A Case Study on Blockchain-based Anonymous Reviewer Incentive Token (BARIT)

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***Abstract*—Peer review is an integral part of academic publication necessary to maintain high standards and novelty of published research. Despite its importance, peer reviewers are rarely provided incentives, leading to journals having difficulty finding reviewers inclined to accept invitations and submit reviews on time. This paper proposes a Blockchain-based Anonymous Reviewer Incentive Token (BARIT) to incentivize peer reviewers. BARIT introduces flexible incentive schemes to provide both recognition and tangible benefits for the reviewers' contribution while preserving the anonymity of reviewers. Using blockchain technology to record reward tokens ensures their permanence and acceptance across different publishers. Incentive models are designed to encourage the involvement of researchers as reviewers, reduce reviewer refusal rates, and prompt the timely submission of review reports.**

***Index Terms*—peer review, incentives, blockchain, soul-bound token**

I. Introduction

Peer review is a widely accepted practice in academia to ensure the quality and significance of scientific publications. Each paper submission is first evaluated to ensure its quality and then assigned to expert reviewers, who critically evaluate the submission for relevance, originality, and methodological rigor before recommending publication [1]. Different publication venues use various models of peer review. The most common types are open, single-blind, and double-blind named according to their anonymity level. In an open peer review model, all participants are aware of each other identities, whereas reviewers are anonymized in single-blind, and both authors and reviewers are anonymized in the double-blind review process.

Journals have seen a significant increase in the number of submitted papers in recent years, which outpaces the corresponding number of reviewers willing to accept review invitations [2]. Publons data reveals a significant workload disparity in peer review. Just 10% of reviewers conduct nearly 50% of peer review submissions [3]. For the 2022 peer review cycle, *Cyberpsychology: Journal of Psychosocial Research on Cyberspace* reported needing to contact 22.6 reviewers on average to obtain two reviews per article - almost double the number compared to the previous year [4]. Of the requests sent, a substantial portion (33.1%) were declined, with an even larger percentage (52.4%) simply ignored. Only 14.5% were accepted, and of those, 11.7% ultimately failed to deliver a review. This situation hinders the ability of publication venues to perform a timely and thorough evaluation of the growing volume of research output.

Reviewing scientific work is a time-consuming process that competes with researchers' already heavy workload with teaching, research, and administrative duties. While the "culture of service" considers peer reviewing as a voluntary act [5], the intrinsic satisfaction of serving the academic community alone often loses ground to the pressure to publish their own research. Accepting a review invitation doesn't guarantee prioritization, and lack of motivation often leads to delayed reports, hindering the entire review process and eventual publication [6]. Remarkably, slow review times are one of the major complaints against the peer review process [7]. Studies have shown that monetary rewards can have negative effects on reviewer motivation and the quality of peer review [8] [9]. Non-monetary incentives, such as public recognition, free or discounted access to journals or conference proceedings, and publishing fee credits are more effective in motivating reviewers [8] [10]. These incentives can be appealing to both early-career researchers seeking visibility and experienced researchers looking to advance their research.

Many publishers offer recognition for reviewers through platforms like Web of Science (previously Publons) or ORCID [11]–[14]. Publishers such as Copernicus [15], Elsevier [16], and IEEE [17] acknowledge their reviewers by publishing a yearly list of reviewers. Hindwai [18] and MDPI [19] offer reviewer badges and certificates. In 2015, Colabra: Psychology offered a new reward system for researchers where the reviewers and editors could either "elect to pay themselves" or volunteer their contributions to waiver funds or their institutions' open access fund [20]. Publishers like Elsevier, MDPI, Sage, and Wiley offer benefits such as discounts on their products, vouchers, and academic activity credit [8]. However, these current programs often face limitations, such as confinement to individual platforms and data security concerns due to reliance on centralized servers. We propose a system that addresses these drawbacks and effectively incentivizes expert reviewers.

We conducted interviews with reviewers and editors of several top-tier journals to understand their motivations and the various requirements of publishing venues. The insights from these discussions are used to design and develop Blockchain-based Anonymous Reviewer Incentive Token (BARIT) - a flexible and trustworthy peer review platform. It aims to motivate the reviewers by providing them with recognition and rewards while keeping their identity preserved.

