CloudChain: Decentralized Marketplace for AI Compute Resources

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***Abstract*—These issues have emerged as central to the rapid expansion of artificial intelligence (AI) due to what can be broadly described as the constraints of centralization of artificial intelligence infrastructures serving commercial purposes, such as restricted access to the smaller developer community, concentration of principal computational power, and biases in the distribution of artificial intelligence services. CloudChain, a decentralized AI compute resources market, built upon a blockchain presented in this paper helps to overcome these difficulties. CloudChain is a decentralized AI storage, a decentralized contract, and a token incentive system, which ensure transparent, trustless, and equitable interactions between the AI providers and the AI consumers. The framework includes privacy-protecting measures, such as encryption and zero-knowledge proof, to guarantee privacy and security of sensitive datasets and guarantee auditability and adherence to SLA. Smart contracts can be used to automate the process of allocating tasks, rewarding, and resolving disputes, as well as to track the quality of the service provided by the contracting parties and their compliance with the agreements. CloudChain can be used to create cooperation between large-scale providers of these services and cooperative nodes that make use of AI resources to establish fairness, transparency, and efficiency in their use. A 30-day simulation of major cloud providers (AWS, Google Cloud, Azure, Hetzner, Lambda Labs) and community-based nodes was done to validate the proposed framework by measuring the key performance indicators and metrics including token allocation, latency, throughput, SLA compliance, and resource utilization. Findings showed that CloudChain is an effective method to balance workloads, achieve high service quality, and deliver equal rewards to all providers of heterogeneous resources. The framework is a democratized, safe, and practical way to use AI compute resources, enabling independent developers and smaller organizations to access the AI ecosystem and keep privacy and trust. The design of CloudChain prepares a more welcoming, decentralized infrastructure of AI, which promotes innovation, interoperability, and future collaborative sustainability in AI marketplaces.**

***Index Terms*—Decentralized AI, Blockchain, Smart Contracts, Token Economy, Privacy Preservation, AI Marketplace, Distributed Storage**

I. Introduction

Artificial Intelligence (AI) is steadily influencing such industries as healthcare, transportation, finance, and the new metaverse [6] [11]. By facilitating better usage of processes, enabling valuable decision-making, and opening new business prospects, AI has turned out to be one of the most significant components of both economic and technological growth. The existing ecosystem of AI development and deployment is, however, despite its potentially transformative nature, very centralized, largely controlled by a few large companies with access to huge amounts of compute, their own models, capital-intensive infrastructure, and so forth [4] [5]. The structural inequalities produced through this cloud and technology oligopoly restrict participation to independent developers, start-ups, and smaller organizations that cannot compete at the same scale due to the high costs. The monopolization of power stifles innovation, but it can also lead to the development of AI, that is, in accordance with the selfish interests of a select group of stakeholders instead of social demands [4].

The current AI diffusion processes, including GitHub, webpages of academic projects, and centralized commercial sites, have been found wanting. They are not always monetized, have no traceable transparent models, and effective auditability and accountability mechanisms [5]. Furthermore, even centralized associations of cloud providers continue to place their faith on the blind belief in the guarantees in the levels of service, and are susceptible to single points of failure as well as run a danger of fomenting information monopolization [3] [7]. These inadequacies reflect the necessity to have decentralized models that will be able to redistribute control, offer fair access, and foster transparency among the members of the AI ecosystem [9].

