



EUROPEAN CENTRAL BANK

EUROSYSTEM

Digital currencies and technology-driven innovation in payments and securities *

LAC payments week

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Technological innovation as constant game changer

➔ **Fintech:** innovation that could result in new business models or products with disruptive potential in the financial sector



**Blockchain
DLT**

**Cognitive
computing**

**Machine
learning**

**Robotics /
robo advice**

Biometrics

**Quantum
computing**

**Cloud
computing**

Digital innovations and the financial sector

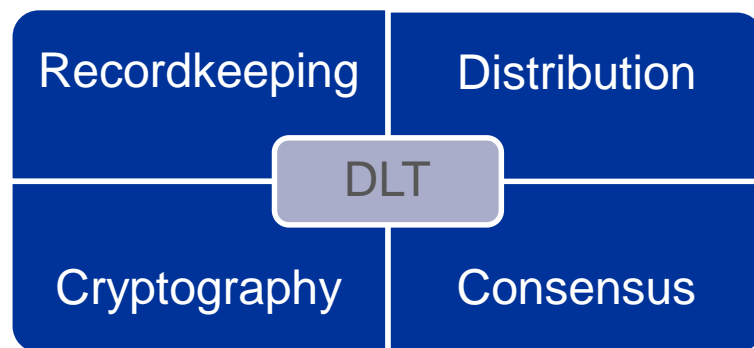
- **Virtual («crypto») currencies** were at the forefront of recent developments
 - ⇒ Separation of **assets** (e.g. Bitcoin) and **technology** (e.g. Blockchain)
- **Potential to induce change across the value chain**
 - Trading
 - Payments, clearing and settlement
 - Data and identity management as well as regulatory reporting
 - Holding of assets, record of ownership and asset services
- ⇒ **Monitoring by central banks and authorities**
 - Cf. recent reports of **CPMI** on *innovations* (2012), the role of *non-banks* (2014), *digital currencies* (2015) and *fast payments* (2016), as well as **ECB** on *virtual currency schemes* (2012, 2015) and *distributed ledger technology in post-trading* (2016)

CPMI Working Group on Digital Innovations

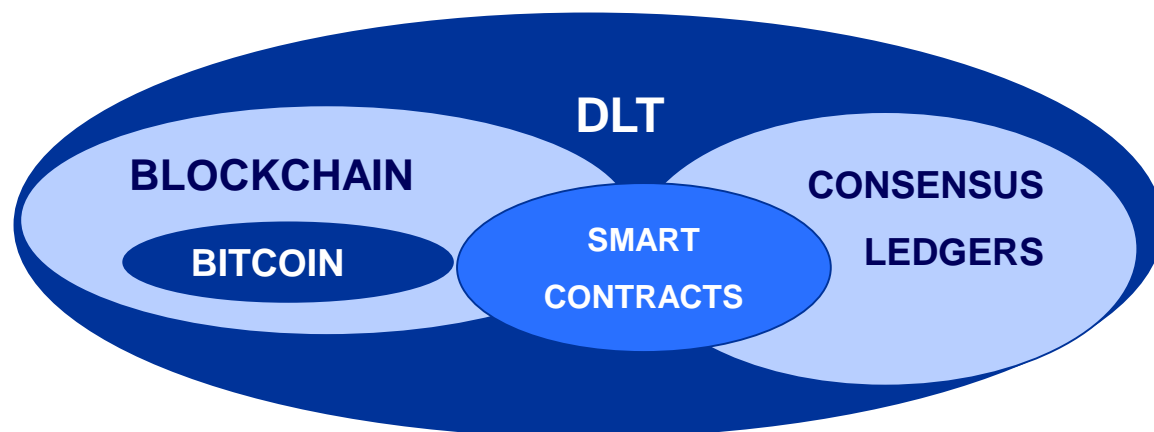
- Established in February 2016 to assess the implications of fintech for activities within the remit of the committee (including key potential efficiency gains and risks):
 - ***Potential impact on the financial markets***
 - ***Potential impact on central bank functions***
- Members from 24 central banks
- The WG has focused on developing an **analytical framework** for *central banks and other authorities to understand and analyse the implications of distributed ledger technology for payments, clearing and settlement*
- Publication of the framework in **February 2017**
- Follow-up work: In-depth analysis of implications for central banks

Distributed Ledger Technology - Terminology

- ➔ Distributed ledger technology (DLT) combines **existing technologies** (cryptography, distribution, consensus mechanisms) to enable **shared use** of a network (distributed ledger) with no need for a central entity or trusted parties



Distributed Ledger Technology - Terminology



The CPMI WG has chosen to define “DLT” as a **concept**:
“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”

Arrangements could encompass a (stand alone) **system**, a **platform** (on which individual applications are based or a **layer** (connecting arrangements)

