

Settlement Finality Onchain: A Practical Framework for Policymakers

Settlement finality—the legal moment when a transfer becomes unconditional and irrevocable—lies at the heart of financial stability. When settlement is slow, uncertain, or exposed to after-the-fact reversals, the system must absorb significant credit, liquidity, and operational risks. Traditional finance has spent decades building safeguards around these vulnerabilities, yet settlement delays, collateral burdens, and infrastructure fragilities persist.

Blockchains introduce a fundamentally different settlement model. Atomic settlement enforces simultaneous, conditional exchange: either both sides of a transaction execute, or neither does. Combined with rapid, economically enforced finality and 24/7 availability, this architecture eliminates a wide range of risks that regulators and market operators have long been forced to manage. What remains is a regulatory task: determining the moment at which a technically final onchain transaction becomes legally final. This is not a novel challenge. Every major financial system—from Fedwire to ACH to card networks—relies on statutory or regulatory definitions of finality layered atop imperfect operational realities. Blockchain settlement can be treated in precisely the same way.

1. Atomic Settlement: Eliminating the Core of the T+N Problem

Traditional settlement frameworks rely on sequenced processes—execution, clearing, and eventual settlement—that are separated in time. Even with T+1 reforms, settlement occurs hours or days after a trade. This delay creates the familiar exposure window during which parties must manage principal risk, replacement-cost risk, and counterparty default risk. The infrastructure itself compounds the problem: a trade executed late Thursday may not settle until Monday, and operating hours, holidays, and maintenance windows routinely stretch timelines even further.

Atomic settlement on blockchains collapses this structure. When two assets are exchanged—cash for securities, for example—the ledger enforces that both legs must succeed simultaneously. There is no settlement gap, no lag between obligation and discharge, and no moment in which one party is exposed to the other's failure. Principal risk is eliminated and replacement-cost risk disappears. Further, collateral buffers, which are designed to protect against settlement failure, can be materially reduced or eliminated.

In practical terms, atomic settlement removes the root cause of many systemic exposures in traditional finance. It does not mitigate around the edges: it restructures settlement so that the

problem does not emerge in the first place.

2. Technical Finality: Economic Irreversibility as a Stronger Guarantee

Where traditional settlement relies on institutional rules and operational procedures to establish finality, blockchains achieve it through cryptography and economic deterrence. On a proof-of-stake network like Ethereum, a transaction becomes technically final when it is incorporated into a validated block and subsequently confirmed. Although consensus finality can be formally probabilistic depending on the consensus mechanism used, the economic cost of reversing even a handful of confirmations makes rollback practically impossible.

To unwind a confirmed transaction on a major proof of stake chain, a malicious actor would need control of a supermajority of validators and would incur massive slashing penalties. Billions in staked collateral would be automatically destroyed. This deterrent exceeds any comparable mechanism in traditional payment systems, where reversals can be initiated by a central operator, a court order, or a back-office correction.

In other words, technical finality on blockchains produces an economic guarantee that is stronger,

not weaker than centralized ledgers. Operational reversals may be common in ACH or card networks, and even high-value real-time gross settlement (RTGS) systems can unwind transfers under specific legal circumstances. Blockchain finality, by contrast, is locked in by shared economic incentives and distributed validation, making unauthorized reversals a prohibitively costly act.

3. Always-On Availability and Resilience

Another advantage of blockchain settlement lies in its operational profile. Traditional financial infrastructures settle transactions only within narrow windows—weekdays and business hours, excluding holidays and planned downtime. These constraints extend settlement timelines and introduce liquidity and credit frictions across markets. They also create single points of failure. The full-day outage of T2 (the EU payment system) in 2020, Fedwire disruptions in 2019 and 2021, and the periodic interruptions seen in CHAPS all illustrate how even the most critical market infrastructures can experience system-wide downtime.

Public, permissionless blockchains, by contrast, operate continuously and are not reliant on a central operator's availability. Their decentralized architecture distributes validation across thousands of geographically dispersed nodes, making large-scale outages extraordinarily unlikely. Settlement flows continuously, without regard to the operating constraints that shape traditional systems.

This constant availability has direct risk-reduction benefits: shorter exposures, fewer settlement queues, and fewer contingencies. It also simplifies the process of monitoring systemic risk, as settlement activity becomes more predictable and less subject to batch cycles or infrastructure outages.

