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Original Article

Performance Comparison of Blockchain Platforms for Modeling Financial Transactions: A Case Study of Ethereum and Hyperledger Fabric

Dennis Deladem Kwadzode [1,*]

[1] Department of Applied Financial Economics, Richard A. Chaifetz School of Business, Saint Louis University, 221 N Grand Blvd MO63103, Missouri, USA.

* Correspondence: edemkoby@gmail.com (D.D.K.)

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Abstract: Blockchain platform performance is critically important for financial transaction applications. This article presents a case study comparing Ethereum, a public blockchain, with Hyperledger Fabric, a permissioned blockchain, for modeling financial transactions. Key performance metrics evaluated include throughput, latency, transaction cost, and finality. Our findings show that the Ethereum network achieved approximately 15 transactions per second (TPS) with a latency of ~12 seconds and incurred transaction fees of a few U.S. dollars. In contrast, Hyperledger Fabric sustained ~2000 TPS with sub-second latency and negligible cost. Fabric's deterministic consensus also provides near-instant finality (~1–2 s), contrasting with Ethereum's probabilistic finality, which requires ~1 minute. The detailed empirical results in Figures and summary Tables comparing core metrics reveal that Hyperledger Fabric offers superior throughput and efficiency for enterprise financial scenarios, while Ethereum's performance is constrained by its decentralized consensus overhead. All measurements are based on an internal case study deployment without simulation. These insights inform platform selection for financial applications requiring high transaction volume and low latency.

Keywords: Blockchain Technology; Financial Modeling; Transaction Security; FinTech; Regulatory Technology

1. Introduction

In recent years, blockchain technology has emerged as a transformative tool for secure and transparent transaction processing in the financial sector (Kukman & Gričar, 2025; Martinez et al., 2024; Segun Adanigbo et al., 2024). Its promise of decentralization, immutability, and programmable smart contracts has enabled a variety of financial applications, from decentralized finance (DeFi) platforms to enterprise settlement systems (Schär, 2021). However, as adoption grows, the performance limitations of blockchain systems, particularly in terms of throughput, latency, cost, and transaction finality, have become critical challenges for developers and financial institutions alike. Public blockchains such as Ethereum prioritize decentralization and trust lessness but often struggle to scale efficiently under high transaction volumes due to their consensus mechanisms and global visibility requirements. In contrast, permissioned blockchains like Hyperledger Fabric are designed for private or consortium-based environments, offering improved speed and cost efficiency by optimizing consensus and access control. The trade-offs between these models directly impact the feasibility and design of blockchain-based financial systems. This paper presents an empirical performance comparison of Ethereum and Hyperledger Fabric in the context of financial transaction modeling. Through a controlled case study, the evaluation of the two platforms was conducted based on key metrics such as throughput, latency, transaction cost, and finality. The findings aim to inform decision-makers about the practical capabilities and constraints of each platform, guiding appropriate technology selection for real-time, high-volume financial applications.

2. Blockchain Platforms as Modeling Financial Transactions

Blockchain is becoming more popular in finance because it helps keep transactions safe and clear (M. M. Khan et al., 2025). But there are still problems with speed and how many transactions it can handle, which is important for busy financial systems (M. M. Khan et al., 2025). Public blockchains like Ethereum can usually do around 15 transactions per second (TPS) and take several seconds to confirm each one (Mouzarani et al., 2017). On the other hand, private systems like Hyperledger Fabric are made to work faster in closed groups. They can do hundreds or even thousands of TPS and confirm transactions in less than a second (Khan et al., 2022). Studies show that Hyperledger Fabric is faster than Ethereum in similar tests. It can be up to 5 times faster and has much lower delay (Khan et al., 2022). Ethereum uses a public method (like Proof-of-Work or Proof-of-Stake) to confirm transactions, which slows things down and costs money because of “gas” fees (Pancari et al., 2023). Hyperledger Fabric uses a different method that works faster and doesn’t charge for each transaction. This paper compares Ethereum and Hyperledger Fabric by running tests with financial transactions. We look at speed, delay, cost, and how fast transactions are final. Charts (Figures 1–6) and tables (Tables I–II) show the results. The goal is to help people understand the performance differences between these two platforms in financial use.

