

RESEARCH ARTICLE

A COMPARATIVE PERFORMANCE EVALUATION OF EXECUTION OPERATIONS IN ETHEREUM AND ETHEREUM ONTOLOGY: A LOCAL NETWORK EXPERIMENT

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Abstract

This study presents EthOn, an ontology-driven framework designed to enhance the efficiency of the Ethereum blockchain. By integrating semantic ontologies into the Ethereum layer, EthOn enables context-aware reasoning, thereby improving smart contract execution and enhancing interoperability among decentralized applications (dApps). The framework was experimentally evaluated using Protégé, Web3.js, Ganache Network, and Apache Jena. The results indicate that the Ethereum network consumes between 204,345 and 4.365 million gas units per block under low-load conditions, and between 4.448 million and 11.872 million gas units under high-load conditions. In contrast, the EthOn model achieves lower gas consumption, ranging from 132,560 to 3.697 million gas units under low load, and from 3.2 million to 10.034 million gas units under high-load conditions. This reflects a significant and consistent reduction in gas consumption, ranging from 15% to over 30% across different transaction workloads, while maintaining a high level of accuracy and reliability. Furthermore, the framework preserves its efficiency under high-load conditions, demonstrating strong robustness and scalability. These findings highlight the promising potential of semantic technologies in advancing blockchain infrastructures, paving the way for more intelligent, efficient, and scalable decentralized systems.

Keywords: Blockchain; Ethereum; Smart contracts; Ontology; EthOn; Gas price; Transaction execution.

1. Introduction

Blockchain technology has emerged as a disruptive innovation that is fundamentally reshaping the mechanisms of data storage, verification, and exchange in distributed environments. By enabling decentralized, transparent, and tamper-resistant ledgers, blockchain systems eliminate the reliance on centralized intermediaries and thereby redefine the concept of digital trust [1]. Among existing platforms, Ethereum represents a leading second-generation blockchain, distinguished by its introduction of programmable smart contracts and support for decentralized applications (dApps), which has accelerated innovation across multiple domains, including finance, healthcare, supply chain management, and digital identity systems [2][3]. Despite its functional versatility and broad adoption, Ethereum faces significant performance constraints that limit its scalability. These challenges include elevated gas costs, restricted transaction throughput, and increased latency

in transaction finalization, particularly under conditions of high network congestion [4]. Moreover, the platform's underlying data representation is predominantly syntactic, lacking semantic richness and formal meaning, which restricts its capacity to model, interpret, and reason over complex and heterogeneous datasets [5]. Consequently, these limitations hinder the development of intelligent, context-aware blockchain applications capable of adaptive reasoning and automation. In contrast, Semantic Web technologies—especially ontologies—provide structured, machine-interpretable representations of domain knowledge that facilitate interoperability, contextual understanding, and logical inference [6][7]. Ontologies formally define domain concepts and their relationships, enabling semantic annotation, enhanced querying capabilities, and knowledge-driven reasoning. The integration of ontological models into blockchain ecosystems has the potential to enrich data interpretation and improve the reasoning capabilities of smart contracts, thereby

enhancing automation, consistency, and system adaptability [8]. Although prior research has primarily explored the use of blockchain for ensuring the integrity, provenance, and traceability of semantic data, relatively limited attention has been given to leveraging semantic technologies—particularly ontologies—to enhance blockchain performance and optimize smart contract execution [9][10]. To address this research gap, this study proposes ETHON, a novel ontology-driven framework designed to improve the operational efficiency of the Ethereum blockchain. The proposed framework employs domain ontologies to semantically structure transactional data and to guide smart contract execution logic. ETHON is implemented using the Protégé ontology modeling environment and integrated with Web3.js libraries to interact with Ethereum-based test networks. Experimental evaluations demonstrate that the proposed framework achieves measurable improvements in execution efficiency, computational performance, and gas consumption, thereby offering a promising approach for the development of semantically enhanced blockchain infrastructures.

