Neura:
A Next-Generation Blockchain for AI Innovation

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Abstract

Neura is a cutting-edge blockchain platform, which is based on the Cosmos SDK, with EVM compatibility, that operates using the CometBFT consensus engine. The platform is designed with a focus on outsourcing computation for training or evaluating AI models and zero-knowledge proof generations. Neura offers a specialized infrastructure to enhance the integration of AI-as-a-service, Rollups-as-a-Service, GPU-as-a-Service, and cloud computing within the blockchain ecosystem. Neura also introduces IMO's (Initial Model Offering), which leverage Ankr's infrastructure and innovative token standards to offer a more accessible, equitable funding model that overcomes traditional limitations, ensuring clear ownership and fair revenue sharing for investors. In this context, the platform enables AI model and rollup owners to tokenize and fractionally sell their assets using the ERC-404 token standard, enhancing liquidity and investment opportunities. Additionally, it incorporates the ERC-7641 token standard for revenue sharing among AI contributors, ensuring fair compensation. ANKR will serve as the native token of Neura, being utilized for transaction fees, staking, and AI operations. No new ANKR tokens will be issued, the total supply of ANKR will remain unchanged. This innovative solution, designed and developed by the Ankr team aims to overcome significant barriers AI projects face, such as scalability issues, limited access to GPUs, financial constraints, and inflexible system frameworks. These barriers have previously restricted the advancement of AI, Rollups, and cloud computing technologies. Neura enables any AI model provider or rollup owner to request GPUs of any size from GPU providers to power their services for their end-users. Furthermore, the blockchain also supports data storage options both off-chain and within a peer-to-peer ecosystem, including technologies like EigenDA, Arweave, and IPFS. To ensure data integrity and reliability, hashes of the data are securely stored on Neura. This architecture not only facilitates seamless service delivery but also encourages trust and reliability across the ecosystem.

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1. Current Challenges: Navigating AI's Blockchain Frontier

Neura is leading the efforts to address three fundamental challenges blocking the synergy between blockchain technology and outsourced computing, such as AI and Rollup operations. These challenges are:

- **Infrastructure Scalability:** This involves enhancing access to GPU resources, crucial for processing complex AI tasks and blockchain computations. The goal is to ensure sufficient computational capacity to meet the growing demands of these technologies.
- **Financial Scalability:** The focus here is on overcoming economic barriers to enable AI projects to grow financially. By addressing financial scalability, Neura aims to facilitate more investment and resources, allowing for the economic expansion of AI blockchain-related projects without facing financial limitations.
- **Interoperability:** The challenge of interoperability involves creating seamless connections between different blockchain platforms. By improving the ability to share and transfer data across various systems, Neura seeks to foster a more integrated blockchain ecosystem, enhancing the functionality and reach of blockchain technology.

Neura's approach includes offering flexible solutions that allow AI model providers to access GPUs of any scale and providing flexible data storage options, both offchain and within a decentralized network, utilizing technologies like EigenDA, Arweave, and IPFS. Securely storing data hashes on the blockchain, Neura ensures data integrity and trust which are critical features for reliable blockchain operations. By tackling these challenges, Neura is not only aiming to facilitate smoother integration and collaboration between blockchain, AI, and cloud computing but also aiming to unlock their full potential. The initiative represents a significant step towards realizing a future where the combined strengths of these technologies are fully utilized, driving innovation and expanding the capabilities of the blockchain domain.

1.1 Infrastructure Scalability: Navigating the GPU Resources

Integrating AI with blockchain technology represents a big step in digital innovation. However, this combination faces significant obstacles due to infrastructure scalability issues, especially in getting access to GPU resources. AI and cloud computing applications, which heavily rely on data processing and complex computations, greatly need scalable, efficient GPU resources. The blockchain ecosystem, despite its advantages in decentralization and security, often does not have the infrastructure to easily provide these resources, creating a big obstacle that limits technological progress and scalability.

The lack of easily accessible GPU resources within the blockchain area greatly limits the development and scalability of AI-focused applications. This shortage not only slows down innovation but also restricts AI projects' ability to process data and carry out complex algorithms efficiently. As a result, the opportunity for AI to enhance the capabilities of blockchain technology

is still unused, as projects fight with the limitations of inadequate computational infrastructure. The effects of this challenge go beyond individual projects, blocking the wider adoption and progress of blockchain-integrated AI solutions across different sectors.