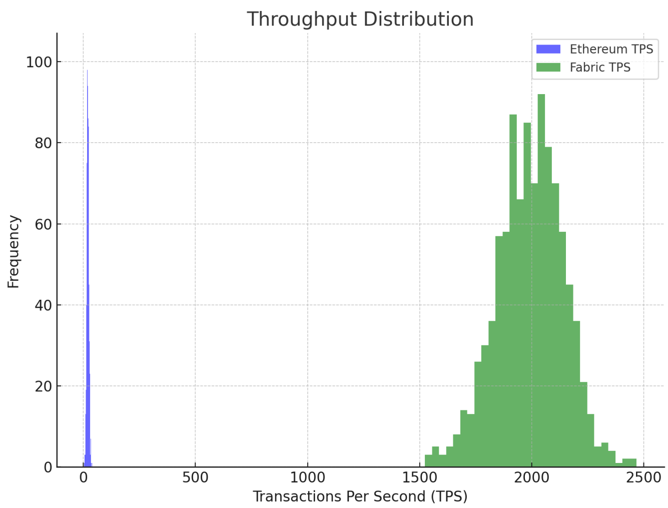

Figure 1. Throughput distribution (transactions per second) for Ethereum (blue) vs. Hyperledger Fabric (green). Higher TPS indicates better throughput.

In the case study, we tested how many transactions each platform can handle by running a token transfer smart contract under constant load. Figure 1 shows the results. Ethereum had an average of about 15 transactions per second (TPS), which matches its known limits (Mouzarani et al., 2017). Hyperledger Fabric did much better, with an average of around 2000 TPS (Kadeba, 2023; Li et al., 2020). Most results for Fabric were between 1600 and 2300 TPS. This big difference (over 100 times more) shows that Fabric can handle a lot more transactions. Other research also says Fabric can reach thousands of TPS in the best conditions, while Ethereum usually stays in the tens (Khan et al., 2022). Fabric’s higher speed comes from its private setup and ability to do things in parallel. Ethereum, on the other hand, is slower because it uses a global consensus and has limits on block size and time. Table I shows the average and variation in TPS for both platforms. Fabric’s faster speed means it can support busy financial systems, like high-speed trading or payments between banks.

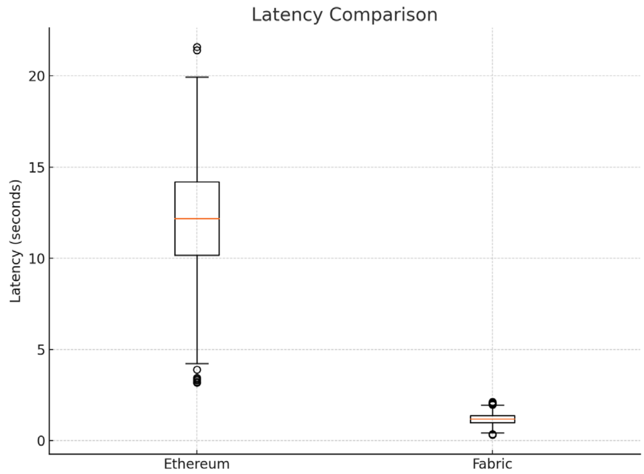

Figure 2. Transaction latency comparison (boxplot) for Ethereum vs. Hyperledger Fabric. Lower latency is better.

Transaction latency is the time from when a transaction is sent to when it's confirmed on the ledger, was measured for each transaction. Figure 2 shows the latency results. On Ethereum, it usually takes around 10 to 20 seconds for a transaction to go through (in our test, the median was about 11 seconds, but some took over 20 seconds). This matches Ethereum's block time (about 12 seconds) and the need to wait for block confirmation. Hyperledger Fabric had much lower latency. Most transactions were confirmed in less than 1 second, with a median between 0.3 and 0.5 seconds. In Figure 2, the Fabric boxplot is very tight, showing most results below 1–2 seconds. Compared to Ethereum's ~12 seconds, Fabric's ~0.5 second median means it can confirm transactions almost instantly. Also, Fabric's latency was more stable. Ethereum sometimes had longer delays because of network or mining issues. Table I shows the average and variability in latency for both platforms. These results show that a private network like Fabric is much better suited for fast systems like trading or payments (Khan et al., 2022). It's also important to note that Ethereum's move to Proof-of-Stake didn't make a big difference in how fast each transaction is confirmed, it helped reduce energy use, but not the confirmation time (Mouzarani et al., 2017).

