Impact of Blockchain on Financial Services

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Singapore Exchange

In partnership with

ASEAN Bankers Association

THE BRUNEI ASSOCIATION OF BANKS

abs
The Association of Banks in Singapore

Introduction to Singapore Exchange

A diversified exchange group that runs key market infrastructure including the Singapore stock market and a pan-Asian derivatives exchange covering all major asset classes

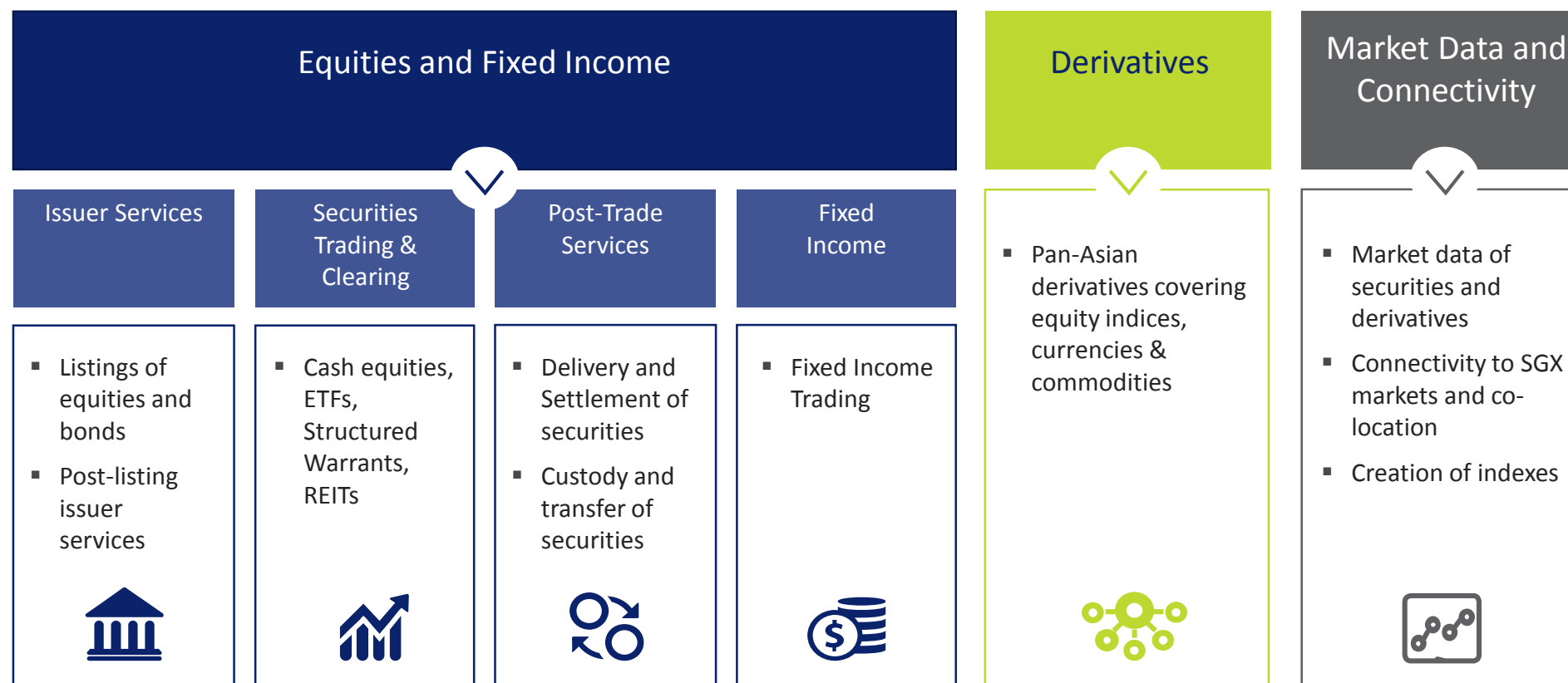High annual dividend of 28 cents for the past 5 years

Strong Cash-flow with Debt-free Balance Sheet

Anchored in Singapore, Asia's only triple AAA-rated economy

SGX Business Lines

Three business units covering the entire exchange value chain

Equities and Fixed Income				Derivatives	Market Data and Connectivity
Issuer Services	**Securities Trading & Clearing**	**Post-Trade Services**	**Fixed Income**		
▪ Listings of equities and bonds ▪ Post-listing issuer services	▪ Cash equities, ETFs, Structured Warrants, REITs	▪ Delivery and Settlement of securities ▪ Custody and transfer of securities	▪ Fixed Income Trading	▪ Pan-Asian derivatives covering equity indices, currencies & commodities	▪ Market data of securities and derivatives ▪ Connectivity to SGX markets and co-location ▪ Creation of indexes

