

OPINION

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Concept and Implications of DLT-Based Atomic Settlement

On October 25, 2024, legislative proposals concerning the issuance and distribution of security tokens were introduced in the 22nd National Assembly of Korea. This legislative package for security tokens is pivotal in establishing infrastructure for transforming the Real-World Asset (RWA) market into a tokenized ecosystem. Once the Bank of Korea's projects for whole Central Bank Digital Currency (wCBDC) and deposit tokens, designated as innovative financial services, are enacted and stablecoins are institutionalized through the second phase of virtual asset legislation, a new era of tokenized payments may be on the horizon. Trading tokenized RWAs and payment instruments on decentralized and disintermediated Distributed Ledger Technology (DLT)-based networks could unlock blockchain's full potential for innovation and efficiency. The simultaneous execution of RWA transfers and payments through tokenized payment instruments is known as atomic settlement.

DLT-based atomic settlement holds promise for significant innovation, but substantial time may be required to address institutional and technological challenges. Currently, DLT-based atomic settlement systems are being established, driven by global collaboration and competition. This momentum underscores the risk that delays in institutionalizing atomic settlement could cause Korea to lag behind in the global digital asset market. Thus, the Korean government needs to develop a long-term and systematic strategy for fostering a digital asset ecosystem in consultation with domestic digital asset experts. If this comprehensive strategy facilitates real-time atomic settlement and optimizes blockchain innovation, atomic settlement is anticipated to become a robust growth engine for the Korean economy.

* All opinions expressed in this paper represent the author's personal views and thus should not be interpreted as Korea Capital Market Institute's official position.

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Introduction

On October 25, 2024, legislative proposals for security token issuance and distribution were introduced in the 22nd National Assembly of Korea. This legislative package includes amendments to the Act on Electronic Registration of Stocks and Bonds, which would grant a presumption of rights to distributed ledgers, and revisions to the Financial Investment Services and Capital Markets Act (FSCMA) to facilitate the distribution of investment contract securities.¹⁾ The legislative package is pivotal in establishing infrastructure for transforming the Real-World Asset (RWA) market²⁾ into a tokenized ecosystem.

Once the Bank of Korea (BOK)'s initiatives for wholesale Central Bank Digital Currency (wCBDC) and deposit tokens, designated as innovative financial services on October 30, 2024, are enacted and stablecoins are institutionalized through the second phase of virtual asset legislation, a new era of tokenized payments may be on the horizon. Trading tokenized RWAs and payment instruments on decentralized and disintermediated networks based on Distributed Ledger Technology (DLT) can maximize blockchain's potential for innovation and efficiency. In this context, atomic settlement emerges as a groundbreaking payment mechanism, enabling Delivery versus Payment (DvP)—a synchronized process for transferring RWAs and executing payments via tokenized instruments. This article explores the concept and structure of atomic settlement, evaluates its benefits and limitations, and provides insights from global implementations to inform the development of the Korean market.

Concept and structure of atomic settlement

Atomic settlement refers to a payment mechanism that enables the synchronization of asset transfers and payments in a single transaction, minimizing the need for intermediaries.³⁾ The term “atomic” signifies indivisibility, ensuring that a transaction is either fully executed or not executed at all, with no partial fulfillment. For transactions involving multiple parties and

1) Amendment to Act on Electronic Registration of Stocks and Bonds, October 25, 2024, proposed by National Assembly member Jae Seop, Kim, Bill No. 2204921; Amendment to the Financial Investment Services and Capital Markets Act, October 25, 2024, proposed by National Assembly member Jae Seop, Kim, Bill No. 2204919. The security token legislative package was also proposed in the 21st National Assembly, but it was automatically discarded at the end of the session despite the lack of disagreement between the ruling and opposition parties.

2) For further details on the RWA market, refer to Maeng, J.H., 2024, Current state and implications of the Real-World Assets (RWA) market, Korea Capital Market Institute's Capital Market Focus 2024-2.

3) Forbes, December 21, 2022, The future of cross-border payments in Asia is atomic.

significant volumes, the simultaneous DvP or Payment versus Payment (PvP) is essential to maintain transaction security and trust.

In asset and securities markets, the optimal settlement method is the Real-Time Gross System (RTGS), which facilitates the concurrent execution of asset transfers and payments. However, implementing RTGS efficiently within the current dual-account financial infrastructure—where rights transfer accounts and payment accounts are separate—poses challenges. The RTGS mechanism requires instantaneous settlement for each transaction, demanding high liquidity and imposing a heavy processing load on the system. Due to these constraints, Korea’s on-exchange securities trading system—encompassing the Korea Exchange (KRX), the Korea Securities Depository (electronic registration entity), and brokerage firms—employs the Central Counterparty (CCP) model. Under this system, the KRX guarantees clearing and settlement with a T+2 settlement cycle, completing settlement two days after the trade date (T).