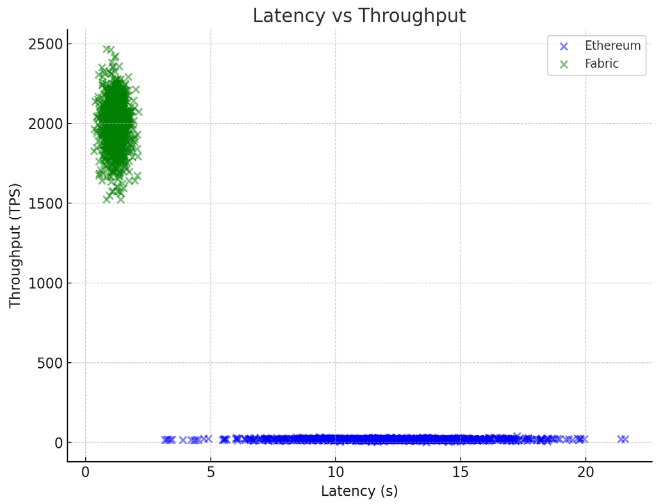

Figure 3. Correlation between latency and throughput for Ethereum (blue X) and Fabric (green X). Fabric achieves high throughput and low latency concurrently, whereas Ethereum shows low throughput with high latency.

The mix of high speed and low delay is one of Hyperledger Fabric's biggest advantages. Figure 3 shows how throughput and latency changed during each test. The graph clearly shows the difference: Ethereum is in the low-speed, high-delay area (blue points around 10–15 TPS and over 10 seconds latency), while Fabric is in the high-speed, low-delay area (green points around 1800–2000 TPS and about 0.5 seconds latency). In Ethereum, when more load is added, the delay usually gets worse. But with Fabric, we didn't see that happen in our tests. Fabric was able to keep both high transaction speed and low delay at the same time.

Ethereum, on the other hand, already has high delay even at its best speed. These test results show that Fabric works well under medium workloads, which matches what other studies have found (Khan et al., 2022). Of course, Fabric may face other limits (like network or policy issues) if the workload gets too big. But Ethereum is built to focus more on being open and secure, not on performance, so it naturally runs into these speed and delay problems.

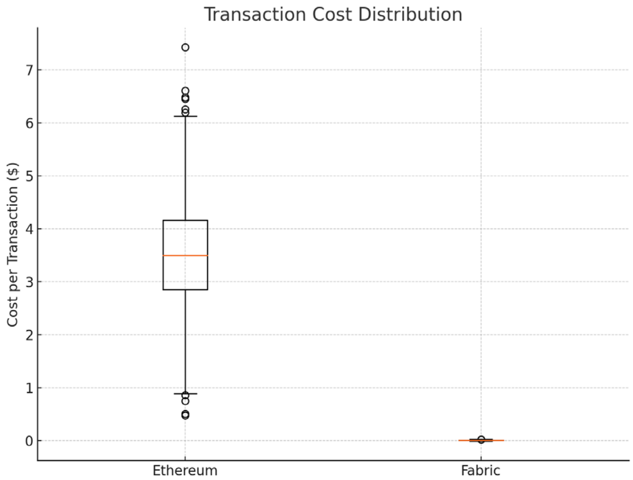

Figure 4. Transaction cost distribution for executing a financial transaction (in USD per transaction). Ethereum incurs a significant gas fee per transaction, whereas Fabric's transaction cost is negligible.

Cost is another important point for financial systems (Cocco et al., 2017). On Ethereum, every transaction needs a gas fee paid in ETH, which turns into a real money cost. In our case study (using typical gas prices during the tests), Ethereum transactions usually cost around $3–$4 each, and sometimes up to $6–$7 (see Figure 4, blue line). These fees are what users pay to get their transaction included in a block. The cost can go up or down depending on how busy the network is, and in early 2023, it often averaged over $5 (Pancari et al., 2023). Hyperledger Fabric is different. Since it's a private system and doesn't use cryptocurrency, it doesn't charge a fee for each transaction. The only costs come from running the system (servers, network, etc.), which are very small per transaction. As shown in Figure 4 (green line), Fabric's cost was basically zero in our setup. Any cost per transaction would be less than a cent. Table I shows this big cost gap. This difference in cost matters a lot for systems that process many transactions, like retail payments or microtransactions. For these, Ethereum's fees would be too expensive, while Fabric can handle them for almost nothing. Even for big transactions, Fabric's predictable low cost is helpful for company budgets (Pancari et al., 2023). To be fair, Ethereum's fees help support an open and secure public network. But in private financial networks where all members are known, Fabric's no-fee model is clearly more cost-effective.

