BANK FOR INTERNATIONAL SETTLEMENTS

Distributed ledger technology in payment, clearing & settlement: *An analytical framework*

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WORKSHOP ON FINTECH, PAYMENTS, AND FINANCIAL INCLUSION

"Unlocking the Potential of Financial Innovation for sub-Saharan Africa"

Disclaimer

Structure of the discussion

1. Introduction

2. Definition & Design Arrangements

3. Analytic Framework

1. Introduction

1.1. An Increasingly Digital World

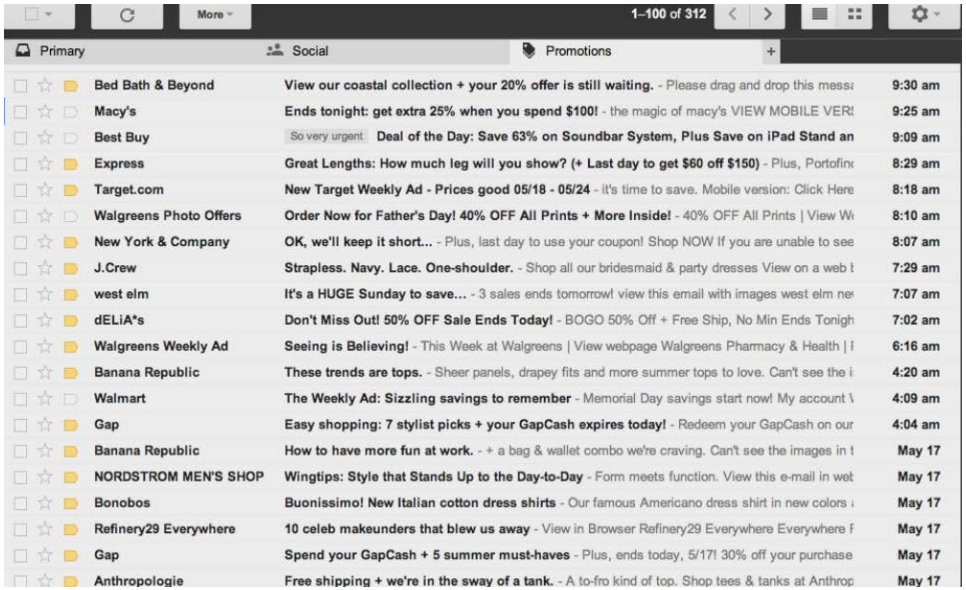
1.2. DLT: Hope vs Hype?

1.3. Aim of paper & main conclusion

1.4. Potential of DLT & Risks

1.1. An increasingly digital world

2.4 billion emails per second
205 billion per day
74 trillion per year



1.2. DLT: Hope versus Hype?

1.3. Aim of the paper & main conclusion

i. Help understand uses of DLT

i. Identify both opportunities & challenges

ii. Better determine technology's potential to provide operational efficiencies & make financial markets more robust and resilient

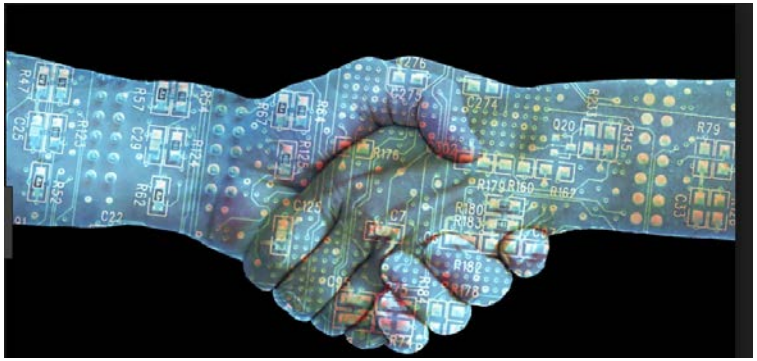
Still a long way to go before that promise may be fully realised

1.4a. Potential of DLT

Proponents highlight its ability to transform financial services and markets by:

i. reducing complexity;
ii. improving end-to-end processing speed & thus availability of assets & funds;
iii. decreasing the need for reconciliation across multiple record-keeping infrastructures;
iv. increasing transparency & immutability in transaction record keeping;
v. improving network resilience through distributed data management; &
vi. reducing operational and financial risks.

