Rutgers 40 WCARS
2017

Presentation by
Jake Benson & Dr. Rod Brennan from Libra

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Agenda

❖ Libra Overview

❖ What is Blockchain?

❖ Accounting & Audit

❖ Discussion, Q&A's

❖ Appendix: Tax Compliance & Reporting

Libra Overview

"Libra is a US-based (NY, NY) software company that **automates** and **optimizes** financial business processes for professionals who interact with distributed and decentralized technologies.
(i.e. Cryptocurrencies, DLT, Blockchain etc.)"

www.libra.tech

Origin Story

Our Team

ROD
BRENNAN
Director of Audit Tech

JAMES
LANG
Director of Ops

EMIL
WOODS
CSO

JAKE
BENSON
Founder & CEO

COMMERCIAL

JEREMY
DRANE
CCO

MELISSA
CRAIG
Interim CFO

Gary
REIFMAN
VP of Product

TECHNICAL

VADIM
SHTEYNBERG
VP of Engineering

DEEPAK
RAO
VP of Product

ANDREW
LE
Sr Engineer

ALEXANDER
ZAKHAROV
Sr Engineer

SATISH
MUMMADI
Sr Engineer

JONATHAN
BLAISING
Engineer

CHRISTOPHER
BIELAK
Engineer

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Libra's Audit Advisory Committee

Michael Cangemi

Michael currently serves as President of Cangemi Company LLC, which he founded in 1968. Mr. Cangemi was a **member of the FASB's Financial Accounting Standards Advisory Council (FASAC)** from 2007 to 2010 and the **International Accounting Standards Board AB** from 2007 to 2008. Mr. Cangemi is currently a senior advisor to Oversight Systems, and serves on the **SOX&GRC Institute Advisory Board**, the **Pace University Lubin School of Business Advisory Board**, the **Rutgers Continuous Audit Advisory Board**, and the **ISACA Strategic Advisory Board**.

Miklos Vasarhelyi

Professor Vasarhelyi is **credited with developing the original continuous audit application** and is considered by many as the leading researcher in this field. At Rutgers Business School, he **heads the Continuous Auditing and Reporting Laboratory**, which works on projects for such leading companies as **Siemens, Procter & Gamble, AICPA, CA Technologies,** and **Brazil's Itau-Unibanco**. Professor Vasarhelyi also **leads the RADAR (Rutgers AICPA Data Analytics Research Initiative)** project which is supported by the **eight leading CPA firms, AICPA, and CPA Canada**.

Robert (Bob) Herz

Bob served as one of the **original members of the International Accounting Standards Board** which was set up to develop **International Financial Reporting Standards (IFRS)** and was **Chairman of the Financial Accounting Standards Board (FASB)** from 2002 to 2010. More recently he began a three-year term on the **Sustainability Accounting Standards Board (SASB)** which develops sustainability accounting standards for publicly-listed US companies.

Libra's Technology Advisor

Steve Yatko

Steve is an advisor supporting Libra on mission critical technology and architectural decisions. Steve is the founder and CEO of Oktay Technology, an advisor at Starr Investment Holdings, is a cofounder of AcordIQ, a cofounder of Quanton, is Vice Chairman and cofounder of YSBNow, a Board of Directors member of IQ4, and was also a cofounder of DynamicOps, a Credit Suisse spin out acquired by VMware.

As CEO of Oktay Technology, Steve has led his firm over the past seven years into multi-year strategic technology advisory partnerships supporting on state of the art trading and big data systems with some of the most innovative and successful firms on Wall Street, including **Bank of America**, **Wells Fargo**, **Bloomberg**, **Deutsche Bank**, **Morgan Stanley**, and **Bridgewater Associates**.

Previously, Steve was a **Managing Director and Global Head of the IT Research & Development at Credit Suisse** including over fourteen years of driving innovative technology into solutions that differentiated **Credit Suisse's Trading and Analytics technology platform**. In this role, Steve was responsible for setting the direction of the firm's next generation computing environment across all of its IT divisions. During his tenure at Credit Suisse, Steve also served as **Head of Global Core Technologies** and **CTO of Mission Critical Systems**, including the firm's world class **Global Equity Trading and Analytic system, Agora and OMan**.

Throughout his career, Steve has worked closely with serial Entrepreneurs, top venture capital firms around the world, and some of the world's largest technology providers including being a selected **member of several CTO Advisory boards at companies such as Sun Microsystems, Microsoft, EMC, HP, IBM Research, Veritas, and Cisco**.

Libra's AsiaPac Advisor

David Lee
Kou Chuen

David is an advisor supporting Libra's growth in the Asia-Pacific region. He is a Walter H. Shorenstein Asia-Pacific Research Center (APARC) visiting scholar and is currently the **Director of Sim Kee Boon Institute for Financial Economics**. He also holds the appointment of Practice Professor of Quantitative Finance, Lee Kong Chian School of Business, at Singapore Management University. He is also the founder of Ferrell Asset Management Group.