Recently, there has been much research exploring the potential of emerging blockchain technology to enhance review and recognition systems. A decentralized rating framework using a public blockchain network is introduced in [21] to reward users for submitting reviews. Reviewers earn fungible utility tokens redeemable for discounts at registered businesses like restaurants and shops. The number of tokens awarded is proportional to the reviewer's reputation score, calculated based on past review activity [21]. The Soulbound Token Certification (SBTCert) Verification System utilizes the decentralized nature of blockchain to issue and verify educational certificates as non-transferable soulbound tokens [22]. In [23], the use of blockchain-based tokens with incentivization schemes is proposed to attract qualified peer reviewers in information system conferences.

Initiatives like ARTiFACTS [24] and CryptSubmit [25] leverage blockchain to foster fair participation, accessibility, and plagiarism detection in the academic peer review process. PubChain [26] introduces crypto-tokens known as PubCoins as monetary incentives for peer reviewers. Pluto [27] proposes reputation scores for reviewer recognition, while EUREKA [28] and Orvium [29] implement token-based incentive mechanisms with tokens redeemable for various actions, such as paper submissions and award voting. Existing efforts have focused on transparency, cost reduction, and reviewer rewards. However, many operate within an open peer review framework and often lack flexibility. They often adopt a rigid review structure and reward model, functioning as standalone platforms or requiring conformity from journals and other publication venues. The novelty of this research lies in its emphasis on providing a flexible platform for participating journals, offering customizable review processes with support for reviewer anonymity and reward options, all while upholding the integrity and permanence of rewards facilitated by blockchain technology.

BARIT ensures perpetual recognition for reviewer contributions along with the issuance of crypto tokens that can be used within the system and potentially exchangeable for other cryptocurrencies once pegged against a popular cryptocurrency. Moreover, BARIT provides flexibility for participating journals to choose their preferred level of anonymity for peer review and determine the issuance and value of review reward tokens. The main contributions of this research are:

- Provides a public platform independent of individual centralized publication platforms to facilitate engagement in the peer review process.
- Development of a flexible framework capable of supporting various peer review processes and incentivization models tailored to the needs of participating journals.
- Suggests a hybrid system combining blockchain technology with a database to ensure robust support for all peer review models with incentives while safeguarding reviewer anonymity.
- Introduces flexible incentivization schemes based on non-transferable certificates of recognition and spendable utility tokens.
- Implement and demonstrate the feasibility of the proposed design and make the code "open-source" through public repository [30].

II. Motivation and Goals of BARIT

In this section, we discuss our motivation, research methodology, key requirements, and corresponding features. We follow the design science approach by identifying the problem and gathering requirements from domain experts, followed by defining solution objectives, designing and developing the prototype, and evaluating the solution. We interviewed ten academic researchers with experience working in various roles, such as reviewers, editors, and editor-in-chief. The semi-structured interviews focused on learning their motivations for contributing to scientific publications and the challenges faced in their respective roles.

A. System Requirements

Based on the domain knowledge gained from the interviews, the following design requirements were identified:

1) Incentives: Reviewers are mostly motivated by opportunities to learn about research progress in their field of interest, give back to the community, and gain recognition for their contributions to bolster their career prospects. The system must accommodate all these diverse motivations so that the reviewers will be incentivized to participate actively in the peer review process.

2) Flexibility: Different publication venues have different needs and requirements. The system must offer customizable options to support various peer review frameworks and incentivization policies, ensuring easy integration with publication venues' existing workflow.

3) Trust: Users should be able to trust the system for fairness of the review process, assignment of rewards, and protection of their earned rewards.

B. Design principles

Three design principles are derived from the system requirements: incentives engineering, perpetual rewards, and transparency.

1) Incentives Engineering: Editors should have the ability to configure the review process and associated incentives. This includes options such as recognition for review submissions, credits for subscription or manuscript fees, and the ability to adjust reward weightage based on quality metrics like timeliness. This satisfies the incentives and flexibility requirements.

2) Perpetual Rewards: Rewards should be perpetual regardless of the journal or conference venue. This ensures trust and encourages participation from all stakeholders.

3) Transparency: All users should have access to transparent information about the system architecture, review process, and incentive distribution.