DLT may radically change how assets are maintained & stored, obligations are discharged, contracts are enforced, and risks are managed



1.4b. New risks using DLT

Possible new risks:

(i) potential uncertainty about operational and security issues arising from the technology;

(ii) lack of interoperability with existing processes and infrastructures;

(iii) ambiguity relating to settlement finality;

(iv) questions regarding the soundness of the legal underpinning for DLT implementations;

(v) absence of an effective and robust governance framework; &

(vi) issues related to data integrity, immutability and privacy.

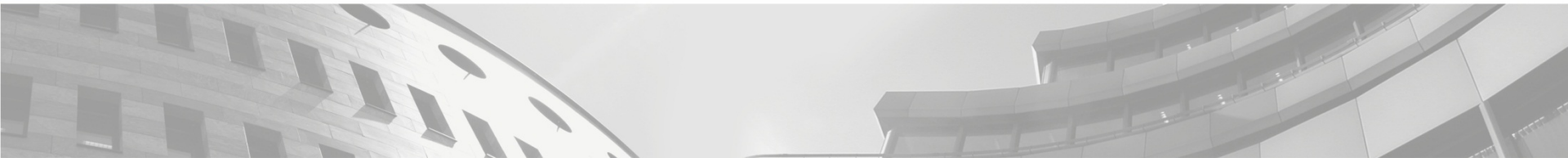
Risks associated with payment, clearing and settlement activities are the same irrespective of whether the activity occurs on a single central ledger or a synchronised distributed ledger

2. Definition & Design Arrangements

2.1. DLT: What is it…

2.2. Technical design elements

2.3. Potential configuration of DLT arrangements



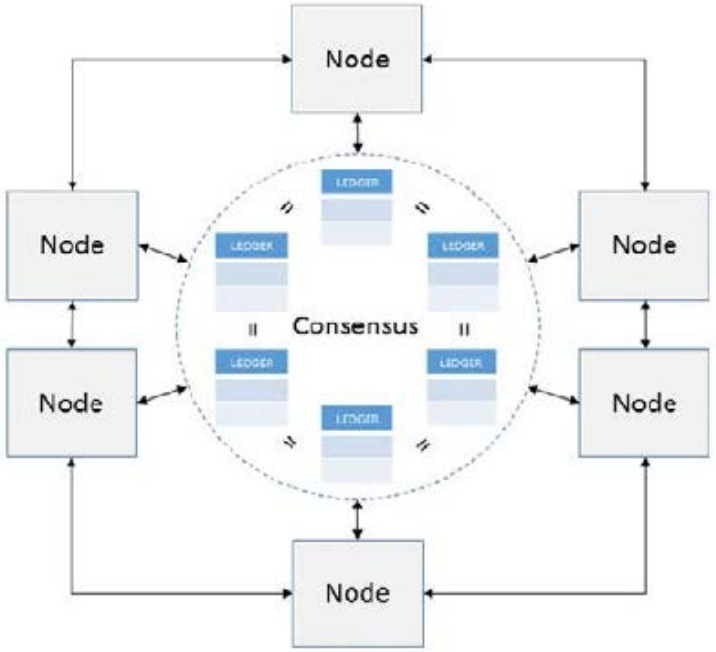
2.1. DLT: what is it?