David's research interests encompass digital and Internet finance, digital banking, Asia finance, impact investing, financial inclusion and asset allocation. During his time as a Fulbright Scholar at Shorenstein APARC, his research will focus on harnessing Silicon Valley technology for connectivity and financial inclusion in ASEAN and Singapore.

David is also an Independent Director of two SGX-listed companies and sits on the Investment Committee and Council of two charitable organizations. He is the Vice President of the Economic Society of Singapore. He was the **Founding Vice Chairman of the Alternative Investment Management Association** (Singapore Chapter), a member of the **SGX Security Committee,** and **MAS Financial Research Council**. He was also the Group **Managing Director of OUE Limited and Auric Pacific Limited,** as well as the **Non-Executive Chairman of MAP Technology Limited**.

David speaks frequently in international conferences with occasional appearances in Bloomberg, Reuters and Channel NewsAsia. He has published in Financial Analyst Journal, Journal of Investing, Journal of Wealth Management, Journal of Statistical Computation and Simulation, Applied Financial Economics, and several books and chapters on Household Economics and Hedge Funds. His two books on Asia Finance focus on Banking, Sovereign Wealth Funds, REITs, Financial Trading & Markets, and Fund Performance. His latest book is on Digital Currency.

David has a Bachelor's in Economics, a Masters in Econometrics and Mathematical Economics, and a PhD in Econometrics and Quantitative Mathematics from The London School of Economics and Political Science.

Enterprise Experience*

22+ Audit	**25+** Blockchain & Crypto
50+ FinTech	**60+** Enterprise Technology

SIEMENS

Goldman Sachs

IHS Markit™

Bank of America

CREDIT SUISSE

PAXOS

CEDAR HILL CAPITAL PARTNERS LLC
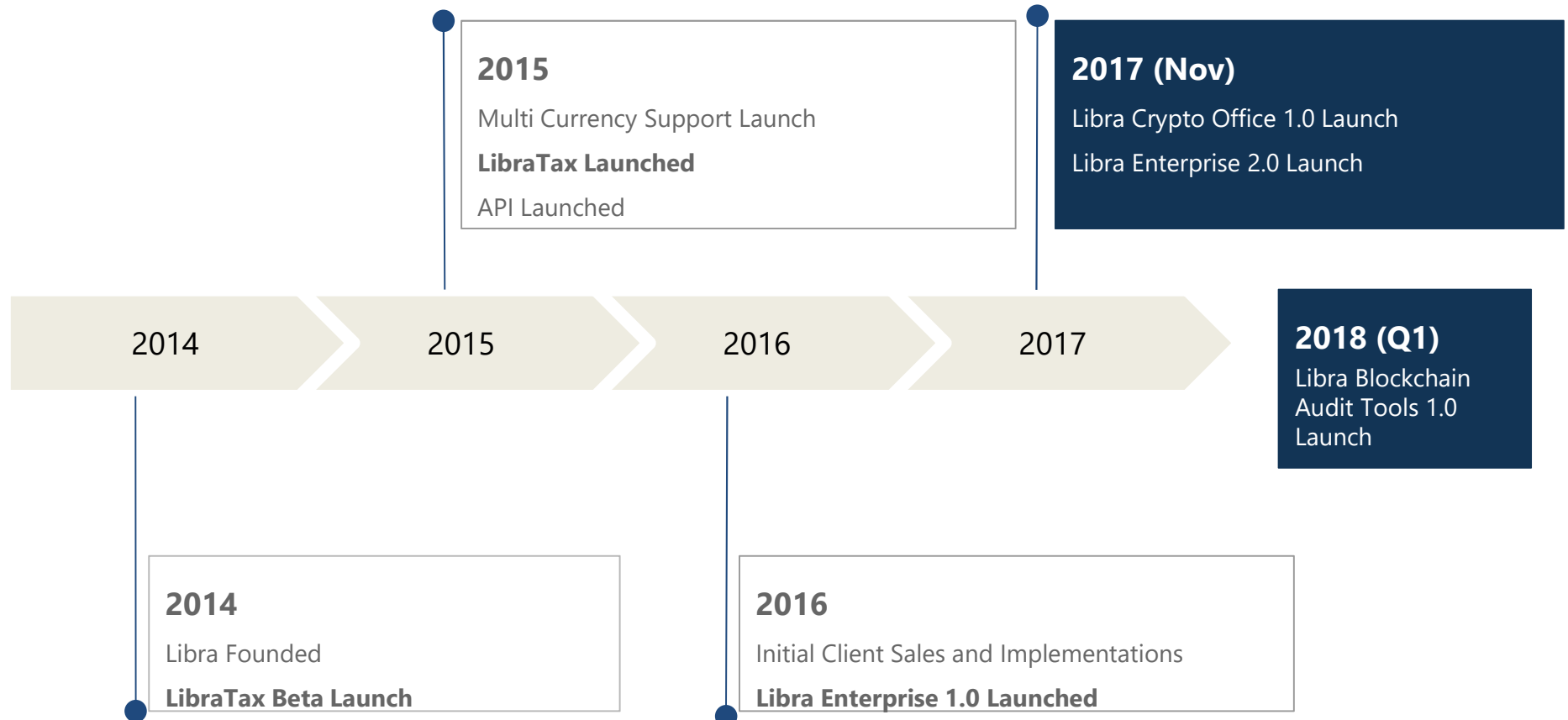
Capgemini
CONSULTING.TECHNOLOGY.OUTSOURCING