2. Literature Review

Over the past decade, extensive research has investigated the performance constraints of the Ethereum blockchain, with particular emphasis on gas consumption and transaction throughput. Early foundational work by [11], the principal architect of Ethereum, highlighted that the Ethereum Virtual Machine (EVM) prioritizes generality over efficiency, resulting in increased computational overhead and reduced transaction processing performance. Subsequent studies have explored various approaches to address these limitations through protocol-level enhancements and off-chain computation strategies. [12] proposed sharding as a scalability mechanism that enables parallel transaction processing across multiple subnetworks; however, its full implementation within Ethereum 2.0 remains technically complex and only partially realized. At the smart contract level, several optimization techniques have been introduced to improve gas efficiency. [13] developed Oyente, a static analysis tool designed to identify inefficient patterns and gas-related vulnerabilities in smart contracts. In a similar direction, [14] proposed a compiler-level optimization framework that automatically refactors Solidity code to eliminate redundant operations and reduce gas consumption while preserving semantic equivalence. More recently, [15] investigated Layer-2 scaling solutions, such as Optimistic Rollups and zk-Rollups, which offload computation from the main chain to improve throughput and reduce on-chain resource usage; nevertheless, these approaches introduce additional complexity and new trust assumptions that may affect system design and interoperability. Despite these advancements, existing

solutions are largely concentrated at either the protocol modification level—often requiring consensus changes and widespread adoption—or rely on external off-chain infrastructures, which may introduce increased system complexity and potential centralization risks. Consequently, a significant research gap remains in exploring semantic enrichment and ontology-based reasoning as a lightweight yet effective approach for optimizing Ethereum performance without altering its core architecture.

3. Methodology

This study adopts an implementation-driven methodology to assess the impact of semantic ontologies on Ethereum blockchain performance. The methodology is organized into three main phases: ontology modeling, system integration, and semantic execution with performance evaluation. Initially, a domain-specific ontology (EthOn) was developed using Protégé to formally represent key Ethereum concepts, including blocks, transactions, gas consumption, and smart contracts. The ontology, defined in OWL, provides a semantically enriched representation of blockchain data to support context-aware reasoning and semantic querying. Subsequently, a system integration environment was established to enable interaction between Ethereum and the ontology layer. This setup utilized Node.js as the execution environment, Web3.js for blockchain communication with a Ganache-based test network, and Apache Jena Fuseki for ontology storage and SPARQL-based querying. Finally, the EthOn ontology was integrated into a simulated Ethereum environment, where smart contract transactions were semantically annotated. Execution data were extracted in real time and stored in RDF format for analysis using SPARQL queries. The evaluation focused on key performance metrics, including gas consumption and block latency. The results indicate that the ontology-enhanced approach improves execution efficiency, reduces gas usage, and decreases transaction latency, demonstrating the effectiveness of semantic technologies in optimizing blockchain systems.

4. EthOn Framework: A Semantic Representation for Enhancing Interoperability and Knowledge Modeling in Ethereum Blockchain Systems

The primary objective of the Ethereum Ontology (EthOn) framework is to formally and semantically represent the fundamental components and relationships within the Ethereum blockchain ecosystem. EthOn utilizes established Semantic Web standards, including RDF and OWL, to structure blockchain data in a machine-interpretable and interoperable format. This

Listing 1: Ethereum Tx RDF

```

ibb:{{tx_block_number}} ethon:containsTx tx:{{tx_hash}}.
tx:{{tx_hash}} ethon:cumulativeGasUsed "{{tx_gas}}"^^xsd:integer.
tx:{{tx_hash}} ethon:txHash "{{tx_hash}}"^^xsd:hexBinary.
tx:{{tx_hash}} ethon:txNonce "{{tx_nonce}}"^^xsd:integer.
tx:{{tx_hash}} ethon:txIndex "{{tx_index}}"^^xsd:integer.
tx:{{tx_hash}} ethon:txGasPrice "{{tx_gas_price}}"^^xsd:integer.
tx:{{tx_hash}} ethon:txGasUsed "{{tx_gas}}"^^xsd:integer.