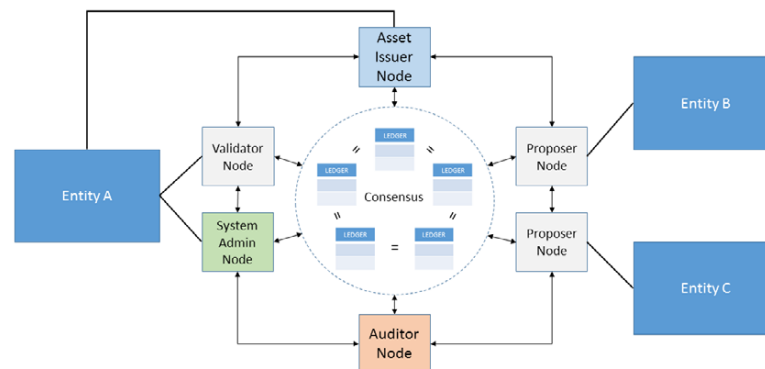
DLT and its component parts

- **Technical design** elements

- Maintaining information on the ledger (transaction history, account balances, tokens, other elements)
- Updating the ledger (validation, consensus, roles of nodes)
- Process flow

- **Institutional design** elements

- Governance of the ledger
- Access to the arrangement (unrestricted or *restricted*)



Potential configurations and trade-offs

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	

- **Trade offs**
 - access vs. scalability/latency
 - consensus vs. speed
 - anonymity vs. regulatory compliance
 - ...

CPMI analytical framework (February 2017)

- Guidance on **understanding the arrangement (scope)**
 - Functionality and nature of the arrangement
 - Key factors for an effective implementation
- Potential implications for **efficiency, safety and the broader financial markets**

Efficiency	Safety
Speed of end-to-end settlement Costs of processing Reconciliation (speed, transparency) Credit and liquidity management Automated contract tools	Operational and security risk Settlement issues Legal risk Governance Data management and protection
Broader financial market implications	
Connectivity issues and standards development Financial market architecture (actors, markets, regulators) Broader financial market risks (micro- and macro-level)	

Understanding the arrangement

- **Functionality and nature of arrangement**
 - Problems, inefficiencies or improvements it is addressing
 - Affected part or parts of the value chain
 - Design, technology and associated processes
 - Affected market participants
- **Key factors for effective implementation**
 - Environmental factors (acceptance of technology, market size and structure, legal and regulatory conditions, industry coordination)
 - Technological factors (maturity, interoperability with other systems/processes)
 - Financial factors (cost savings, revenue potential)

Potential implications for efficiency

Speed of end-to-end processing

- Impact of validation or consensus; comparison with or impact on existing payment, clearing and settlement processes

Cost of processing

- Costs compared to existing processes; cost redistribution among participants (hidden costs); social costs

Speed and transparency in reconciliation

- Reconciliation process automatisation; visibility of transaction information to other participants, the market and relevant authorities; data privacy

Cost of credit and liquidity management

- Credit and liquidity implications on participants, the system and the broader market; comparison with existing arrangements

Efficiency gains from automated contract tools

- Elements to be automated; mechanisms used; treatment of malicious or faulty codes

Potential implications for safety

Operational and security risk

- Management of key risks - resilience and reliability (multiple nodes), security (reliability of cryptography; points-of-entry) and operational capacity and scalability; comparison to existing arrangements

Settlement issues

- Types and legal nature of records on the ledger (e.g. balances, digital assets, digital representations of a physical or immaterial asset)
- Modes of operational settlement (consensus/synchronisation across nodes, proof-or-work, etc.)
- Recognition of legal settlement finality
- Achievement of delivery versus payment (also across autonomous ledgers or between a ledger and a traditional FMI)

Potential implications for safety

Legal risk

- Clearly established, sound and enforceable legal basis (cross-border)
- Applicable law and conflicts of laws
- Determination of rights and obligations of the participants (rules, contracts, code)
- Liability issues
- Enforceability (dispute resolution)

Governance

- Governance structure (responsibility for setting or changing the rules/protocols, control of access, operational design and risk management)
- Sharing of information or maintenance of the ledger across entities (roles of involved parties)
- Mechanism for decision-making

Data management and protection

- Data integrity (including traceability); data privacy and confidentiality
- Immutability of data (error handling)

Potential broader financial market implications

Connectivity issues and standards development

- System, platform, layer, or combination thereof used
- Protocol used (open source or proprietary; degree of interconnectivity)

Financial market architecture

- Impact on the role of existing intermediaries; involvement of new actors
- Potential to change existing market and regulatory practices

Broader financial market risks

- Implications for broader financial market risks now or in the future (e.g. concentration/single point of failure, herding behaviours, etc.)
- Interconnections with other systems, including other DLT arrangements