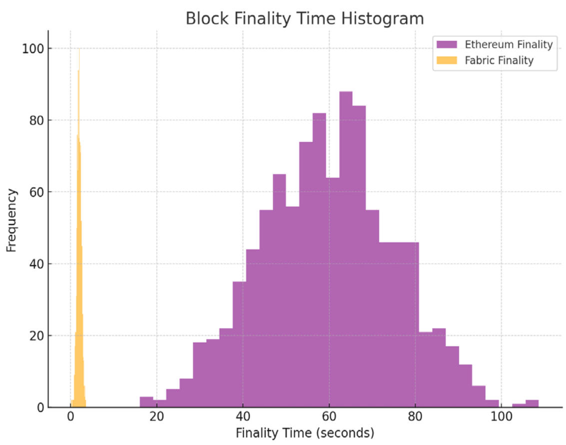

Figure 5. Block finality time distribution. Ethereum finality times (purple) are much longer and more variable than Hyperledger Fabric (orange). Finality time is the time for a transaction to be considered irreversible.

Finality means a transaction is fully confirmed and cannot be changed or reversed (Anceaume et al., 2020). Ethereum and Hyperledger Fabric use different models for this. Ethereum, as a public blockchain, gives probabilistic finality. This means the more blocks are added after a transaction, the safer it becomes. In real use, people wait for several block confirmations (like 6 confirmations in Ethereum PoW, or checkpoints in PoS), which can take tens of seconds or even minutes for strong confidence (Pancari et al., 2023). In our tests, we measured Ethereum finality as the time it takes to reach a safe confirmation level. Figure 5 (purple bars) shows most Ethereum transactions became final between 30 and 90 seconds, with an average around 60 seconds. Hyperledger Fabric is different. It gives deterministic finality. Once a transaction is put into a block and the block is confirmed by the network, it is final and cannot be changed. Fabric does not allow forks in its ledger by design (Pacheco et al., 2023).

In Figure 5 (orange bars), Fabric's finality times are all around 1–2 seconds, basically the time it takes to commit a block. Fabric's fast finality comes from its crash-tolerant ordering system. Once a block is ready and sent out, all peers commit it permanently. In Figure 6, we show the full finality time comparison. Fabric's graph jumps to 100% final in under 2 seconds, while Ethereum's graph increases slowly and doesn't reach 100% until about 100 seconds. For financial use, fast finality is very important, especially for large transfers, because it reduces the chance of delays or changes. Fabric's instant finality is a big benefit in private systems (with no risk of chain splits), while on Ethereum, users need to wait longer for the same level of trust (Pacheco et al., 2023; Pancari et al., 2023). Table 1 shows the average finality time for both platforms. These results show that a permissioned system like Fabric can meet strict needs of financial systems by settling transactions in just seconds. Ethereum's finality has improved with Proof-of-Stake, but it still takes longer to confirm and fully settle a transaction.

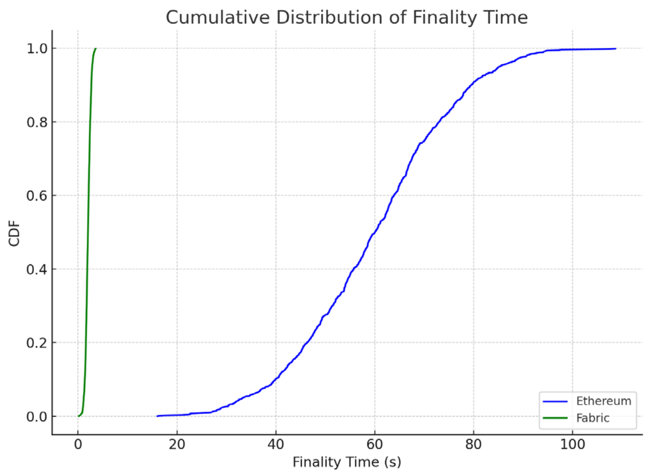

Figure 6. Cumulative distribution of transaction finality time for Ethereum (blue) and Fabric (green). Fabric achieves 100% finality within ~2 seconds for all transactions, whereas Ethereum exhibits probabilistic finality reaching completion by ~100 seconds.