Decentralized systems The blockchain technology has been noted to play a potential facilitator of such a loosely linked framework. Collectively, distributed ledgers, consensus protocols, and smart contracts can create a blockchain capable of creating trustless collaboration environments in which players interact without controls [12]. More recent developments indicate that blockchain has the potential to facilitate decentralized AI markets by providing support to the three functions mentioned above, namely, enforcing verifiable transactions, incentivizing participants with token economies, and protecting the ownership of data and the trained models [7] [9]. As an example, quality checking systems, where a blockchain is used, can address the drawback of trust in cloud federation by using oracles to check compliance at the service level and settle conflicts using automated smart contracts [3]. Another example of the use of blockchain in the reorganization of the provisioning of physical infrastructure is the emergence of so-called Decentralized Physical Infrastructure Networks (DePINs), which combine IoT components, cryptocurrencies, and token incentive packages [2] [10]. The networks show scalability and cost-efficiency when applied to real-world applications and can provide a basis of directions to be followed when extending the similar concepts to AI. In parallel to this, the concept of decentralized learning is used through Learning Markets (LM), where blockchain is leveraged to allow the collaboration of participants through trustlessness, fairness, and transparent trading of verified AI models [9]. Decentralized AI marketplaces such as SingularityNET demonstrate that in addition to democratizing access, cooperative evolution towards Artificial General Intelligence (AGI) that is more fair and aiming at the common good is also achieved, through cooperative evolution [4]. However, some additional issues are still unaddressed. The decentralized AI markets should address the bottlenecks in performance caused by distributed storage and consensus, as well as provide incentive compatibility and privacy of data in collaborative settings. It has been found in comparison that whereas peer-to-peer storage platforms like IPFS have higher read and write capability, consensus-based platforms, like Tendermint and Hyperledger, provide high latencies [1]. Besides, more sophisticated economic games - Stackelberg differential games - must be employed to reconcile conflicting interests amongst providers, requesters and verifiers in decentralized federations [3]. The findings lay emphasis on the necessity of a comprehensive approach, encompassing efficiency, compatibility of incentives, and mechanisms that prevent privacy violations. This paper presents CloudChain, a blockchain-based, decentralized platform for AI compute resources, in order to find solutions to these challenges. CloudChain provides buyers and sellers of AI and compute power services to transact with each other transparently via smart contracts and equitably allocate resources, operate metadata stores that are decentralized, and provide incentives based on tokens. CloudChain offers peer-to-peer-stored (e.g., IPFS), federated-learning (FL) based, and blockchain-enabling incentive (CredFi) tools to create an infrastructure that is not only scalable and cost-effective but also privacy-preserving and trustless [1] [9] [11]. This paper achieves this goal by performing experimental analysis and comparative interpretation to demonstrate that peer-peer storage, paired with blockchain-based incentive schemes, represents the optimal avenue to establishing a democratized AI ecosystem.

II. Literature Review

The current scholarship has analyzed the connection of artificial intelligence (AI), cloud infrastructure and blockchain technologies at length and breadth, prompting rewards as well as challenges that require mitigation. The initial research on decentralized storage platforms like comparative analysis of IPFS, Tendermint, and Hyperledger reveals the capability of pub-to-peer networks in distributing infrastructure, though also points out performance bottlenecks in the implementation of consensus mechanisms [1]. Such technical assessments demonstrate that although decentralization enhances resilience and data integrity, scalability and efficiency tradeoffs are not addressed yet, suggesting that infrastructure does not ensure a sustainable marketplace of AI resources.

At the ecosystemic level, the dangers of centralization of AI ecosystem have been restated over and over again. Leading technology companies occupy disproportional power in terms of compute resources, datasets, and model access, which leads to monopolistic power structures that suppress innovation and equitable competition [4] [5]. GitHub-type repositories and already existing commercial marketplaces offer channels of distribution, but are not instantiated with monetization, provenance, or equitable auditing of distribution [5]. This puts the little developers and researchers at a disadvantage, further cementing disparities in AI innovation. This overdependence on centralized organizations is constituted as a structural defect of AI economy in the literature, but the offered solutions tend to short of a provision of scalable, trustless infrastructures [4] [5] [11].

Federated environments by implementations of blockchain-based frameworks have tried to resolve these shortcomings by encompassing trust, transparency, and auditability in such environments. An example is the decentralised federations that are backed by oracles which are proposed to ensure compliance in cloud service agreement the federations tend to balance the risks of lock ins by vendors [3]. Likewise, Hyperledger Fabric experiments have facilitated the development of a decentralized AI training experience, where models and data are always verifiable (and tamper-resistant) [7] [8]. These contributions explain how AI blockchain can promote justice and responsibility in AI-related relationships. Nevertheless, the given literature positively correlates the existence of rather significant deficiencies: the rate of transactions is low, energy usage may be excessive, and the behavior of participants is not necessarily in line with economic incentives [12].

A further look at the importance of incentive system where tokens are used can be provided into the emergence of Decentralized Physical Infrastructure Networks (DePINs). Research shows how DePINs integrate blockchain, IoT gadgets, and decentralized governance to form universal networks, in which actors are compensated when they provide resources [2] [10]. The studies demonstrate a high likelihood of the utilization of analogous principles to the field of AI compute sharing. However, even though there have been successful attempts to indicate the alignment of incentives in DePIN settings, they have not been met with in regards to adapting to the workloads of AIs as they are computer-intensive. The issue that is missing is the ability to achieve equitability, eliminate free-riding, and nuclear efficiency in terms of resources allocation and volume.