VISA

Orchard

pwc

*Does not include Advisor experience

Product Overview

2015
Multi Currency Support Launch
LibraTax Launched
API Launched

2017 (Nov)
Libra Crypto Office 1.0 Launch
Libra Enterprise 2.0 Launch

| 2014 | 2015 | 2016 | 2017 |

2018 (Q1)
Libra Blockchain Audit Tools 1.0 Launch

2014
Libra Founded
LibraTax Beta Launch

2016
Initial Client Sales and Implementations
Libra Enterprise 1.0 Launched

Industry Trends

Cryptocurrency market cap rallies $75bn:

- Aggregate valuation of blockchain tokens skyrockets 4x to all-time high above $100bn

Transaction volumes and fees set records:

- Usage and cost to send cryptocurrencies on numerous blockchains increased dramatically

Permissioned blockchains move forward:

- Major platforms like R3, Hyperledger, and EEA pick up corporate funding, membership, and integrations

ICOs vastly exceed VC funding: *

- Blockchain token sales raise $729m as compared to $235m of total venture capital, record setting ICO quantities and deal sizes

Regulators increasingly acknowledge reality:

- Blockchain technology, digital currency, and token sales are now far too large for anyone to ignore or refuse to think critically about

Interoperability remains large focus:

- Numerous groups and protocols are now tackling connecting blockchains for transacting and trading on diverse ledgers
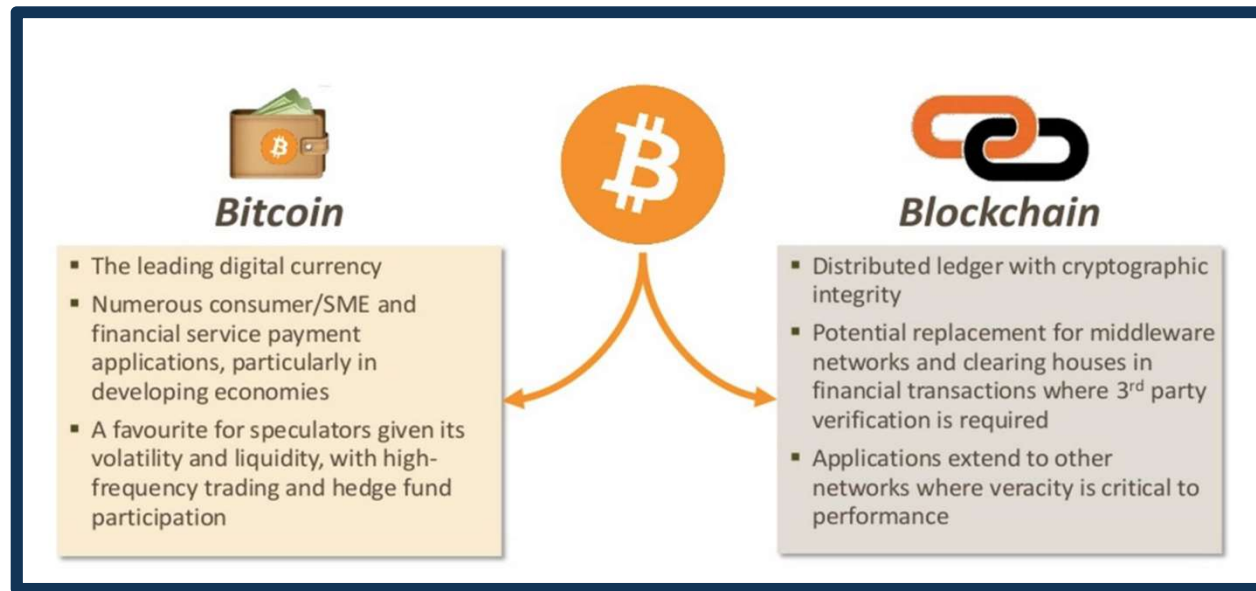
Data Source: CoinDesk

coindesk

*NOW $3.25 Billion

State of Blockchain – Q2 2017 | 4

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What is Blockchain?