C. Features

The following features satisfy design principles for BARIT:

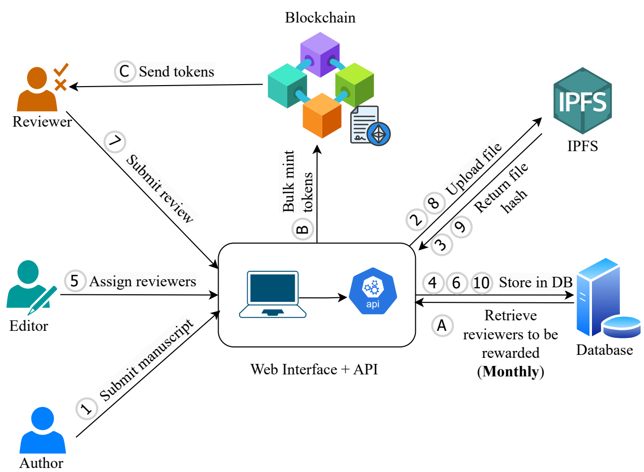


Fig. 1: System Architecture of BARIT

1) Blockchain: BARIT utilizes blockchain technology to manage incentives. It maintains a permanent ledger that tracks all rewards received by reviewers. This immutability ensures rewards are perpetual and verifiable once awarded to the reviewer. The public nature of blockchain ensures the transparency of the reward mechanism while adhering to confidentiality standards by anonymizing reviewers as needed.

2) Tokenization: Tokenization allows for the customization of digital assets into crypto-tokens [31]. These tokens can hold varying values, supporting diverse incentive forms such as recognition and redeemable tokens. Editors can determine the value and functionality of tokens in accordance with their policies.

3) Review Rewards Database: : As the system needs to support different review processes (open, single-blind, double-blind), it is necessary to protect the privacy of the authors and reviewers. Storing all the information related to the peer review process on a private database ensures that such information will remain confidential.

4) File Storage: The system needs to handle a high volume of file uploads and downloads, including manuscripts from authors, review reports, and editor notes, which can vary in size from kilobytes to megabytes. Directly storing large files in a database or blockchain network can be expensive. Therefore, a dedicated file storage system offers reduced resource costs and improved throughput.

III. System Design

BARIT presents a framework designed to facilitate all types of peer review processes and encourage active reviewer participation through a versatile incentive model that meets reviewers' motivating factors. Recognizing the varied methodologies and incentive preferences of journals, this platform empowers them to determine the most suitable reward mechanism for their needs.

Figure 1 illustrates the architecture design for BARIT. BARIT provides an interface for the following user roles: 1) *Authors* who submit their manuscripts to the journal for review and track submission decisions; 2) *Editors* who verify the quality of manuscripts and assign reviewers; and 3) *Reviewers* who can view and submit reviews for the manuscripts assigned to them. With each manuscript submission, reviewers get a certificate token and possibly utility tokens. The backend consists of blockchain technology, the Interplanetary File System (IPFS) [32] for file storage, and an off-chain database. Communication between the frontend and backend components is facilitated through REST API.

A. Blockchain and Cryptowallets

Blockchain is a digital ledger technology that allows secure and transparent transactions without the need for a trusted third party [33]. There are a variety of available public blockchain networks with their own set of functionalities, advantages, and shortcomings. The key factors for network selection are transaction costs, throughput, decentralization, and security. Ethereum [34], a popular and most widely recognized network, has a robust ecosystem, an extensive developer community, and provides comprehensive documentation. Despite newer competitors such as Avalanche and Solana, Ethereum's proven security track record remains a significant advantage. Additionally, it offers advanced functionality and support for non-fungible tokens (NFTs) such as Soulbound tokens [35], making it a better choice for applications like ours that involve such tokens.

Crypto wallets serve as digital repositories for managing, storing, and transferring cryptocurrencies securely. They are equipped with cryptographic keys that enable users to sign transactions on the blockchain, thus validating ownership of their digital assets. Reviewers benefit from the secure infrastructure provided by crypto wallets, which allows them to securely receive and manage their earned reward tokens.

B. Reviewer Anonymity with Hybrid Approach

Blockchain transparency is crucial for network integrity but raises privacy concerns when dealing with identifiable information [36]. Transactions often contain sensitive information that should not be exposed to unauthorized parties. Although obfuscation methods like zero-knowledge proofs and cryptographic techniques can help protect privacy, they often require substantial resources and tech-savvy users with a basic understanding of how these techniques work.