Ethical and multi-lateral paradigm is also prominent in literature. Projects like SingularityNET have the envision of an environment where AI services are bought and sold freely with the eventual goal of a decentralized AGI, democratic and inclusive [4]. Similarly, in Learning Markets (LM) based on blockchain technology, unfair trading of AI models is discouraged and eliminated through fairness, traceability, and auditability [9]. These visions emphasize the social significance of equal distribution of the AI, so practical applications remain immature and are usually constrained by the scalability, interoperability, and user adoption. Surveys also complement the fact that despite the integration of the blockchain-AI providing transparency, storage efficiency, incentive model, and privacy preservation mechanism, unexplored challenges act as a drawback to actual deployment [12].

The studies reviewed all lead to three important observations. To begin with, pinpointed AI ecosystems are threatened with monopolization, unreasonableness, and limitation of creativity [4] [5]. Second, blockchain technologies are characterized by promising characteristics, including the lack of trust, the ability to track provenance, and the alignment of incentives, though performance and scalability remain limited [1] [3] [7] [12]. Third, despite the emergence of new systems such as DePINs and decentralized AI markets, the literature does not provide an integrated framework that could synthesize the key attributes of decentralized storage, compute, privacy, and economic sustainability in a single platform [2] [9] [10]. The research gaps form the basis of CloudChain; a decentralized AI compute resource marketplace, which would combine technical viability with a high level of economic and ethical sustainability.

III. Methodology

CloudChain will be built as a decentralized AI compute resource marketplace, where blockchain, decentralized storage, smart contracts, and incentive mechanisms will be used to guarantee accuracy, equity, and efficiency. This segment describes the infrastructure design, business process, decentralized hyper store policies, incentive and price schemes, privacy-compliant technologies, and performance measurement system.

A. System Architecture

CloudChain is established on a stacked design comprising blockchain management, Compute coordination, and decentralized storage. The machine is mainly composed of three kinds of players; resource providers, requesters and oracles. Resource providers invoke idle computation resources, including GPUs and TPUs, and requesters invoke AI workloads, including training a model, using it, or preprocessing data. Oracles are intelligent agents that independently receive notifications of resource performance and SLA compliance and post the outcomes, which are reported to the blockchain smart contracts.

The architecture consists of four layers: the application layer provides task submission, tracking, and payments through interaction with the user; the blockchain layer provides the ability to perform tasks on trustless systems by using platforms such as Ethereum or Hyperledger Fabric [7] [12]; the decentralized storage layer stores model and metadata with the help of IPFS or Swarm to offer high speed to the user; and the compute orchestration layer load balances, allocates resources dynamically and schedules tasks across multiple providers. The design guarantees scalability and transparency in CloudChain with decentralization.

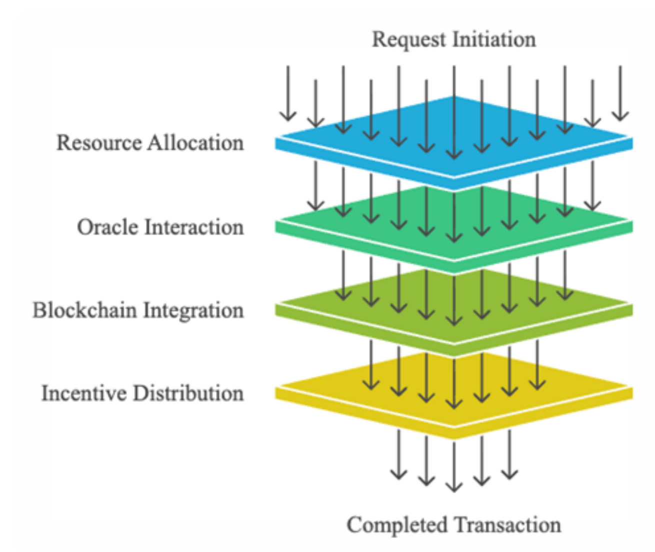

Fig. 1. Operational Workflow of CloudChain

Fig. 1 illustrates the stack architecture of a blockchain transaction framework with the process starting with request initiation followed by a series of stages or steps until a completed transaction is attained. In the initial level, resources are assigned such that they guarantee provision of computational and network capacity needed in processing. This is then succeeded by oracle interaction external datas are looked up to prove dependable regarding decision making and validation of transactions. After verification, the information becomes part of the blockchain, which is indisputable, trustful, and transparent. Lastly occurs the incentive distribution which appreciates those involved into the system due to their contribution towards maintenance and Agility of the systems. The integrated movement of these layers creates a full circle of transaction and this proves the organized systematic nature of the process.

