Disruption” describes a process whereby a **smaller company** with fewer resources is able to **successfully challenge established incumbent businesses**. Specifically, as incumbents focus on improving their products and services for their most demanding (and usually most profitable) customers, they sometimes exceed the requirements of some areas and **ignore the needs of others**. Entrants that prove to be disruptive begin by successfully **targeting those overlooked areas**, gaining a foothold by delivering more-suitable functionality – frequently at a **lower price**. Incumbents, chasing higher profitability in more-demanding areas, tend not to respond vigorously. Entrants then **move upmarket**, delivering the performance that incumbents’ mainstream customers require, while preserving the advantages that drove their early success. **When mainstream customers start adopting the entrants’ offerings in volume, disruption has occurred.**¹



¹Harvard Business Review
Source: Deutsche Bank AG

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Distributed Ledger Technology (DLT)

Review of the last paper

- **Blockchains** and connected **cryptocurrencies** are probably the inventions with the most **disruptive** potential for the finance sector and the public since the invention of the internet.
- Blockchains could revolutionize industries from the bottom-up and create new business models around a peer-to-peer community.
- Bitcoin, Ethereum et al are only the **first pioneer projects**, whose success or failure depends on several factors like technical security, regulations and also their political impact.
- As a **new asset class**, and one which is getting a lot of attention nowadays, Crypto Assets could be an **interesting alternative to diversify portfolios**. But there is an appreciable risk of major losses. Crypto Assets are in our opinion a highly speculative investment.
- Economists have long been interested in **the origins and uses of money**, from Adam Smith, through Ludwig von Mises and on to the present day: they will now need to explore new aspects of it.
- If blockchain can win **trust** in professional services, then it could **sharply reduce** the need for lawyers, accountants and so on in these traditional public or private sector functions: in other words, artificial intelligence is not the only threat to white-collar jobs.
- For more information have a look at our [CIO Insights Reflections: Cryptocurrencies and blockchains – their importance in the future](#).

Features of Distributed Ledger Technology

Core distributed ledger functionality

Consistent, immutable recording of data

An ongoing process where ledgers are updated to hold the **same data** in the **same order**. Historical data cannot be easily or secretly changed by any single actor, making it practically **sacrosanct**.

Distribution across a network

Databases (ledgers) are replicated automatically across network participants. Validation of data is performed via a **pre-defined algorithm** rather than a central authority.



Richer data sources

- Comprehensive and transparent audit trail
- Near real-time access to accurate data across multiple parties (single version of truth)

Security & complementary innovations

Encryption & signature validation

Data “fingerprints” generated through one-way encryption makes checking **data integrity** fast. In distributed ledgers, identity and permissions are **continually validated** with each transaction.

Smart contracts

Allow business logic and workflows to be built into a distributed ledger. Capable of **updating the ledger** (e.g., making payments) based on pre-defined conditions.



Frictionless value transfer

- Ability to record transfer of digital assets without central authority
- Efficient transaction processing with settlement finality

Malleable and robust data environment

- No single point of failure

Source: J.P. Morgan and Oliver Wyman, Deutsche Bank AG

Challenges need to be overcome



Scalability:

For a broad-based adoption of DLT, the scalability problem (transaction cost/ transaction time) is a key issue to solve. The speed and effectiveness with which DLT networks can execute peer-to-peer transactions comes at a high **aggregate cost**, which is greater for some types of DLT than others. This inefficiency arises because each node performs the same tasks as every others. This inefficiency arises because a number of independent parties have to reach consensus in a distributed fashion.



Interoperability:

As the DLT ecosystem expands, so does the need for these **DLT to be able to communicate with each other**. Organisations are developing their own DLT and applications to run on top of them. In any one industry sector, many different chains are therefore being developed by many different organisations to many **different standards**. This defeats the purpose of distributed ledgers, fails to harness network effects and can be less efficient than current approaches. It has been estimated that a blockchain implementation is about 80% business process change and 20% technology implementation.



Privacy:

The Distributed Ledger Technology allows full transparency on transactions. For some DLT applications, it is vital that some information can't be accessed by just anyone. Many potential applications of DLT require **smart contracts** for transactions to be indisputably linked to known identities, and thus raise important questions about privacy and the security of the data stored and accessible on the shared ledger.



Regulation:

Broader uptake of DLT will also depend on addressing certain regulatory and legal challenges. Various DLT products and services will likely have discrete **risk profiles** and implications for markets and should therefore be viewed separately. Not only should new rules be designed **technology-neutral**, but existing regulation needs to be reviewed to identify and reduce barriers to innovation and deployment of DLT solutions. The situation of DLT nodes in multiple jurisdictions will also raise conflict of law issues. Open questions still exist on which jurisdictional law should apply in the case of cross-border transactions.

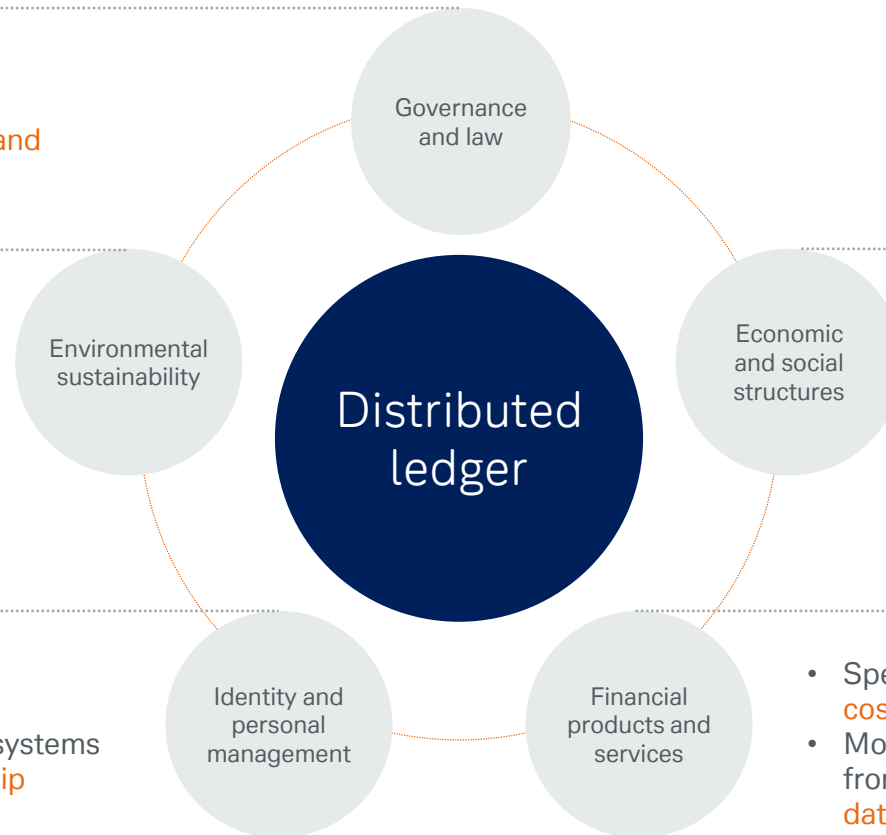
Source: Deloitte, Deutsche Bank AG

Potential economic impact of DLT¹

- Deep impact on **accountancy, law, regulation and policy**
- Faster implementation of **economy and policy frameworks**