In blinded peer review processes, anonymity preservation of the involved participants is a non-negotiable requirement. However, the small size of the scientific community and transaction timestamps on blockchain make full anonymization difficult. Even with identity obfuscation, timestamps for token distribution done after the submission of reviews could potentially link reviewers to their reviews and the manuscripts they assessed.

To address these privacy concerns, we adopt a hybrid approach as suggested in [37]. This approach involves using blockchain for incentive management while storing user identities in an off-chain database. Author and reviewer identities, along with other sensitive data such as transactions related to the review process (manuscript submission, reviewer assignment, and review report submissions), are logged in the off-chain database. This ensures sensitive information remains secure and is only disclosed to relevant parties based on the peer review process (open, single-blind, or double-blind). The incentive scheme is built upon blockchain technology using smart contracts and tokenization. The system periodically queries the database for new reviews. For each submission, reviewers are allocated crypto-tokens as incentives. Token distribution is recorded on the blockchain, making the rewards perpetual and publicly displaying accumulated tokens, associated journals, and reviewer addresses. Reviewer anonymity regarding reviewed papers is maintained because all identifying information remains off-chain. Distributing tokens to a large pool of reviewers each month makes it nearly impossible to trace papers back to reviewers using timestamps alone.

C. Incentive Engineering

Incentivization is at the core of BARIT, designed to motivate high-quality reviews. The system empowers editors to customize settings to fit their journals' specific requirements. We explore two primary incentive models: non-transferable certificates and utility tokens.

1) Non-transferable Certificates: Non-transferable certificates are cryptographic tokens that serve as proof of achievement or credentials. Unlike traditional tokens, they can't be freely transferred or exchanged. These tokens are similar to digital badges or certificates tied to a specific individual's or entity's identity, ensuring that the achievements or credentials they represent remain with the original recipient. Issuance of such non-transferable certificates will be particularly valuable for researchers at early career stages by acknowledging their contribution to academic progress.

2) Utility Tokens: Utility tokens are digital assets designed to be used within a specific blockchain ecosystem, providing access to goods or services offered by the platform [38]. Unlike non-transferable certificates, utility tokens are transferable and can be traded on various exchanges. The design of utility tokens focuses on creating intrinsic value within the ecosystem, such as payment for services, or access to premium features. Such utility tokens can be used as credits for subscription-based journals or as currency required for authors to make a manuscript submission themselves.

D. User Story

Figure 2 illustrates the overall interaction between different users and BARIT components. The peer review process commences with the submission of a manuscript by an author to a publishing venue for review. The system periodically checks for new review submissions and mints reward tokens based on the venue's policy. The anonymity of the author and reviewer in the peer-review process depends on the participating journal's policy. The sequence of steps in the overall process is outlined below:

1) Manuscript Submission: When an author submits a manuscript to a journal, the manuscript file is uploaded to the designated file storage. The author and manuscript details are stored in an off-chain database.

