



Blockchain for Education & Research Webinar

December 6, 2016



Agenda

- Blockchain basics & potential use cases
- Promises & challenges
- Major players & areas of activity
- Potential use cases in education & research
- The path forward
- Appendix: Resources



Blockchain Basics & Potential Use Cases



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ETHEREUM
July 2015



BITCOIN
2008



HYPERLEDGER
Dec 2015
(Linux Foundation)



LINQ
Oct 2015



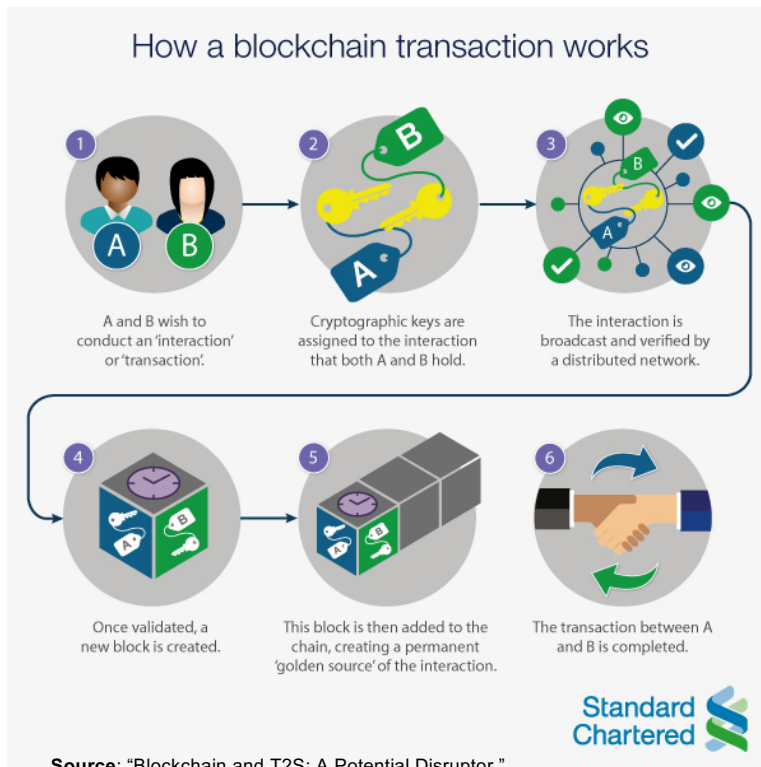
CORDA
Apr 2016

Blockchain Basics

- **Bitcoin** – Specific term for the cryptocurrency & technology infrastructure underlying the Bitcoin network, first introduced in 2008*
- **Blockchain** – Generic term for many different distributed ledger technologies (DLTs) that have gained interest & attracted huge investments in recent years

*"Bitcoin: A Peer to Peer Electronic Cash System,"
Satoshi Nakamoto (November 2008)
<https://bitcoin.org/en/bitcoin-paper>

Basic steps in a generic blockchain transaction



Source: "Blockchain and T2S: A Potential Disruptor," Standard Chartered Bank (June 2016)

1. Parties A & B wish to conduct a transaction
2. Parties A & B assign cryptographic keys to the transaction
3. The encrypted transaction is broadcast to a distributed network of nodes; the nodes agree the transaction is valid (consensus)
4. Once nodes have consensus a transaction is valid, a new block is created
5. This block is then added to the chain, creating a permanent "golden source" of the transaction
 - ❑ Each block includes the "hash" (cryptographic seal) of the prior block in the chain, linking the two blocks (thus the word "blockchain")
6. Transaction between Parties A & B is complete

Key components of a permissioned blockchain

SHARED LEDGER
Append-only distributed
“system of record”
shared across a
permissioned network



CONSENSUS
All parties agree to
network verified
transaction

PRIVACY
Ensure appropriate
visibility; transactions are
secure, authenticated &
verifiable