First, Bitcoin is NOT Blockchain

Mental Model: Think of Blockchain as the operating system (i.e. Windows, IOS, etc.) and Bitcoin (and other cryptocurrencies) as apps that runs on top of it.

Second, 'Blockchain' refers to a 'chains of blocks'

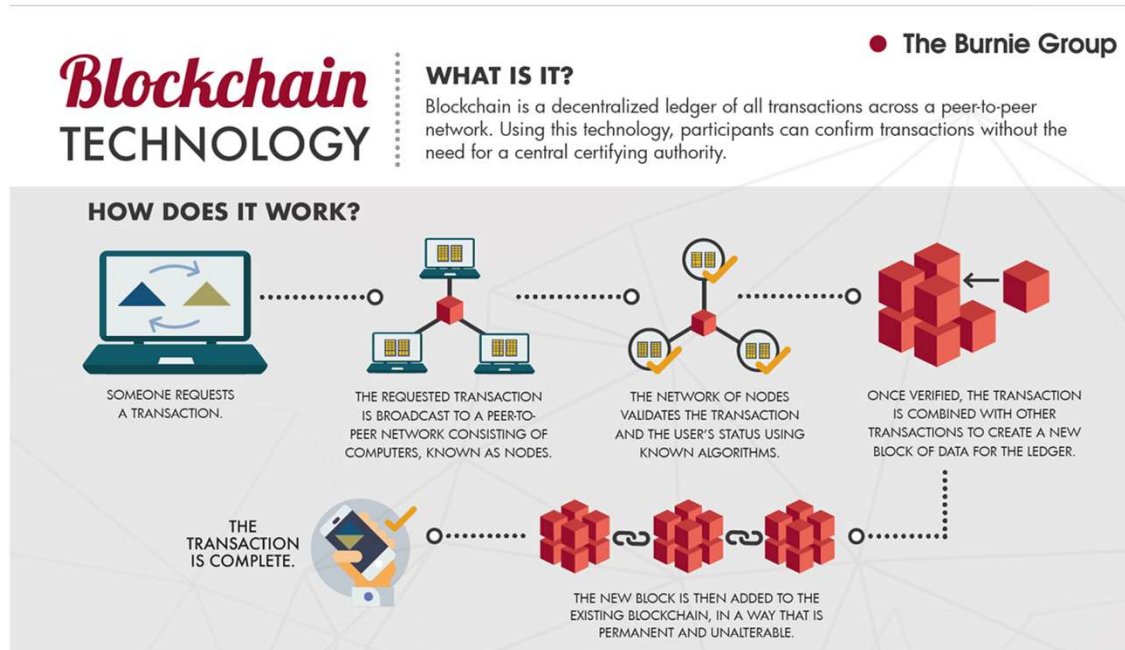A 'blockchain' is just a file on computer(s) that contain 'blocks' of data...

...with the chain of 'blocks' being like pages in a book...

...where each block references *the previous block* using a cryptographic fingerprint called a 'hash.'

Third, it's really a 'process'

Click here for an awesome Youtube video that shows a blockchain demo in action!

Assurance / Audit

High Level: Auditing Blockchains & DLT

Pros:

- Much higher level of control precision & formalization.
- Security / Sustainability via distributed ledgers -- no single point of failure.
- Fully automated / integrated ecosystems secured by cryptology.
- Consensus prevents collusion - instead of "4 eyes", 8, 100, 1000 eyes!

Cons:

- Blockchain new / suspect first implementation less than a decade ago.
- Objectives, risks & controls are new and different than for single database processes.
- Limited technical expertise / experience in audit and IT around blockchains.