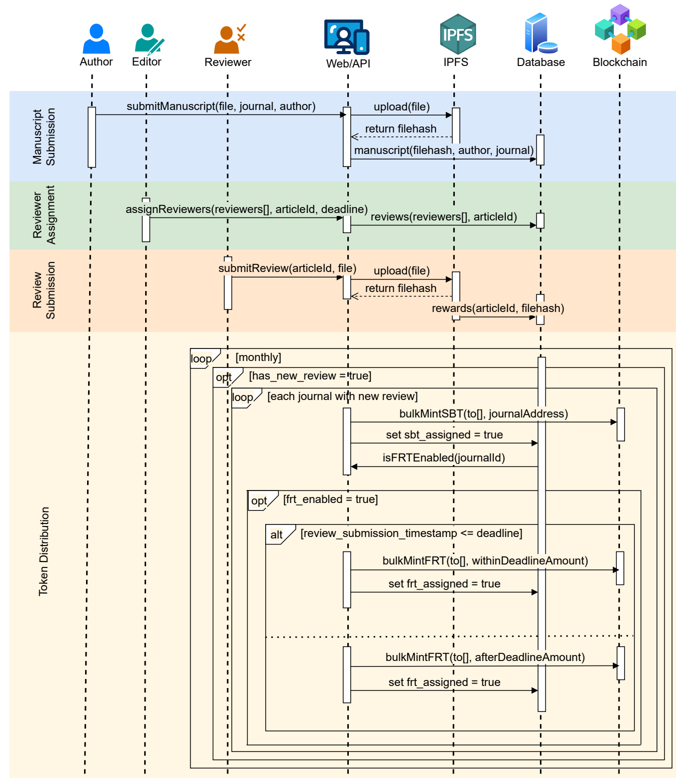


Fig. 2: Sequence Diagram of BARIT

2) Assign Reviewers: The editor gains access to the submitted manuscript. If the manuscript meets the requisite standards, the editor assigns one or more reviewers, along with a review deadline. Editors have the option to allocate different amounts of utility tokens from their settings, depending on whether the review is submitted on time or after the deadline.

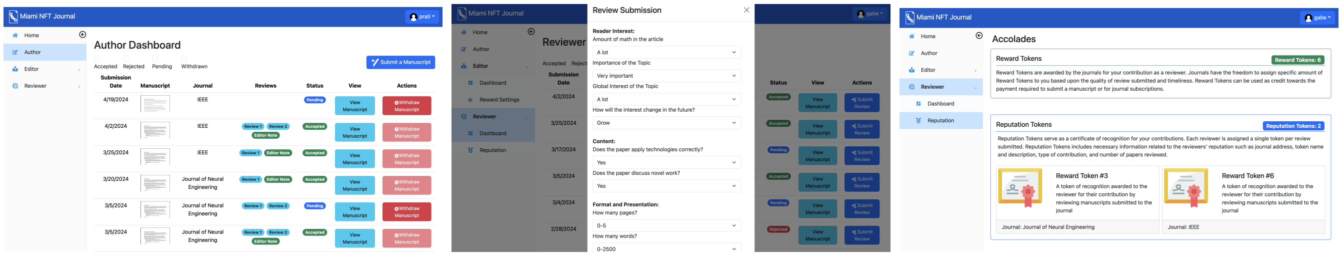
3) Submit review: : Reviewers receive review invitations along with deadlines for submission. Reviewers upload their review reports, accompanied by questions related to the paper they reviewed. Details related to the review submission are stored in the database.

4) Manuscript final decision: : The submitted reviews are accessible to the editor. Based on the reviews, they make an informed decision to either accept or deny the paper. Authors can now view the status of their paper's acceptance along with the review reports. The anonymity of the reviewer may be maintained, depending on the review process followed by the journal.

5) Reward Distribution: : The system periodically queries for new reviews submitted on the platform. Upon finding new reviews, reviewers are awarded non-transferable recognition tokens (SBTs) linked to the journal they reviewed for. If the journal's incentivization policy allows, then reviewers are also assigned transferable utility tokens (FRTs) whose value and amount depend upon the journal's policy and may vary depending on review timeliness.

IV. Prototype Implementation

The prototype for BARIT is designed to be simple and intuitive for all users. The primary functionalities of the



(a) Author Dashboard

(b) Review submission questionnaire

(c) Reviewer Reputation page

Fig. 3: Screenshots of BARIT User Interface

system are illustrated in screenshots in Figure 3. We used the `React.js v18` library to build a clean and scalable user interface. React.js offers a component-based architecture and has efficient rendering capabilities [39]. This ensures a seamless and responsive user experience along with efficient development and maintenance due to its reusable components. For interaction with the backend components, we utilize a `REST API` developed using the lightweight and minimalist `Express.js v4.16.x` framework for `Node.js v18` [40]. Express.js simplifies request handling and routing for client requests and allows easy integration with other modules and libraries. Additionally, Express.js's extensive documentation and active community support make it a safe choice for system's longevity. Both the user interface and REST API are containerized with Docker [41] and hosted on Ubuntu virtual machine running on Openstack hypervisor. Docker containerization simplifies deployment, guarantees a consistent environment, and optimizes resource utilization. This setup supports reliability and security, providing a stable and accessible platform for the peer review system's operation and future growth.

A. Blockchain Network

We chose Ethereum [34] due to its maturity and established ecosystem. Compared to other blockchain networks, Ethereum boasts a higher degree of decentralization, larger community support, and extensive tooling and infrastructure support. It also inherently supports smart contracts- executable codes that automate the execution of contract agreements.