SMART CONTRACT
Rules embedded in
transaction database;
executed with
transactions

Source: “Making Blockchain Real for Business,” IBM
(July 2016)

Potential use cases

Exhibit 6
Selected Potential Blockchain Use Cases

Financial Institutions	Corporates	Governments	Cross-industry
International payments	Supply chain management	Record management	Financial management & accounting
Capital markets	Healthcare	Identity management	Shareholders' voting
Trade finance	Real estate	Voting	Record management
Regulatory compliance & audit	Media	Taxes	Cybersecurity
Anti-money laundering & know your customer	Energy	Government & non-profit transparency	Big data
Insurance		Legislation, compliance & regulatory oversight	Data storage
Peer-to-peer transactions			Internet of Things

Source: Moody's Investors Service



Promises & Challenges



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Blockchain, trust & the role of intermediaries

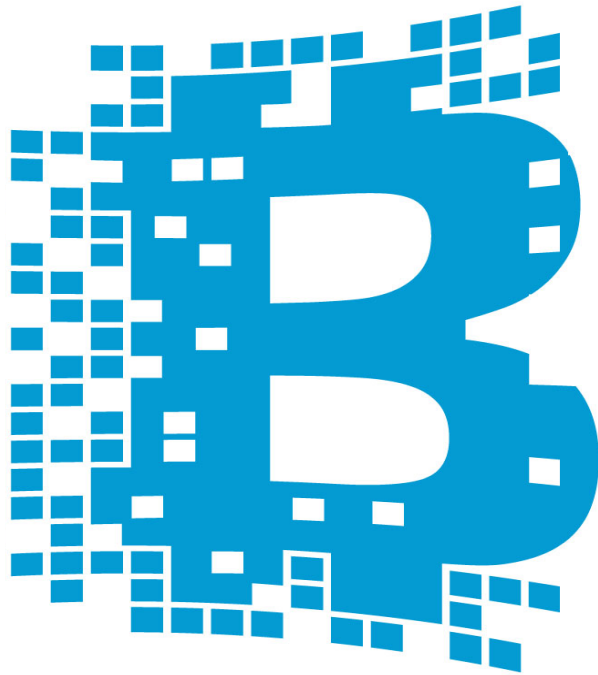


WORLD
ECONOMIC
FORUM



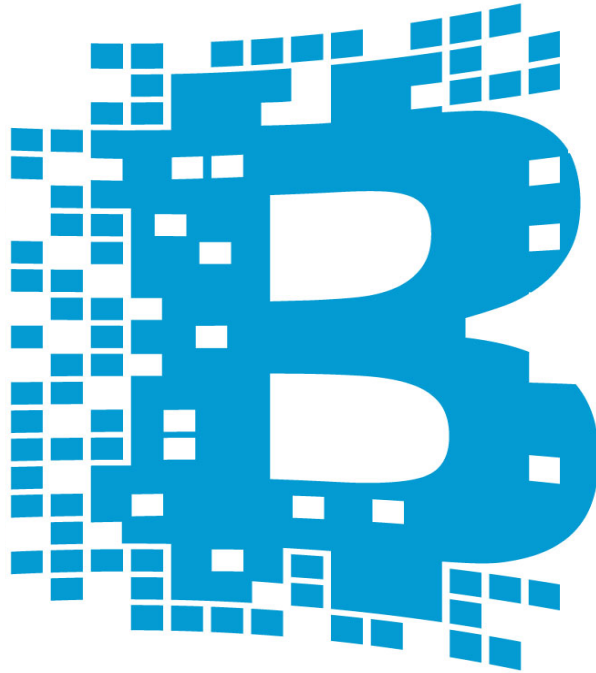
“DLT provides transaction immutability, which is a key for eliminating the need for an ***enforcer of trust*** in the ecosystem. Tamper-proof distributed data enables an environment in which trust is not an issue and allows counterparties to operate with a single version of the truth.”