- Most valued public blockchains e.g. Bitcoin use **very large amounts of energy**
- Enabling and auditing the **circular economy, carbon trading** and **peer-to-peer energy markets**

- **Immutable** and **contextual** identity management
- **Robust** and **resilient** digital identity systems
- **Tamper proof e-voting** and **ownership tracking**

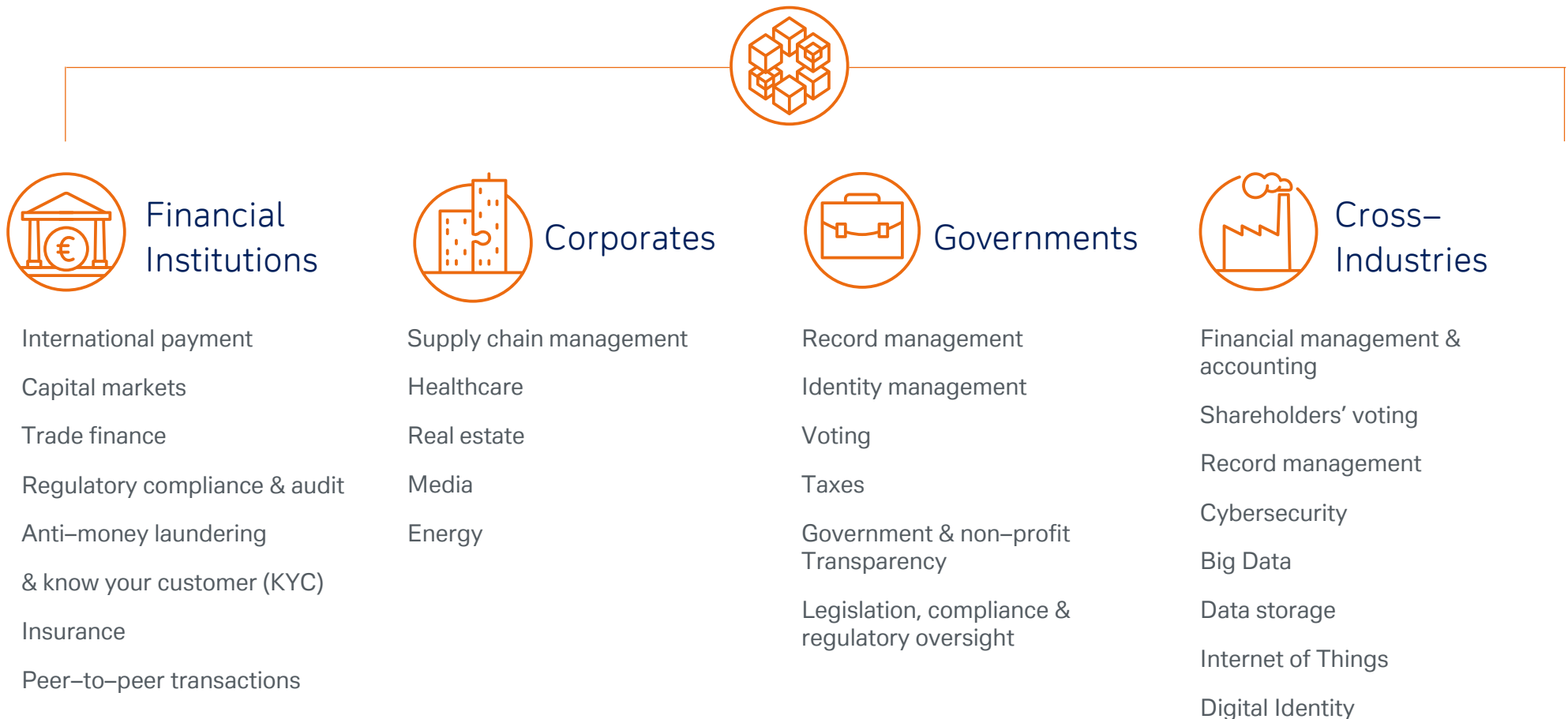


- **Rebalancing** local and global supply chains
- Provide **transparency** and create **efficiencies** in social systems

- Speed up transactions, reduce **transaction costs** and enable **frictionless traceability**
- Moving the financial services industry away from process-oriented approaches towards **data-based workstreams**
- **Decentralization** of financial services
- **Securitisation** e.g., Private Market, Debt, Crowdfunding

¹extract
Source: weforum.org, Deutsche Bank AG

Potential use cases (example Blockchain)



Source: Moody's Investors Service, Deutsche Bank AG

DLT has the ability to disrupt most industries



Financial industry:

- Decentralized asset management: Tokenization of assets by representing an asset (e.g. oil, gold) as a digital token¹.
- Speeding up and simplifying cross-border payments.



Health care:

- Insure the authenticity and traceability of drugs.
- Provide a decentralized data base for patient data management, with ability to share sensitive patient data on a secure basis.



Food industry:

- Improve transparency and traceability in the food industry to target food-fraud.
- Identify and remove food that has been recalled or is expired.



Automobile industry:

- Improving just-in-time logistics, reducing erroneous orders and raising inventory turns.
- Trace the provenance of spare parts back through every step in the supply chain and reveal a vehicle's real wear and tear.



Music Industry:

- Record metadata and ownership information for digital creative assets.
- Solutions for releasing music, streamlining the distribution model and funnelling more of the revenue towards the creators.



Environmental Social Governance (ESG):

- Veridium is collaborating and using IBM's blockchain technology to create "social and environmental impact" tokens.
- The tokenization of carbon credits comprises the entire process of carbon footprint accounting and will simplify the trading process.