```

Listing 2: Ethereum Block RDF

```

ibb:{{block_number}} a ethon:Block.
ibb:{{block_number}} ethon:number "{{block_number}}"^^xsd:integer.
ibb:{{block_number}} ethon:blockHash "{{block_hash}}"^^xsd:hexBinary.
ibb:{{block_number}} ethon:hasParentBlock ibb:{{block_parent_hash}}.
ibb:{{block_number}} ethon:block_nonce "{{block_nonce}}"^^xsd:hexBinary.
ibb:{{block_number}} ethon:knowsOfUncle ibu:{{block_sha3_uncles}}.
ibb:{{block_number}} ethon:blockLogsBloom "{{block_logs_bloom}}"^^xsd:hexBinary.
ibb:{{block_number}} ethon:hasTxTrie ibtx:{{block_transactions_root}}.
ibb:{{block_number}} ethon:hasPostBlockState ibs:{{block_state_root}}.
ibs:{{block_state_root}} ethon:stateRoot "{{block_state_root}}"^^xsd:hexBinary.
ibb:{{block_number}} ethon:blockDifficulty "{{block_difficulty}}"^^xsd:hexBinary.
ibb:{{block_number}} ethon:blockSize "{{block_size}}"^^xsd:integer.
ibb:{{block_number}} ethon:blockExtraData "{{block_extra_data}}"^^xsd:hexBinary.
ibb:{{block_number}} ethon:blockGasLimit "{{block_gas_limit}}"^^xsd:integer.
ibb:{{block_number}} ethon:blockGasUsed "{{block_gas_used}}"^^xsd:integer.
ibb:{{block_number}} ethon:blockCreationTime "{{block_timestamp}}"^^xsd:dateTime.

```

5. Implementation of Transactions on a Local Ethereum Network

In this point, it was developed a javaScripts file called Transaction.js, The primary objective of this script is to execute an Ether transfer between two accounts on a local Ethereum network while applying a dynamic gas pricing mechanism that scales with the amount of Ether being sent. The implementation is developed using Node.js in conjunction with the Web3.js library, enabling programmatic interaction with the Ethereum blockchain through the JSON-RPC interface.

6. Implementation of Transaction requires the execution of a smart contract on a Local Ethereum Network

The experimental results illustrate the execution of a transaction that involves processing a set of iterative operations within a smart contract, where multiple values are inserted into persistent blockchain storage. These operations require repeated modifications to the contract's state, resulting in relatively high gas consumption due to the reliance on storage write operations, which are among the most expensive operations in the Ethereum execution model. As shown in Figure 4, executing the transaction under the

traditional model resulted in a gas consumption of approximately 200,000 units, reflecting the direct and unoptimized execution of storage-intensive operations. In contrast, Figure 5 demonstrates that executing the same pattern of operations using the EthOn model reduced gas consumption to approximately 110,000 units, indicating a significant improvement in execution efficiency. This reduction in gas consumption can be attributed to minimizing redundant operations and optimizing data handling within the contract. The semantic-driven approach contributes to reducing unnecessary state modifications, thereby lowering the overall computational cost of the transaction. These findings highlight the effectiveness of the proposed model in enhancing gas efficiency for storage-intensive blockchain operations.

7. Dynamic Gas Consumption Analysis in a Smart Wallet Contract

The Smart Wallet Advanced contract is a smart contract on the Ethereum network that enables multiple deposit and withdrawal operations while updating user balances in real time using a mapping. When integrated with Node.js and Web3, the contract can be deployed on a local network and executed with randomized deposit and withdrawal operations, providing a practical framework

for analyzing gas consumption and the effects of operation type, repetition count, and data size on network efficiency. The Figure 6, Figure 7 illustrates the results of executing deposit and withdrawal operations on Ethereum wallet smart contracts. In the The Figure 6, the balance increases progressively after each transaction, but gas consumption is relatively high, while the final balance accurately reflects the total deposits minus withdrawals. In Figure 7, which utilizes the EthOn

model, performs the same operations with significantly improved gas efficiency, maintaining the same pattern of balance changes. Overall, employing EthOn enhances smart contract performance by reducing gas usage while preserving transaction accuracy and precise balance outcomes.

```
transactionHash: '0xf313fb5e93738c979d99c213005940fdcbd082bd3ec579139d3904d4238efe88',
transactionIndex: 0n,
blockNumber: 8n,
blockHash: '0x514829ecea9eccc6a522c0768440958c8aae6327e4552b3cedaf5fb22beddbaa',
from: '0x16bfc0bb2333bca67c7d0d6c1cce902d9a9fdacf',
to: '0xcab51363e1ed3ffa5df003d9170818c98fdcf635',
gasUsed: 21284n,
```