Most client-facing API calls either interact with the private database or with read-only smart contract methods, which are usually fast and do not incur gas costs. Therefore, high blockchain throughput is not a big concern. Security and reliable management of fungible and non-fungible cryptotokens are essential due to the token-based incentive structure. With Ethereum's pioneering support for non-fungible tokens and established standards, such as `ERC-20` and `ERC-721` [42], the platform provides a reliable framework for minting, ownership, and transferring tokens. Ethereum's smart contract capabilities facilitate the creation of non-transferable fungible tokens. Moreover, if increased transaction throughput or lower costs are required in the future, a transition can be made to Layer 2 solutions like Polygon [43].

BARIT's smart contracts are built using `Solidity v0.8.4`, an object-oriented programming language specifically designed for Ethereum Virtual Machine (EVM) [44]. These smart contracts are deployed on the *Ethereum Sepolia* test network.

B. Crypto Wallet

The prototype is integrated with *MetaMask*, a popular crypto wallet that provides stringent security and widespread support. It offers a user-friendly browser extension that is compatible with most popular browsers. This allows our diverse user base the freedom to choose their preferred web browser for claiming and managing tokens.

C. Tokenization for Incentives

BARIT utilizes blockchain tokens to represent different forms of supported incentives. We are using two standards for token creation: `ERC-20` tokens as utility tokens and modified `ERC-721` tokens as non-transferable recognition certificates.

1) Soulbound Token (SBT): Soulbound Tokens are non-transferable certificates of recognition built upon the `ERC-721` standard with enhancements. Soulbound Token are permanently tied to a specific blockchain address or 'soul' assigned after minting [45]. Reviewers earn one SBT per completed review, serving as an immutable record of their contributions and a public acknowledgment of their work. They contain details about the review, including contribution type, journal name, token name, and description, ensuring transparency and authenticity in acknowledging reviewer efforts.

2) Fungible Reward Token (FRT): Fungible Reward Tokens are transferable fungible tokens adhering to the `ERC-20` standard. These tokens are disabled by default and can be enabled by the venue's editors. Publishers can opt-in for FRTs and offer varying amounts of tokens based on the timeliness of review submission. Different token amounts can be awarded based on meeting deadlines, encouraging reviewers to submit reviews promptly. Journals can assign values to FRTs according to their policies, such as offering them as credits towards subscription fees, submission fees, or other publication ecosystem incentives.

As illustrated in Figure 2, reviewers are periodically awarded SBTs and FRTs based on reviewed journal policies. Each blockchain transaction incurs a computational overhead associated with its initialization. When individual transactions are created for each token minting process, transaction overhead can significantly elevate cumulative gas costs. To mitigate this issue and enhance cost-effectiveness, all tokens of the same type are minted within a single transaction. This is achieved by consolidating the necessary information, including the reviewer's addresses, into a single blockchain method, from which all tokens are then minted. This approach reduces gas fees, minimizes resource utilization, and alleviates blockchain congestion. Additionally, various Solidity cost-optimization techniques like textitstruct packing and use of *unchecked for operations that cannot overflow or underflow*, are implemented to further optimize efficiency.

D. File Storage - IPFS

All the files associated with the review process are stored in the InterPlanatory File System (IPFS) network, a decentralized protocol enabling peer-to-peer file sharing that eliminates the reliance on centralized servers [32]. This allows the files to be accessed faster and more reliably. IPFS uses content-addressable storage, ensuring that the files once uploaded can't be tampered with, thus maintaining the data integrity of the submitted manuscripts and review reports. We used Pinata as the IPFS provider to handle storage and dedicated gateways for faster retrieval.

E. Review Rewards Database

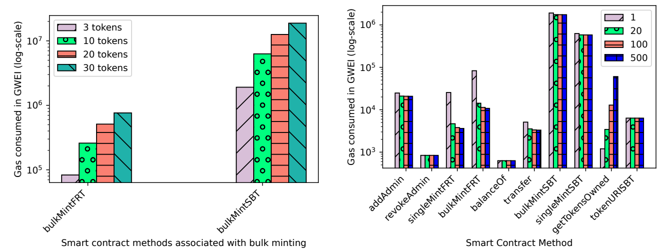
All the data related to user profiles, manuscript submissions, and reward allocation are stored in Oracle autonomous database [46]. Oracle offers high performance, scalability, and reliability through advanced technologies like in-memory processing and automatic fail-over, making the system resilient to failures. The database uses five tables: users, journals, manuscripts, reviews, rewards_allocation, and reward_settings. The tables store identifying information about users and journals, logs of manuscript submissions, review assignments, journal reward policies, and token allocation logs, including token claim status.