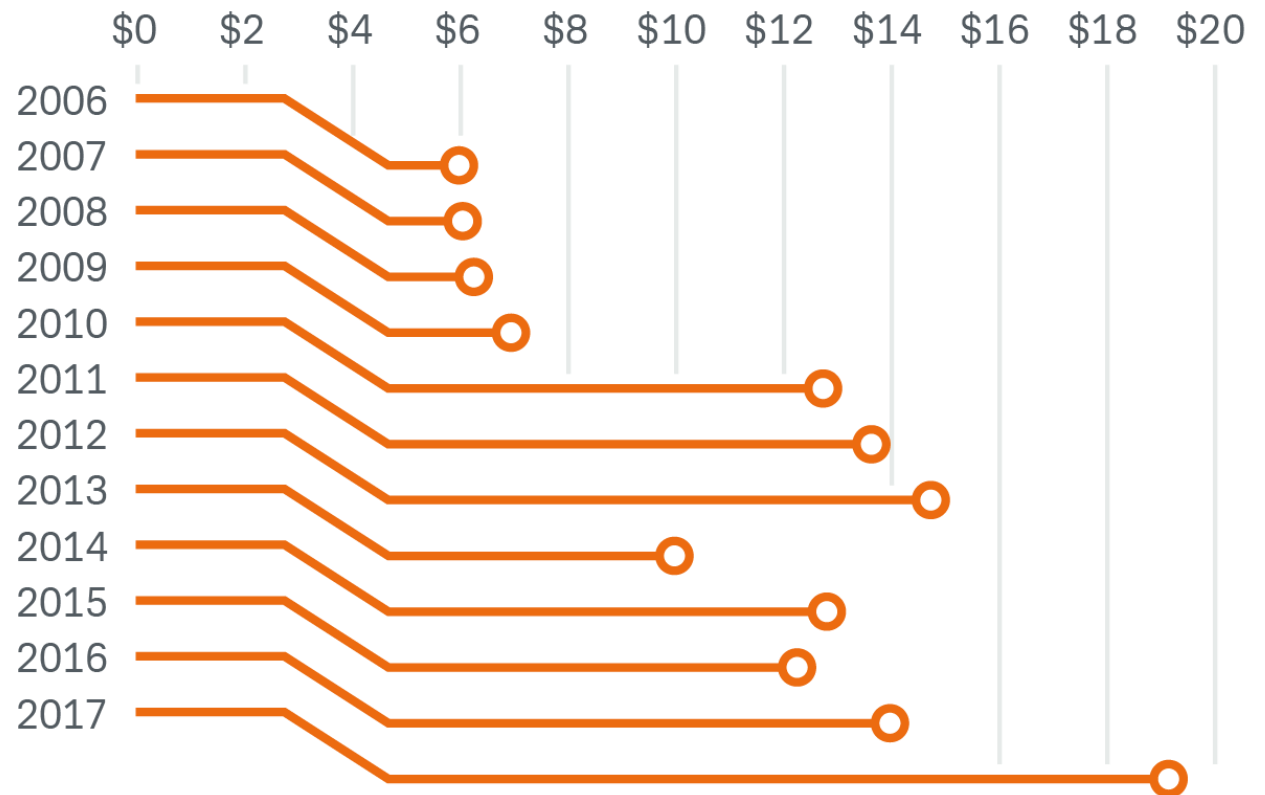
¹Tokenization or digitalization of assets is the process of converting rights to an asset into a digital token on a Distributed Ledger. Tokenization reduces much of the friction involved with holding, storing and transferring physical assets such as gold or oil.

Source: deloitte.com, weforum.org, IBM, Deutsche Bank AG

Cyber security is an important component

- **Democratization** of industries e.g. financial services on a DLT shifts the organizational and process risks to **technological risks**.
- To sustain trust, **cyber security** will become a key success criteria of public DLTs.
- Breaches of multiple cryptocurrency exchanges in recent history underlines the importance of industry-grade **secure wallet management**.
- The concept of smart contracts will lead to **high automation**, but at the same time introduce a high **risk of vulnerabilities**.
- An automated and decentralized DLT does not offer same grade of response flexibility as a manual process if exposed by risks. **All potential risks** needs to be **engineered in the contract upfront**.

Rising expenditures on cyber security (USA, in billion USD)



Footnote: Data as of February 16, 2017. 2017 forecast from Cybersecurity Ventures.
Source: sia.tech, phys.org, Deutsche Bank AG

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What does the future
hold?

What does the future hold?

10%

of the global GDP information might be stored on Distributed Ledger Technology by 2025.

\$11-12 billion

overall savings by applying distributed ledgers to the clearing and settlement of cash securities.

\$150 billion

annual cost savings by using DLT to represent assets (e.g. oil, gold) as digital tokens.

\$2-4 billion

annual cost savings in the United States alone by recording property rights via DLT.

\$15-20 billion

annually operational cost savings in the financial services industry by 2022.

75%

time savings by using DLT to resolve financial disputes.



Distributed Ledger Technology has the potential to increase efficiency dramatically, leading to significant time savings and cost reductions and thus to an increase in productivity.

What does the future hold?

We have interviewed industry experts



Keith Bear



CONSENSYS

Joseph Lubin (founder)
Chelsea Burkhart
Clark Thompson
Andrew Keys
Ajit Tripathi
Jeremy Millar
John Zimmerebner
Jason Jones
Rouven Heck (uPort)



Paul DiMarzio
Lance Arlaus
Dan O'Prey
Vera Newhouse
Ashta Doyle



HYPERLEDGER

Brian Behlendorf



Brian McNulty

Source: IBM, ConsenSys, Digital Asset, Hyperledger, r3, uPort, Deutsche Bank AG

Major issues regarding blockchain

What is your vision for blockchain?

Where are we in the 'hype cycle'?

What are the next steps?



What are the challenges of blockchain implementation?

What are the benefits of the decentralized business model?

How does your kind of blockchain work?

Different blockchain technologies

ConsenSys

Ethereum Foundation

Ethereum is a public, open-sourced blockchain, led by Ethereum developers. It enables the development of systems of automated and executable agreements that ensure that all counterparties are treated fairly throughout a transaction. Through the proof-of-work scheme (PoW) all participants agree upon a common ledger. This resource intensive process affects performance of transaction processing. Ethereum has a build in cryptocurrency called Ether, rewarding nodes that contribute to reach consensus by mining blocks.

Digital Asset

Global Synchronisation Log (GSL)

Distributed Ledger Technology based on the smart contract language named Digital Asset Modeling Language (DAML). GSL focuses on using the benefits from shared, replicated ledgers, but at the same time providing security and anonymity using blockchain as a privacy-preserving service, ensuring mutually exclusive events by deriving these states from the stream of transaction. As it ensures integrity of the data, GSL is compliant with GDPR¹. GSL doesn't require a proof of work and is therefore highly scalable.