Fig. 2: Snapshot of the Transaction Execution result

```
transactionHash: '0x56d0cec616a3ab4bc2dd8b0890a57fc26859eb2cd1933cb117df03094a62286c',
transactionIndex: 0n,
blockNumber: 1n,
blockHash: '0xba962fc240adbafdc2747eae24daf83ce1da05453415ee7ce43deedc2b764fb6',
from: '0xe4812e46dbf0175085a0d5236a762410e9076e52',
to: '0x825acb561496ccf1ad09ca9c3d6a83bf9c11ad3a',
gasUsed: 21000n,
```

Fig. 3: Snapshot of the Transaction Execution result used Ethon

```
transactionHash: '0xaf46d45d51b957414f449201155dacfc946863c2c3816957c0a3e9da0c92939c',
transactionIndex: 0n,
blockNumber: 20n,
blockHash: '0x038692d9ec01e59962a20ccae6be944876d9d2b26b26a6b52fd90ed1b8a6c4a5',
from: '0x16bfc0bb2333bca67c7d0d6c1cce902d9a9fdacf',
to: '0xe28f049333aec4a6a51a98032fd0b799e9bd223c',
gasUsed: 200000n,
```

Fig. 4: Snapshot of the Transaction requires the execution of a smart contract

```
transactionHash: '0xc22e502ffd8c9e79baec6a919ce2f72c5ef17dedc5e5c13c262522e1bc0c46ac',
transactionIndex: 0n,
blockNumber: 16n,
blockHash: '0x0382cfb6219f180323e2c0f86251d0ef419aaa82da9ca2f8759d50acf02c21ab',
from: '0x16bfc0bb2333bca67c7d0d6c1cce902d9a9fdacf',
to: '0xc33af1d28a2a074eca474d8f388edfca95d07574',
gasUsed: 110000n,
```

Fig. 5: Snapshot of the Transaction requires the execution of a smart contract used Ethon

```

Using account: 0x708B8167eAF9785eA7CcdB861c08209B5C88F95e
Deploying Contract...
Contract Address: 0x5371Ea9db4bbc258B5398AC7ba4b191B18BDEBf5
Deposit 0.143 ETH , gas used: 391140
Withdraw 0.113 ETH , gas used: 212959
Current balance: 0.0300 ETH

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Deposit 0.335 ETH , gas used: 194218
Withdraw 0.125 ETH , gas used: 273255
Current balance: 0.2400 ETH

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Deposit 1.055 ETH , gas used: 194218
Withdraw 0.519 ETH , gas used: 273255
Current balance: 0.7760 ETH

-----

Deposit 1.990 ETH , gas used: 496416
Withdraw 0.949 ETH , gas used: 152663
Current balance: 1.8170 ETH

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Deposit 1.461 ETH , gas used: 170972
Withdraw 0.294 ETH , gas used: 182799
Current balance: 2.9840 ETH

```

Fig. 6: Execution results of deposits and withdrawals in smart wallet contract

```

Using account: 0x7619AA94BE7b4C0E654C60919378592653BB1f4e
Deploying Contract...
Contract Address: 0x44F3F817FB1601A06f5FeA64346817E5EdA3AF7d
Deposit 0.619 ETH, gas used: 43644
Withdraw 0.593 ETH, gas used: 34110
Current balance: 0.026 ETH

-----

Deposit 0.998 ETH, gas used: 26544
Withdraw 0.646 ETH, gas used: 34098
Current balance: 0.378 ETH

-----

Deposit 0.594 ETH, gas used: 26544
Withdraw 0.375 ETH, gas used: 34110
Current balance: 0.597 ETH

-----

Deposit 0.475 ETH, gas used: 26544
Withdraw 0.293 ETH, gas used: 34110
Current balance: 0.779 ETH

-----

Deposit 0.760 ETH, gas used: 26544
Withdraw 0.741 ETH, gas used: 34110
Current balance: 0.798 ETH

```

Fig. 7: Execution results of deposits and withdrawals in smart wallet contract used Ethon

8. Evaluation

8.1 Improved gas cost for blocks

The presented analysis examines the improvement in gas efficiency at the block level achieved by the proposed EthOn model compared to the conventional Ethereum network. The findings reveal a consistent reduction in

gas consumption per block when high -load, highlighting the effectiveness of integrating the semantic layer. This improvement reflects more structured transaction handling and reduced computational overhead during execution, ultimately leading to lower operational costs and enhanced scalability. Overall, the results confirm

that EthOn provides a more efficient approach to managing gas consumption in blockchain environments.