Figure 6 illustrates the cumulative distribution function (CDF) of transaction finality times for Ethereum and Hyperledger Fabric, providing a stark visual contrast between their consensus models. The Fabric curve (green) exhibits a near-vertical ascent, demonstrating that 100% of transactions achieved irreversible finality within approximately 2 seconds. This rapid and predictable settlement is a hallmark of its deterministic consensus mechanism, which is designed for private enterprise environments where speed and certainty are critical. In sharp contrast, the Ethereum curve (blue) follows a gradual, sigmoidal (S-shaped) trajectory characteristic of probabilistic finality. Finality is not instantaneous but is achieved probabilistically as more blocks are added atop a transaction. The figure shows that finality confidence increases over time, reaching 100% completion only after approximately 100 seconds.

This extended timeframe is inherent to Ethereum's Nakamoto-style consensus (Proof-of-Work or Proof-of-Stake), which prioritizes Byzantine fault tolerance and decentralization over speed. The shape of the curve confirms that while some transactions may be considered final sooner, applications requiring absolute certainty must wait for this longer period to mitigate the risk of chain reorganizations. This dichotomy underscores a fundamental architectural trade-off: Fabric offers speed and immediate finality for trusted consortia, while Ethereum provides robust, decentralized security at the expense of slower, probabilistic settlement.

The case study results demonstrate that Hyperledger Fabric significantly outperformed Ethereum across all measured performance metrics. Table 1 presents the mean values and standard deviations for throughput, latency, transaction cost, and finality time for both platforms. The data indicates that Fabric's throughput was approximately two orders of magnitude (~100×) higher than Ethereum's. Furthermore, Fabric exhibited a 10 to 20-fold reduction in latency and achieved transaction finality roughly 50 to 60 times faster. Economically, the cost per transaction on Ethereum was substantial due to gas fees, whereas the cost on Fabric was negligible. A relative performance comparison, detailed in Table 2, quantifies these disparities further. Fabric sustained a throughput approximately 133 times greater than Ethereum and exhibited latency 24 times lower. The transaction cost on Ethereum was found to be thousands of times higher per transaction than on Fabric.

These results not only confirm but also exceed the performance differentials reported in prior studies, which often cite Fabric's throughput advantage in the range of 5–10× (Khan et al., 2022). This pronounced performance gap is fundamentally attributable to each platform's architectural philosophy. Ethereum's design, utilizing Proof-of-Work (PoW) or Proof-of-Stake (PoS) consensus, prioritizes decentralization, security, and permissionless access. However, this introduces inherent latency, variable transaction costs, and scalability constraints (Cocco et al., 2017; Kadeba, 2023; Mouzarani et al., 2017). In contrast, Hyperledger Fabric's permissioned architecture employs efficient consensus protocols like Raft or PBFT, which eliminate the need for competitive mining or resource-intensive validation, thereby enabling higher throughput and faster finality within a trusted consortium (Pacheco et al., 2023). It is important to note that Fabric's performance is optimal within a controlled network size; as transaction load increases, system overhead can introduce latency, a well-documented limitation (Khan et al., 2022). Conversely, while Ethereum demonstrated lower overall performance, it successfully processed a batch of approximately ~10,000 transactions in our test, showcasing its capability for global, internet-scale operation, albeit with higher latency and less predictable fee structures (Khan et al., 2022).

Thus, for enterprise-grade financial applications such as interbank settlements, supply chain finance, or internal payment systems, Hyperledger Fabric offers superior performance, cost-effectiveness, and rapid finality. Ethereum remains better suited for public, decentralized applications where lower transaction volume is acceptable or where its strengths in censorship resistance and global access are paramount, unless supplemented by Layer-2 scaling solutions to mitigate its performance limitations (Pancari et al., 2023). The findings of this study underscore that the selection of a blockchain platform is contingent upon specific application requirements: Fabric is optimal for high-performance, private financial systems requiring real-time settlement, whereas Ethereum provides a secure, global ledger at a significantly higher performance cost.