IBM / Hyperledger

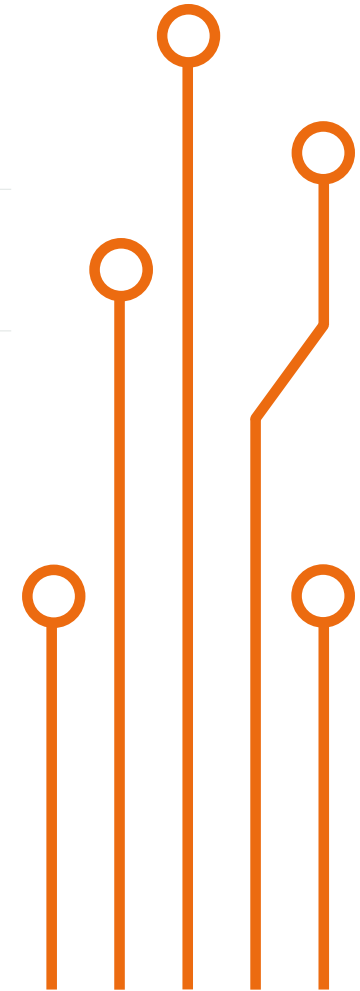
Hyperledger Fabric

Modular blockchain platform governed by the Linux Foundation. It provides user access through so called "channels" that ensure information are only shared with authorized participants. As a consequence, consensus has only to be reached at transaction level, not at a ledger level, reducing the required resources and improving performance scalability. Assets can not be moved from one channel to another. Fabric provides the possibility to develop a native currency or a digital token with chaincode.

R3

Corda

Specialized distributed ledger technology focusing on the financial industry and privacy by providing encrypted point to point connections. It is considered as a "subjective" DLT as it only stores the particular information in which the participants were involved in and saves this in the so called Corda Vault. Corda does not use the proof-of-work scheme but reaches consensus at transaction level by only taking involved parties into account. By running smart contracts validity is ensured.



¹General Data Protection Regulation

Source: Frankfurt School Blockchain Center, Corda, Digital Asset, Hyperledger, Ethereum, Deutsche Bank AG

What is the vision of blockchain?

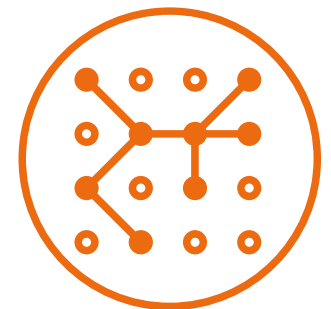


- Blockchain and Distributed Ledger Technology is a lot more than just Bitcoin and cryptocurrencies.
- Blockchain technology and apps have the ability to **decentralize power from existing authorities** through the use of **smart contracts and asset ownership**. This shift will **change current businesses and economic and social paradigms**. Transaction costs and barriers to entry will be reduced in various industries. The result could potentially lead to an **increase in economic exchange and prosperity**.
- Blockchain is a new and advancing technology. Even though it started with Bitcoin and is used widely in cryptocurrencies, it now has **non-financial uses** in many areas and applications. For example IBM became aware of the DLT because of Bitcoin, then experimented with Ethereum, turned to blockchain, built an own blockchain network and donated the code into the Hyperledger project.
- Companies are unlocking the potential of blockchain by making it **more accessible** and **more open** via open source, philosophically, it's about moving from a world of building siloed systems to collaborative systems.
- The vision is to provide robust and efficient standards for distributed ledger technologies which facilitate mainstream commercial adoption. Future applications will involve a world with many **interconnected distributed databases and blockchains**, each of which will be specialized to suit the purpose of its users and will have the potential to **communicate with other ledgers**, as necessary.
- The goal is to explore new ways to advance the science of blockchain by helping **remove** some of the **complexity**, making it more accessible and open. Furthermore, the optimal focus is to advance industry goals of distributed ledger and smart contracts.
- If it would be possible to turn the markets to use DLT, it will unleash a lot of creativity. Everyone would have **access to a single version of the truth** and know the data is correct.
- **The true limits of blockchain are still unknown** and developers and pioneers are in uncharted territory. New businesses models will arise and may co-exist for a while with legacy business models.

Source: IBM, ConsenSys, Digital Asset Holdings, Hyperledger, r3, Deutsche Bank AG

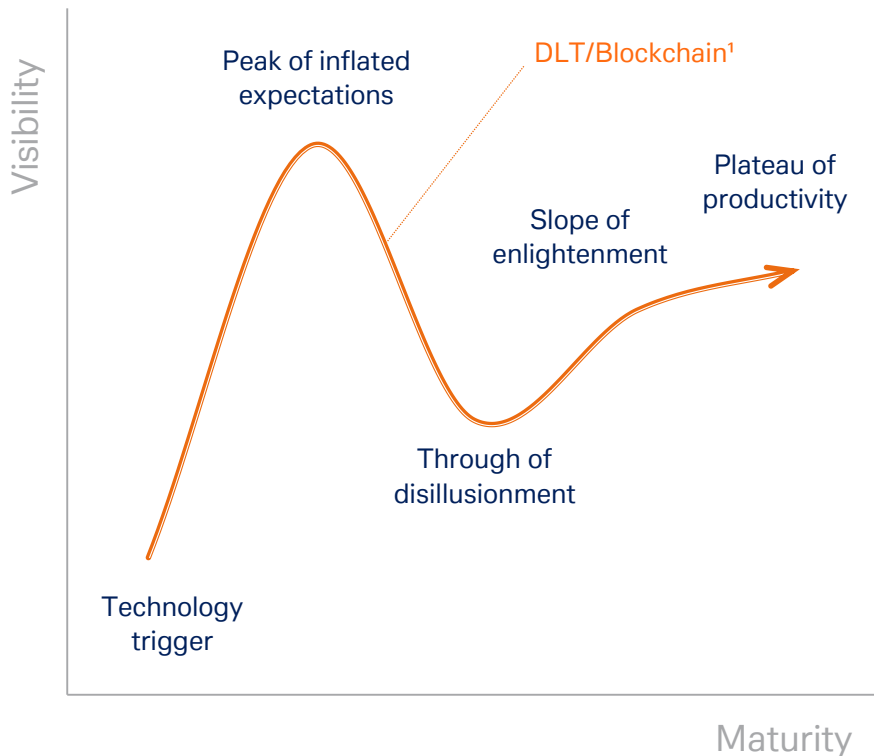
The vision for decentralisation

- Decentralisation is where technology is empowering brands and communities to seize the initiative and **challenge centralised ways of doing things**.
- Blockchain provides **political and architectural decentralization** as there is no dependence on a mandatory central authority and the infrastructure is spread on computers throughout the world. However, from the logical point of view, **blockchain** is **centralized** as there is **one commonly agreed state** and a shared set of rules for agreeing on the agreed state.
- Some of the biggest players in the distributed ledger field such as IBM or Digital Asset don't aim to use blockchain for general decentralization but as an **improvement of the current system**, while other leading players such as ConsenSys have a larger vision for decentralization **aiming for socioeconomic change**.
- Blockchain used in a **hybrid centralized – decentralized** model allows to adopt the **advantages of central control** as well as **avoiding** the necessary of setting up **central entities**.
- Some of the big players see that the **centralization of business processes** does not cause any issues and is usually **mandated by legislation** and the idea would be to use blockchain in order to make the **system more efficient, effective and secure**.
- Others, like ConsenSys aim to **revolutionize** the way **economic, social and political systems are built** and decentralize power from rent seeking monopolies which will lead to a shift towards **fairer, more open and transparent political, economic and social paradigms**.
- The reduction of transaction costs and barriers to enter in a decentralised model will likely lead to an **increase in economic exchange and prosperity**.



