BLOCKCHAINS

ARCHITECTURE, DESIGN AND USE CASES

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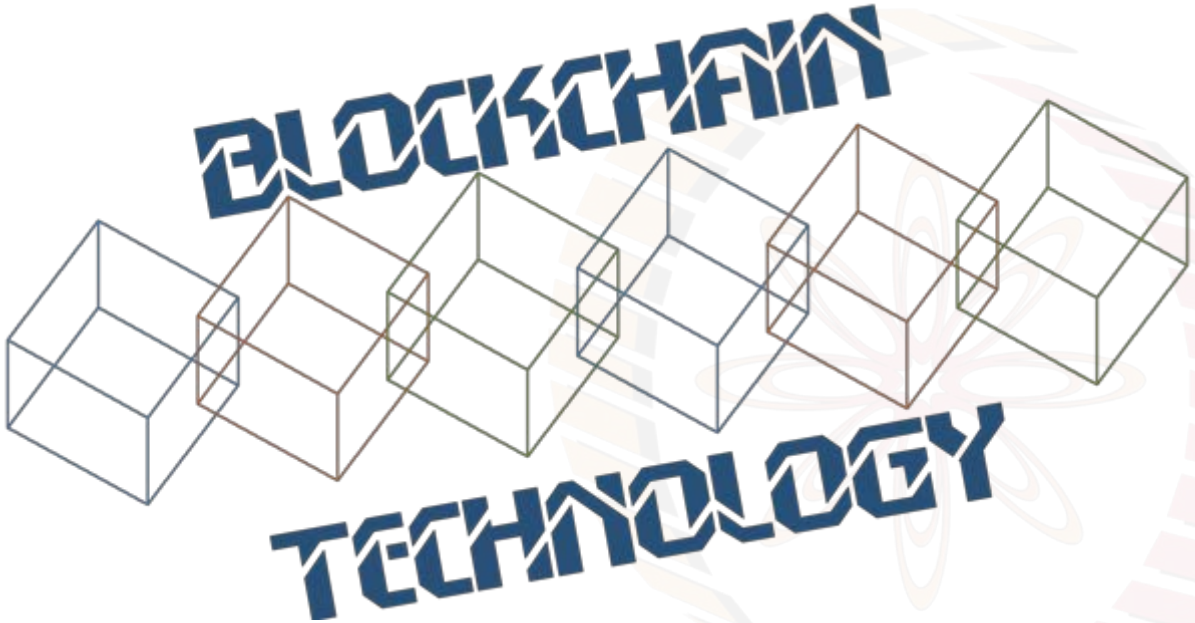


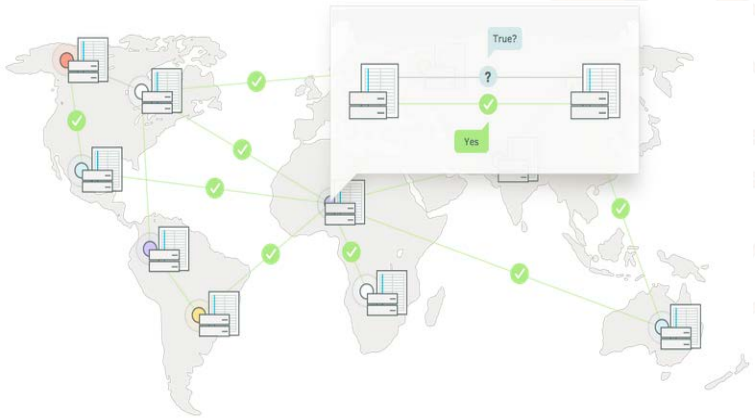
Image courtesy: http://beetfusion.com/

BLOCKCHAIN IN FINANCIAL SERVICES: PAYMENTS AND SECURITIES TRADING

Cross-Border Payments

- Classic use case for which Bitcoin was created and perhaps the holy grail of cryptocurrencies
- To date, we have over 1500 cryptocurrencies!
- But, what qualifies as a currency. In economics, the following criteria must be satisfied:
  - Medium of exchange: Are merchants willing to accept the currency in exchange for goods and services
  - Unit of account: Is it a measure of the real value of goods and services (e.g., would a merchant be willing to accept the same value regardless of relative currency fluctuations)
  - Store of value: A mode of investment