F. User Interface

Users log in to the platform using their Metamask [47] account. Upon successful authentication, they are redirected to their dashboard tailored to their specific role. Users can manage their profiles from the profiles page. Authors can submit their manuscripts and track their submission status through the author dashboard. Editors can assign reviewers, set deadlines, and make final decisions via the editor dashboard. Additionally, from the settings page, editors can customize incentive policies, including the option to enable or disable the issuance of utility tokens (FRTs) and adjust token allocation based on the timeliness of review submissions. Reviewers can upload review reports from their dashboard and access the reputation page, where they can monitor their accumulation of both fungible and non-transferrable recognition tokens.

V. Evaluation

We evaluated the prototype using both quantitative and qualitative methods. The quantitative evaluation assessed the estimated gas consumption by smart contracts and the latency



(a) (b)

Fig. 4: Gas estimate for BARIT smart contract API calls (a) Gas estimate for bulk minting SBTs and FRTs with varying number of tokens minted in one call; (b) Gas estimate for BARIT smart contracts with varying load factor

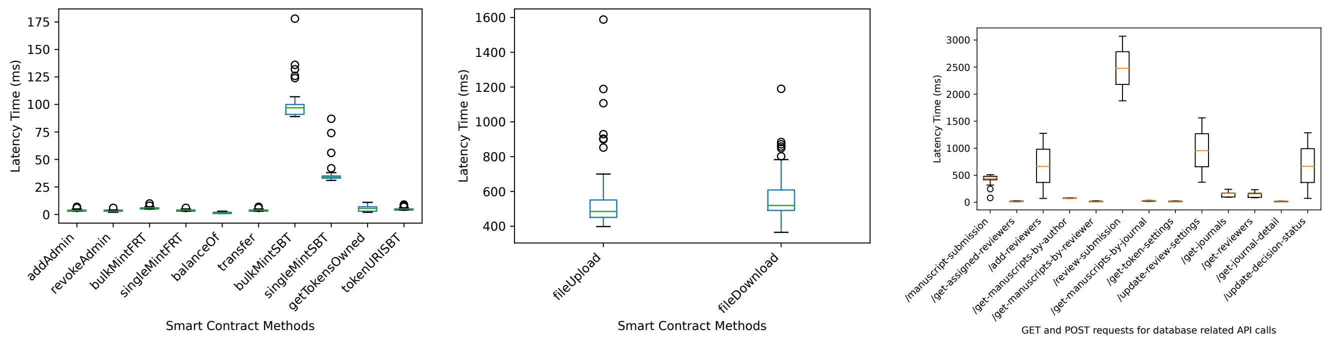
of API calls for smart contract methods, database queries, and file transfers. Qualitative evaluation gathered feedback on the developed prototype and its usefulness through interviews.

A. Quantitative Evaluation of the Prototype

All the functionalities of the smart contract methods were tested by writing unit tests using *Hardhat*, an Ethereum development environment [48]. We integrated *Foundry toolchain* [49] with the Hardhat to estimate gas prices and latency for smart contract methods under varying load conditions. We utilized *AutoCannon*, a benchmarking tool known for its accuracy and reliability to measure the request latency of database API calls and IPFS file transfers [50].

1) Gas Price Estimates: Figure 4b analyzes estimated gas prices for varying load factors, ranging from 1 to 500 API calls. Most smart contract method calls exhibit consistent gas costs across loads. The `balanceOf` API call returns the total amount of FRTs available to the user. The transfer API is responsible for token transfers. These methods will be used frequently for different token transactions in the system. Their low gas cost variance ensures predictable transaction costs and minimizes the risk of unexpected fees. The `getTokensOwned` API retrieves a user's SBT IDs for displaying earned SBTs with metadata obtained from `tokenURISBT` API. Methods such as `bulkMintFRT` and `bulkMintSBT` facilitate the bulk minting and assignment of FRTs and SBTs, while `singleMintFRT` and `individualMintSBT` handle the minting and assignment of single tokens. These minting methods for SBTs have consistent gas prices. However, single and bulk minting of FRTs, and `getTokensOwned` methods show some variance. Token minting can be scheduled for low gas cost periods to optimize efficiency. Low variance in gas costs is a desired attribute for accurate transaction cost estimation, enhancing system reliability