Source: IBM, ConsenSys, Digital Asset Holdings, Hyperledger, Vitalik Buterin, Deutsche Bank AG

Where are we in the Hype Cycle?



Divergent opinions about the current position in the Hype Cycle:

"It started with Bitcoin and since then it seems to be the tiny blip, it often overshoots and then we correct"

"We are in a bubble and the bubble is getting larger and larger"

"We still see a huge amount of hype"

ConsenSys

"Mass deployment taking place starting in 2018. Therefore, this year will bring significant milestones of commercial and social value being transferred."

Keith Bear, IBM

"We are definitely through the peak and probably at the beginning of an enlightenment"

Brian McNulty, r3

Simplifying/replacing current infrastructure is a long-term process

- Substantial change management projects need to be set up
- Crypto ecosystem is characterized by different pace of development

¹Deutsche Bank Global Transaction Banking (GTB) House View
Source: Gartner, IBM, Consensus, Digital Asset Holdings, Hyperledger, Deutsche Bank AG

Challenges

- The principal challenge associated with blockchain is a **lack of awareness of the technology**, especially in sectors other than banking, and a widespread lack of understanding of how it works. This is hampering investment and the exploration of ideas.
- Introduction phase: Increasing number of products & technologies
 - Organisations are developing their own blockchains and applications to run on top of them. In any one industry sector, many different chains are therefore being developed by many different organisations to many different standards. This defeats the purpose of distributed ledgers, **fails to harness network effects** and can be less efficient than current approaches.
- Foundational functionality is missing:
 - Currently there is **no cash** on the ledger which would allow for a **frictionless value transfer** if we assume that other things of value (e.g. securities, land titles) would be on the blockchain.
 - Further there is **no connection to a digital identity** which would provide an easy identification.
- Implementation & Standardization:
 - No consistent definition of blockchain at the moment.
 - **Shortage of developers** who have experience in building a blockchain technology.
 - As it is hard to find a standard since **multiple blockchains are needed in order to solve diverse cases** there is **no network effect**.
 - **Interoperability** with legacy and other blockchain technologies is key.
 - **Uncertainty** about future development of the legal and regulatory alignments.
- Shift in culture:
 - End to End value chains need to be **assessed across the different players** in order to really benefit from the efficiencies that blockchain promises.
 - **Collaboration** across silos and industries is **necessary** (“collaborate to compete”).
- Rush of judgement about scalability and putting something in production:
 - The internet was also not overly scalable, secure and private in the beginning. **Time was needed** to develop these attributes.
 - Putting systems into production in big organisations has a longer lead time even with proven technology. It has to make sure that the blockchain ensures the safety and security of the system that will be implemented, and the **learning curve of organisations can be compared to early days of the internet**.

Source: Deloitte, World Economic Forum, ConsenSys, Deutsche Bank AG.

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Spotlight on companies and use cases

Spotlight on companies and use cases

r3

Founded in 2014, r3 leads a consortium of more than 200 members and partners from both the private and public sector. These include **foremost financial companies** such as Bank of America, Barclays, BNP Paribas, HSBC or Deutsche Bank, but also renowned institutions such as the Royal Bank of Canada, making it the **largest collaboration** of its kind in the **blockchain space**. Combining the massive resources and capabilities of these members leads to huge opportunities, but at the same time represents a big challenge as **collaborating** is an **unconventional approach** to them. r3' global team, consisting of over

180 professionals in 13 countries and being supported by over 2000 technology, financial and legal experts, is working on Corda, an open-source blockchain platform.

The Corda platform is designed to **remove costly friction** in business transactions by enabling businesses to **transact directly**. The Platform is already being used in industries from financial services to healthcare, shipping, insurance and more.

In 2018, Corda Enterprise was introduced, a **commercial distribution** of the open-source, created specifically to meet the demands of modern day business. It allows enterprises to **select the blockchain platform that fits their unique needs the best**— regardless of their industry, size or stage of development.

Corda's core capabilities include:

- **Consensus:** Bringing participants to consensus on shared facts, removing costly and time-consuming reconciliation.
- **Privacy:** Minimizing information leakage by only sharing required transaction data.
- **Integration:** Corda has been built to easily integrate and interoperate with existing systems.
- **Cross-industry:** Corda provides a gateway to a vibrant network of blockchain applications for cross-industry complex, real world problems.



Source: r3

Spotlight on companies and use cases

Marco Polo

TradelX and r3 launching Marco Polo as a joint undertaking

- Collaborating with a dozen of the world's foremost financial institutions, r3 and TradelX created Marco Polo, one of the fastest growing trade finance business networks.
- Marco Polo is focusing on a **Trade Finance Platform**, providing benefits for financial institutions and their corporate clients by **reducing costs, risk and time involved in business trading**, covering:

Identities

Purchase orders

Invoices

Shipping/logistic information

Trade assets

Credit risk

- Today's trade finance ecosystem faces numerous difficulties/obstacles as there is a **lack of standards between trading participants**. The single trade systems are soiled and non-interactive.
- Based on Corda's blockchain technology, Marco Polo aims to overcome these obstacles by enabling **interoperability with rules and standards** and at the same time allowing members to integrate easily with internal and external systems through Application Programming Interfaces (APIs).
- Primary objectives include an **increase of trade finance volume** and diminishing fraud risk and costly errors by using single source of truth for critical trade data, becoming a global, secure open business network.



Marco Polo

Source: Tradelx, r3, marcopolo.finance

Spotlight on companies and use cases

Hyperledger

Hyperledger is incubating and promoting enterprise grade, **open source business blockchain technologies**, including distributed ledgers, smart contract engines, client libraries, graphical interfaces, utility libraries, and sample applications. Hyperledger is one of the fastest-growing open-source blockchain communities hosted by the Linux foundation.

