WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

UPayChain: A Tokenized Cloud Payment System for Transparency and Fairness

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Abstract

With the exponential growth of cloud services, transparent and fair billing systems are critical. UPayChain introduces a blockchain-powered cloud payment architecture that ensures transparency, fairness, and efficiency through smart contracts and tokenized billing. This system addresses the challenges of dynamic resource consumption by leveraging real-time metrics and decentralized validation to offer a more accountable cloud ecosystem.

Keywords: Cloud Computing, Blockchain, Smart Contracts, Tokenized Billing, Transparent Cloud Payments

1. Introduction

Cloud computing provides scalable, on-demand computing services. Despite its advantages, current billing mechanisms often lack transparency and fairness. UPayChain addresses these issues through blockchain integration, promoting a tokenized, real-time billing framework that ensures cost accuracy and accountability for users.

2. Related Work

Previous works on cloud billing primarily focused on fixed-rate models or pay-as-you-go structures, often lacking fairness in dynamic usage environments. Blockchain applications in cloud services have emerged to solve trust and verification issues, but limited studies combine billing precision with smart contract automation.

3. Proposed System

UPayChain integrates blockchain technology into the billing layer of cloud computing platforms. It introduces a decentralized ledger for transaction recording, smart contracts for real-time and fair pricing, and tokenized payments representing resource value. The system supports multi-cloud environments and emphasizes data privacy.

3.1 System Architecture

The architecture consists of cloud service providers, blockchain nodes, smart contracts, and users. Users interact with the platform to consume services, with usage metrics recorded and payments processed via smart contracts.

4. Implementation

The system is developed using Flask for backend, MySQL for data management, and Python packages like Pandas and Matplotlib for data handling and visualization. Blockchain interaction is managed using JSON structures, and transactions are validated in real-time.

4.1 Modules

Major modules include: Cloud Service Interface, Owner and User Dashboards, Data Consumption Monitoring, Billing Engine, Payment Gateway Integration, and Notification System. Each module is tied together via a secure blockchain infrastructure.

5. Evaluation

Testing covered functionality such as registration, service selection, data upload, invoice generation, and secure payment. Real-time simulations validated fairness and accuracy. All test cases passed successfully, including edge cases such as dynamic pricing and concurrent access.

5.1 Results Summary

UPayChain demonstrated reliable billing, secure token transfers, and accurate consumption monitoring. Real-time alerts and dynamic token calculations ensured precision and user confidence.

6. Discussion

The integration of blockchain addresses transparency issues effectively. Token-based payments offer flexibility and auditability. However, computational overhead and scalability under high loads remain areas for enhancement.

7. Conclusion and Future Work

UPayChain offers a transformative approach to cloud billing, merging blockchain's transparency with smart contract automation. Future work includes integration with AI for predictive billing and extending to edge computing and DeFi platforms.

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