If rights transfer accounts are linked to payment accounts within a single automated system, RTGS-based DvP can be executed simultaneously and seamlessly. Such integration can be highly efficient within a DLT-based settlement system utilizing smart contracts.⁴⁾ A DLT-based system suggests the use of stablecoins or CBDCs as payment methods, streamlining blockchain-based settlements.

A DLT-based atomic settlement system can be implemented within both single and multiple blockchain networks. In a single blockchain network, atomic settlement is conducted through the network’s consensus algorithm.⁵⁾ In multiple blockchain environments, atomic settlement involves cross-chain payments, requiring interaction between distinct blockchain systems. This process is enabled by smart contract protocols such as Hash Time-Locked Contracts (HTLCs),⁶⁾ which ensure synchronization without the need for a trusted intermediary by utilizing hash lock and time lock features.

4) A “smart contract is a computer program that can be run on hardware which automatically executes those conditions. Nick Szabo uses the example of a vending machine”. Buterin, V., 2022, *Proof of Stake: The Making of Ethereum and the Philosophy of Blockchains*, p.38.

5) A consensus algorithm refers to an algorithm that helps multiple nodes reach an agreement on a consistent data value to protect the integrity and reliability of distributed ledger technologies. For further details on consensus algorithms, refer to Dedeoglu, V., etc., 2020, *Advanced Applications of Blockchain Technology*, pp.62-66.

6) For detailed exploration of cross-chain atomic swap as a typical HTLC use case, refer to Huw Grano, 2023. 1. 21, Exploring HTLCs in solidity.

Benefits and limitations of DLT-based atomic settlement

Implementing a DLT-based atomic settlement system has the potential to transform financial infrastructure by significantly reducing or even eliminating the roles of intermediaries, resulting in substantial transaction cost savings. The roles include the central bank's securities settlement network, the Korea Securities Depository's settlement instructions, and brokerage firms' functions.⁷⁾ In DLT-based systems, rights transfer and payments are conducted with minimal intermediary functions to facilitate RTGS-based settlements. The RTGS model not only enhances the speed and transparency of transactions but also improves the safety and finality of settlements.

As DLT-based atomic settlement systems utilize cryptographic technology, they provide a high level of transaction security. Through rapid processing and analysis of rights transfer data, these systems enable instant asset verification, effectively preventing illegal practices such as naked short selling. Moreover, their swift and complete transfer of rights also ensures more efficient liquidity management by financial institutions. Recently, a business model using DLT-based atomic settlement has emerged to facilitate the ownership transfer of High Quality Liquid Assets (HQLAs) and thus, improve asset liquidity.

Given these benefits, DLT-based atomic settlement has the potential to gradually replace traditional payment and settlement infrastructure. However, institutional and technical barriers may affect the pace of this transition. The primary focus lies in establishing the system as Financial Market Infrastructure (FMI). For atomic settlement, legal recognition of distributed ledger account substitution and regulatory framework for tokenized payment methods (such as stablecoins) are required. Additionally, comprehensive legislative measures must address privacy and security concerns, though developing such regulations will require considerable time.

The biggest technical obstacle to adopting atomic settlement is the limited TPS (Transactions Per Second). The processing speed of DLT-based transactions currently falls short of the demand of large-volume financial transactions, particularly in on-exchange securities trading, thereby limiting the scalability of atomic settlement. The diversity of DLT networks constrains network integration and interoperability, and the technical complexity and irreversibility of DLT

7) The Bank of Korea's wCBDC and deposit token projects, designated as innovative financial services on October 30, aim to establish a DLT-network-based disintermediated system that replaces the banking network by allowing the use of the CBDC system. Financial Services Commission, October 30, 2024, Designation of nine innovative financial services including deposit token-based payment and transfer services within the CBDC system, press release, p.4.

drive up infrastructure development costs. Nevertheless, advancements in TPS capabilities and improved bridge technology or interchain solutions can help atomic settlement overcome these technical hurdles and foster continued growth.

Global use cases of DLT-based atomic settlement

In the US, home to the world's largest digital asset market, the Biden administration has been inactive in promoting atomic settlement, but financial infrastructure based on atomic settlement continues to expand. This expansion is driven by growing market demand and advancements in distributed ledger technology (DLT). The US Depository Trust & Clearing Corporation (DTCC) leads these developments through several DLT-based atomic settlement projects including Project ION. In addition, DTCC is working alongside the Digital Dollar Project (DDP) to explore clearing and settlement using CBDC in the US, while also collaborating with leading international financial institutions (such as Deutsche Börse Group and Euroclear) to establish digital asset transaction principles.⁸⁾ In the private sector, various financial services utilizing atomic settlement have been launched in the US, including J.P. Morgan's Onyx digital asset platform and Broadridge's Distributed Ledger Repo (DLR). The potential implementation of atomic settlement using stablecoins may accelerate, particularly given President-elect Donald Trump's campaign pledge to promote US dollar-pegged stablecoins. This direction aligns with World Liberty Finance (WLFI), a Trump family company, which advocates for US dollar-denominated stablecoins as a global payment method,⁹⁾ suggesting increased adoption of atomic settlement for DvP or PVP transactions.