Figure 4a illustrates a direct correlation between gas costs and the number of tokens minted per API call. The cost of bulk minting rises proportionally with the number of tokens minted. If the tokens minted per API call are unchecked, it can result in exorbitant gas prices. To prevent this, the API limits minting to a maximum of 30 tokens per transaction, ensuring affordable transaction costs while minimizing the



(a) API calls to smart contract methods (b) API calls for IPFS file transfer (c) API calls with database connection

Fig. 5: Request latency of BARIT API calls with 50 concurrent API calls

overhead of multiple transactions. Future exploration could involve alternative solutions like consortium or permissioned networks to leverage blockchain benefits without significant financial constraints.

2) API call latency estimates: We assessed delays for API calls involving database queries, smart contract interactions, and file transfers. The prototype underwent load testing with 50 concurrent requests per second for each API call, simulating a high user volume. Figure 5a represents the latency of different smart contract methods with 50 concurrent API calls. All read-only methods exhibit minimal latency within the range of 2-10 ms. The consistently low latency of `balanceOf` and the transfer method ensures smooth token trading even under high network traffic. Similarly, the users won't have issues displaying their accumulated SBTs as `tokenURISBT` and `getTokensOwned` methods also have low and consistent latency. The only smart contract method that exhibits a variance with a higher delay in the range of $70-170$ ms is `bulkMintSBT`, minting 3 tokens at a time in this setup. However, token minting is performed once a month in the back-end and doesn't directly impact user experience.

The latency and performance metrics of API calls responsible for various database queries are illustrated in Figure 5c. The system maintained consistent performance under multiple concurrent requests, with minimal delay times averaging between 15-80 ms for most GET methods. However, calls such as get-journals and get-reviewers, responsible for retrieving all registered journals and reviewers, showed slightly higher average latency in the range of 140-150 ms. Despite this, the API latency remained sufficiently low for users not to perceive any noticeable wait times. The `POST` methods responsible for the submission of manuscripts, review submissions, decision submissions, and setting updates exhibited higher average latencies ranging from 426 ms to a maximum of 2.4 sec (for review submission). Considering the nature of form submissions, delays below 3 sec are generally acceptable. It's important to note that this experiment was conducted with a load of 50 requests per second, which exceeds the anticipated user traffic for the system.

The latency for file upload and download from the IPFS network is illustrated in Figure 5b. The average latency for file upload was recorded at 573.32 ms, while for file download, it was slightly higher at 578.36 ms. The majority of requests for both methods fell within the range of 400 ms to 800 ms, with a few outliers reaching up to 1600 ms.

B. Qualitative Evaluation With User Survey

We presented the prototype to previous interviewees and gathered their feedback through open-ended questions. Interviewees expressed that the system effectively incentivizes reviewers to engage more actively. They also found the user interface to be intuitive and user-friendly, with features that cater to the peer review community's needs. Interviewees with editorial experience suggested conducting a pilot study with a small journal or conference, offering valuable insights for further refinement and validation of the system. On the other hand, two interviewees expressed concerns about whether this incentivization scheme would be effective in enhancing the quality of the reviews.

VI. Conclusion

This research tackles the challenges of finding expert reviewers by leveraging a hybrid on-chain/off-chain database system. The token incentives motivate the researchers to actively participate as reviewers with added benefits for timely review. Permanent records of token distribution on blockchain ensure that the rewards remain secure regardless of the journal or its physical systems. To encourage broader adoption the system is agnostic to peer review types and preserves user anonymity. This prototype follows a double-blind approach which can be easily adjusted to support open and single-blind review systems. The evaluation results demonstrate the system's ability to handle high user traffic and has received positive user perception within the academic community. However, the success of this system is dependent on its adaptation by multiple journals and publication venues. We plan to introduce BARIT to a few publication houses and do a test run to evaluate its application in real-world scenarios. The token valuation for publication-related activities will be implemented in the next phase. In the future, we aim to make the reward distribution more fair and appropriate by adding more flexibility with metrics such as review quality, length of the paper being reviewed, and experience level of the reviewer along with a penalty when the reviewer fails to submit a review after accepting review invitation.

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