Current key trends and developments

- Application of the technology mainly to **limited activities**, with recordkeeping and information sharing services more advanced than those involving asset transfers
- Experimenting with **tokenization** of assets is ongoing
- No use case in full production as **time is needed** to let the technology and its application to clearing and settlement processes mature
- Use cases based on **restricted, permissioned ledgers** with some use cases maintaining centralised control of the ledger
- Focused on **incremental improvements in post-trade processes** rather than substantial replacements of current market structures and practices
- Typically **rely on existing infrastructures** for settlement

Implications for central banks

Operational role

- assessing potential of digital innovations for efficient and safe *central bank infrastructure services* for payments and securities settlement
- assessing impact on *monetary operations* and *central bank money issuance*

Catalyst role

- facilitating private sector efforts to improve *market efficiency*
- promoting work on *standardisation and interoperability*, countering the risk of silos and proprietary solutions

Oversight, supervisory and financial stability role

- assessing possible *impact of technology adoption* on overseen/supervised entities and their business models and the financial markets at large
- adapting central bank frameworks for *data collection and handling*

Impact on central bank services

- Identification of the relevant implications for central banks as service providers: *PS or SSS operation, collateral management services, intraday liquidity provision, fiscal agency services*, etc.
- Following a central bank survey (about 60 respondents), main focus of analysis and experimentation is on *DLT*
- However, there are other digital innovations that may have implications for central bank services too, such as:
 - *digital identity (eg biometrics)*
 - *smart contracts*
 - *big data / predictive analytics*
 - *cloud computing and distributed data storage*

Potential areas of enhancement

Core activity	Current practice	Potential enhancement
Recordkeeping, asset transfer and data management	Use of a centralised structure to manage recordkeeping, transfers, and data management; typically transactions are processed by a central entity	Participants may be able to have some degree of direct read/write access to the ledger and the sharing of limited transaction processing responsibilities without going through an intermediary
Authentication, networking and messaging	Use of a central hub to manage IDs and often using passwords. Closed network using a central gatekeeper to control the flow of information	Participants could have direct communications with each other in the network; allows for a distributed database for ID management and authentication
Risk management	Manual processes related to the issuance, redemption and interest payments of securities	Automated processes that are triggered by certain predetermined events

Central bank digital currency – a taxonomy

	Physical currency		Digital deposits
Central bank	Cash (eg banknotes)	Digital currency	Central bank deposits (eg settlement and reserve accounts)
		Central bank digital currencies	
Commercial bank	Commercial bank notes	Commercial bank digital currencies	Commercial bank deposits (eg transaction accounts)
Other (including non- bank entities and no issuers)	Other issued notes and commodities	Private digital currencies (eg bitcoin)	Non-bank accounts and stored-value records (eg broker-dealer accounts)

Key elements and design features

- CBDC:** - a **liability of a central bank**
 - in **digital** form
 - denominated in a **sovereign currency**

	Cash	CBDC (for retail payments)	CBDC (for wholesale payments)	Digital deposits
Holders of direct claims on the central bank	Public	Public	Restrictions based on central bank policy	Primarily restricted to financial institutions
Recording of transfers and holdings	Not recorded on the central bank ledger	Recorded on or off central bank ledger	Recorded on or off central bank ledger	Recorded on central bank ledger
Transfer mechanism	Physical peer-to-peer	Digital peer-to-peer or intermediated	Digital peer-to-peer or intermediated	Intermediated
Anonymity of counterparties	Not at issuance and initial distribution, but possible after issuance	Not at issuance and initial distribution, but possible after issuance	No	No
24/7 availability of the instrument	Yes	Possibly	Possibly	Possibly
Capacity to bear interest (directly)	No	Yes	Yes	Yes

Feasibility and desirability

- The central bank's statutory authority to issue digital currency varies across jurisdictions, also depending on design
- Cyber risks pose a significant threat to CBDC
- Central banks will need to balance compliance with supervisory or tax regimes with an appropriate amount of privacy, particularly for a retail CBDC
- The robustness of possible technologies in providing a sound risk management framework are uncertain
- For most jurisdictions, the motivation for issuing CBDC as a payment instrument is not strong at this time
- Initial cost-benefit analyses for CBDCs based on DLT are not conclusive
- An alternative to a wholesale CBDC is expanding account access
- An alternative to a retail CBDC is expanded use of fast payment services

Potential implications

- Proposed CBDC implementations for wholesale payments, designed in compliance with existing central bank system requirements, look similar to what is used today (but could change in the future, disrupting existing infrastructures)
- Proposed CBDC implementations for retail payments face a number of potential challenges and risks (for monetary policy, bank funding, bank business models, legal and regulatory requirements, etc.)
- Further monitoring and analytical work is needed as our understanding of CBDC evolves