SGX Global Footprint

SGX is headquartered in Singapore, with overseas offices in Beijing, Chicago, Hong Kong, London, Mumbai, Shanghai and Tokyo.
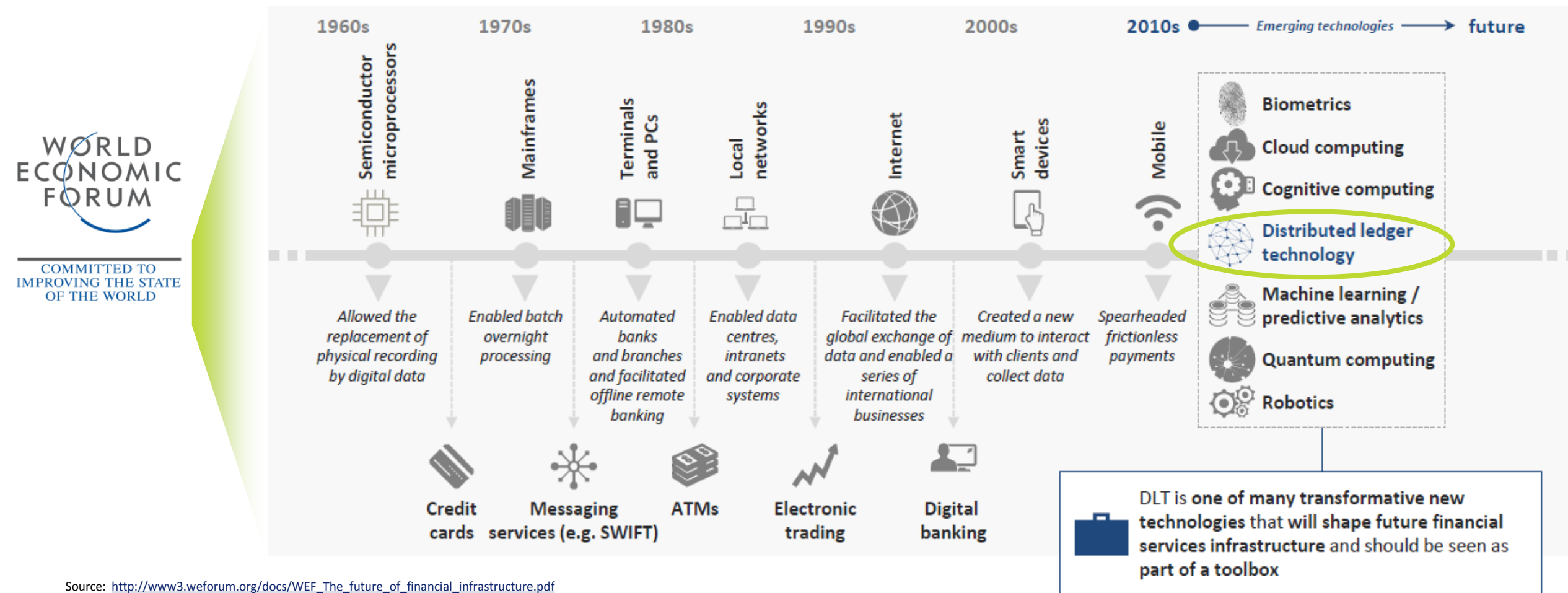
End of an Era through Market Innovation

The **closure of Trading Pits** brought back the most memorable experiences,

the tradition of Open-Outcry trading...

- Buyers and Sellers *stood on steps* that descend into the pit
- Orders were *shouted or flashed* to the trading specialist through hand gestures/signals, or *delivered* to the pit by runners
- Each pit specialised in a *specific* commodity, and was the *only place to trade* that commodity

A New Era of Innovation

Over the last 50 years, technology innovation has been fundamental to financial services industry transformation.

WORLD ECONOMIC FORUM

COMMITTED TO IMPROVING THE STATE OF THE WORLD

| 1960s | 1970s | 1980s | 1990s | 2000s | 2010s | Emerging technologies → future |

Semiconductor microprocessors — Allowed the replacement of physical recording by digital data → Credit cards

Mainframes — Enabled batch overnight processing → Messaging services (e.g. SWIFT)

Terminals and PCs — Automated banks and branches and facilitated offline remote banking → ATMs

Local networks — Enabled data centres, intranets and corporate systems → Electronic trading

Internet — Facilitated the global exchange of data and enabled a series of international businesses → Digital banking

Smart devices — Created a new medium to interact with clients and collect data

Mobile — Spearheaded frictionless payments

Biometrics
Cloud computing
Cognitive computing
Distributed ledger technology
Machine learning / predictive analytics
Quantum computing
Robotics

DLT is **one of many transformative new technologies that will shape future financial services infrastructure** and should be seen as part of a toolbox

Source: http://www3.weforum.org/docs/WEF_The_future_of_financial_infrastructure.pdf
Reference Video: https://www.youtube.com/watch?v=6WG7D47tGb0

What is Blockchain and its impact?