The processes and related technologies that enable nodes in a network (or arrangement) to securely propose, validate and record state changes (or updates) to a synchronised ledger that is distributed across the network's nodes

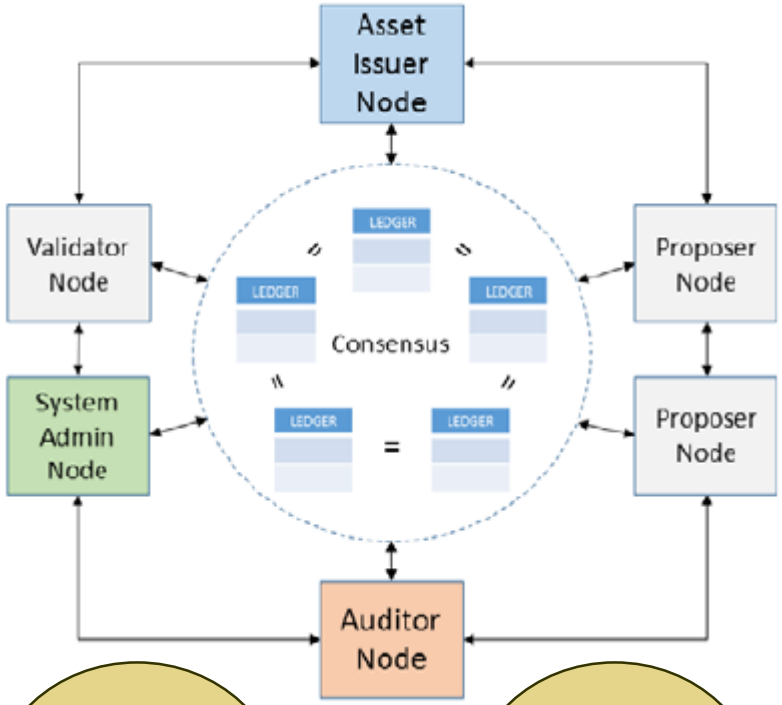
No need/reliance on central authority for 'golden copy' of ledger