Stellar Protocol and Network

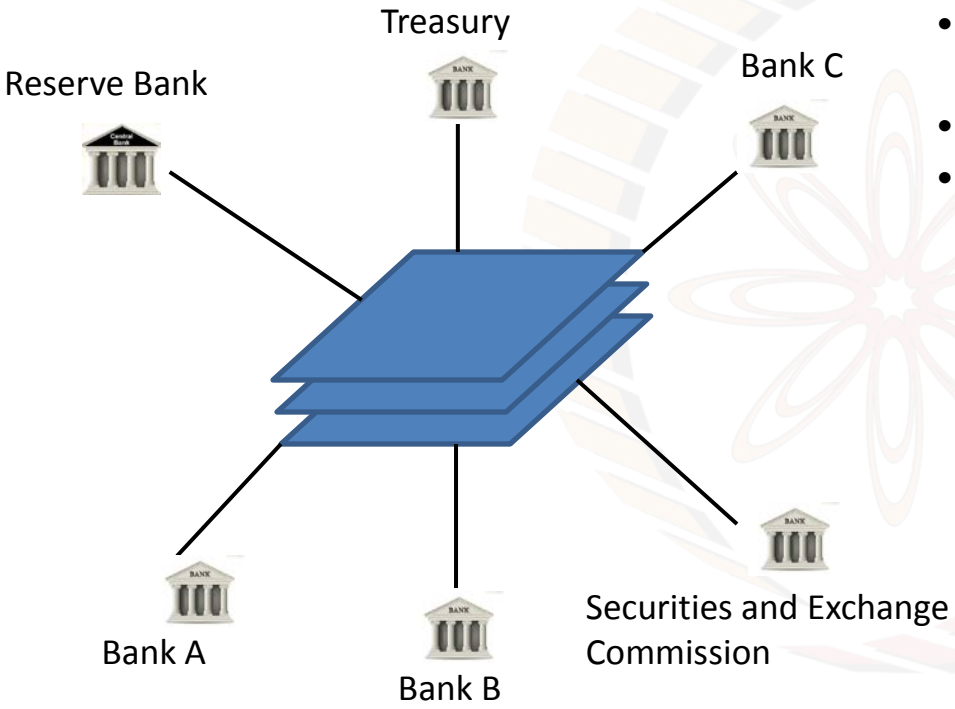


- Decentralized, hybrid blockchain platform with open membership; Lumens as native asset
- Federated Byzantine Agreement (FBA) – quorums formed based on participants individual trust decisions, followed by agreement within quorums
- 2-5 second transaction clearance
- Anchors act as bridges between a given currency and Stellar network
- Has a distributed exchange: pay in EUR with INR balance and network will automatically convert it at lowest rate for you
- https://www.stellar.org/