*Not long ago, a ledger would have taken the form of a book, hence the term **book-keeping** to record transactions.*
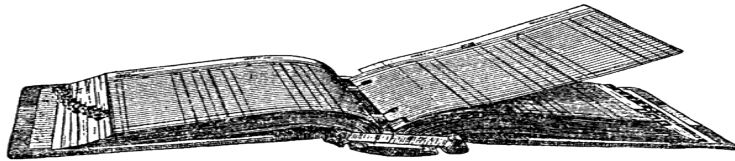
Blockchain (also known as 区块链; 블록체인; ブロックチェーン) is an implementation of a Distributed Ledger Technology (DLT):

- ☑ A *digital record of an exchange* for the Sender
- ☑ A *digital store of value* for the Receiver

That is, a *digital trust* through maths and cryptography that is *coherent and consistent* to safeguard both, the Sender and Receiver.

Thus DLT is a *business network,* built upon *Contracts* which determines the *Rights and Obligations of Participants* and is a *medium for digital exchange* to be achieved directly or with minimal intermediation.

Project Ubin marks the first step in the Monetary Authority of Singapore (MAS)'s exploration to harness DLT and the potential of

Central Bank-issued Digital Currency (CBDC)
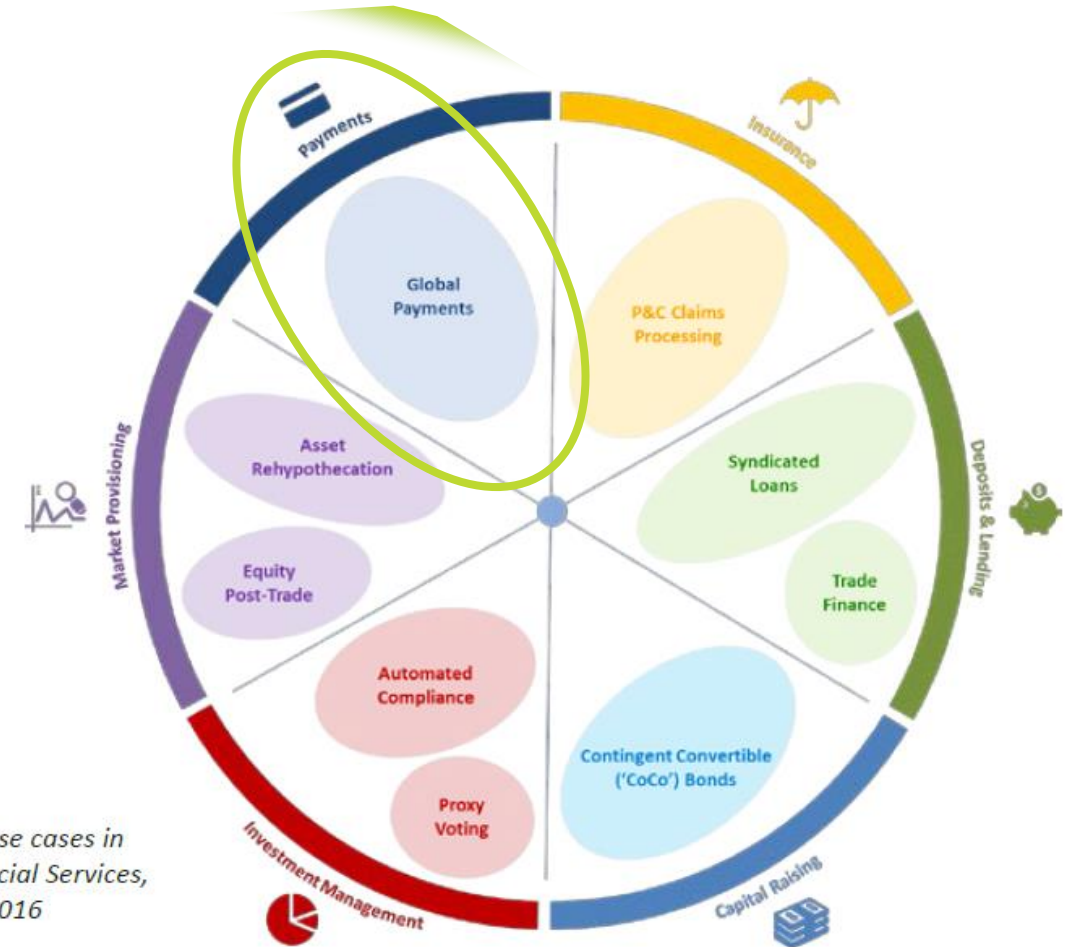
DLT use cases in Financial Services, July 2016