Source: “The Future of Financial Infrastructure,”
World Economic Forum (August 2016)



Promises: Decentralized Trust & Internet of Value

- Provides near real-time exchange of data &/or value in a cryptographically secure & permanent manner
- Increased transparency
- Reduces role for intermediaries & challenges information silos
- Lowers computing costs thru decentralization
- Supports creation of digital assets
- Enables audit trails with significant reduction in disputes
- Includes regulators as required



Emergent Technology Challenges

General

- Anonymity & identity
- Consensus mechanisms
- Standards
- Governance
- Legal & regulatory
- Business models & commercialization

Technology

- Use of tokens
- Scalability & interoperability
- Data management: On & off chain
- Reference architecture
- Legacy infrastructure integration
- Governance
- Security



Major Players & Areas of Activity



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Major players & areas of activity

Startups: > 1,500 worldwide

- Open source protocols – Bitcoin, Ethereum & Hyperledger (Linux Foundation)
- Private shared ledgers
- Cryptocurrencies, wallets & exchanges
- Identity management – Federated & self-sovereign
- Key management
- Decentralized applications
- Reporting

Sectors

- Banking, securities markets, payments & insurance
- Supply chain
- Healthcare
- Provenance & digital rights management
- Transportation, energy & utilities
- IoT
- Big IT – Hardware, software & services
- Government agencies; central banks
- Regulators