Ripple Protocol and Network

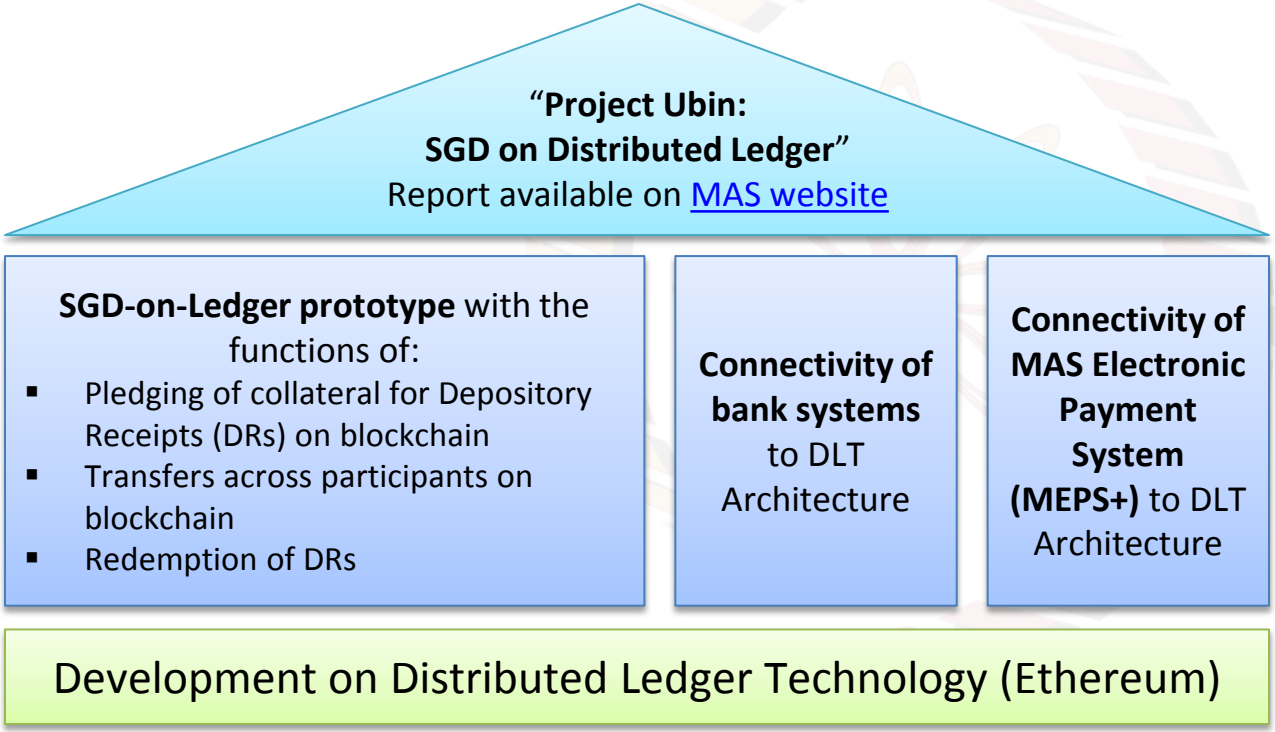
- Protocol for banks to clear and settle payments in real time through a distributed network
- Consensus allows payment exchanges and remittance to happen without need for a centralized clearing house
- Average 5 second confirmations; no mining, custom protocol that hasn't yet been validated for correctness and fault tolerance
- Gateway nodes convert fiat currencies to XRP (currency in Ripple)
- Market-makers convert from one currency to another
- Centralized governance, with Ripple still holding a large fraction of the cryptocurrency
- https://ripple.com

Permissioned Networks for Payments and Settlement



- Complex correspondent banking arrangements today; Nostro-Vostro accounts
- Nostro (“Ours”) and Vostro (“Your”)
- With Blockchain:
  - Only member banks are permitted to transact, ensuring privacy and confidentiality of transactions
  - Eliminate need for reconciliation and errors that happen, reducing cost and delays in clearing and settlement (like RTGS)
  - The treasury has instantaneous view on the currency position of their nostro accounts across the globe, allowing for optimal use of capital that is otherwise idle
  - Reduced foreign exchange and capital exposure, lower fees
  - Increased compliance and security