Why we need to rethink audit processes

- Latency

- Demands of a Millennial Workforce

- Non-Statistical Sampling vs. Population Auditing

- Periodic vs. Continuous Audit Methods

- 4 Eyes & Collusive Fraud

ACFE 2016 Fraud Report to the Nations

$6.3 BILLION IN TOTAL LOSSES

23% OF CASES CAUSED LOSSES OF $1 MILLION OR MORE

$150,000 MEDIAN LOSS PER CASE
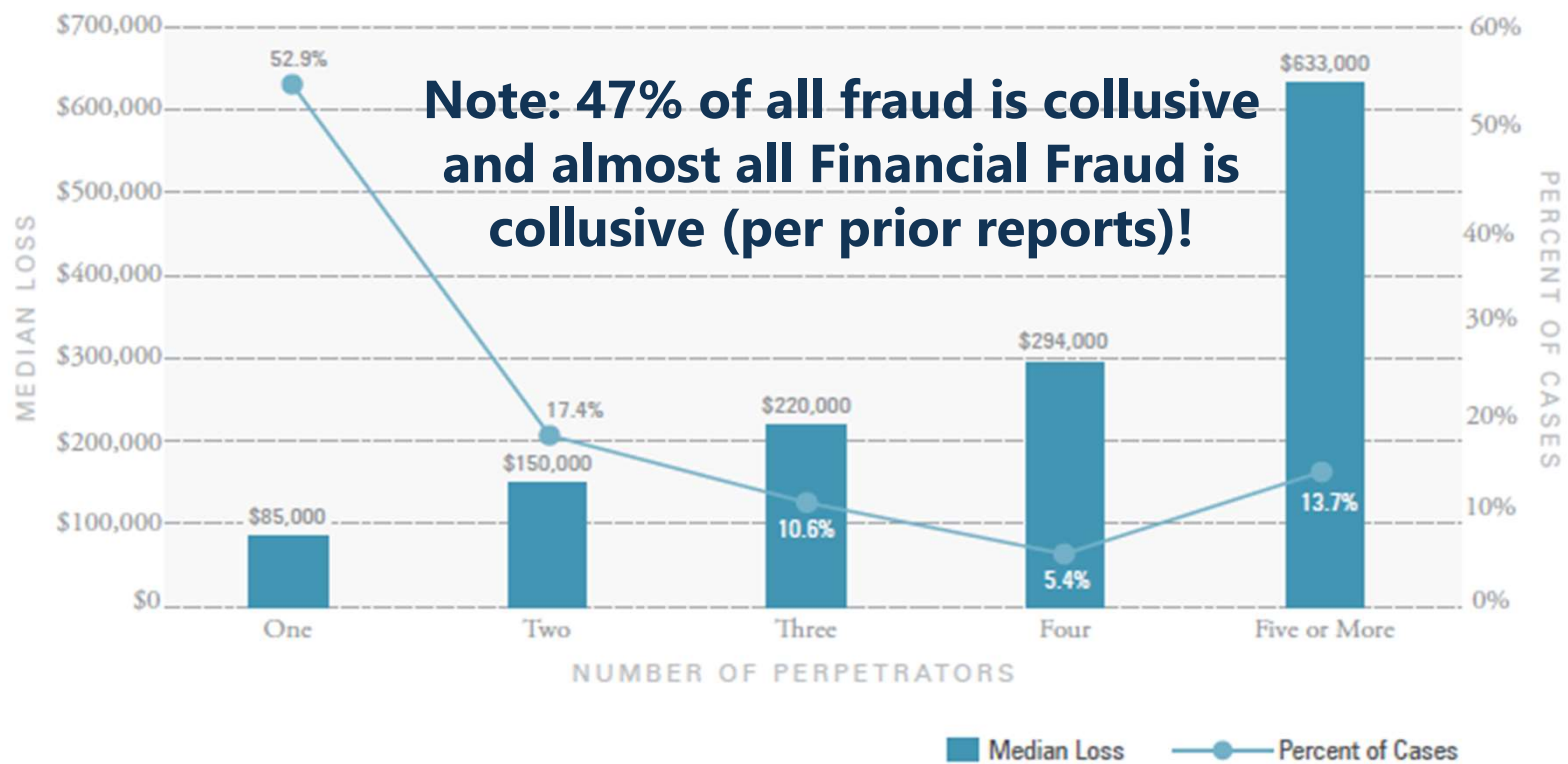
The CFEs who participated in our survey estimated that the typical organization loses 5% of revenues in a given year as a result of fraud.

ACFE 2016 Fraud Report to the Nations

Figure 87: Number of Perpetrators—Frequency and Median Loss

Note: 47% of all fraud is collusive and almost all Financial Fraud is collusive (per prior reports)!

Auditing Blockchains is needed now!

Enterprises are already harnessing blockchain technology

Finance
- Cross-border payments
- Initial Coin Offering (ICO)

Nasdaq · NORTHERN TRUST · AXIS BANK · DTCC

Supply chain
- Verify origin
- Timestamping and tracking

MÆRSK · Walmart · AIRBUS

Healthcare
- Medical data management
- Facilitate payments

HIPAA COMPLIANCE · patientory

Insurance
- Fraud reduction
- Efficient insurance claims

InsurETH · DYNAMIS · SLEM

Energy
- Balanced energy flow
- P2P energy trading network

BROOKLYN MICROGRID · oxygen INITIATIVE

Internet of Things
- Exchange IoT data
- Supports IoT ecosystem

CHRONICLED · modum

Government
- Maintain trusted records
- Integrity and security of data

UN · WFP

Identity
- Secure online digital identity
- Sensitive user data

blockstack · uport · civic

Advanced technologies
- Secure backend databases
- M2M networks

DeepMind

Source: CLSA, TheNounProject (Lloyd Humphreys, Creative Stall, Rico Reinhold, Kelcey Hurst, and Delwar Hossain), Nasdaq, HIPAA, UN, WFP

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Blockchain addresses risks and reduces activities