Source: http://www3.weforum.org/docs/WEF_The_future_of_financial_infrastructure.pdf

About Ubin - Rights and Obligations

Rights and Obligations model in Project Ubin[*], for Central Bank-issued cash-depository receipts with the Monetary Authority of Singapore (MAS)

#	Who can?	Exercise what Rights?	On which Obligations?
1	Financial Institution such as The Central Depository (Pte) Ltd, SGX Derivatives Clearing Limited, Banks etc	Pledge Cash	FI's Own Cash
2		Transfer Cash	(Sender) FI's Own Cash (Receiver) Other FI's Cash
3		Reprioritize Queued Cash Transfer	(Sender) FI's Queued Cash Transfer (Receiver) Other FI's Queued Cash Transfer
4		Settle Queued Cash Transfer	
5		Defer Queued Cash Transfer	
6		Cancel Queued Cash Transfer	
7		Propose Netting Plan on Queued Cash Transfers	FI's Nettable Queued Cash Transfers Other FI's Nettable Queued Cash Transfers (Sender) FI's Own Cash (Receiver) Other FI's Cash
8		Participate in Proposed Netting Plan on Queued Cash Transfers	
9		Settle Proposed Netting Plan on Queued Cash Transfers	
10		Redeem Cash	FI's Own Cash
11	Central Bank (Monetary Authority of Singapore etc)	Reject/Approve Pledge Cash	FI's Pledge Cash FI's Own Cash
12		Reject/Approve Redeem Cash	FI's Redeem Cash FI's Own Cash

[*]Excludes Delivery verses Payment (DvP) for Securities settlement and excludes Payment verses Payment (PvP) settlement for cross-border transfers.

About Ubin - Phase 1

The future is here
Project Ubin: SGD on Distributed Ledger

A report developed with the contributions of Bank of America Merrill Lynch, BCS Information Systems, Credit Suisse, DBS Bank, HSBC, J.P. Morgan, Mitsubishi UFJ Financial Group, OCBC Bank, R3, Singapore Exchange and UOB Bank
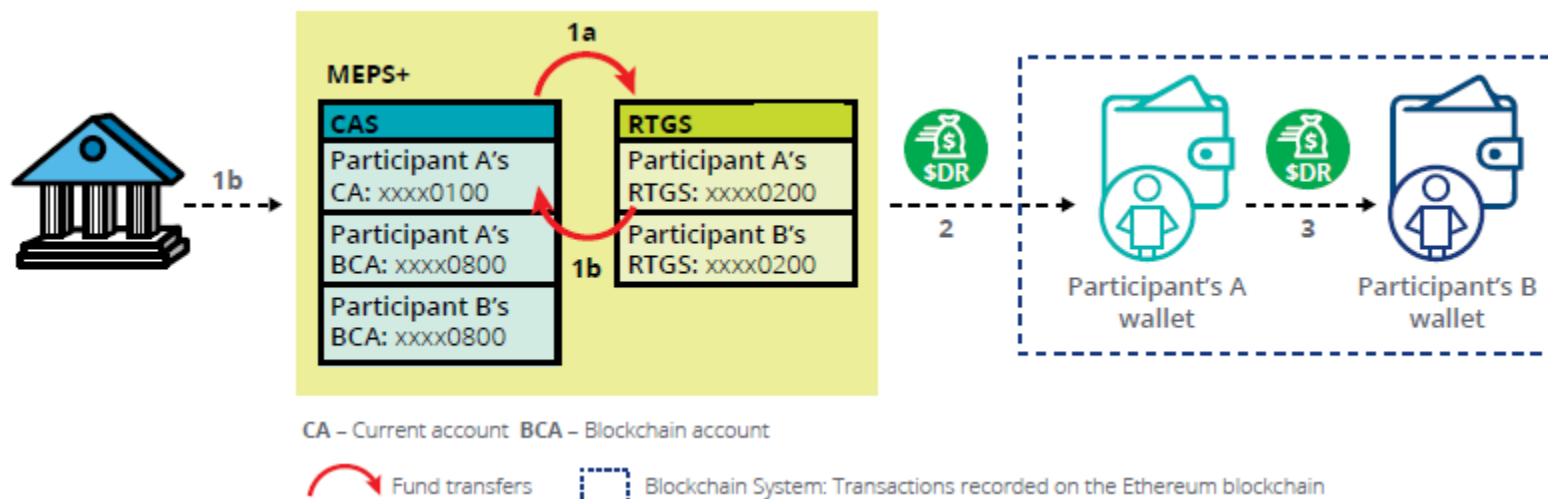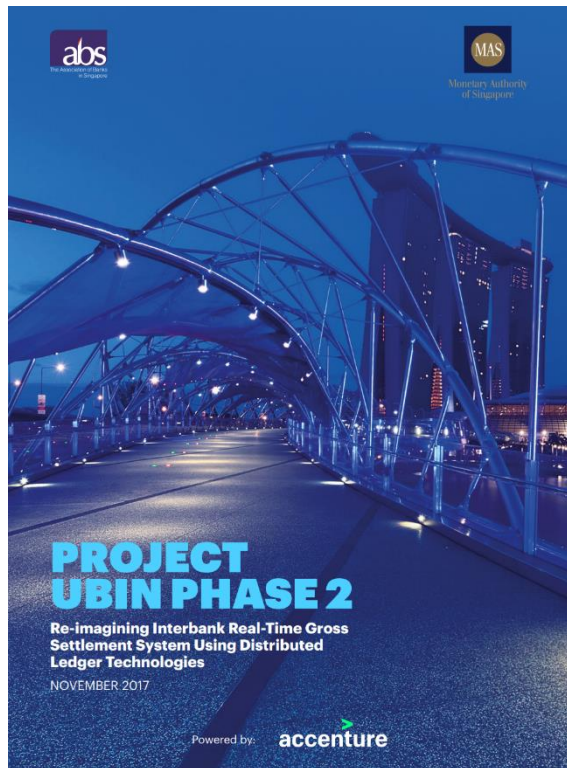
Vision - MAS 'Project Ubin': SGD on Distributed Ledger