8.1.1. Reduced Gas Cost per Block used Ethon (Low-Load)

Table 1 presents a comparative experimental evaluation of gas consumption per block between the conventional Ethereum network and the proposed EthOn model, under a workload of low –load block. The results clearly demonstrate a consistent reduction in gas usage when employing EthOn across all examined blocks. A detailed analysis of the data indicates that EthOn achieves significantly lower gas consumption compared to Ethereum. For instance, in Block 1, the gas usage in EthOn is recorded at 709,104, whereas Ethereum consumes 1,254,681, reflecting a substantial reduction. This pattern persists across the dataset; notably, Block 5 exhibits a gas consumption of 132,560 in EthOn compared to 204,345 in Ethereum, highlighting a pronounced improvement in efficiency. Furthermore, in high-load scenarios, such as Block 4 and Block 8, EthOn continues to outperform Ethereum. In Block 8, for example, gas consumption reaches 3,697,660 in EthOn, while Ethereum records 4,365,743. This observation suggests that the proposed model maintains its efficiency advantages even as the number of transactions per block increases, indicating robustness under intensive operational conditions.

8.1.2. Reduced Gas Cost per Block used Ethon (High-load)

Table 2 presents a comparative analysis of gas consumption per block between the traditional Ethereum network and the proposed EthOn model under a higher transaction load. The results consistently demonstrate that EthOn achieves lower gas consumption across all evaluated blocks, confirming its effectiveness in optimizing resource utilization even under intensive workloads. A closer examination of the data reveals that EthOn significantly reduces gas usage compared to Ethereum in every instance. For example, in Block 1, EthOn records a gas consumption of 5,874,104, whereas Ethereum consumes 6,853,424. Similarly, in Block 7, one of the highest-load cases, EthOn uses 10,034,765 compared to 11,872,344 in Ethereum. This consistent reduction indicates that the efficiency gains of EthOn are not limited to low or moderate transaction volumes but extend to high-density blocks as well. Moreover, the variation in gas consumption across different blocks suggests that EthOn maintains stable performance regardless of fluctuations in transaction complexity and volume. Even in blocks with comparatively lower gas usage, such as Block 8, EthOn continues to outperform Ethereum, further reinforcing the robustness of the proposed model.

Table 1: illustrates the results of generated blocks contain (low-load) in ganache

Block No.	Block Gas Used (ethon)	Block Gas Used (ethereum)
Block 1	709,104	1,254,681
Block 2	423,630	980,089
Block 3	585,040	1,076,976
Block 4	2,773,990	3,578,311
Block 5	132,560	204,345
Block 6	245,670	576,546
Block 7	2,148,760	3,138,763
Block 8	3,697,660	4,365,743
Block 9	1,458,570	2,487,632
Block 10	205,678	503,786
Block 11	806,345	1,376,349
Block 12	1,954,378	2,897,634
Block 13	998,456	1,487,654
Block 14	654,833	1,065,437

Table 2: illustrates the results of generated blocks contain (high-load) in ganache

Block No.	Block Gas Used (ethon)	Block Gas Used (ethereum)
Block 1	5,874,104	6,853,424
Block 2	6,208,765	7,107,653
Block 3	9,865,328	10,135,321
Block 4	5,176,543	6,065,432
Block 5	7,198,235	8,365,144
Block 6	4,276,413	5,354,178
Block 7	10,034,765	11,872,344
Block 8	3,239,874	4,448,752
Block 9	8,132,498	9,076,125
Block 10	3,901,237	4,810,876
Block 11	4,500,245	5,112,984
Block 12	9,107,548	10,034,768
Block 13	8,578,429	9,601,276
Block 14	7,006,532	8,156,439

Table 3: Comparison of Gas Consumption of generated blocks contain (low-load)

Metric	Ethereum	Current Study (EthOn)
Minimum Gas Used	204,345 units	132,560 units
Maximum Gas Used	4,365,743 units	3,697,660 units