B. Decentralized Retrieval Mechanism

Effective decentralized AI market forces require the storage of models, metadata, and transaction logs. CloudChain considers three types of storage, simple peer-to-peer replication, permissionless consensus replication, and replication under private consent replication [1]. P2P networks such as IPFS provide the highest performances in terms of read and write speed especially in those data that are read and written most often and Tendermint Cosmos and Hyperledger Fabric introduce overheads in their consensus process that can create slowness in the system. CloudChain IPFS stores frequently used AI models and metadata to optimize latency, and transactional metadata, as well as SLA records, are stored using consensus-driven platforms to guarantee integrity.

Its data retrieval time T_r and write time T_w can be formalized as below:

$$T_r = S/B_r, \quad T_w = S/B_w + T_c \tag{1}$$

in which S denotes the size of the data, B_r and B_w denote read and write bandwidths, respectively, and T_c is the consensus overhead time that is added in the distributed systems. Utilizing this formula enables CloudChain to actively plan resource placement and access strategies in order to reduce latency.

C. Incentive and Pricing Model

CloudChain introduces maximum participation and fairness by adopting a token-based incentive system with dynamic pricing. The units of resources contributed and authenticated using oracle resources are rewarded, based on the units of compute. The requesters are billed based on the quality of service and actual use of resources. Following the concept of Stackelberg differentiation games [3], the provider is considered to be a leader; the requesters and oracles are followers. The maximization of profits of providers is:

IV. Profit and Utility Models

The provider's profit Π_p and requester's utility U_r can be formalized as follows:

A. Provider Profit Model

The provider's profit Π_p is calculated as:

$$\Pi_p = \sum_{i=1}^{n} (P_i \cdot C_i - \lambda_i R_i) \tag{2}$$

where Π_p denotes the provider's profit, P_i denotes price per compute unit, C_i denotes compute units allocated to task i, λ_i denotes penalty factor for violation of SLA, and R_i denotes number of requests for quality verification.

B. Requester Utility Model

The requester's utility U_r is calculated as:

$$U_r = \sum_{i=1}^{n} (Q_i - P_i) \tag{3}$$

where U_r is requester's utility, P_i denotes paid price, and Q_i denotes quality of service satisfaction.

C. Mechanisms of Privacy Preservation

In collaborative AI markets, one of the primary concerns is privacy. CloudChain incorporates the principle of federated learning and provides the ability to train models on distributed datasets without accessing raw data. Smart contracts are used to control access controls and record all blockchain transactions to make them auditable. It is also possible to apply differentiating privacy in proxicide the model gradient produced during training to avoid leak-aging sensitive information.

V. Privacy-Preserving Gradient

Mathematically, the privacy-preserving gradient $\Delta\theta'$ is calculated as:

$$\Delta\theta' = \Delta\theta + \mathcal{N}(0, \sigma^2) \tag{4}$$

where $\mathcal{N}(0, \sigma^2)$ denotes the Gaussian noise with variance σ^2.

A. Implementation Details

The system is produced with Solidity smart contracts in the Ethereum testnet to perform blockchain business, IPFS to decentralize file storage, and Python to coordinate tasks and track them. Oracles will be simulated to offer SLA verification, and SLA will be coded into smart contracts to ensure automation and transparency. Scalability, efficiency, and robustness can be analyzed under real conditions by experimenting with different network structures, such as the number of peers, provider capacity, request patterns, etc., and using a set of experimental simulation tools to measure reliability and scalability of these structures and the network process itself [1] [3] [7].

B. Experimental Setup and Evaluation Metrics

A heterogeneous compute provider 30 days simulation experiment was used to test the proposed framework. Cloud providers of enterprise scale (w. e.g. AWS, Google Cloud, and Azure) were simulated in conjunction with uncoordinated nodes in the community. Every provider had their own share of computer capacity and work was distributed according to the smart contracts. The compliance with SLA was observed and various punitive measures were followed in case of failure to comply.