Developed with the contributions of Bank of America Merrill Lynch, BCS Information Systems, Credit Suisse, DBS Bank, HSBC, J.P. Morgan, Mitsubishi UFJ Financial Group, OCBC Bank, R3, Singapore Exchange and UOB Bank.

Objectives

1. Produce a digital representation of the Singapore Dollar for interbank settlement
2. Test methods of connecting bank systems to a DLT
3. Making the MAS Electronic Payment System (MEPS+) interoperate with the DLT for automated collateral management

CA – Current account BCA – Blockchain account

Fund transfers   Blockchain System: Transactions recorded on the Ethereum blockchain

Source: http://www.mas.gov.sg/Singapore-Financial-Centre/Smart-Financial-Centre/Project-Ubin.aspx

About Ubin - Phase 2

PROJECT UBIN PHASE 2
Re-imaging Interbank Real-Time Gross Settlement System Using Distributed Ledger Technologies
NOVEMBER 2017
Powered by: accenture

MAS 'Project Ubin': Re-imaging Interbank RTGS using DLT

Consortium of 11 financial institutions in Singapore: Bank of America Merrill Lynch, Citi, Credit Suisse, DBS Bank Ltd, HSBC Limited, J.P. Morgan, Mitsubishi UFJ Financial Group, OCBC Bank, Singapore Exchange, Standard Chartered Bank and UOB Bank.

Despite similar experiments (e.g., Brazil, Europe & Japan, Canada), Project Ubin is first to address six industry problem statements:

1. **Digitalization of Payments**: CBDC with real-time gross settlement capabilities
2. **Decentralized Processing**: Distributed and resilient infrastructure with no single point of failure
3. **Payment Queue Handling**: Uniform queueing system with prioritization, holding and cancellation facilities
4. **Privacy of Transactions**: Only relevant parties will have visibility to transaction details
5. **Settlement Finality**: Final and irrevocable settlement of payment instructions with deterministic finality
6. **Liquidity Optimization**: Implement netting and gridlock resolution (i.e., multilateral and bilateral) algorithms to maximize liquidity efficiency

Source: http://www.mas.gov.sg/Singapore-Financial-Centre/Smart-Financial-Centre/Project-Ubin.aspx