Computer Operations / Cloud
Archiving / Interfaces
Change Management
Logging / Checking
User Authentication / Authorization
General Systems Controls
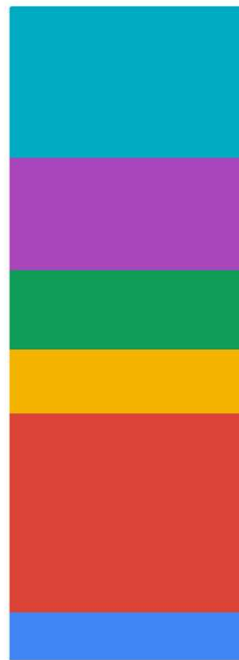
Traditional System Audit

Blockchain System Audit

Blockchain is more secure and represent a significant reduction in audit activities!

- Blockchain protocol code is open source and secured by the consensus mechanism - mostly self audited. Blockchain transaction controls include ubiquitous cross protocol controls which help address risks with smart contracts

- No passwords, permission is by the consensus or all participants, no SOD, super users, etc..

- The blockchain is an immutable log

- All transactions & change management is controlled by the consensus mechanism

- The blockchain is an immutable archive

- Blockchain has no need of a data center

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Blockchain Impact on Assertions

Table 3.1: Using distributed ledgers to test audit assertions

	AUDIT ASSERTION	DESCRIPTION	POTENTIAL FOR DIRECT BENEFIT FROM DISTRIBUTED LEDGERS (INDICATIVE VIEW)*
1	Completeness	All transactions are recorded in the financial statements	√√
2	Occurrence	The transactions in the financial statements actually happened	√√√
3	Valuation	Items in the financial statements have been included at appropriate amounts	√
4	Classification and understandability	Financial information is correctly categorised and disclosures are clearly communicated	√
5	Accuracy	Data is recorded at the correct amounts, which are verifiable in source documents	√√
6	Rights and obligations	Correctly establishing right to use or dispose of assets as well as obligations to pay off liabilities	√
7	Cut-off	Recording of transactions for the correct accounting period	√√√

* More √ indicates greater potential for direct benefit. Excludes indirect benefit where DL might improve data quality in general terms which creates knock-on benefits

Designed Around Key Standards

- Financial Standards : SOA / AICPA / PCAOB / FASB, TPA - SSAE-16's etc..

- Internal Audit Standards: IIA

- IT Standards: Cobit / ITIL / ISO 27001 / BS-7799

- Cyber Security Standards: NIST - 800 171

- Etc:

Key Learning: The fit around standards built for single database processes is sometimes weak -- standards will need to updated for Blockchain / DLT technology

Introducing - Libra's Blockchain Audit Tools App

Protocol Accreditation

❖ **Verify for participating nodes & regulators the sound design of the protocol** against industry standards & best practice respected frameworks / standards (NIST, Cobit, ISO 27001, IIA, etc.) -- assuring key controls and are not missing.