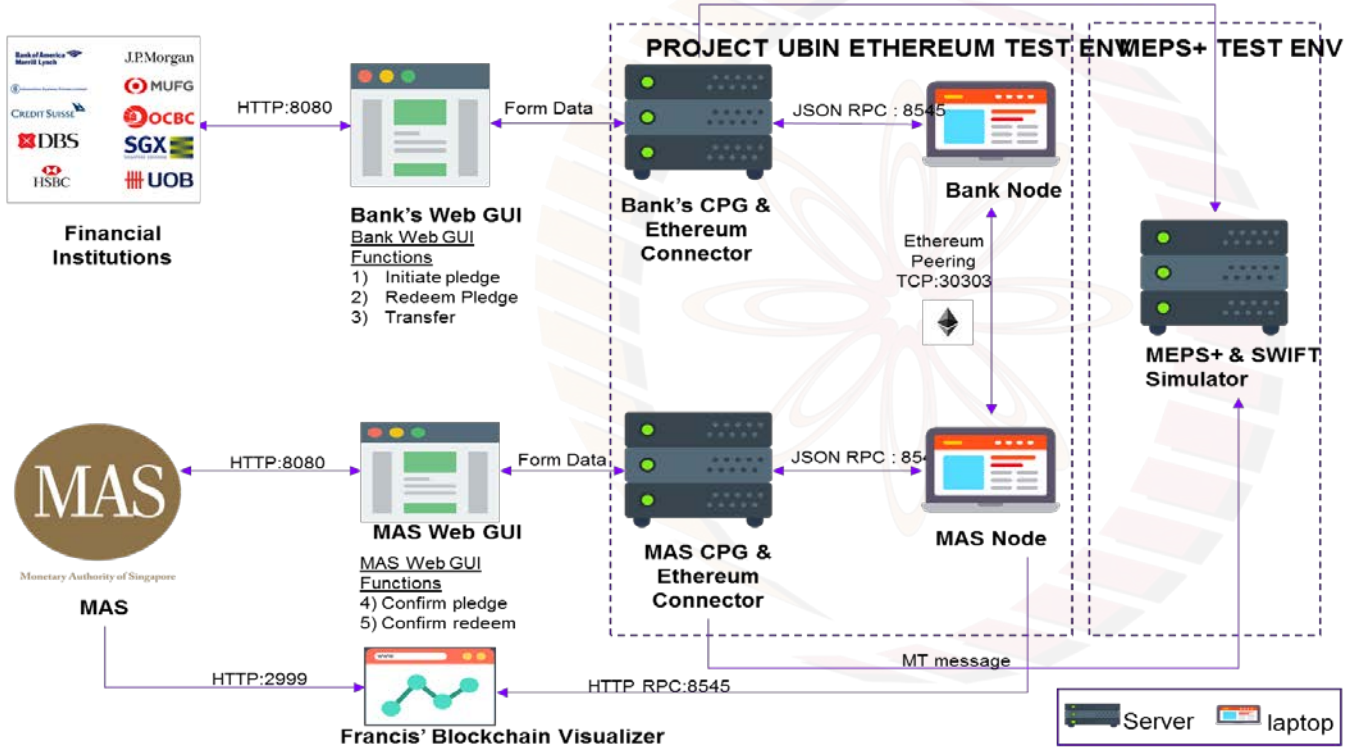
Project Ubin: SGD on Distributed Ledger



Phase 1: Domestic payments using Central Bank issued SGD equivalent

Phase 2: Reimagining Real-Time Gross Settlement (RTGS) on multiple DLT platforms

Project Ubin Phase 1: Technical Architecture



Key Takeaway: Blockchain is only a part of the solution

Many off-chain components and its an important design consideration for what should be on-chain vs off-chain

Project Ubin: Phase 2

WHO ARE INVOLVED

70+ Project members

3 product owners from the banks

10 Participating banks (MUFG, JPMC, Credit Suisse, Citi, BAML, DBS, UOB, OCBC, HSBC and Standard Chartered), with MAS, ABS and SGX

5 Technology partners (Accenture, ConsenSys, IBM, R3 & Microsoft)

WHAT IS USED

9 languages (Golang, Kotlin, Solidity, Java, Node.js, Shell, AngularJS, HTML, CSS)