The EU is working on various projects designed to promote DLT-based atomic settlement as part of its policy agenda. The European Central Bank (ECB) is testing DLT-based atomic settlement through multiple projects, including its CBDC initiatives. In the private sector, HQLAx¹⁰⁾, which collaborates with diverse global players, launched the world's first blockchain-based securities lending service using atomic settlement in 2018, and introduced the first cross-chain Repo swap service in 2022.

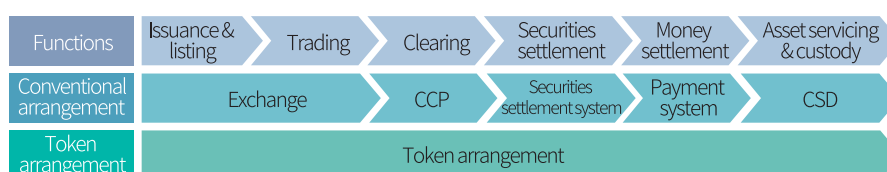
8) DTCC & DDP, 2022, *Digital Dollar Project and DTCC: Security Settlement Pilot*; DTCC, etc., 2024, *Building the Digital Asset Securities Ecosystem*.

9) Cointelegraph, 2024. 9. 5, Trump family's DeFi project wants to 'ensure US dollar dominance'.

10) HQLAx is a financial technology company which leverages blockchain-based settlement infrastructure to enable instant and transparent securities lending, thereby unlocking trapped liquidity for global financial institutions.

Emerging financial centers for digital assets, such as Singapore, Hong Kong, and Switzerland, have prioritized DLT-based atomic settlement as their policy agenda. These financial centers are promoting global projects through the BIS Innovation Hub.¹¹⁾ The BIS Innovation Hub promotes global financial stability, enhances international settlement efficiency, and drives digital innovation through its DLT-based tokenization project, working alongside government agencies and central banks worldwide. While CBDCs currently serve as the primary payment method on distributed ledger platforms in the BIS Innovation Hub, the outcome of the November 5 US presidential election may shift the dynamic. The Trump victory might lead to increased use of stablecoins in international settlements. Regardless of whether CBDCs or stablecoins emerge as the dominant settlement instrument in distributed ledger platforms, atomic settlement remains the cornerstone mechanism for digital asset transactions across tokenization initiatives. Over the long term, these blockchain-powered infrastructures aim to transform traditional financial markets through decentralized transaction ecosystems. As illustrated in Figure 1, entities responsible for managing atomic settlement may hold a dominant position in the tokenized RWA market.

Figure 1. Financial market functions and conceivable arrangements



CCP = Central Counterparty, CSD = Central Securities Depository.

Source: BIS (2024)¹²⁾

Implications: Need for long-term and systematic policy development

As discussed, DLT-based atomic settlement offers significant innovative potential, but overcoming institutional and technological limitations will require considerable time. As shown in Figure 1, a fully-fledged DLT-based trading system is unlikely to replace large-scale, competitive trading systems, such as on-exchange securities trading, in the next few years.

11) Hong Kong's Project Genesis and Switzerland's Project Helvetia pursue DvP atomic settlement, while Singapore's Project Dunbar and its Project Agora backed by the BOK focus on PvP atomic settlement. BIS, 2024, *Tokenisation in the Context of Money and Other Assets*, p.15.

12) Id. at 10.

This suggests that DLT-based atomic settlement is expected to be established and expanded in cross-border payment markets, private placement markets of major economies, and OTC transactions.

Amid global collaboration and competition, major economies, including the US and the EU, are building and advancing DLT-based atomic settlement systems to reinforce the influence of their national currencies and payment systems and foster blockchain-driven innovation. If Korea delays institutionalizing payment and settlement for digital asset transactions, it risks falling behind in the competitive global digital asset market. Given that blockchain-based atomic settlement proves useful for cross-border transactions where no global central securities depository or central bank exists, Korea should strategically engage in tokenization initiatives and standardization frameworks championed by international bodies such as the BIS. Moreover, the Korean government needs to establish a long-term, systematic strategy for fostering a digital asset ecosystem in consultation with various domestic digital asset experts. By implementing this strategy to facilitate atomic settlement and maximize blockchain's innovative potential, atomic settlement could emerge as a powerful catalyst for Korea's economic growth.