❖ Verify via automated analytics that ubiquities, **"best practice" protocol rules / controls are in place** for any public or private blockchain.
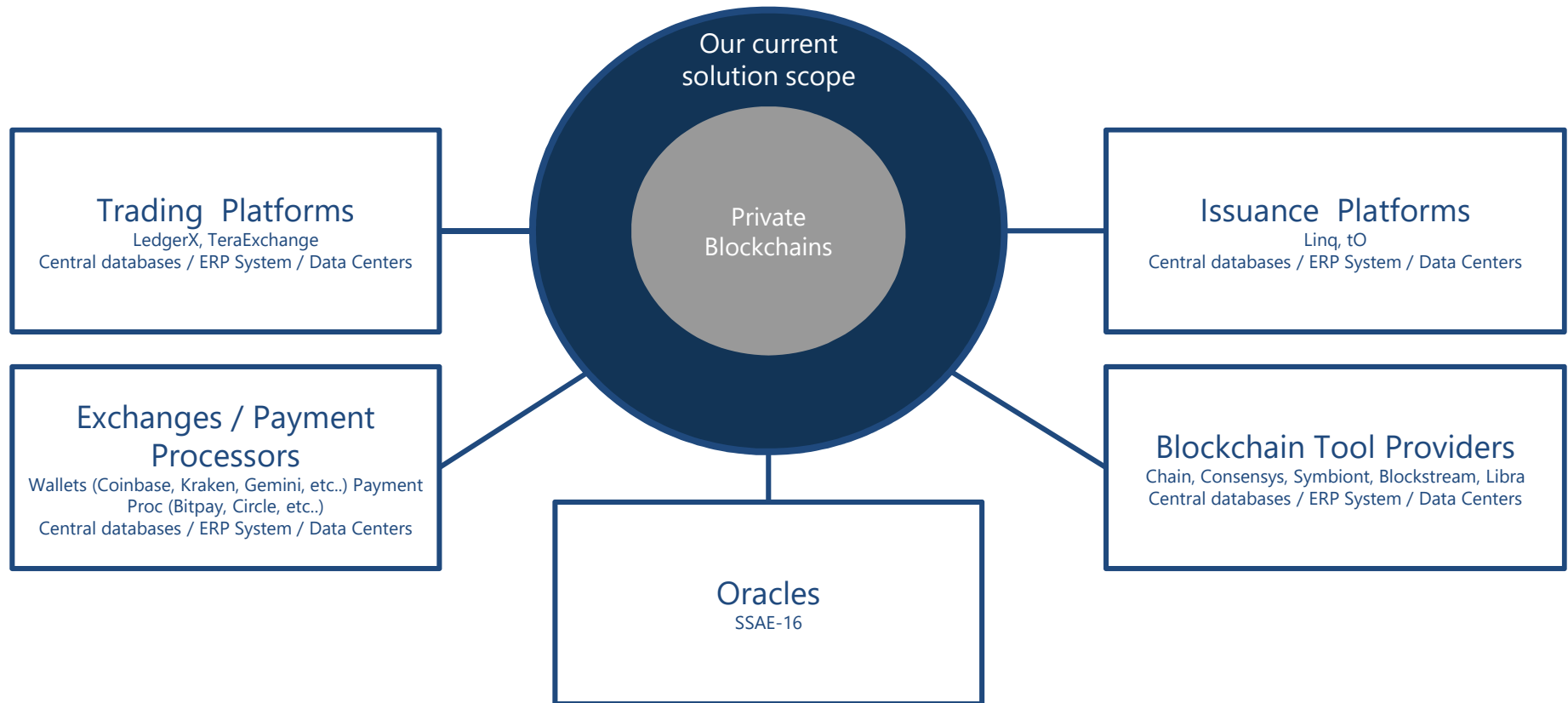
Consensus Mechanism Monitoring

❖ **Verify the sound design of consensus mechanism consistent** with requirements of respective protocols and the baseline design approved by the participating nodes.

❖ **Validate node rights / participation, quorum, voting participation**, etc. to ensure the protocol required and user defined baseline consensus Mech. is operating effectively.

Transaction Assurance

❖ **Assure the security, availability, immutability, processing integrity, confidentiality, validity, scalability,** etc. of all transactions on the blockchain / network.

❖ The controls engine will provide **assurance on ubiquitous controls related to any smart contract** (i.e. Reentrancy, Race Conditions, etc.) and will allow **user configuration of additional transactional controls** to address use case specific smart contract (SC) driven processes.

Initial Scope - Libra Blockchain Audit Tools

Our current solution scope

Private Blockchains

Trading Platforms
LedgerX, TeraExchange
Central databases / ERP System / Data Centers

Issuance Platforms
Linq, tO
Central databases / ERP System / Data Centers

Exchanges / Payment Processors
Wallets (Coinbase, Kraken, Gemini, etc..) Payment Proc (Bitpay, Circle, etc..)
Central databases / ERP System / Data Centers

Blockchain Tool Providers
Chain, Consensys, Symbiont, Blockstream, Libra
Central databases / ERP System / Data Centers

Oracles
SSAE-16

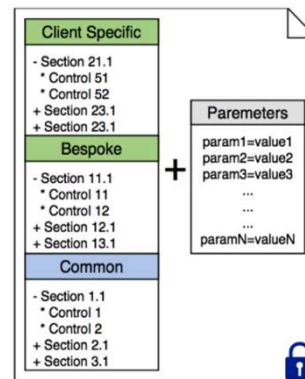# Libra Blockchain Audit Tools - Key Components

1. Libra Audit Interface
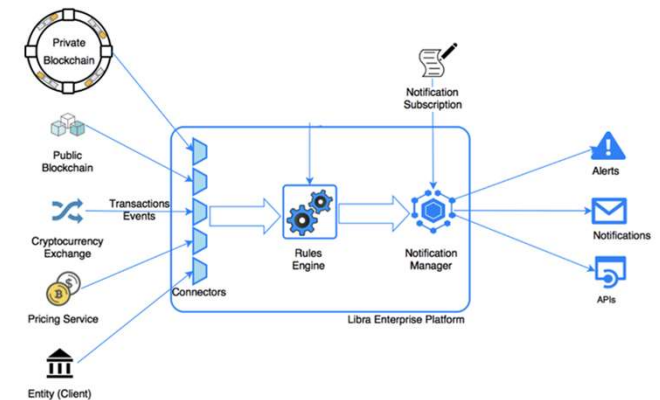- Questionnaire
- User Configuration
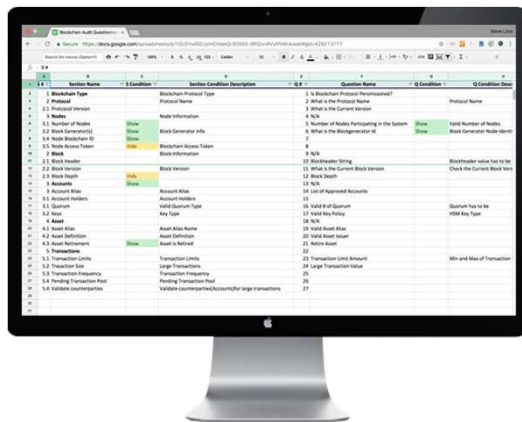
2. Libra Audit Library
- Base set of blockchain controls
- Ability to add custom rules