5 IT tools (Postman, Newman, Jira, Confluence, and Slack)

145 user stories,
7 functional test scenario,
10 exception scenarios

>35 MS Azure cloud VMs

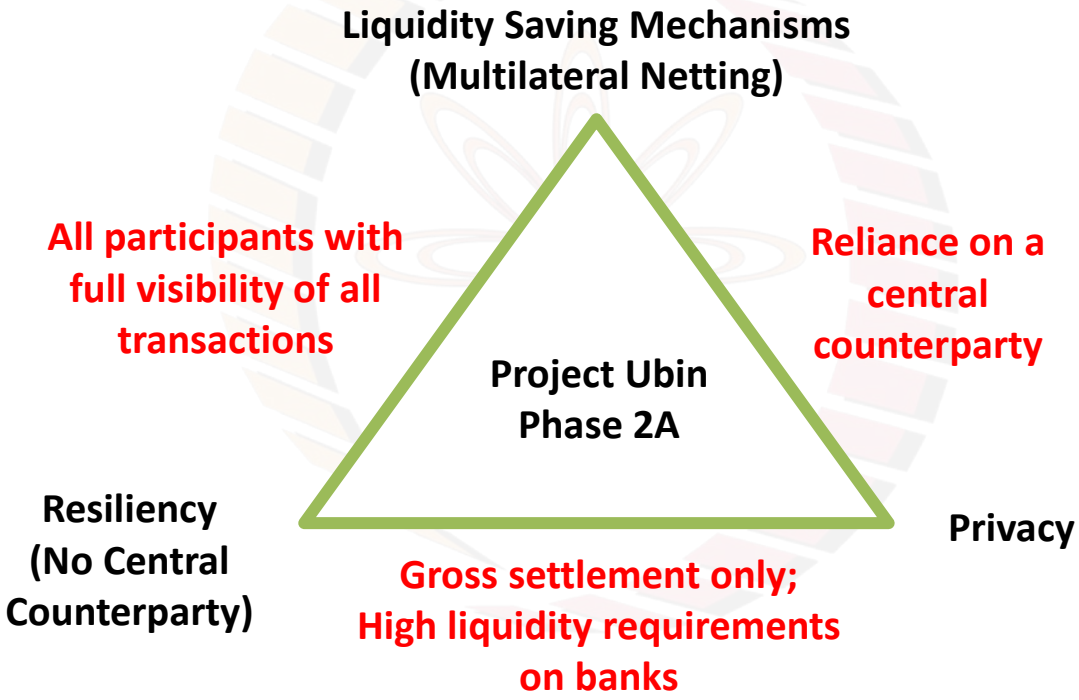
WHAT WAS ACHIEVED

3 POC systems on 3 platforms
Corda | Hyperledger Fabric | Quorum

3 Successful sprint demos

1 Common UI and API design

Project Ubin Phase 2: Decentralized Netting

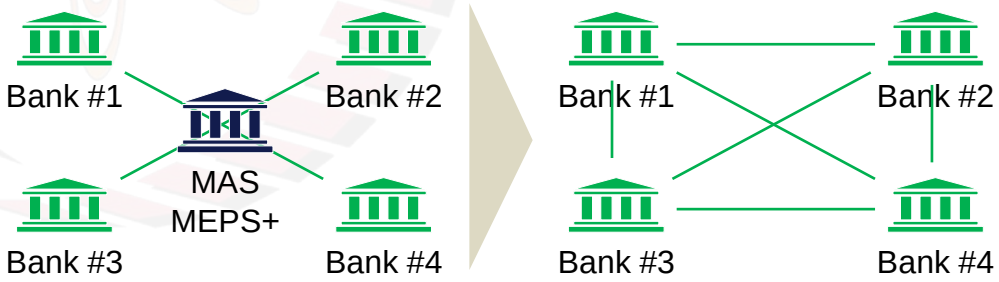


Project Ubin: Phase 2

- Develop POC using **three DLT platforms** (Quorum, Hyperledger Fabric and R3 Corda) specifically to address Bank and MAS functionalities for domestic real time gross settlement payments (RTGS), focusing on the following objectives:

Digitalization of Payments | **Decentralized Processing** | **Payment Queue Handling** | **Privacy of Transactions** | **Settlement Finality** | **Liquidity Optimization**

- Address use-cases of **queuing and gridlock resolution mechanism** on a **decentralised** inter-bank payment system without compromising on **privacy** of participating members
- Conduct an objective holistic **evaluation and produce a technical report** outlining the design, strength, challenges, functional gaps and for future development for each platform
- Contribute the **work-products** to the DLT community



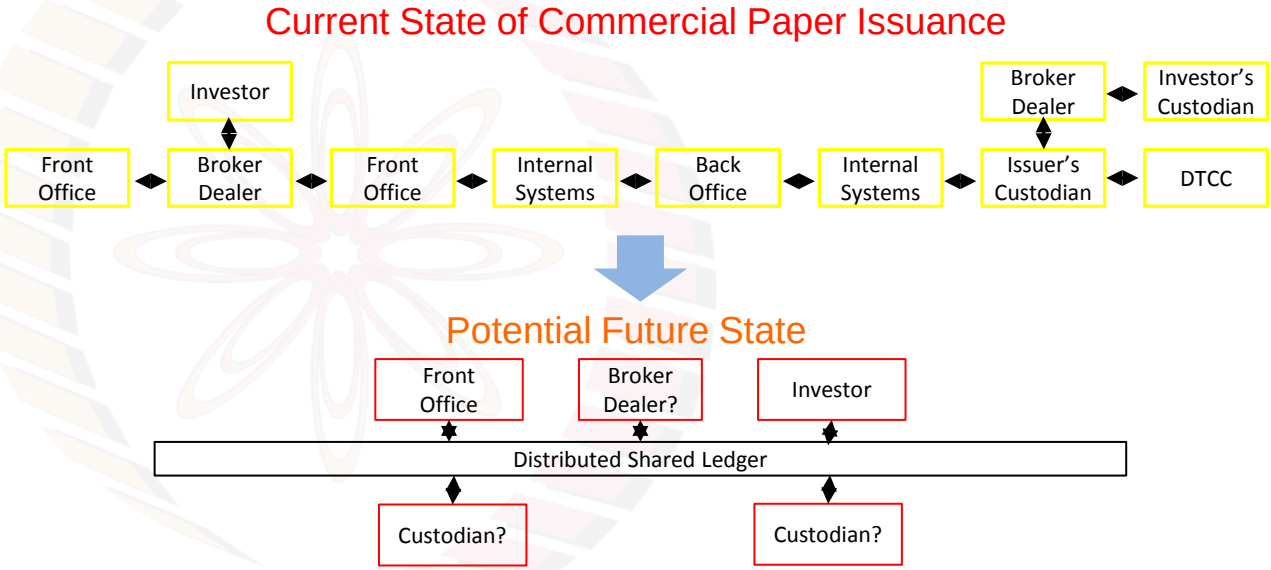
Blockchain for Commercial Paper

What?

- Corporations issue Commercial paper to raise money; Corporate lender(s) purchase the paper to be repaid with interest at time of maturity
- Blockchain can reduce cost of commercial paper issuance by transforming the current complex process involving many intermediaries

Benefits

- Automation and efficiency
- Transparency, immutability
- Cost reduction



Other use cases such as corporate bonds, exchange traded products, corporate actions (e.g., dividend payments, proxy voting)