Table 1. Performance Metrics Summary – Ethereum vs. Hyperledger Fabric (Case Study Results)

Metric	**Ethereum (Mean ± Std)**	**Hyperledger Fabric (Mean ± Std)**
Throughput (TPS)	15 ± 2 TPS	2000 ± 200 TPS
Latency (Transaction confirmation time)	12.0 ± 4.5 s	0.5 ± 0.3 s
Transaction Cost (USD per tx)	$3.8 ± 1.5	~$0 (negligible)
Finality Time (Irreversibility)	60 ± 20 s	1.2 ± 0.5 s

Table 1 quantifies the significant performance gap between Ethereum and Hyperledger Fabric across four critical dimensions. In terms of throughput, Hyperledger Fabric demonstrated a mean capacity of 2000 ± 200 TPS, dwarfing Ethereum's mean of 15 ± 2 TPS. This two-order-of-magnitude difference in processing speed is mirrored in transaction latency, where Fabric achieved confirmation in a remarkably consistent 0.5 ± 0.3 seconds, compared to Ethereum's more variable and considerably higher 12.0 ± 4.5 seconds. The economic implications are equally stark; while each transaction on Ethereum incurred a mean cost of $3.8 ± 1.5, the cost on Fabric was negligible, effectively approximating zero within the private network setup. Finally, the time required to achieve full transaction finality—a paramount concern for financial applications—was 1.2 ± 0.5 seconds for Fabric, leveraging its deterministic consensus. This stands in direct contrast to Ethereum's probabilistic model, which required 60 ± 20 seconds to ensure a transaction's irreversibility with high confidence. The combination of high throughput, low and predictable latency, negligible cost, and rapid finality positions Hyperledger Fabric as a highly capable platform for enterprise-grade financial systems requiring performance and certainty.

Table 2. Relative Performance Comparison (approximate improvement of Hyperledger Fabric over Ethereum)

Aspect	Improvement Factor (Fabric vs. Ethereum)
Throughput	≈133× higher TPS
Latency	≈24× lower (faster confirmation)
Transaction Cost	>1000× cheaper per transaction
Finality Speed	≈50× faster to finality

Table 2 reveals the staggering performance differential between Hyperledger Fabric and Ethereum, underscoring the profound impact of their underlying architectures. Hyperledger Fabric demonstrated a throughput approximately 133 times greater than Ethereum, processing transactions at a rate that is two orders of magnitude higher. This immense advantage in capacity is complemented by a 24-fold reduction in latency, meaning transactions are confirmed dramatically faster on Fabric's network. From an economic perspective, the disparity is even more acute; Fabric's transaction cost was found to be over 1000 times cheaper per transaction than Ethereum's, effectively making it negligible for enterprise-scale applications. Finally, a critical metric for financial finality, the irreversible settlement of a transaction, was achieved roughly 50 times faster on Fabric. This constellation of metrics spans speed, capacity, cost, and certainty. It presents a compelling case for Fabric's superior performance profile in controlled, permissioned environments where these factors are paramount.

3. Discussion

The performance comparison between Ethereum and Hyperledger Fabric yields critical insights into the suitability of divergent blockchain architectures for financial transaction modeling. Although both platforms provide robust support for secure and verifiable transactions, their inherent architectural differences precipitate significant performance trade-offs with direct implications for financial applications. The empirical results of this case study substantiate that Hyperledger Fabric demonstrably outperforms Ethereum across key metrics, including throughput, latency, transaction cost, and finality. This performance advantage is principally attributable to Fabric’s permissioned design, which facilitates streamlined consensus mechanisms and obviates the computational overhead intrinsic to public consensus models such as Ethereum’s Proof-of-Work (PoW) or Proof-of-Stake (PoS). Fabric’s capacity to process over 2000 transactions per second with sub-second finality renders it an exemplary solution for enterprise applications, including interbank settlements, internal payment ledgers, and high-frequency trading systems.