Liquidity optimization

'SuperTree' visualization of settlement obligations on DLT
(inspired by Singapore's *Gardens By The Bay*)
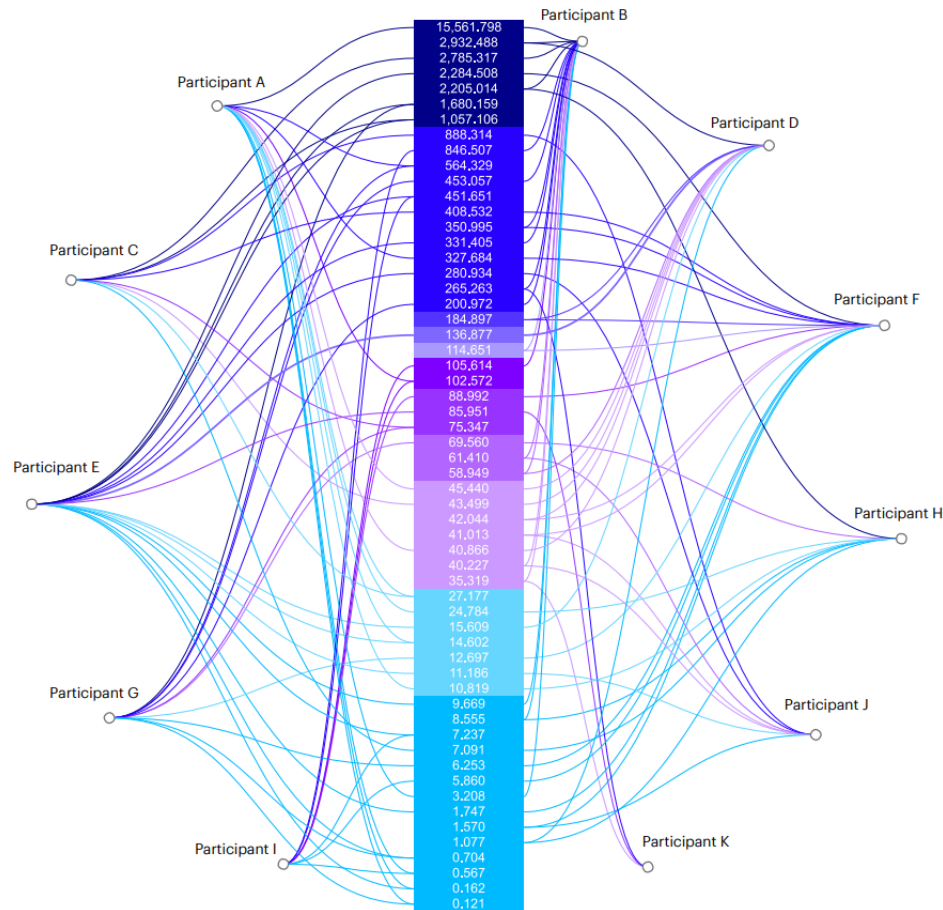
Propose, participate and settle netting plans
with gridlock resolution
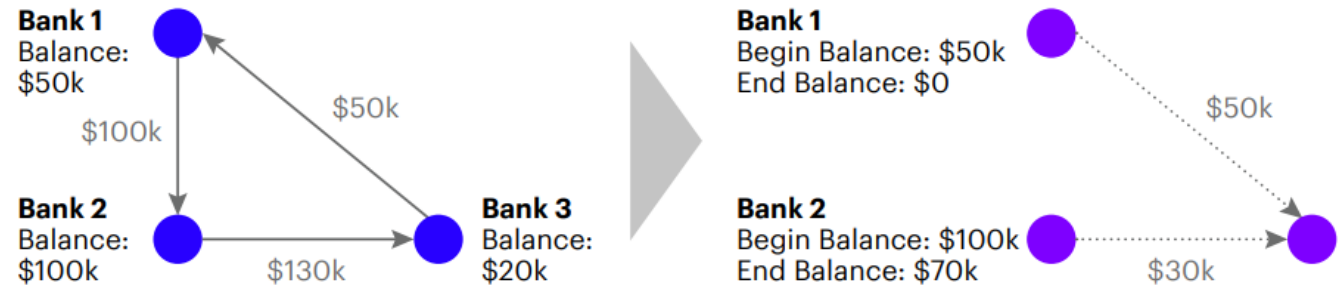
When both, incoming and outgoing payments are netted and the available liquidity is used, then payments can be settled if ALL payments are coordinated together, atomically.

☑ A *Liquidity Saving Mechanism (LSM)* is achieved
☑ All payment details are protected within the DLT and solves for *data sovereignty and privacy laws* to protect bilateral relationships
☑ Participants are able to *reduce liquidity costs* by minimizing amount of regulatory capital required to cover for settlement obligations

Principles and capabilities

Three principles to shape nine critical capabilities:

PRINCIPLE

P1 Disintermediate or automate intermediation

CAPABILITY	CAPABILITY	CAPABILITY
D1 Digital Identities and Assets	D2 Distributed Ledger	D3 Distributed Consensus

PRINCIPLE

P2 Secure communication, distribution and interaction

CAPABILITY	CAPABILITY	CAPABILITY
S1 Secure Interaction	S2 Secure Transaction	S3 Secure Communication

PRINCIPLE

P3 Manage Risks for higher throughput, lower latency

CAPABILITY	CAPABILITY	CAPABILITY
R1 Strong, tamper-Resistant Cryptography	R2 Reliable Storage	R3 Robust, Resilient Network

Smart Contracts are *stored logic to automate and limit one's actions* after agreement is reached

CAPABILITY
Turing-complete or domain-specific language Smart Contracts

r3. c•rda

Quorum™

HYPERLEDGER FABRIC

Three DLT implementations; each with varied capabilities and features

How to confirm transactions?