Components, Processes in Securities Trading

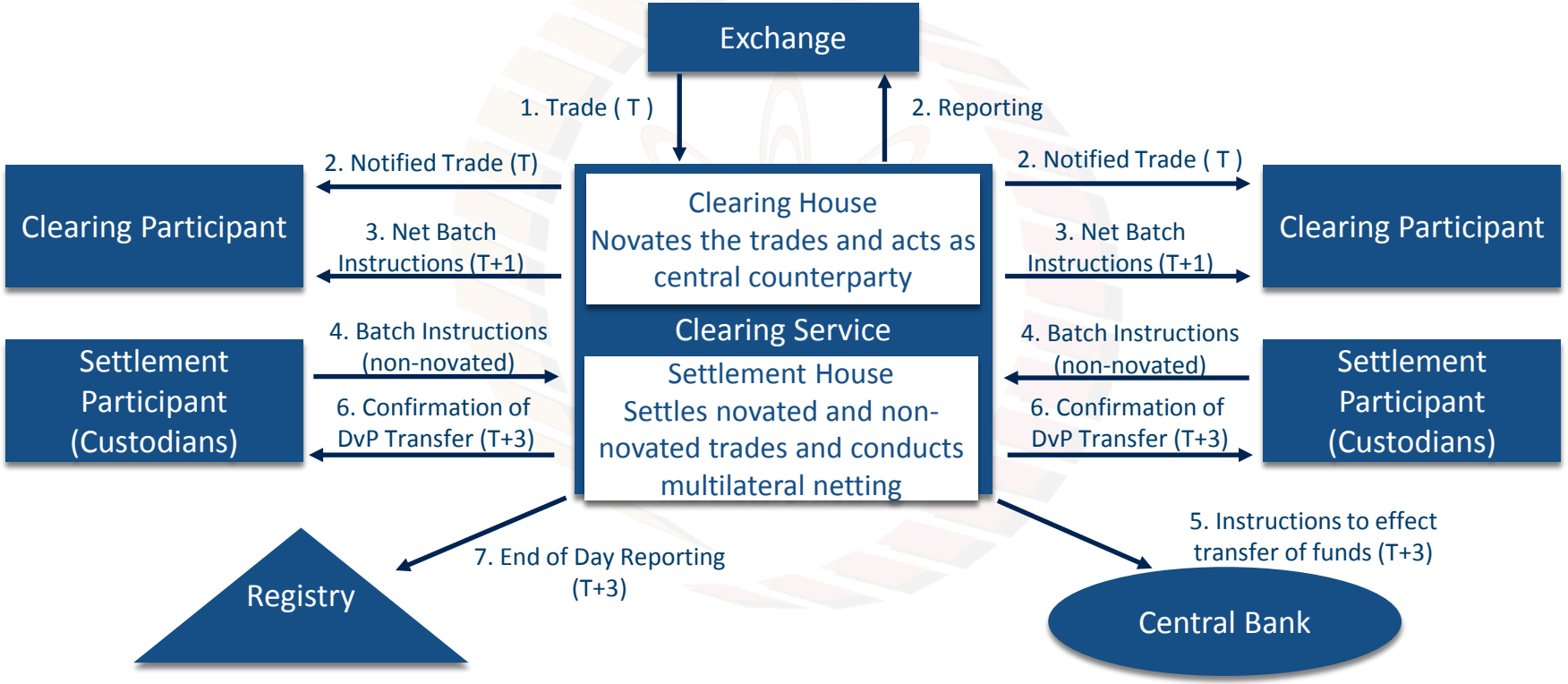
Components in the system:

Stock Exchange: Solves the matching problem.
•**Broker**: Gets buyers/sellers the best deals.
•**Market Maker**: Unlike brokers who are agents, market makers act in their own capacity, buying and selling shares they specialize in.
•**Custodian**: Are trusted with the safe-keeping of share certificates.
•**Clearing House**: Does the clearing process, Resolves counter-party exposure.
•**Registrar (UK) or Share Transfer Agent (US)**: Work on behalf of the company. Responsible for maintaining a register of shareholders and keeping it up to date. If company pays dividend, these companies are responsible for distributing it. They rely on one of the participants in the process to tell them about share transfer. (e.g., Equiniti.)
•**Central Security Depositories**: A depository where the share certificates were placed in exchange for an equivalent entry on the electronic register.