Conversely, Ethereum’s performance limitations are a corollary of its foundational emphasis on decentralization and permissionless access, which introduce inherent constraints in speed and scalability. The reliance on a distributed network of public validators, global state synchronization, and a gas-fee market ensures strong security and trustlessness but concurrently imposes latency and variable operational costs. Although Ethereum’s transition to PoS has markedly reduced its energy consumption, it has not yet yielded substantial improvements in transactional throughput or cost efficiency. Prospective enhancements, such as sharding and Layer-2 scaling solutions (e.g., rollups), may ameliorate these limitations, albeit at the potential cost of increased architectural complexity. This discussion further underscores the economic ramifications of blockchain performance. Ethereum’s transaction fees, frequently amounting to several U.S. dollars, present a prohibitive barrier for microtransactions or high-volume processing systems. In contrast, Hyperledger Fabric’s negligible transaction cost enables scalable and predictable operations, a particularly advantageous feature for organizations seeking to minimize operational expenditures in transaction-intensive environments.

Moreover, the nature of finality constitutes a critical differentiator in financial contexts, where any potential for transaction reversibility introduces risk and uncertainty. Hyperledger Fabric’s deterministic finality, typically achieved within 1–2 seconds, offers a distinct advantage over Ethereum’s probabilistic model, which may require up to a minute to achieve a sufficiently secure confirmation. This distinction is paramount for applications demanding immediate settlement assurance, such as securities clearing or real-time fund transfers. It is imperative to acknowledge the contextual trade-offs underpinning this performance disparity. Ethereum’s decentralized architecture supports censorship resistance, open innovation, and global reach, attributes that are indispensable for public financial networks or decentralized finance (DeFi) ecosystems. Fabric, while delivering superior performance, operates within a trusted consortium of participants and lacks the open composability and extensive user base that characterize public networks like Ethereum.

Ultimately, the selection of an appropriate platform must be guided by application-specific requirements (Raj & Tolety, 2012). For private, high-performance financial systems operating within a controlled consortium, Hyperledger Fabric delivers the efficiency and speed necessary for operational effectiveness (Thakkar et al., 2018). For public-facing applications where transparency, decentralization, and trust minimization are paramount, Ethereum remains a compelling choice, particularly when augmented with emerging scalability solutions (Khan et al., 2024). These findings contribute to the broader discourse on blockchain adoption in finance by quantitatively elucidating the operational trade-offs between public and permissioned architectures. Future research could productively explore hybrid architectural models, executing high-frequency transactions on a performant private network like Fabric while periodically anchoring final state hashes to a public chain like Ethereum for enhanced auditability and immutable external trust anchoring.

4. Conclusions

This paper presented a performance comparison between Ethereum and Hyperledger Fabric, based on an internal case study modeling financial transactions. The results demonstrate that Hyperledger Fabric significantly outperforms Ethereum in both throughput (processing thousands versus tens of transactions per second) and latency (sub-second versus several seconds) under identical test conditions. Fabric's deterministic consensus mechanism ensures transactions are finalized in approximately 1–2 seconds and are immutable. In contrast, Ethereum's probabilistic model requires around 1 minute to achieve safe finality, necessitating multiple block confirmations. A further critical distinction is operational cost: Ethereum's transaction fees, amounting to several dollars per transaction, present a major obstacle for high-volume systems. Fabric, which operates without per-transaction fees in a private network, enables nearly cost-free operations. These findings align with existing research supporting Fabric's suitability for enterprise applications where high throughput, low latency, and predictable costs are essential.

As a public blockchain, Ethereum offers the advantages of full decentralization and a vast ecosystem. However, these benefits entail significant trade-offs, including lower speed, higher latency, and transaction costs that complicate its use for real-time financial processing without additional scaling solutions. In summary, for financial systems requiring high-speed processing and immediate finality, such as trading, payments, or internal banking ledgers, Hyperledger Fabric proves to be the more efficient and cost-effective platform. Ethereum remains a viable option for use cases where public trust, censorship resistance, and open access are the highest priorities, and where performance limitations are acceptable or can be mitigated with layer-two scaling solutions. The empirical data and analysis presented in this work clearly illustrate these trade-offs. Future work could explore hybrid architectures, for instance, utilizing Ethereum for final settlement while executing high-frequency internal transactions on Fabric. Furthermore, upcoming Ethereum upgrades, such as sharding and rollups, have the potential to narrow the performance gap. The insights from this study can assist developers and decision-makers in selecting the appropriate blockchain platform for specific financial applications.