3. Libra Audit Engine
- Rules Engine
- Alerts & Notifications

Example configuration
- Protocol = **Hyperledger Fabric**
- **15** = # of allowable nodes?
- **2MB** = Max Block / transaction size?
- User configuration - **"If XX, Then YY - Alert To.."**

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Sample controls and framework

Analytic	Detail: Objectives /Risks / Assertions	Impact on Blockchain	Analytic - IF/Then	Alerting Workflow: (i.e. Failure = send closed loop escalating alert to the following via the following workflow / escalation)	Framework Alignment (i.e. COSO, COBIT, ITIL, Basel3, etc..)
Formalizable Controls:					
Protocol Version / Change Management	**OBJECTIVES** = Assure the most up to date and secure version of the software is being deployed in the network. **RISKS:** Business interruption or security compromise and expiring support of the release level for the system **ASSERTIONS** = Accuracy / Completion	Applies to private BC's, as in are the protocol / nodes using the most up-to-date / approved version of the protocol as defined in the baseline configuration	If the software version on the system / network is not equal to current version at www.companywebsite.com or in the protocol code / Smart Contract (SC) defined version plus <x> months from version effective date (if appropriate) then create an alert Check Node Version: For e.g. All Nodes should operate on ver 1.1.2 in Chain	System Admin-->CIO (after 1 week)-->CEO(after two weeks)	US-GAP, IFRS, COBIT 6.6-7, ITIL 8.5.1 , NIST171 - Sec 3.4
Validating Nodes	OBJECTIVE: Determine if the onboarding/offboarding process, through membership, CM or other methods, satisfies security concerns regarding keeping unwanted actors out of the democratic processes for join/leaving network. RISK: Centralization of this responsibility could lead to potential compromise in terms of unwanted players participating/ legitimate players being forced out. ASSERTIONS: Rights & Obligations, Occurrences.	(Per Omar) In Corda & Fabric, there is a membership Certificate Authority (CA) which provides the nodes with certificates/identities (i.e. hashed keys) needed to participate in the network and maps out the nature of their participation. This is normal for privBC since onboarding/offboarding is agreed upon before protocol level, so decentralization is not seen as important. Deepak: Another way is to upgrade the PrivBC protocol to ensure nodes(Organizations) which have agreed to stay will upgrade. The Node which does not upgrade or not given the upgrade function will be out of the privBC.	IF status of node participation (enrolled, unenrolled, status switched to read only or vice versa, etc.) does not match the current permissioned network nodes stored on the chain in the protocol code / a smart contract / or payload THEN alert Note: could also alert if there is a vulnerability with a Central Authority (i.e. a competitor, wallet, exchange, etc.) to compromise the private blockchain.	ISystem Admin-->CIO (after 1 week)-->CEO(after two weeks) OR Maybe to all nodes / users on the PrivBC??? Note: there may also be a curtoesy alert to the node trying to access that they do not have or no longer have permission to participate in the PrivBC??	IIA, NIST, ISO 27001 etc..
Multisig	OBJECTIVE: Assure the appropriate level of signiture for specfic value transactions as defined by the the Wallet, Exchange, Protocol, etc.. RISK: Signiture requirements are circumvented resulting in a compromise of the integrity of the private blockchain. ASSERTIONS: Rights & obligations	Deepak: Blockcahain Protocol should support Multi-Sig. No direct impact	If Txn has <2 signatures then the Transaction is not MultiSig	Alert the Rest of the Signaturies. E:G, if A,B,C is supposed to Sign and only A does, Alert B and C	IIA, NIST, ISO 27001 etc..

Why is change so elusive?

- "The phonograph is of no commercial use" (Thomas Edison, 1880).

- "Everything that can be invented has been invented" (Charles Duel, Director US Patent Office, 1899).

- Who the hell wants to hear actors talking?" (Harvey Warner, 1927).

- "I think there is a world market for about five computers" (Thomas J Watson, Chairman, IBM, 1943).

- "There is no reason for any individual to have a computer in their home" (Ken Olhson, President of Digital Equipment Corp., 1977).

- "640k ought to be enough for anyone" (Bill Gates, 1981).

Discussion, Q&A's