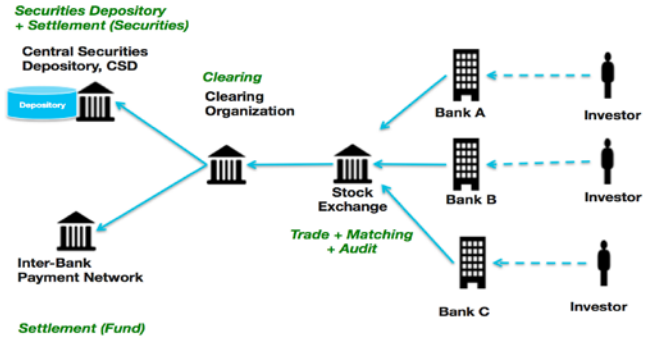
Processes in the system:

- **Clearing**: Matching, maybe netting, agreement of settlement details, agreeing on time and place of settlement, etc. To be done *post-trade* but *before settlement*.
- **Settlement**: Actual movement of cash and share certificate to new owners.

Securities T+3 Trade Life Cycle

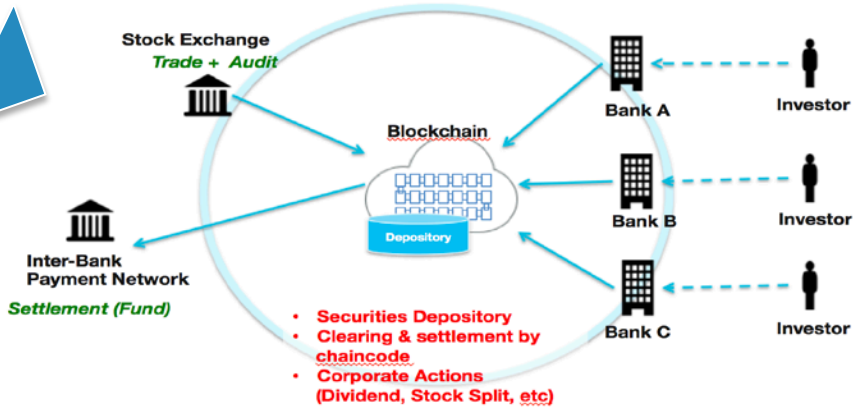


Securities Settlement in Low Liquidity Markets



Today's process

Reduce trade settlement time by automating the end-to-end multi-party interactions from trade execution to settlement on the blockchain for low liquidity trading



Settlement Process with Blockchain

JPX
JAPAN EXCHANGE GROUP

Benefits

1. **Reduced settlement time**
2. **Reduced settlement risk**
3. **Lower cost transactions**
4. **Visibility in Asset Ownership**

Private Equity Administration

What?

- Infrastructure supporting private equity has seen little innovation in recent years at a time when investors are seeking greater transparency, security and efficiency.

How?

- Creation of an innovative private equity ecosystem designed to deliver increased efficiency, security and transparency.

Benefits

- Provides real-time insight and transparency to all parties, including the fund managers and investors.
- Designed to allow regulatory access as required.
- Support compliance of local regulations.
- In production

NORTHERN TRUST

Fun Reading

- Real-Time Gross Settlement (RTGS), Wikipedia article: https://en.wikipedia.org/wiki/Real-time_gross_settlement
- Project Ubin and reports: http://www.mas.gov.sg/Singapore-Financial-Centre/Smart-Financial-Centre/Project-Ubin.aspx
- Project Ubin Github: https://github.com/project-ubin
- Commercial Paper, Wikipedia article: https://en.wikipedia.org/wiki/Commercial_paper
- Trading Commercial Paper on Blockchain Demo Video: https://www.youtube.com/watch?v=2O1rxn2wh2o
- Private Equity, Wikipedia article: https://en.wikipedia.org/wiki/Private_equity


thank you!