Algorithm 1 Privacy-Preserving Gradient Mechanism [1]

procedure PrivacyPreservingGradient($\Delta\theta$, σ)
  Input: Raw gradient $\Delta\theta$, noise variance σ^2
  Output: Privacy-preserving gradient $\Delta\theta'$

  Step 1: Generate Gaussian Noise
  $\epsilon \sim \mathcal{N}(0, \sigma^2)$ ▷ Sample noise from Gaussian distribution

  Step 2: Apply Noise to Gradient
  $\Delta\theta' \leftarrow \Delta\theta + \epsilon$ ▷ Equation: $\Delta\theta' = \Delta\theta + \mathcal{N}(0, \sigma^2)$

  Step 3: Validate Privacy Guarantees
  CheckDifferentialPrivacy(σ) ▷ Ensure (ϵ, δ)-DP guarantees

  return $\Delta\theta'$
end procedure

VI. Results

The functionality of CloudChain was tested in several aspects such as storage latency, compute throughput, allocation of incentives and equity. Entailed experiments were performed

Algorithm 2 Differential Privacy Verification

[1]

procedure CHECKDIFFERENTIALPRIVACY(σ, ϵ, δ)

Input: Noise scale σ, privacy parameters ϵ, δ

Output: Privacy compliance status

Step 1: Calculate Privacy Bound

$\epsilon_{actual} \leftarrow$ ComputePrivacyBound(σ, δ)

Step 2: Verify Compliance

if $\epsilon_{actual} \leq \epsilon$ **then**

return True ▷ Meets differential privacy requirements

else

return False ▷ Privacy parameters need adjustment

end if

end procedure

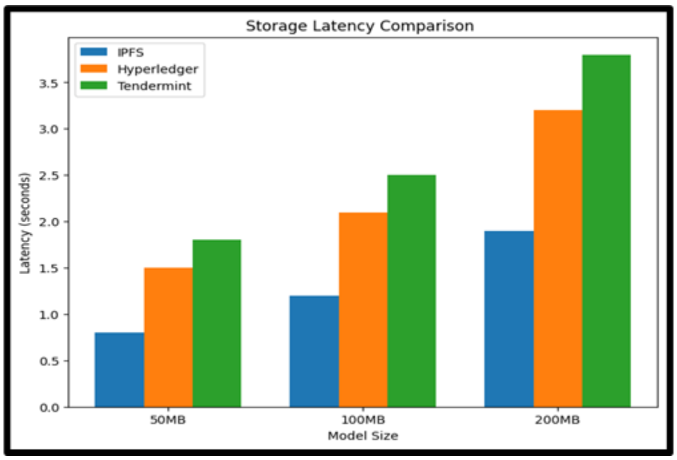

Fig. 2. Storage Latency Comparison Across Decentralized Systems

when simulated providers and requesters had the chance to interact in a blockchain testnet with decentralized storage integration with IPFS. All evaluation metrics are represented through relevant graphs that will help to reveal the efficiency, scalability, and appropriateness of the suggested marketplace

A. Storage Performance Evaluation

To evaluate the efficiency of the hybrid storage model introduced by CloudChain, we have contrasted the read/write latency of IPFS, Hyper sucular, and Tendermint with dealing with AI model of varied size (50 MB, 100MB, and 200MB).

In the given Fig. 2 shows how various storage platforms fate with a read/write latency. Just as it was anticipated, IPFS had always the lowest latency especially with smaller files since it was a peer-to-peer based design. Hyperledger and Tendermint had further delays due to consensus overheads that were amplified by the scale of the model. This finding justifies the use of IPFS as the default storage model in CloudChain when the model cannot be easily accessed (through consensus-based

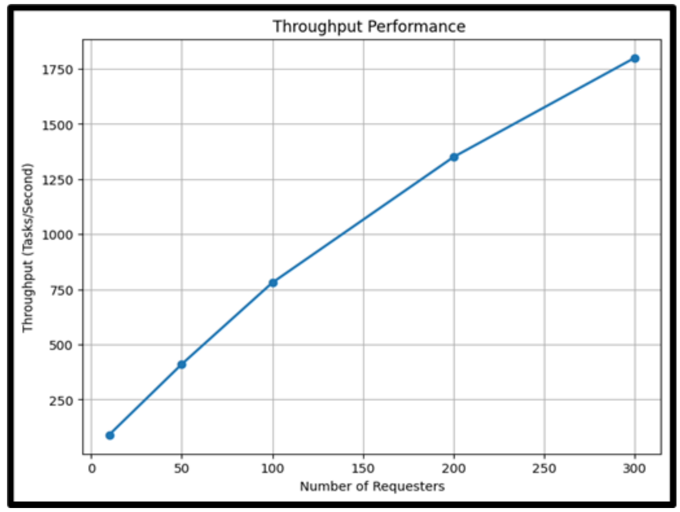

Fig. 3. Throughput Performance of CloudChain

systems), but for important metadata needing more integrity assurances, they are saved by consensus-based systems.