Hyperledger provides the underlying open source software, on top of which **anyone can set up apps** to meet business needs.

Built under technical governance and open collaboration, individual developers, service and solution providers, government associations, corporate members and end users are all invited to participate in the development and promotion of these **game-changing technologies**.

Hyperledger Business Blockchain Technologies

- Hyperledger **incubates and promotes a range of business blockchain technologies**, including distributed ledger frameworks, smart contract engines, client libraries, graphical interfaces, utility libraries and sample applications. The Hyperledger greenhouse strategy encourages the re-use of common building blocks and **enables rapid innovation of DLT components**.

Hyperledger has 5 frameworks...

1. Hyperledger Fabric – Intended as a foundation for developing applications or solutions with a modular architecture, Hyperledger Fabric allows components, such as consensus and membership services, to be **plug-and-play**.
2. Hyperledger Sawtooth – A modular platform for building, deploying, and running distributed ledgers. Hyperledger Sawtooth includes **a novel consensus algorithm**, Proof of Elapsed Time (PoET), which targets large distributed validator populations with **minimal resource consumption**.
3. Hyperledger Burrow – A permissionable **smart contract machine**. Burrow provides a modular blockchain client with a permissioned smart contract interpreter built in part to the specification of the Ethereum Virtual Machine (EVM).
4. Hyperledger Iroha – A business blockchain framework designed to be simple and easy to **incorporate into infrastructural projects** requiring Distributed Ledger Technology.
5. Hyperledger Indy – A distributed ledger, purpose-built for **decentralized identity**. It provides tools, libraries, and reusable components for creating and using independent digital identities rooted on blockchains or other distributed ledgers for interoperability.



Source: Hyperledger

Hyperledger

...and 5 tools.

1. Hyperledger Caliper – A blockchain benchmark tool, which allows users to **measure the performance** of a specific blockchain implementation with a set of predefined use cases.
2. Hyperledger Cello – It aims to bring the on-demand “**as-a-service**” **deployment model** to the blockchain ecosystem to **reduce the effort** required for creating, managing and terminating blockchains.
3. Hyperledger Composer – A collaboration tool for building blockchain business networks, **accelerating the development of smart contracts** and their deployment across a distributed ledger.
4. Hyperledger Explorer – It can **view, invoke, deploy or query blocks**, transactions and associated data, network information, chain codes and transaction families, as well as any other relevant information stored in the ledger.
5. Hyperledger Quilt – Offers **interoperability between ledger systems** by implementing ILP, which is primarily a payments protocol and is designed to transfer value across distributed ledgers and non-distributed ledgers.

These are to build a multi community of stakeholders.

Diamond Supply Chain

This system is empowering organizations to get **specific on tracking where conflict diamonds are entering the supply chain** and preventing them from entering the market.

To keep conflict diamonds from entering the supply chain, Hyperledger Premier members SAP Ariba and IBM are collaborating with Everledger to pilot a distributed ledger diamond track and trace system using **Hyperledger Fabric v1.10** that everyone in the industry can write to from miners, to distributors, to retailers.

Holding a diamond to light creates a **unique pattern** that may be used to create an ID. When a bag of diamonds changes hands in the supply chain, it forms two entries in the chain: the diamond IDs present upon sending and receipt. Once a diamond ID number is inside the system it **provides integrity** as any stakeholder can then query and instantaneously **verify a diamond’s provenance**.



Source: Hyperledger

Spotlight on companies and use cases

IBM

International Business Machines Corporation (IBM) provides **computer solutions** through the use of **advanced information technology**. The company's solutions include technologies, systems, products, services, software, and financing. IBM offers its products through its global sales and distribution organization, as well as through a variety of third party distributors and resellers.

Progress

Taking notice of bitcoin, IBM quickly began to examine how the blockchain technology could be exploited in order to **support industries and their businesses**. IBM started to build its own open sourced blockchain network and donated the code to the Linux Foundation's Hyperledger project, emphasizing a permissioned and private network system. Later IBM launched an initiative on **Carbon Credit trading via tokenization**.

Technology

IBM has contributed Fabric to the Hyperledger foundation which was the first project to move to an active status. Fabric is a blockchain framework implementation allowing components, such as consensus and membership services, to be plug-and-play. Fabric provides a permissioned network, confidential transactions and a pluggable architecture. Hyperledger Fabric is well on its way to emerge to the de-facto **standard for enterprise blockchain platforms**.

Use Cases

Japan Exchange Group Launch Their Own Blockchain Consortium

Banking consortium awards Digital Trade Chain contract to IBM

DTCC selects IBM, AXONI and R3 to develop DTCC's distributed ledger solution for derivatives processing

Deutsche Börse CollCo project green-lighted by Eurex

Borsa Italiana collaborate with IBM to develop securities data blockchain solution for European SMEs

Northern Trust Goes Live With IBM-Powered Private Equities Blockchain

IBM and leading banks complete POC of blockchain-based shared KYC

CLS Group has partnered with IBM to release a payment netting service, CLS Netting



Focus areas

Financial Services

Corporates

Consumers

Cross-Industries

Source: IBM

Spotlight on companies and use cases

We.Trade

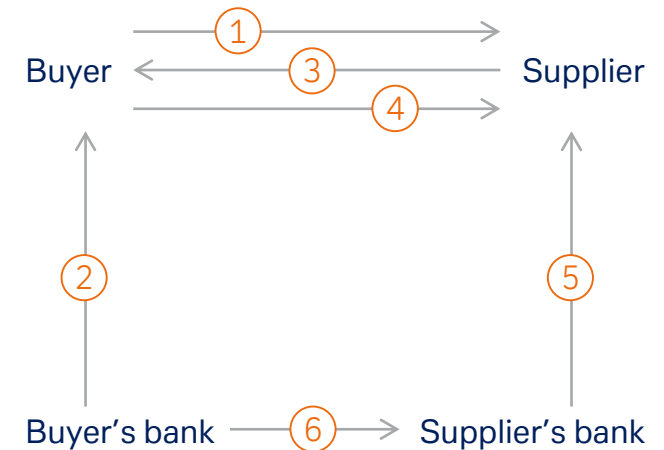
We.trade Innovation DAC is a joint-venture company owned by 9 European banks (Deutsche Bank is a founding member) that has developed and licenses the **first blockchain trade platform** available on the market for commercial clients and their banks. Through **Distributed Ledger Technology** and **smart contracts**, the platform provides a **secure, innovative environment for banks' commercial clients** engaged in import and export activities to trade in a user-friendly and efficient way with the aim of creating **trust and transparency** between them and each individual bank. As a result, a participating bank may be able to offer **more credit facilities** than they would without this facility. The platform uses **Hyperledger Fabric** and is run and supported by IBM.



we.trade provides an intermediary blockchain environment network to which all banks are connected to and the banks in turn are connected to the SMEs¹ to whom they have a banking relationship with.