In order to prevent forgery and maintain transaction integrity, a **Transaction Signature** is generated uniquely for every transaction, and therefore cannot be reused for another transaction, and any changes would invalidate the signature.

Sender's **Private Key** is used to generate the **digital signature**:

$$TransactionSignature = f \left\{ \begin{array}{c} \textbf{\textit{PrivateKey}} \\ TransactionDetails \end{array} \right\} Sign$$

Thereafter, the Sender's **Public Key** is used by others to verify the **digital signature** (i.e., proof that Sender is the rightful owner without having to reveal the **Private Key**):

$$IsTrue = f \left\{ \begin{array}{c} \textbf{\textit{PublicKey}} \\ TransactionDetails \\ \textbf{\textit{TransactionSignature}} \end{array} \right\} Verify$$

What is **Private** for *Clark Kent* is very different to the **Public** for *Superman.*

Similarly, the **Block Signature** builds upon the above and is further developed by distributed consensus and data synchronization.

What is stored?
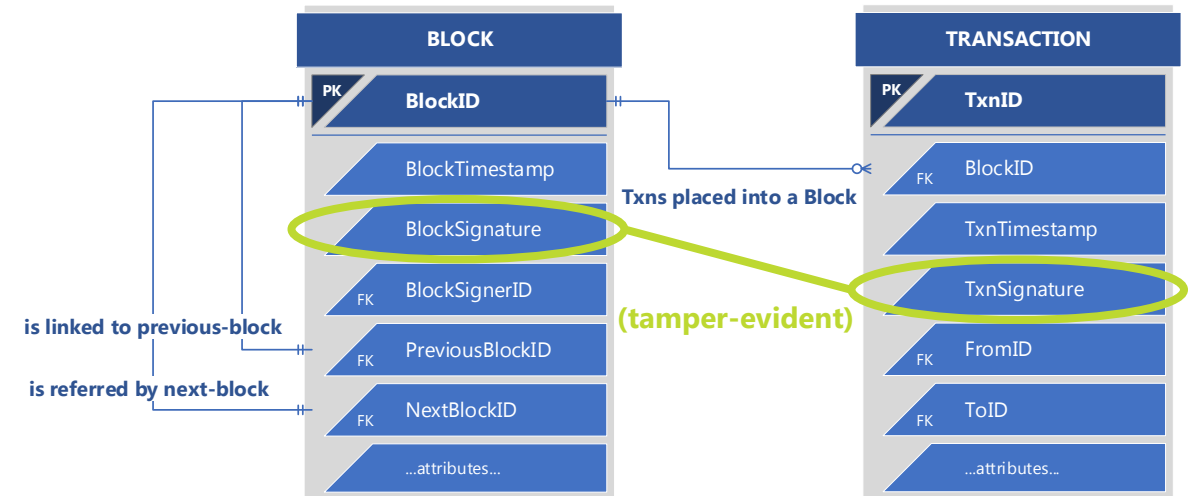
Crow's foot notation illustrating how confirmed transactions are placed into a Block. And like *'doubly-linked list'*, how each Block is linked to the previous and referred by the next to maintain data chronology, in order of occurrence in time.

Steps to a Blockchain-enabled strategy

1. Develop awareness
- Business Lens
- Legal, Risk & Compliance
- Operations & Technology

2. Incubate Proof of Concepts
- Potential Use Cases
- Business Network Participants
- Technical Platform & Design
- Minimum Viable Product

3. Plan transformations
- Stakeholders buy-in
- Lessons learnt from POCs
- As-Is and To-Be target state
- Migration plan
- Participation and consortium

4. Pilot tests
- Tests for operational readiness
- Extend participation
- Harden business cases
- Regulatory and industry associations approval

5. Operate and maintain
- Consortium launch
- Participant on-boarding
- Functional continuous improvement
- Non-functional requirements management

Prudent with the emerging businesses and technologies; prepare and get ready to pounce when the opportunities arises.