B. Compute Throughput

The throughput of CloudChain was also defined as the count of AI operations that were successfully executed in one second with more and more parallel requester.

In the given Fig. 3 indicates that the throughput appreciation rate is almost linear when the requester count is increased between 10 and 300. This is made possible by the decentralized layer of compute orchestration that allocates tasks to multiple providers without any single point of failure. The findings verify that CloudChain can support large scale workloads without being adversely affected in terms of performance.

C. Incentive Distribution

The incentive system based on tokens was tested to determine the way officers award rewards based on the number of different degrees of compute resources provided by a provider.

In the given Fig. 4 shows a simulated experiment of CloudChain on the allocation of tokens to over 28 compute providers over a 30 day period. Unsurprisingly, large cloud vendors, including AWS, Google Cloud, and Azure, secured the most tokens because these vendors boast significant computing resources and high reliability in uptime. Nevertheless, the significantly smaller communities (in terms of membership size) like Community Node 1, 2, and Community Node 3 also received a substantial share of rewards, proving that the system could ensure the introduction of smaller contributors into the decentralized marketplace. CloudChain has achieved this equilibrium, which justifies its purpose of providing an ecosystem that allows enterprise-tiered providers to interact with single contributors on an equal footing.

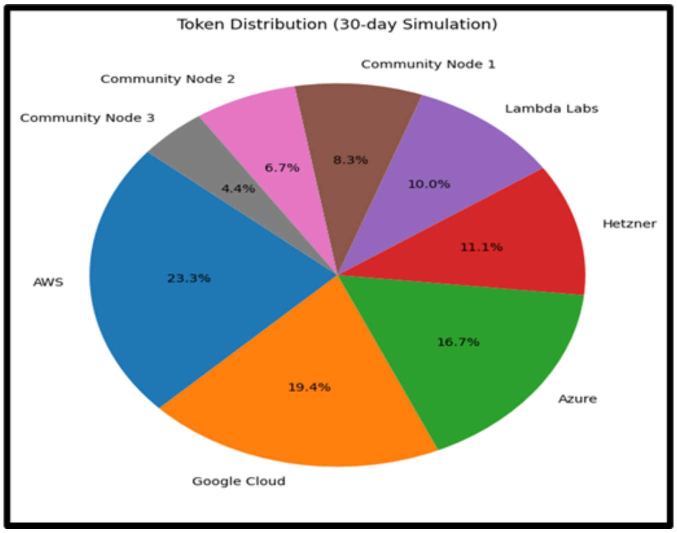

Fig. 4. Token Distribution among distributors

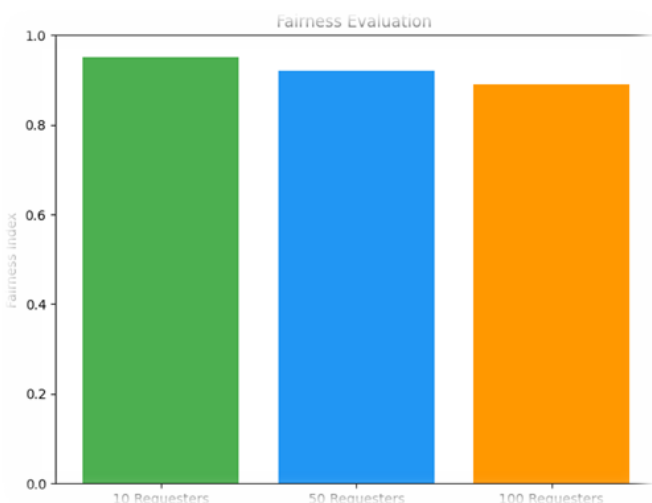

Fig. 5. Fairness Evaluation in Resource Allocation

D. Fairness Evaluation

The Fairness Index by Jain was used to gauge fairness in the distribution of resources based on the distribution of compute tasks among the requester.