How it works

1. Buyer initiates purchase order with agreed payment terms and settlement conditions, e.g. 60 days payment terms after invoice acceptance.
2. Buyer requests bank to provide Bank Payment Undertaking (BPU, optional).
3. Supplier ships and sends invoice through the platform.
4. Buyer confirms the receipt of goods.
5. Supplier asks his bank to provide invoice financing arrangement for next 60 days (optional).
6. Buyer's bank debits buyer account and initiates payment of invoice on due date, either to the supplier's bank, if invoice has been financed or to the supplier's account.



Key benefits for clients:

- Identification of unknown counterparts (all clients on we.trade are known and onboarded by one of the user's banks).
- User-friendly and efficient way to handle trades and associated services.
- Bank Payment Undertaking (BPU): Counterparty risk transferred to bank.
- Event based automatic payment triggers through smart contracts.
- Invoice Financing: Additional working capital without leveraging credit lines.
- Track and trace for over 426 couriers.
- Real time settlement enabled by one platform for all parties.

Source: IBM; Footnote:¹ Small and medium-sized enterprises

Spotlight on companies and use cases

Digital Asset

Digital Asset is the leading provider of Distributed Ledger Technology to regulated financial institutions such as exchanges, banks and other financial market infrastructure providers. Digital Asset combines unparalleled financial markets leadership with world class technologists across multiple fields in one of the **fastest growing fintech companies in the world**.

\$110 million
amount DA has raised by
15+
strategic investors

ABN-AMRO | ACCENTURE | ASX |
BNP PARIBAS | BROADRIDGE | CITI
| IBM | J.P. MORGAN



The Digital Asset Platform is the only distributed ledger platform to have been developed according to the **production requirements of the world's largest financial institutions**. Founded in 2014, Digital Asset now has offices in six countries, serving global clients like the ASX and DTCC. They understand the needs of regulated markets and deliver an effective and safe solution, combining a permissioned distributed ledger with a powerful contract modelling language in order to ensure that each institution operates from a **single source of truth**.

Digital Asset's technology provides continuous and distributed **data integrity** and hence eliminates the needs and costs of reconciling between multiple parties automatically and in real-time. Moreover, Digital Asset technology increases auditability by giving regulators **true market transparency** so that they can comply with reporting and compliance requirements **in real-time** rather than days or weeks after transactions have been completed.

The reduction of complexity for value transfer processes and the **increase of efficiency and security** is of significant importance not only for

financial services but also for other markets, therefore Digital Assets approach can be **applied to any market** where value is being transferred, such as the health care market or the transportation sector.

Based on the Digital Asset Modeling Language (DAML), a modular, distributed privacy preserving domain specific language, Digital Asset ensures that evidences of events are cryptographically linked to private trade data, which in contrast to a normal blockchain, is only replicated selectively among those parties entitled to view or interact with them. Therefore **each participant** can create their **own subsection** of the ledger which is consistent with that of other parties.

On the 23rd of July 2018, **Digital Asset and Google** announced that they had established a collaboration, bringing Digital Asset's blockchain platform and developer tools to the Google Cloud Platform.

Source: Digital Asset

Spotlight on companies and use cases

ASX

Australian security exchange to move to blockchain:

- Australia's main security exchange became the **first global market** to use the **technology behind Bitcoin** to clear and settle trades.
- The Australian Securities Exchange (ASX) **replaces its current clearing system** with **blockchain technology**.
- ASX is not using bitcoin or any cryptocurrency in any part of its investigation of the blockchain.
- The aim is to cut cost of transactions and make them **faster and more secure**. The **lower costs** are a key advantage for traders and investors, as over the long term it would mean fewer staff in the settlement process. Furthermore, it enables the customers to develop new services.
- Provide issuers and end investors **with greater control** and **enhanced confidence** in their market activities through timely, secure and simplified access to the register of holders (for issuers), financial assets (end investors) and associated information.
- At the end of 2017, ASX decided to replace its current system that records shareholdings and manage the clearing and settlement of equity transaction with a **DLT by Digital Assets**. It is scheduled to go live at end of 2020.
- Customers will be able to connect as they do today via using the current global ISO 20022 messaging, or they could interact directly with the distributed ledger.



Source: Digital Asset Holdings , finextra.com

Spotlight on companies and use cases

ConsenSys

Overview:

Operating in 30 countries | 900
technologists and entrepreneurs | 50
different nationalities

ConsenSys is a global formation of technologists and entrepreneurs building the infrastructure, applications, and practices that **enable a decentralized world**. It operates in widely defined sectors which include:

Labs: ConsenSys' venture studios providing resources and capabilities to entrepreneurs and developers helping them to become a successful company.

Academy: ConsenSys Academy's aim is to overcome the Ethereum knowledge gap and develop a global blockchain ecosystem, revolutionizing education through blockchain technology.

Solutions: ConsenSys solutions represents their consulting arm, helping organizations throughout the world to build and implement private and public blockchain solutions.

Capital: ConsenSys Capital is a constellation of financial service offerings for digital assets and blockchain-based companies.

Ethereal: ConsenSys Ethereum is a summit bringing people from different diverse sectors such as futurists, entrepreneurs, artists and government officials together for exchange and knowledge sharing.

The **decentralized blockchain production studio**, a so called "hub", coordinates, incubates, accelerates and spawns "spoke" ventures through development, resource sharing, acquisitions, investments and the formation of joint ventures. These spokes benefit from foundational components built by ConsenSys that enable **new services and business models to be built on the blockchain**. 30+ spokes have been set up through ConsenSys all around the world.

ConsenSys is already working with **major governments** such as the EU or the Emirate of Dubai. Moreover, the city of Zug is about to use a **decentralised identity network**.

ConsenSys provides **profound expertise** due to the considerable span of operations and the usage of highly innovative technology.

It is focused on evolving the internet and web protocols and **building Internet 3.0** and they believe that the web 3.0 will underlay the global economy.

ConsenSys sees itself as between **venture capital** and **Microsoft**.