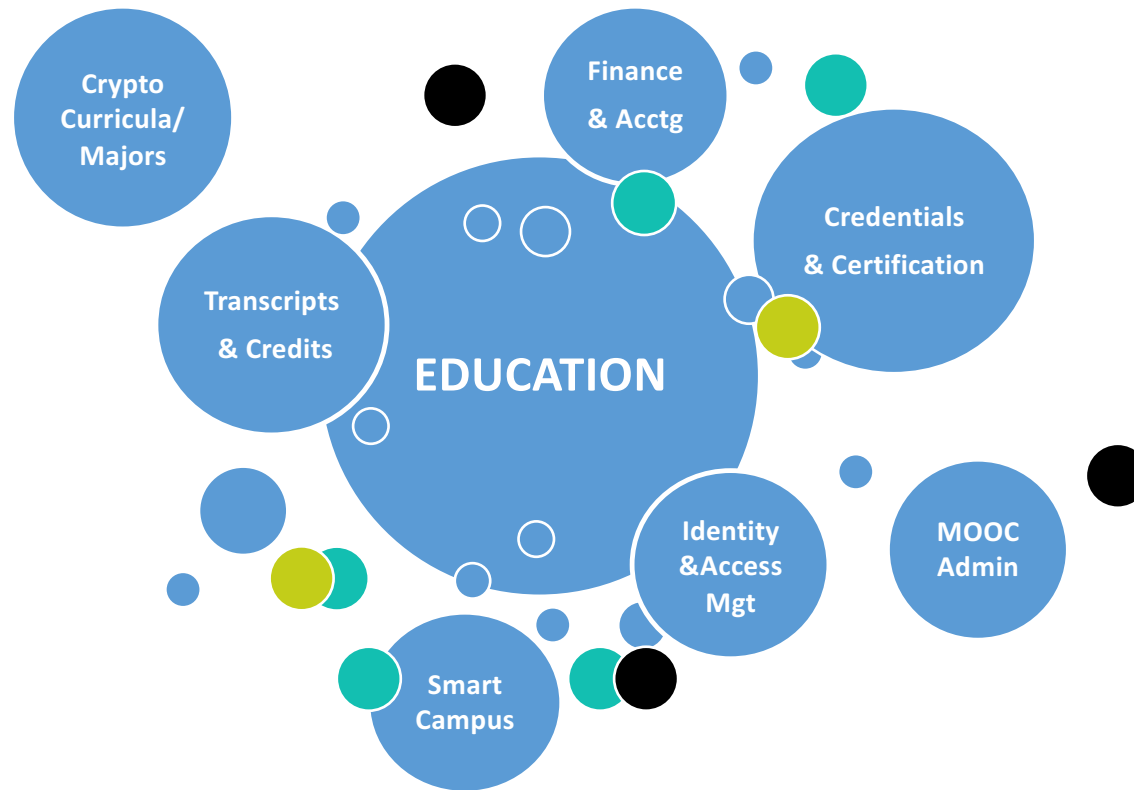


Potential Use Cases in Education & Research

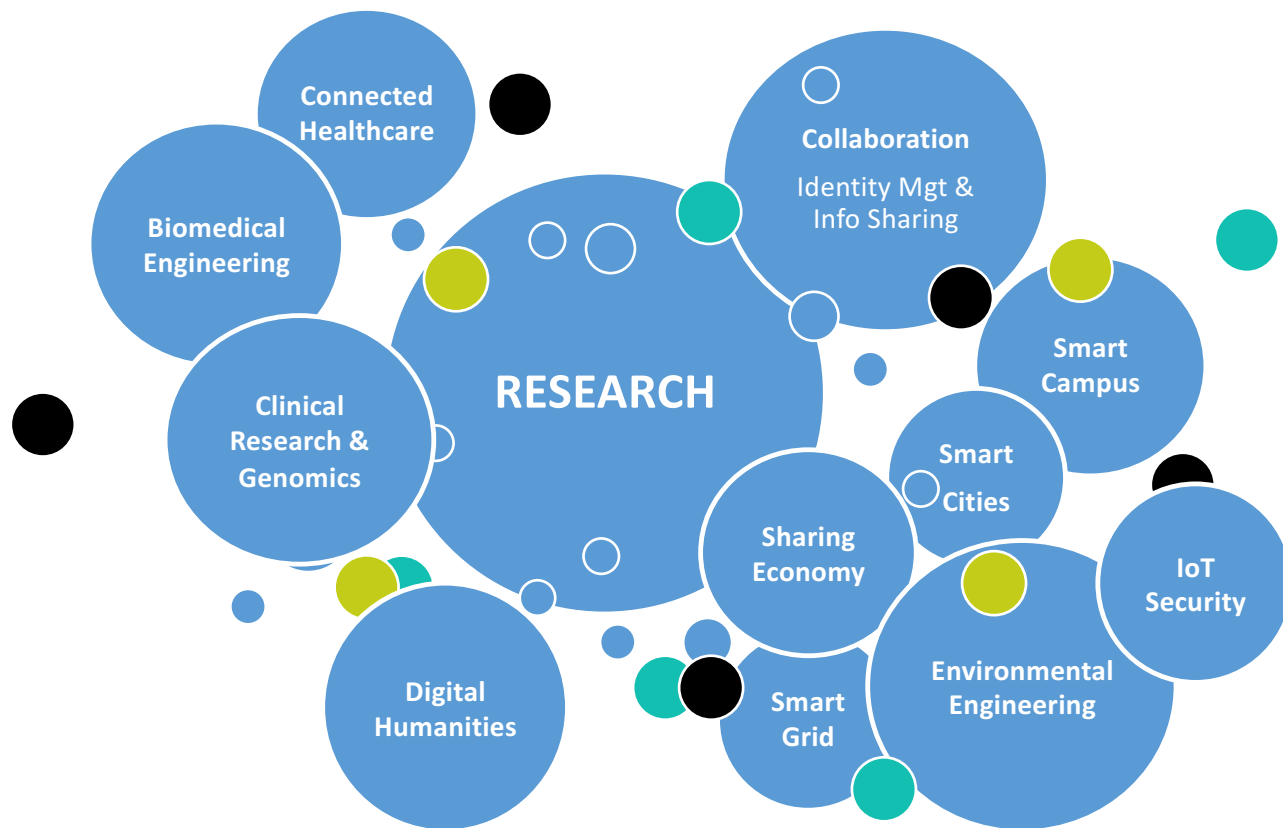


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Potential use cases in education