2.2a. Technical design elements

Ledgers distributed across multiple nodes



Varying responsibilities



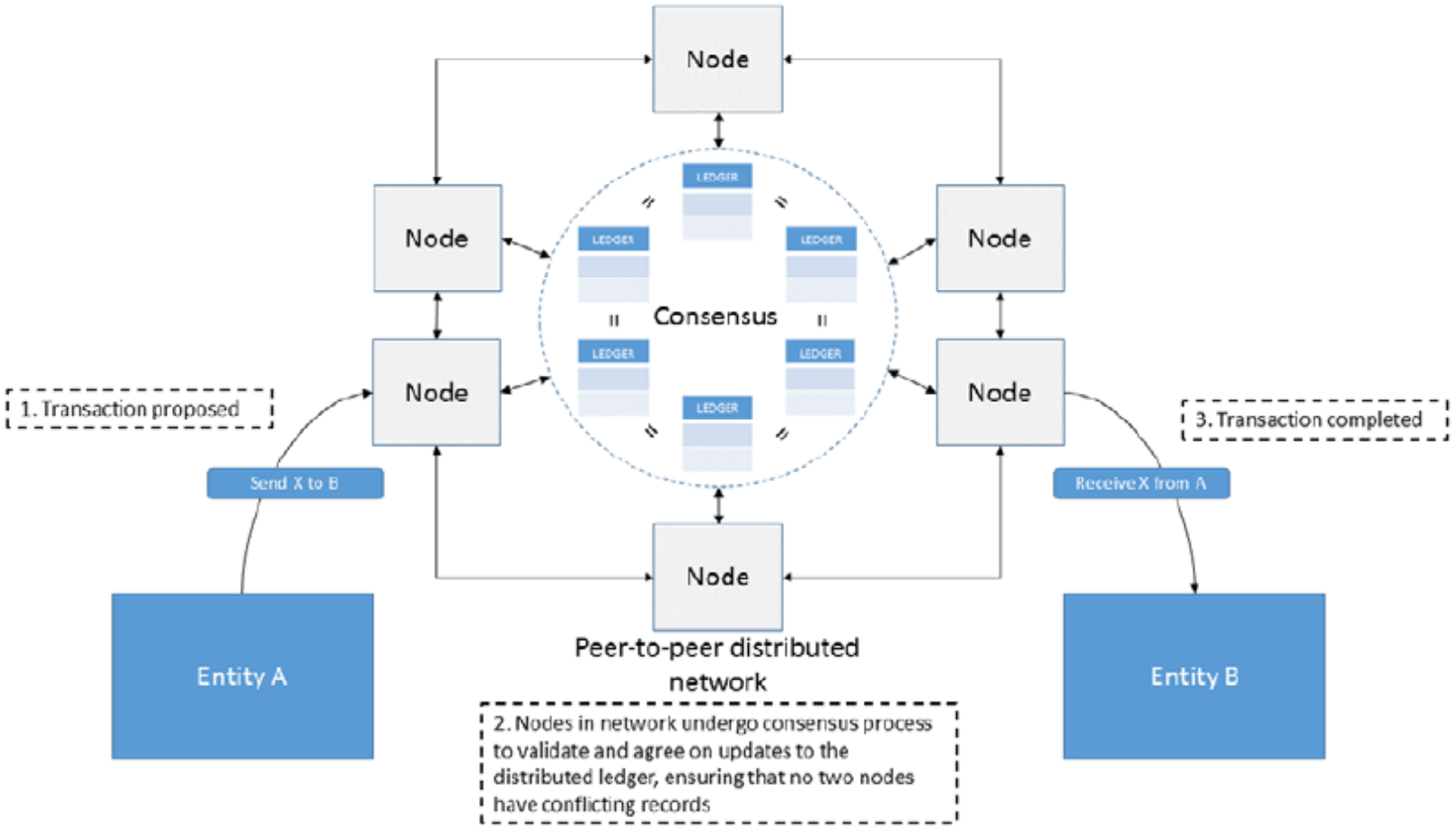
Maintaining info on the ledger

Updating the ledger (Validation & Consensus)

Technical role of nodes

Process flow

2.2b. Stylised process flow



2.2. Potential configurations of DLT arrangements

Description of arrangement	One entity maintains and updates the ledger (for example, a typical FMI)	Only approved entities can use the service; entities can be assigned distinct restricted roles	Only approved entities can use the service; entities can play any role	Any entity can use the service and play any role
Operation of the arrangement	Single entity	Multiple entities		
Access to the arrangement	Restricted			Unrestricted
Technical roles of nodes	Differentiated		Not differentiated	
Validation and consensus	Within a single entity	Within a single entity or across multiple entities	Across multiple entities	

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3. Analytic framework

3.1. Overview

3.2. Understanding the arrangement

3.3. Potential implications for efficiency

3.4. Potential implications for safety

3.5. Broader financial market implications

3.1a. Overview

i. **Scope**: understanding the arrangement, includes functionality & nature of service, & factors for effective implementation;

ii. **Efficiency**: analysing arrangement's implications for efficiency

iii. **Safety**: analysing the arrangement's implications for safety

iv. **Broader implications**: analysing the arrangement's broader financial market implications

Framework is starting point; neither extensive nor exhaustive; may not have concrete answers to questions; may not cover every arrangement

3.1.b. Overview

35 analytic questions

- 2 understanding arrangement
- 9 efficiency
- 17 safety
- 7 broader FM implications

3.2. Understanding the arrangement

What is the functionality and nature of arrangement?

- Identifying problems, inefficiencies or improvements it is addressing
- Identifying the affected part or parts of the value chain
- Understanding the design, technology and associated processes
- Identifying the affected market participants

What are the key factors for effective implementation?

- Environmental factors
- Technological factors
- Financial factors

3.3a. Potential implications for efficiency

Speed of end-to-end processing

- How does the arrangement affect (or compare to) existing payment, clearing and settlement processes with regards to the speed of end-to-end processing?