Source: ConsenSys, reason.com, gridplus.io

uPort



- uPort enables the user to be in **charge over his own digital identity** and provides an Ethereum based identity verification and login system. As the user is in complete control of his own data, uPort aims to **empower the user** by shifting current status from a service centric approach to a more **user centric approach** by relocating user identities from e.g. Google's or Facebook's servers to their **own devices/smartphones**.
 - **No personal information** such as the name, phone number or email address are **stored on the blockchain** but are stored on the user's device. The blockchain is only used to **store the public key**.
 - Identity ownership is determined by the private key which controls the public key. In the past the loss of the public key lead to the **loss of identity**. uPort however, allows **identity recovery by smart contracts** if the device is stolen or lost.
 - As users can receive **digital attestation to their identity** by employers, government entities, or other trustworthy entities, **registration processes** are **simplified and speeded up** as the user does not have to enter personal data such as the name, addresses, bank accounts over and over again or verify email addresses.
 - The user is able to make statements about their identity when interacting with smart contracts etc. **without relying on centralized identity providers**.
- uPort's self-sovereign identity solution can be transferred to a broad application area:
- **P2P Marketplaces**: increases interoperability as user reputations could be transferred e.g. from eBay to Amazon.
 - **Social Media**: allows user lifecycle management as data is not fragmented and stored on different servers.
 - **Digital Media**: Portable preferences in order to provide an increased and user centric content.
 - **E-commerce and Retail**: Boost conversion by reducing customer drop-off fraud.
 - **Regulated Finance**: Secure credentials and improved KYC process.

Source: uPort

uPort

In 2017 the Swiss city of Zug announced a cooperation with uPort to launch the **first publicly verified blockchain technology** which works as follows:

1. Zug citizen downloads the uPort app and registers uPort ID on Ethereum Blockchain
2. Using the newly registered uPort ID, citizens sign in to the Zug ID web portal by scanning a QR code
3. After authenticating into the Zug web portal, citizens enter personal information and pre-existing Zug ID number
4. After registering, the citizen has 14 days to visit Zug records office in person to verify his identity
5. Zug officials sign into the Zug admin portal using their own uPort ID in order to review the submitted data
6. A digital citizenship is issued and provides the resident with a digital attestation of his data

Digital attestation can be used for:

Public surveys / eVoting

Identification for the City's tax portal

Bike lending

Evidence that a citizen is of full age



Source: uPort

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Summary & outlook

Summary

- Distributed Ledger Technology has the ability to provide **frictionless value transfer** and more **comprehensive data sources**. The result could potentially lead to an increase in **economic exchange and prosperity**.
- The DLT “**revolution**” might have a **tremendous impact** on major areas that influence **our everyday life**, such as law and regulation, financial services or health care.
- Democratization shift risks to the technological level. **Cyber security** will become even more crucial in the future and turn into a key issue.
- The DLT field consists of **different tendencies**, while some developers of the technology only aim to **improve current systems**, others have the vision of changing the current socioeconomic status, leading to a **decentralized world**.
- Distributed Ledger Technology still faces many challenges:
 - One major challenge is to find a robust and efficient **standard for blockchain** which is adjusted to the special use cases.
 - Lastly, uncertainty concerning the **regulation** of DLT and blockchain, for instance in the case of cross-border transactions, continues. New regulation should be designed **technology-neutral**, reducing barriers to innovation and progress of DLT solutions.
- Big international corporations are already experimenting and working with blockchain and Distributed Ledger Technologies, and we can already **see first real world implementations**.
- Distributed Ledger Technology still needs time to prove itself and convince that it has the ability to change industries from the bottom up. We expect the largest wave of **change to lie ahead of us**.
 - It may become pervasive in 5 to 10 years.
 - Nevertheless, the **true limits** of blockchain are still **unknown** and developers and pioneers are in uncharted territory.



Source: Deutsche Bank AG

Outlook: What's next?

- The current state of the Distributed Ledger Technology is often compared to the **early stages** of the **World-Wide Web**. It is widely believed that the technology will lead to similar disruptive innovation as the **internet revolution** and cause a **significant impact** on the way we trade, pay, interact and store information.
- We will see **first live production** systems **this year** which will have not only to proof technical feasibility, but also **business viability** and **adoption** beyond the hype.
- More efficiently **initial application** of blockchain may follow current products and services. Second and third generation of application will show new business models enabled by blockchain technology.
- There could be a **convergence of blockchains** such as Bitcoin or Ethereum with blockchains such as Fabric or Corda in order to **exploit different advantages**.
- **Implementation of smart contracts**: Programs which are built on blockchain technology and helping **credible** and **legally-binding** agreements between two parties which are **automatically executed**. Currently its legality depends on jurisdiction and application.
- **Regain control**: Especially in recent times where people are getting more concerned about the **distribution** and **usage of their data**, blockchain based applications such as uPort can help to regain control of personal information. The **user himself** can decide what kind of information he wants to share and even **demand money** for data sharing.
- **Smart Dubai**: Adopting blockchain technology Dubai aims to replace all visa applications, bill payments and license renewals accounting for over 100 million documents a year, **saving \$1,5 billion** just in document processing, **114 million tons of CO2 emission** and **25,1 million hours of economic productivity**.
- **Generalization of E-Voting**: DLT has the ability to **strengthen democratic processes** within countries by building trustworthy, corruption-resistant real-time voting systems while maintaining voter anonymity. The Swiss "crypto valley" Zug is currently testing a blockchain based e-Voting system.

Source: smartdubai, European Union Blockchain Observatory & Forum, stadtzug, Deutsche Bank AG

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Appendix

Glossary

Bitcoin is the most popular cryptocurrency, and was founded in 2008 by a scientist with the Japanese synonym Satoshi Nakamoto.

Blockchain is a continuously growing list of records, called blocks, which are linked and secured using cryptography.

Crowdfunding is a way to source money for a company by asking a large number of backers to each invest a relatively small amount in it.

Cryptocurrencies are currencies in digital form, without a central authority behind them.

Cyber security refers to the measures taken to keep electronic information private and safe from damage or theft.

Distributed Ledger Technology (DLT) refers to the technological infrastructure and protocols that allows simultaneous access, validation and record updating in an immutable manner across a network spread across multiple entities or locations.

Ethereum is a decentralized platform that runs what it calls smart contracts: applications claimed to run exactly as programmed without any possibility of downtime, censorship, fraud or third-party interference.

Gross domestic product (GDP) is the monetary value of all the finished goods and services produced within a country's borders in a specific time period.

Internet 3.0 also referred to as **Web 3.0** is the next generation of the internet, enabling the internet to not only transfer information but also interpret and contextualizing them.

Tokenization is the process of converting rights to an asset into a digital token on a Distributed Ledger.

USD is the currency code for the U.S. Dollar.

Valuation attempts to quantify the attractiveness of an asset, for example through looking at a firm's stock price in relation to its earnings.

Volatility is the degree of variation of a trading-price series over time.

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