Potential use cases in research



The path forward

Research & experiment:

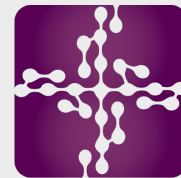
- White papers & open source protocols
- Use cases & proofs of concept (POCs)
- Working groups & mini-consortia

Evaluate & engage:

- Internet2 programs – InCommon & TIER; TIPSS & IT infrastructure; collaborative research
- IEEE, NSF, W3C, NIST, DHS, etc.
- Accrediting bodies & associations
- Regulatory entities
- Strategic & IT consulting firms; IT providers



Appendix



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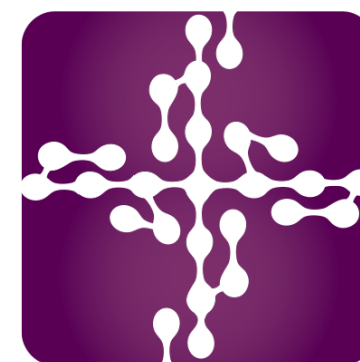
Resources

White papers

- “Bitcoin: A Peer to Peer Electronic Cash System,” Satoshi Nakamoto (November 2008) <https://bitcoin.org/en/bitcoin-paper>
- <http://www.virtualschool.edu/mon/Economics/SmartContracts.html>
- [An Introduction to Bitcoin and Blockchain Technology](#) by Kaye Scholer, February 2016 [13 pages]
- [Sharing ledgers for sharing economies: an exploration of mutual distributed ledgers](#) Professor Michael Mainelli and Mike Smith of Z/yen Group for the EY Global Financial Services Institute, November 2015 [47 pages]
- “The Bitcoin Blockchain as Financial Market Infrastructure: Operational Risk,” Angela Walch, St. Mary’s University School of Law, March 2015 [58 pages] https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2579482
- [Digital Assets on Public Blockchains White Paper](#) by the BitFury Group, March 2016 [37 pages]
- <https://home.kpmg.com/us/en/home/insights/2016/06/consensus-opportunities-blockchain-and-beyond.html>
- <https://www.weforum.org/reports/the-future-of-financial-infrastructure-an-ambitious-look-at-how-blockchain-can-reshape-financial-services>

Other

- <https://bitcoin.org>
- <https://ethereum.org/>
- <https://www.hyperledger.org/>
- <http://www.coindesk.com>
- <http://www.epicenterbitcoin.com> (Video series)
- Trust:: Data – A New Framework for Identity and Data Sharing (Hardjono, Shrier and Pentland, Oct 2016) https://www.amazon.com/dp/153911421X/ref=sr_1_fkmr0_3?s=books&ie=UTF8&qid=1477067469&sr=1-3-fkmr0&keywords=shrier+ david+mit | MIT OPAL & ENIGMA projects
- Blockchain Protocol Analysis and Cybersecurity Engineering, Stanford University – Call for papers and conference (January 26 & 27, 2017) <https://cyber.stanford.edu/blockchainconf>



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Susan Ramonat is a globally recognized blockchain thought leader. Formerly Blockchain Program Lead and Chief Risk Officer at SEI Investments, she has applied over 25 years of experience in the highly regulated financial services industry and knowledge of blockchain, operational risk and cybersecurity to the healthcare field as Founder and CEO of **Spiritus Partners**. **Spiritus** is dedicated to improving patient safety and reducing the costs and risks of adverse events for medical device manufacturers, healthcare providers, and payers. Susan serves on the Dean's Advisory Council of the College of Arts and Sciences at Loyola University Chicago and on the university's Industrial Advisory Board for Engineering Science. She is also an executive committee member of the Cybersecurity Risk Council, a peer-trusted working group of CISOs from Fortune 500 companies and government agencies. Susan is a *magna cum laude* graduate of Princeton University.

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