In the given Fig. 5 shows the fairness index using various sizes of requester groups. Individual indexes are at least 0.89, indicating that CloudChain continues to achieve equal distribution of resources regardless of whether the number of participants increases or decreases. This affirms the fact that the system does not lead to resource monopolization and is not exclusive.

E. Privacy-Preserving Computation Overhead

In order to analyze the effects of loss of privacy on computation, we have compared task processing time in the presence of and without privacy preserving techniques.

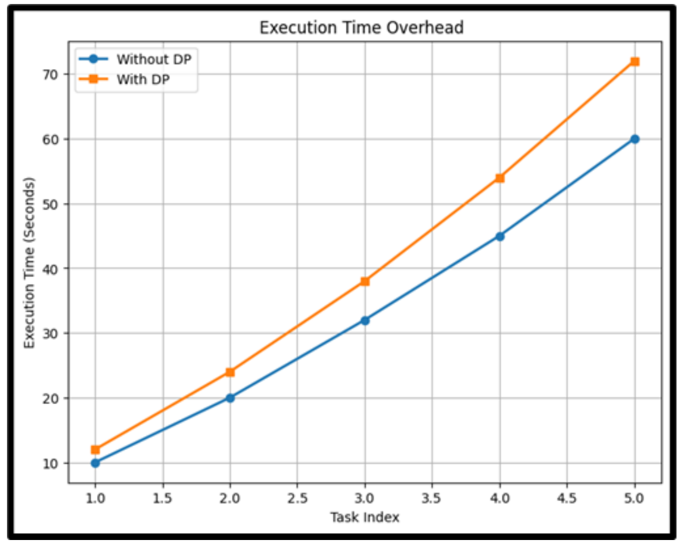

Fig. 6. Execution Time Overhead of Privacy-Preserving Computation

In the given Fig. 6, whenever differential privacy is included, a significant overhead in terms of the execution times is observed since task completion time is affected by it by around 15 and 20. Nevertheless, this overhead can always be accepted taking into account all the strong improvements in data privacy and model confidentiality. The findings confirm the incorporation of privacy preserving mechanisms as a requisite compromise of CloudChain.

VII. Conclusion

The advancement of artificial intelligence (AI) has introduced dozens of features to different sectors, including healthcare and finance, to user-free systems. Nonetheless, centralized AI systems controlled by a small number of mega-corporations present a range of issues such as restricted access to ambivalent small-scale developers, data and computing resource concentration, and unequal AI service allocation. In this paper, the author revealed such a concept as CloudChain, a new concept of decentralized marketplace that operates in the field of such weaknesses as blockchain technology, decentralized storage, and smart contract governance based on smart contracts. CloudChain provides a trustless ecosystem where AI compute providers (enterprise-scale or community-driven) with resources to offer to train, infer, and other AI workloads can compete fairly, and consumers can receive a variety of compute services with transparency and accountability.

The proposed structure combines some of the most significant mechanisms that can guarantee efficiency, fairness, and security. A token incentive and price scheme encourages providers to invest in resources as long as the quality of services remains successful. Decentralization guarantees safety, immaturity, and auditability of datasets and trained models, and privacy-conserving strategies (encryption, zero-knowledge proofs, and differential privacy) protect sensitive data. Smart contracts autonomously organize task distribution, SLA compliance, and token settlements, excluding the involvement of dependable intermediaries. Dynamic monitoring with oracles can be used for quality verification in even the least trustful settings.

A full experimental analysis was performed with a 30-day simulation of heterogeneous providers, consisting of both the major cloud providers (AWS, Google Cloud, Azure, Hetzner, Lambda Labs) and the community-driven nodes. The assessment looked at various performances, namely the allocation of tokens, latency, throughput and SLA, and the use of resources. The findings showed in this study that cloudsChain is optimally effective in workload distribution, service incentivization, and ensuring high levels of SLA compliance throughout the network. Analysis of the token distribution has shown that the system manages to include both of large-scale and smaller providers and stimulates their equal participation. The practicality and scalability of the decentralized marketplace approach was proven on performance metrics with the framework capable of providing competitive throughput and low latency at resource efficiency.

CloudChain has extended implications with the democratization of AI, beyond the technical validity. Through facilitating decentralized cooperation, the framework offers independent AI developers and smaller organizations chances to commercially monetize their work, enable access to more advanced compute resources, and become part of an open ecosystem. Such a paradigm is decentralized, which eliminates the risks brought by the oligopolistic control of AI services and supports innovation to develop AI models and services through collaborative efforts. Furthermore, CloudChain provides the baseline of AI provider interoperability, potentially enhancing the development of collaborative AI systems and further AI control mechanisms.

