Distributed Ledger Technology: Current situation and major issues
(Executive Summary*)

* This paper is executive summary of joint research on DLT (Distributed Ledger Technology: Current situation and major issues) from April to October 2016. The first part, on the policy issues, was written by the Korean Payment & Settlement Studies Association (Professors Sekyung Oh, Jaepil Kim, Youngwhan Lee, and Hyuk Jun Kwon). The second half, covering the technological issues, was written by Coinplug, Inc, a local blockchain company. KFTC (Korea Financial Telecommunications and Clearing Institute) and major banks also contributed to the research, which was coordinated and sponsored by the Bank of Korea.
The full version of the paper (Korean only) is available on the Bank of Korea website.

I Policy issues

(1) Benefits

(Cost reduction)

It is believed that DLT is more secure, efficient, and rapid than traditional centralized systems. Given these strengths, DLT has the potential to help lower the costs of providing financial services.

Sources of cost reduction

Category	Areas
IT system	Cost of developing application technologies
	Cost of procuring infrastructure equipment
	Cost of developing intermediate structures
Management	Auditing cost
	Paper document management cost
	Labor cost

For example, when DLT is adopted by the securities industry the stock exchange (Korea Exchange) and the CSD (KSD) could benefit from significant reductions in their back-office operation costs. Using methods developed by Goldman Sachs (2016), we estimated that the annual cost reduction for these two institutions could have amounted to 107 billion KRW (or 88 million USD) in 2015. In addition, securities brokers could have saved 10 billion KRW in financing costs (i.e., on the opportunity costs of collateral and mandatory deposits).

Reduction in back-office operation costs – Securities industry

(100 million KRW)

Cost reduction	Korea Exchange	Korea Securities Depository
Total cost	5,508	1,188
IT cost	1,186	70
Labor cost (including employee welfare costs)	2,351	605
Sales and general administrative expenses	1,971	513
Estimated cost reduction	△881	△190

However, it is difficult to apply the same methodology to obtain quantitative estimates of the cost reductions for other sectors such as the banking industry, where many different kinds of services are offered simultaneously and making clear-cut distinctions among processes and costs is not feasible. To calculate the direct and implicit reductions in cost for the financial service providers and consumers, we might therefore have to look at individual cases of DLT use, for example for remittances or certification.

(Changes in financial infrastructure)

In the medium to long term, DLT has the potential to bring about changes in the financial infrastructure through dis-intermediation and automation.

Financial infrastructure changes, by sector

Category	Structural change
Remittances	▪ DLT replaces legacy infrastructures such as correspondence banks and Swift (Ripple, etc).
Capital markets	▪ Securities issuance, registration and transactions become more efficient. ▪ Roles of legacy intermediaries are reduced.
Trade finance	▪ Procedures are automated, to increase efficiency and reduce the probability of accidents.
Regulatory compliance & Auditing	▪ Real-time reporting and auditing of transaction data become possible, and cross-agency comparison and integration become easier.
AML/CFT	▪ Sharing of customer identity information is simplified, and regulatory compliance costs can be reduced.
Insurance	▪ Claims and payments are automated, and fraud is reduced.
P2P lending & insurance	▪ Micro-finance and micro-insurance come into wide use.

(2) Risks and regulations

(Digital currency)

There is growing demand for the introduction of regulations on digital currencies, which, because of their anonymity and technical shortcomings, have been used for illicit activities such as money laundering. The United States, the EU, Japan and many other countries have recently introduced regimes for regulation of digital currencies.

Digital currency regulations, by country

Countries	Regulation details
USA	▪ FinCEN (2013) applied anti-money laundering regulations to exchanges ▪ IRS (2014) announced the levying of property taxes on digital currencies ▪ CFTC (2015) declared bitcoin derivative products to be subject to its supervision ▪ New York State (2015) introduced BitLicense
E U	▪ EBA (2013) called for consumers' attention to digital currencies ▪ EC (2016) applied anti-money laundering regulations to digital currency exchanges
Japan	▪ FSA (2016) applied regulations to exchanges, is considering eliminating sales taxation of bitcoin trading

(Distributed Ledger Technology)

The adoption of DLT could in general lead to a significant easing of financial system risks. Firstly, counterparty risks and operational risks can be dramatically reduced, since financial transactions can be securely processed in real time using DLT. DLT will also facilitate introduction of the so-called RegTech, and thus make risk management more effective since compliance becomes automated and all transaction details are available to regulators on a real-time basis.

DLT will not be without its own risks, however, and we should keep a close eye on the risks that may be newly generated or be heightened by introduction of the technology. In particular, many people worry that security and legal risks are likely to increase with the introduction of DLT. We should also pay special attention to the risks that may arise as smart contract features are integrated into DLT (risks for example of programming errors in the smart contract coding, and of DDoS attacks to nullify execution of a smart contract).

(Regulatory measures)

Authorities should design and implement regulations of digital currencies and DLT based on the following principles:

① Regulations should not stifle innovation, but should at the same time properly cope with potential risks.

② Regulations should respond flexibly to the evolutions of digital currencies and DLT.

③ Regulatory frameworks should be designed in consideration of the business structures inherent in the business models.

④ Regulations should impose sanctions on behaviors causing market disturbances, and induce soundness of the related business operators.

Standardization of DLT should also be achieved, to promote the inter-connectivity of systems, the development of web applications, and eventually the construction of cross-industry infrastructures.

(3) Central Bank Digital Currencies (CBDC)

Central Bank Digital Currencies (CBDC) have been actively discussed by many central banks in recent years, and a comprehensive review of the topic is needed.