Summary

Re-imagine a **more efficient and secure way** to conduct cross-border interbank payments and settlements:

- Cross-border payments today rely on a correspondent banking network
- Banks hold balances with one another, and settlement occurs by adjusting these balances
- There is counterparty risk, liquidity is split, and reconciliation is a major pain point
- Cross-border transactions often take days to settle, and at high cost to customers

This is the problem that Project Ubin seeks to solve, using DLT to enable entities across different jurisdictions to make payments directly with one another:

- without intermediaries;
- with much greater speed and efficiency, and
- at lower cost and risk

It is not an easy problem to solve, but we have made some progress.

Collaborate to identify common interests and creating incentives to act on them; unlock opportunities beyond the reach of a single actor.
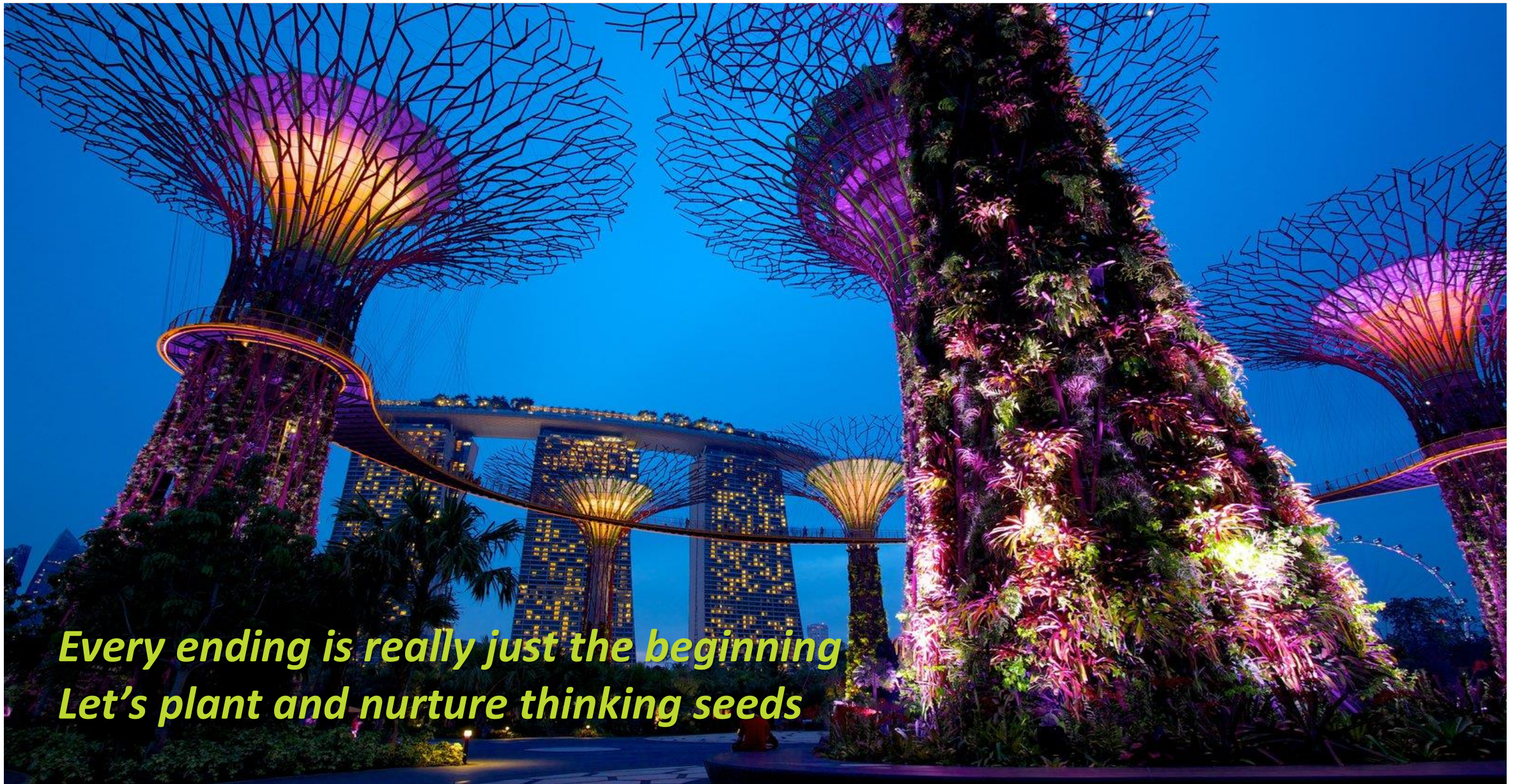
Every ending is really just the beginning
Let's plant and nurture thinking seeds

SGX

Thank You

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