Table 4: Comparison of Gas Consumption of generated blocks contain (high-load)

Metric	Ethereum	Current Study (EthOn)
Minimum Gas Used	4,448,752 units	3,239,874 units
Maximum Gas Used	11,872,344 units	10,034,765 units

The percentage improvement in gas consumption was calculated using the following formula:

$$\text{Improvement \%} = ((\text{Ethereum gas} - \text{EthOn gas}) / \text{Ethereum gas}) \times 100$$

- **Table 3: Low-load**

Minimum Gas Used:

$$204,345 - 132,560 / 204,345 \times 100 \approx 35.1\%$$

Maximum Gas Used:

$$4,365,743 - 3,697,660 / 4,365,743 \times 100 \approx 15.3\%$$

- **Table 4: High-Load**

Minimum Gas Used:

$$4,448,752 - 3,239,874 / 4,448,752 \times 100 \approx 27.2\%$$

Maximum Gas Used:

$$11,872,344 - 10,034,765 / 11,872,344 \times 100 \approx 15.5\%$$

In summary, the findings confirm that EthOn significantly improves resource efficiency in Ethereum-based environments by lowering gas costs and enhancing scalability. These results position the proposed model as a promising approach for optimizing blockchain performance, particularly in applications requiring efficient processing of high transaction volumes. Figure 8 presents a comparison of gas consumption between EthOn and Ethereum under a low-to-moderate transaction load. The results indicate that Ethereum consistently exhibits higher gas consumption than EthOn across most blocks. Although both systems demonstrate fluctuations with noticeable peaks (particularly around blocks 4 and 8), EthOn maintains relatively lower gas usage, suggesting greater efficiency in handling smaller transaction volumes. Figure 9 presents a comparison of gas consumption between EthOn and Ethereum Under higher transaction loads, both EthOn and Ethereum show increased gas consumption, as expected. However, EthOn continues to outperform Ethereum by maintaining lower gas usage across the observed blocks. Despite increased variability in consumption patterns, the performance gap remains evident, indicating that EthOn provides better scalability and efficiency under heavier workloads. Overall, the findings from both figures demonstrate that EthOn achieves superior gas efficiency compared to Ethereum under both low and high transaction loads, with more pronounced advantages as the number of transactions increases.

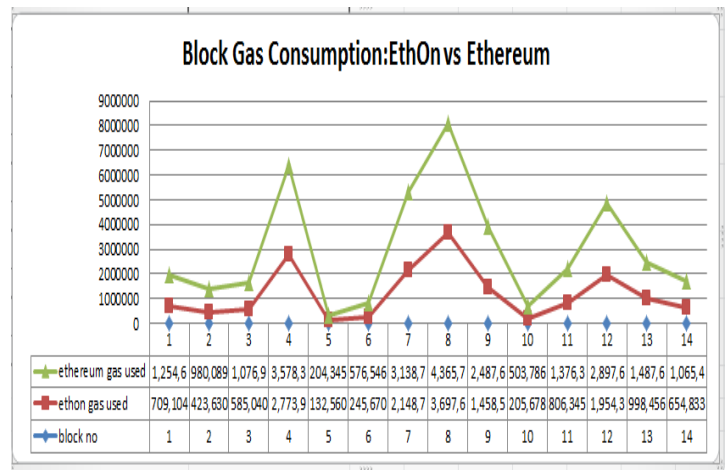


Fig. 8: illustrate Block Gas Consumption: EthOn vs Ethereum (low-load)

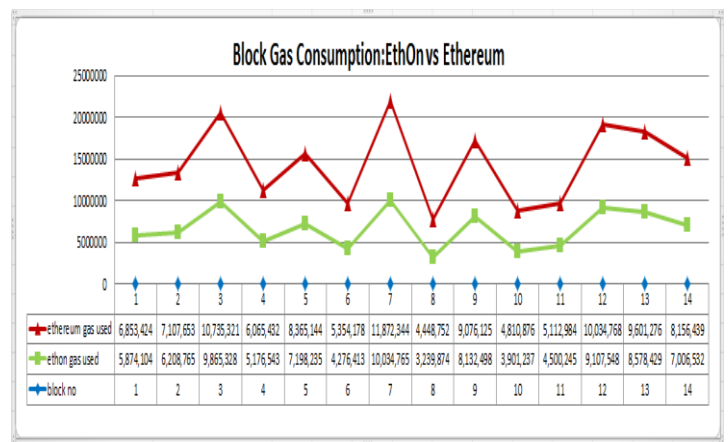


Fig. 9: illustrate Block Gas Consumption: EthOn vs Ethereum (high load)