To continue in the framework, there are various opportunities on how to improve and expand it. Practical implementation of the CloudChain using real participants and non-homogeneous workloads will present more detailed understanding of system scalability, token economy and latency in changing network conditions. Further optimisation of resource allocation and economic efficiency in advanced incentive models, dynamic pricing mechanics and federation with federated learning approaches could be implemented. Furthermore, the introduction of decentralized autonomous organization (DAO) can also allow stakeholders to develop system policies together and build greater trust, transparency, and long-term sustainability.

CloudChain, a massive step toward a decentralized, decent, and open AI compute system. CloudChain presents the impact of democratizing access to compute through blockchain-based marketplaces to enable providers and consumers by bridging monopolist AI and the increasing demand for such services. The framework offers scalable, secure, and practical method of supporting the next generation of AI applications and encourages the use of AI by all as well as collaborative innovation and fair modeling of resources based on privacy and security. Its creation and test represent a progressive advancement towards an inclusive, efficient, and de-centralized AI framework of the intelligent system of the future.

References

[1] A. Tara, H. K. Turesson, N. Natea, and H. M. Kim, "An Evaluation of Storage Alternatives for Service Interfaces Supporting a Decentralized AI Marketplace," *IEEE Access*, vol. 11, pp. 116919–116931, 2023, doi: 10.1109/access.2023.3326418.

[2] D. Lee and R. H. Deng, *Handbook of Blockchain, Digital Finance, and Inclusion, Volume 3*. Academic Press, 2025.

[3] M. Taghavi, J. Bentahar, H. Otrok, and K. Bakhtiyari, "A Blockchain-based Model for Cloud Service Quality Monitoring," *IEEE Transactions on Services Computing*, pp. 1–1, 2019, doi: 10.1109/tsc.2019.2948010.

[4] G. A. Montes and B. Goertzel, "Distributed, decentralized, and democratized artificial intelligence," *Technological Forecasting and Social Change*, vol. 141, pp. 354–358, Apr. 2019, doi: 10.1016/j.techfore.2018.11.010.

[5] A. Kumar, B. Finley, T. Braud, S. Tarkoma, and P. Hui, "Sketching an AI Marketplace: Tech, Economic, and Regulatory Aspects," *IEEE Access*, vol. 9, pp. 13761–13774, 2021, doi: 10.1109/ACCESS.2021.3050929.

[6] H. D. Le, V. T. Truong, and L. B. Le, "Blockchain-Empowered Metaverse: Decentralized Crowdsourcing and Marketplace for Trading Machine Learning Data and Models," *IEEE Access*, pp. 1–1, Jan. 2024, doi: 10.1109/access.2024.3401076.

[7] N. Baranwal Somy *et al.*, "Ownership Preserving AI Market Places Using Blockchain," in *Proc. IEEE Int. Conf. Blockchain*, Jul. 2019, doi: 10.1109/blockchain.2019.00029.

[8] Z. Wang *et al.*, "SoK: Decentralized AI (DeAI)," *arXiv.org*, 2024. [Online]. Available: https://arxiv.org/abs/2411.17461

[9] L. Ouyang, Y. Yuan, and F.-Y. Wang, "Learning Markets: An AI Collaboration Framework Based on Blockchain and Smart Contracts," *IEEE Internet of Things Journal*, pp. 1–1, 2020, doi: 10.1109/jiot.2020.3032706.

[10] K. R. Özyılmaz, M. Doğan, and A. Yurdakul, "IDMoB: IoT Data Marketplace on Blockchain," in *Proc. Crypto Valley Conf. Blockchain Technol.*, pp. 11–19, Jun. 2018, doi: 10.1109/CVCBT.2018.00007.

[11] A. Singh, C. Lu, and R. Raskar, "Overcoming Trust and Incentive Barriers in Decentralized AI," in *Proc. IEEE Conf.*, pp. 85–94, Oct. 2024, doi: 10.1109/cogmi62246.2024.00021.

[12] K. Salah, M. H. U. Rehman, N. Nizamuddin, and A. Al-Fuqaha, "Blockchain for AI: Review and Open Research Challenges," *IEEE Access*, vol. 7, pp. 10127–10149, 2019, doi: 10.1109/access.2018.2890507.