Cost of processing

- Does the arrangement allow for an overall cost reduction compared to existing processes? How are costs redistributed among participants?
- What social costs might arise from operating the arrangement in a distributed environment?

Speed and transparency in reconciliation

- What effect does the arrangement have on the reconciliation processes of participants?
- What transaction information is available to other participants, the market and relevant authorities? How does each party gain access to the information?

3.3b. Potential implications for efficiency

Cost of credit and liquidity management

- What are the credit and liquidity implications of the arrangement on participants, the system and the broader market? How do these compare with existing arrangements?

Efficiency gains from automated contract tools

- For arrangements that allow automated contract tools, what elements are being automated and how?
- How does the arrangement mitigate the introduction of malicious or faulty codes?
- What procedures or mechanisms can the arrangement use to prevent, detect and address quickly the execution of such malicious or faulty codes?

3.4. Potential implications for safety

Operational and security risk

- What are the key operational risks for the arrangement, particularly those that could affect its resilience and reliability, security, and operational capacity and scalability? How does the arrangement generally manage these risks?
- How do these risks and their management differ from traditional arrangements, if at all?
- How does the arrangement layer security that goes beyond the reliance on cryptography?

Settlement issues

- What state changes are being recorded on the ledger (for example, balances, transfers of digital assets, transfers of digital representations of a physical or immaterial asset)?
- What is the legal nature of assets or records reflected in the arrangement?
- How is operational settlement achieved on the ledger and by whom? How does it differ from traditional systems?
- How is settlement finality provided for by the applicable legal framework?
- For exchange-of-value settlement, how is delivery versus payment, delivery versus delivery and payment versus payment achieved, including where relevant across autonomous ledgers or between a ledger and a traditional FMI?

3.4. Potential implications for safety

Legal risk

- Does the arrangement have a clearly established, sound and enforceable legal basis for its activities, in particular if it operates in a multijurisdictional environment?
- How are potential conflicts of laws identified and addressed?
- What are the rights and obligations of the participants? How are they specified (for example, in rules, contracts or code)? What is the dispute resolution mechanism (for example, for liability issues)?

Governance

- What type of governance structure does the arrangement have? Does it support sound decision-making, risk management, incident and emergency response, and provide robust management oversight?
- Does the arrangement involve the sharing of information or maintenance of the ledger across entities? If so, who are the various stakeholders in the arrangement (including direct and indirect participants), and how does the governance structure define their respective responsibilities?
- Is there a clear mechanism for decision-making or agreeing on alterations to the arrangement?

3.4. Potential implications for safety

Data management and protection

- How does the arrangement guarantee data integrity, including the traceability of data?
- Are the data considered immutable? If yes, how are data, transaction or processing errors addressed?
- How does the arrangement handle data privacy and confidentiality?

3.5. Broader financial market implications

Connectivity issues and standards development

- What system, platform, layer, or combination thereof is being considered or used in the arrangement?
- What protocol is being considered or used in the arrangement?
- Is the protocol code open source or proprietary? If proprietary, how flexible is the code in working with other arrangements?