CBDC is not a simple replacement of paper cash with an electronic version of it. When a central bank issues digital currency directly to individuals and non-financial companies, it will inevitably compete with commercial bank deposits and thus have broad impacts on the macroeconomy, monetary policy, financial stability, payment systems, etc. The degree and extent of substitution for commercial bank deposits will depend upon the CBDC's design: whether it has payment add-on features, whether the user's anonymity is guaranteed as in the case of cash, whether interest is paid on CBDC balances, etc.

Concept of Central Bank Digital Currencies (CBDC)

Until now, we do not have any real world examples of DLT-based CBDC in circulation, and the stability and security of the system has not yet been fully scrutinized. It is therefore necessary to closely monitor developments at other major central banks, while at the same time making continued researches and developments to ensure the safety of the related technology. It is in addition necessary to examine diverse scenarios related to the entities to which CBDC is issued, the issuance methods, etc., while also carrying out in-depth studies of legal and regulatory aspects related to CBDC.

Ⅱ Technical issues

(1) Recent developments in technology

Blockchain is a platform operated on a distributed network. To leverage this distributed nature of the technology, many financial institutions and IT companies have formed and joined consortia to develop DLT.

Key global DLT consortia

Consortia	Participants	Features
R3	▪ Established by R3 (US-based IT company) ▪ More than 60 large financial institutions (Goldman Sachs, UBS, etc.) ▪ Five local banks (KB-Kookmin, Shinhan, KEB-Hana, IBK, Woori)	▪ Financial institutions' contract record management (Corda)
HyperLedger	▪ Led by Linux Foundation ▪ More than 100 companies including financial and non-financial institutions and IT companies ▪ Local IT companies and FMIs (Korea Securities Depository, Coinplug, Samsung SDS, etc.)	▪ Open source ▪ Blockchain for cross-industry applications
SBI Fintech Consortium	▪ Led by SBI Financial Gorup, Japan ▪ Ripple, Coinplug, etc	
Chinaledger	▪ Led by Wansiang blockchain lab ▪ Eleven large Chinese financial institutions	▪ R3 and Ethereum on advisory board

In addition, Ethereum, Ripple and a few other blockchain protocols have been developed recently, to improve upon the defects or limitations of the Bitcoin blockchain.

Key blockchain protocols

Protocols	Features	Status
Ethereum	▪ Specialized in smart contracts ▪ Reduces transaction time (to 12 sec)	▪ Issues virtual currency (ETH) ▪ Hacking (DAO)
Ripple	▪ Specialized in international remittances ▪ Real-time clearing & settlement system	▪ Issues virtual currency (XRP)

Financial institutions, IT companies, central banks and governments are actively pursuing measures to improve the efficiency of legacy infrastructures or to develop new services through the adoption of DLT.

Cases of DLT use, by sector

Sectors	Areas	Cases of use
Financial Industry	▪ Remittances	▪ MUFG, VISA, JPMorgan, etc.
	▪ Global funds transfers between branches and HQs	▪ UBS, Deutsche Bank, etc.
	▪ Capital market transactions (OTC)	▪ Nasdaq, Overstock, etc.
	▪ Record-keeping	▪ Mizuho, etc.
	▪ Back-office operations	▪ MUFG (promissory notes), etc.
Central bank	▪ CBDC	▪ UK, Netherlands, Canada
Government	▪ Pension payouts and recordkeeping	▪ UK
	▪ Resident registrations and voting	▪ Estonia, Russia, etc.
	▪ Land ownership registration	▪ Sweden
IT companies, etc.	▪ Genuine product certifications (precious metals, watches, etc.)	▪ Everledger
	▪ Development of generic technology	▪ IBM, Microsoft

(2) Types of DLT

DLTs can be broadly classified, depending upon their operating methods, into two categories: public and private blockchains.

DLT classifications, by type

	Public DLT	Private DLT
Access to ledgers Authentification of transactions	Anyone (no restriction)	Restrictions as desired
Consensus	Proof of work, Proof of stake	BFT (Byzantine Fault Tolerance)
Crypto-currency	Necessary	Unnecessary
Settlement finality	Incomplete (possibility of forking)	Guaranteed
Extensibility	Limited	Unlimited
Cases of use	Bitcoin, Etherium	R3, Hyperledger
Pros and cons	⬆ Safety and reliability ⬆ Transparency and anonymity ⬇ Confidentiality ⬇ Scalability and efficiency	⬆ Control of information sharing ⬆ Efficiency and scalability ⬇ Security issues
Applications	Overseas remittances, crowdfunding, recording and storage of assets and information	Payment system, ID/document authentication, trade finance, smart contracts, etc

(3) Proposal for application of DLT to payment and settlement systems

Before DLT is adopted for a financial service, technical problems should be properly solved related for example to maintaining transaction confidentiality, regulation of participants' rights, maintaining trust and security, and ensuring scalability.

We conducted a thought experiment on designing DLT to perform the role of a large-value inter-bank payment system. Below is a summary of our proposed solutions to many of DLT's shortcomings.

Technical challenges to use of DLT in financial services

Challenges	Solutions
Privacy	▪ PKI-based key exchange - Supernode necessary - Only supernode and trading parties to have access to transaction details
Regulation of rights	▪ Different roles: Supernode, Token Issuer, Token User
Trustworthiness	▪ Periodic hashing (Merkle Root) of ledgers automatically recorded on public blockchain (Bitcoin)
Scalability	▪ More than 3,000 tps guaranteed

Proposal for payment system using DLT