9. Conclusion and Recommendation

This study presented an ontology-driven enhancement to the Ethereum blockchain through the proposed EthOn model, aiming to improve execution efficiency and reduce gas consumption in smart contract operations. By leveraging semantic web technologies such as RDF and OWL, the model enabled a structured and machine-interpretable representation of blockchain data, leading to more efficient processing and reduced computational overhead. The experimental evaluation conducted in a local blockchain environment demonstrated a consistent and significant reduction in gas consumption across various transaction scenarios, while preserving the correctness and integrity of execution. These findings confirm that ontology-based integration can effectively optimize blockchain performance without requiring fundamental modifications to the underlying architecture. In addition to improving efficiency, the proposed approach enhances data interoperability and semantic clarity, making it a promising solution for scalable blockchain systems. Based on these results, it is recommended that future research validate the EthOn

model in real-world environments such as public testnets and mainnet, as well as explore its integration with Layer 2 scaling solutions to further improve performance. Expanding the ontology to include advanced domains such as decentralized finance (DeFi) and non-fungible tokens (NFTs) is also suggested to broaden its applicability. Furthermore, investigating the security implications of ontology integration and developing automated tools to facilitate seamless interaction between ontologies and smart contracts would support wider adoption. Finally, large-scale performance evaluations and comparative studies with other optimization techniques are encouraged to further establish the effectiveness and robustness of the proposed model.

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مقالة بحثية

تقييم مقارن لأداء عمليات التنفيذ في شبكة إيثريوم وأنطولوجيا إيثريوم: تجربة على شبكة محلية

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المُلخَص

تقدم هذه الدراسة (EthOn)، وهو إطار عمل قائم على (Ontology-driven framework) مُصمَّم لتعزيز كفاءة سلسلة الكتل لشبكة إيثريوم (Ethereum Blockchain). ودمج الوجوديات الدلالية (Semantic ontologies) في طبقة إيثريوم يُمكن إطار EthOn من الاستدلال القائم على السياق، مما يؤدي إلى تحسين تنفيذ العقود الذكية وتعزيز التوافق التشغيلي بين التطبيقات اللامركزية (dApps). وقد تم تقييم إطار العمل تجريبياً باستخدام أدوات: Web3.js و Protégé وشبكة Ganache و Apache Jena. وأظهرت النتائج أن شبكة إيثريوم تستهلك ما بين 204,345 و 4.365 ملايين وحدة غاز (Gas units) لكل كتلة تحت ظروف الحمل المنخفض، وما بين 4.448 ملايين و 11.872 مليون وحدة غاز تحت ظروف الحمل العالي. في المقابل، يحقق نموذج EthOn استهلاكاً أقل للغاز؛ حيث يتراوح بين 132,560 و 3.697 ملايين وحدة غاز تحت الحمل المنخفض، وبين 3.2 ملايين و 10.034 ملايين وحدة غاز تحت ظروف الحمل العالي. ويعكس هذا انخفاضاً ملحوظاً ومتسقاً في استهلاك الغاز يتراوح بين 15% وأكثر من 30% عبر مختلف أعباء المعاملات، مع الحفاظ على مستوى عالٍ من الدقة والموثوقية. علاوة على ذلك، يحافظ إطار العمل على كفاءته تحت ظروف الحمل العالي، مما يثبت متانته وقابليته العالية للتوسع. وتبرز هذه النتائج الإمكانيات الواعدة للتقنيات الدلالية في تطوير البنى التحتية لسلسلة الكتل (البلوكشين)، مما يمهد الطريق لأنظمة لامركزية أكثر ذكاءً وكفاءة وقابلية للتوسع.

الكلمات المفتاحية: سلسلة الكتل (بلوكشين)؛ إيثريوم؛ العقود الذكية؛ علم الوجود (أنطولوجيا)؛ أنطولوجيا إيثريوم (EthOn)؛ سعر الغاز؛ تنفيذ المعاملات.

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