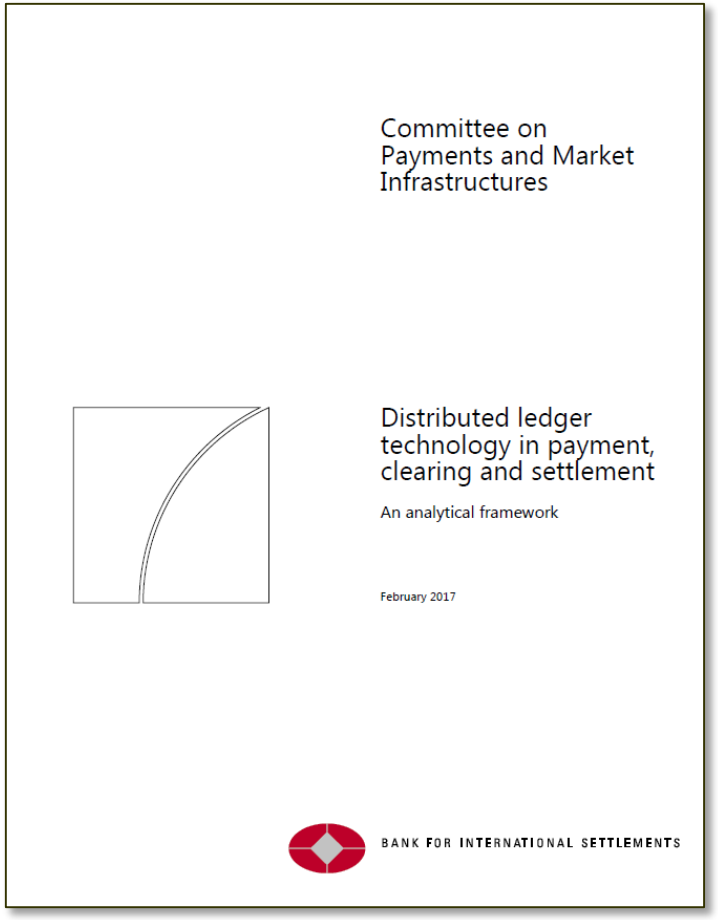
Financial market architecture

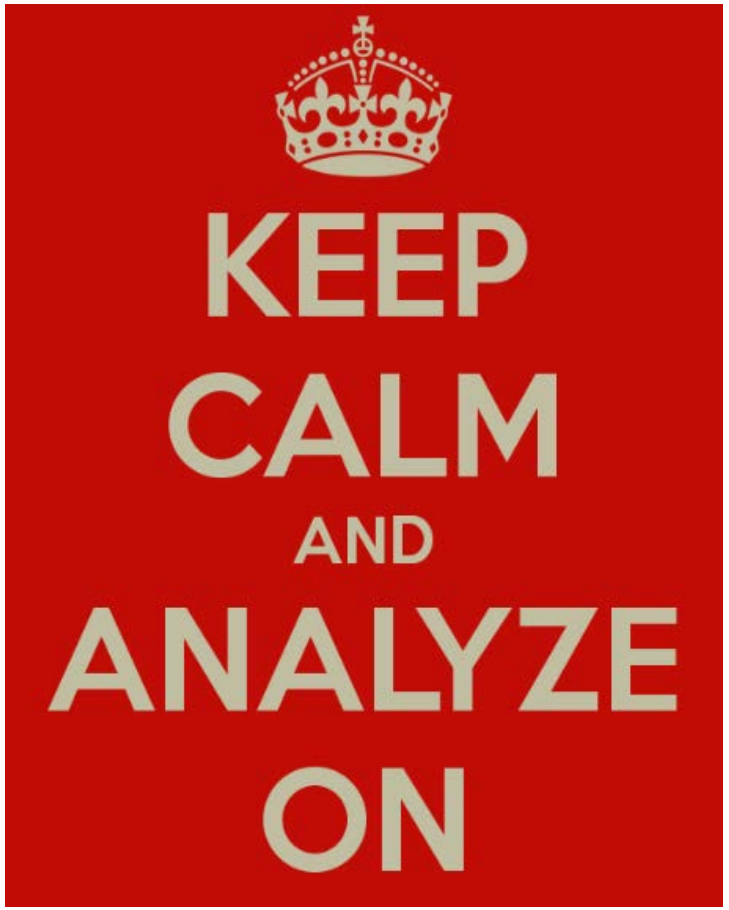
- How does the arrangement change the role of existing intermediaries or involve new actors?
- How could the arrangement change existing market and regulatory practices?

Broader financial market risks

- Does the arrangement pose broader financial market risks at this stage of development and implementation? What risks could it pose in the future?
- What interconnections does the arrangement have with other systems, including other DLT arrangements?

Conclusion





Doubts remain regarding the maturity of the technology and the size of efficiency gains associated with the use of DLT