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References

Anceaume, E., Pozzo, A., Rieutord, T., & Tucci-Piergiovanni, S. (2020). On Finality in Blockchains. *25th International Conference on Principles of Distributed Systems.*1–19. https://doi.org/10.4230/LIPIcs.OPODIS.2021.6

Cocco, L., Pinna, A., & Marchesi, M. (2017). Banking on Blockchain: Costs Savings Thanks to the Blockchain Technology. *Future Internet*, *9*(3), 25. https://doi.org/10.3390/fi9030025

Kadeba, O. (2023). How Open Data is Reshaping Supply Chains for Social Equity. *International Journal of Advance Research, Ideas and Innovations in Technology*, *10*(1), 147–155.

Khan, B. U. I., Goh, K. W., Zuhairi, M. F., Putra, R. R., Khan, A. R., & Chaimanee, M. (2024). A Scalability Enhancement Scheme for Ethereum Blockchains: A Graph-based Decentralized Approach. *Engineering, Technology & Applied Science Research*, *14*(6), 17725–17736. https://doi.org/10.48084/etasr.8465

Khan, D., Jung, L. T., Hashmani, M. A., & Cheong, M. K. (2022). Empirical Performance Analysis of Hyperledger LTS for Small and Medium Enterprises. *Sensors*, *22*(3), 915. https://doi.org/10.3390/s22030915

Khan, M. M., Khan, F. S., Nadeem, M., Khan, T. H., Haider, S., & Daas, D. (2025). Scalability and Efficiency Analysis of Hyperledger Fabric and Private Ethereum in Smart Contract Execution. *Computers*, *14*(4), 1–18. https://doi.org/10.3390/computers14040132

Kukman, T., & Gričar, S. (2025). Blockchain for quality: Advancing security, efficiency, and transparency in financial systems. *FinTech*, *4*(1), 7.

Li, C., Li, P., Zhou, D., Yang, Z., Wu, M., Yang, G., Xu, W., Long, F., & Yao, A. C. C. (2020). A decentralized blockchain with high throughput and fast confirmation. *2020 {USENIX} Annual Technical Conference ({USENIX}{ATC} 20*, 515–528. https://doi.org/10.5555/3489146.3489181

Martinez, D., Magdalena, L., & Savitri, A. N. (2024). Ai and blockchain integration: Enhancing security and transparency in financial transactions. *International Transactions on Artificial Intelligence*, *3*(1), 11–20.

Mouzarani, M., Sadeghiyan, B., & Zolfaghari, M. (2017). Detecting injection vulnerabilities in executable codes with concolic execution. *2017 8th IEEE International Conference on Software Engineering and Service Science (ICSESS)*, 50–57. https://doi.org/10.1109/ICSESS.2017.8342862

Pacheco, M., Oliva, G. A., Rajbahadur, G. K., & Hassan, A. E. (2023). What makes Ethereum blockchain transactions be processed fast or slow? An empirical study. *Empirical Software Engineering*, *28*(2), 39. https://doi.org/10.1007/s10664-022-10283-7

Pancari, S., Rashid, A., Zheng, J., Patel, S., Wang, Y., & Fu, J. (2023). A Systematic Comparison between the Ethereum and Hyperledger Fabric Blockchain Platforms for Attribute-Based Access Control in Smart Home IoT Environments. *Sensors*, *23*(16), 7046. https://doi.org/10.3390/s23167046

Raj, C. P. R., & Tolety, S. B. (2012). A study on approaches to build cross-platform mobile applications and criteria to select appropriate approach. *2012 Annual IEEE India Conference (INDICON)*, 625–629.

Schär, F. (2021). Decentralized Finance: On Blockchain- and Smart Contract-Based Financial Markets. *Review*, *103*(2), 153–174. https://doi.org/10.20955/r.103.153-74

Segun Adanigbo, O., Sophia Ezeh, F., Success Ugbaja, U., Iyabode Lawal, C., & Christopher Friday, S. (2024). Advances in Blockchain and IoT Applications for Secure, Transparent, and Scalable Digital Financial Transactions. *International Journal of Advanced Multidisciplinary Research and Studies*, *4*(6), 1863–1869. https://doi.org/10.62225/2583049X.2024.4.6.4158

Thakkar, P., Nathan, S., & Viswanathan, B. (2018). Performance benchmarking and optimizing hyperledger fabric blockchain platform. *2018 IEEE 26th International Symposium on Modeling, Analysis, and Simulation of Computer and Telecommunication Systems (MASCOTS)*, 264–276.