4. Legal Finality: A Familiar Problem With a Straightforward Solution

The only remaining challenge is the alignment of technical finality with legal finality. But this is not a

novel or complex issue. Financial systems have long established legal rules that determine when a payment or securities transfer becomes final, even when the underlying technical process remains reversible for a period.

In ACH, settlement is explicitly provisional, and reversals for fraud or error are permitted long after the transaction posts. In card networks, settlement occurs in batch cycles, but chargebacks permit weeks or months of ex-post reversal. Even Fedwire, often cited for its strong finality, is subject to reversals under national insolvency law. A payment that is “final” on the system's books may still be clawed back by a bankruptcy trustee months after the fact if it is deemed a preferential transfer.

These examples underscore a simple point: finality is always a legal determination layered atop technical conditions. The legal system routinely overrides operational finality, and market participants operate with that understanding. Blockchain settlement is no different. Policymakers need only specify which technical threshold—such as a defined number of confirmations or epochs—corresponds to the legal moment of finality.

Once these thresholds are defined, the system becomes predictable, enforceable, and fully compatible with existing legal and supervisory frameworks.

5. Technological Progress Is Rapidly Compressing Finality Windows

Concerns about blockchain finality occasionally stem from the fact that different networks achieve finality at different speeds. While this is currently true, the relevance of these differences is quickly diminishing.

Ethereum is moving toward giving Layer 2 users near-instant confirmation times. With upcoming upgrades, L2 transactions could be considered effectively final in about a tenth of a second. In practical terms, users will get sub-second, trust-worthy confirmations because the promise is backed by the next validator who is about to produce the main-chain block. A larger architectural

upgrade, Single Slot Finality, is planned for 2026 and is expected to bring L1 finality down to roughly 12 to 16 seconds. Solana already provides optimistic confirmation at around 400 milliseconds, with full finality in roughly 13 seconds. Its upcoming Alpenglow release aims to reduce full finality to 150 milliseconds. High-performance chains such as Aptos and Sui, which descend from the original Libra research, already offer sub-second settlement guarantees.

Technological progress, in other words, is moving finality toward near-instant certainty. Regulators do not need to wait for uniformity; the trajectory is clear, and the major networks that matter for systemic purposes are already converging on extremely short finality windows.

6. A Practical Path for Policymakers

A coherent framework for blockchain settlement requires only that policymakers recognize technical finality and specify how it translates into legal finality. Regulators can define the moment of finality for each class of network—proof-of-stake Layer 1s, high-throughput chains, and rollups—based on objective, publicly verifiable technical thresholds. This approach aligns with decades of precedent in payment systems and securities settlement.

From there, supervisory expectations can evolve to reflect the reduced exposure profiles of atomic settlement. Liquidity, collateral, and operational risk requirements that were designed around multi-day settlement cycles can be recalibrated to reflect the shorter windows and lower counterparty exposures inherent to blockchain systems. Transparency can also improve if policymakers integrate stablecoin-based and onchain settlement services into the metrics currently used to evaluate progress on cross-border payments. These rails already meet or exceed the targets for speed and are rapidly driving down costs, especially for small-value and high-frequency transfers.

Finally, insolvency and clawback rules can be clarified for onchain transactions in the same way they are applied today in traditional systems. Courts should retain the ability to unwind genuinely fraudulent or preferential transfers, but ordinary

commercial payments that have achieved the designated threshold of finality should not be subject to arbitrary reversal. This balance mirrors current legal frameworks and provides the predictability that businesses require.

Conclusion

Blockchain settlement finality is not an unsolved technical puzzle; it is a regulatory alignment exercise. Open, permissionless blockchains provide a neutral, globally accessible base layer—available to anyone and auditable by everyone—that can increase competition, interoperability, and transparency. Atomic settlement eliminates principal and counterparty risk, technical finality provides stronger economic guarantees than centralized systems, and always-on availability enhances operational resilience. The remaining task—defining the legal moment of finality—is familiar terrain for policymakers.

International standard-setting bodies and national authorities should move quickly to harmonize the legal treatment of settlement finality across jurisdictions, so these systems can scale safely and consistently in global markets. Once technical finality is mapped to legal finality, blockchain-based settlement becomes a safer, faster, and more reliable option for global markets. The tools are in place, the technology is mature, and the benefits are substantial. The path forward is clear, and the opportunity is readily achievable within existing legal frameworks today.

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