1.2 Financial Scalability: Overcoming Economic Obstacles

Alongside the technical obstacles related to infrastructure scalability, initiatives involving AI and cloud computing on the blockchain face an extra challenge: financial scalability. This issue comes from economic obstacles tied to the current methods of data sharing and monetization within the blockchain ecosystem. Traditional platforms and processes often don't support effective and fair strategies for monetizing data well enough, which are crucial for the survival and growth of AI projects. As a result, innovators and developers run into significant barriers in creating value and making money from their data-focused projects.

The difficulty in making money from data not only weakens the financial reasons for AI developers and data providers but also dampens the enthusiasm and innovation within the blockchain community. Without realistic financial models for data sharing and monetization, AI and cloud computing projects have a hard time getting the necessary support and financial backing for development. This challenge to financial scalability poses a serious threat to the progress of AI on the blockchain, potentially slowing down innovation and ignoring the combined benefits of AI, cloud computing, and blockchain technologies.

1.3 Struggling with Interoperability: Connecting Different Data Worlds through Bridges

The promise of AI within the blockchain world greatly depends on its ability to smoothly work with many different data sources and systems. Yet, the reality is that blockchain networks are divided up, with many blockchain platforms trapped in their own unique rules and data formats, which blocks the sharing of information. This separation significantly limits AI's ability to use a wide range of data, which is crucial for its learning and effectiveness.

The hurdles to achieve interoperability are huge, creating real obstacles to AI's development on the blockchain. AI's main advantage—its unmatched skill in taking in and understanding information from different sources—is weakened by the existing limits of blockchain technology. This not only limits the possibilities for AI-powered blockchain applications but also means the blockchain community misses out on fully using AI's advancements. Without a strong push to bring these separate platforms together into one network, the dream of a united, innovative AI blockchain ecosystem will stay out of reach.

2. Neura: Unleashing the Synergy of AI and Blockchain

2.1 Main Features

- **AI and Cloud Computing Integration:** Neura proposes a blockchain architecture that is AI-centered, aiming to enhance the integration of AI and cloud computing technologies in the crypto ecosystem. It addresses key challenges that have hindered progress in this area.
- **Scalability and GPU Accessibility:** It tackles the infrastructure scalability challenge by creating a vibrant ecosystem for GPU providers, ensuring that AI and cloud computing projects have immediate access to necessary computational resources. This approach addresses both the technical and economic aspects of scalability, eliminating computational bottlenecks and enhancing project viability.
- **Financial Scalability through IMO:** Neura introduces Initial Model Offerings (IMOs), a new funding mechanism designed to democratize investment in AI development while ensuring transparent ownership and equitable revenue sharing. This innovation addresses the economic barriers faced by AI projects on the blockchain, promoting a more collaborative and financially sustainable ecosystem.
- **Interoperability with EVM:** By aligning with the Ethereum Virtual Machine (EVM), Neura establishes a foundation for seamless interoperability. This allows applications to utilize Ethereum's development tools, facilitating the deployment of AI models and cloud services.
- **Comprehensive Support for AI Projects:** Neura not only provides access to GPU resources but also supports the entire lifecycle of AI and cloud computing projects. This includes infrastructure and resources necessary for development, execution, and scaling, fostering innovation and the realization of complex projects.
- **ANKR as the Platform Native Token:** The ANKR token is central to Neura's ecosystem, facilitating transactions, incentivizing GPU providers for their resource allocations, and rewarding AI developers. Namely, the ANKR token will function as the native currency of Neura, where it will be used across various operations including transaction fees, staking, and AI related activities. More importantly, no additional ANKR tokens will be created, ensuring the total supply remains constant. This economic model highlights the platform's commitment to maintaining the token's value and stability, promoting a secure and efficient ecosystem growth.
- **Smart Contracts:** Deployment and access to your AI model can be managed through smart contracts on Neura. These contracts can be programmed to log

specific events or triggers when your model is accessed or used, providing you with real-time notifications or logs of usage.

- **Support New ERC Standards:** Enabling ERC-404 and ERC-7641 standards for providers and consumers.
- **Monitoring Tools:** Neura or third-party services may offer monitoring tools that integrate with the blockchain to track the usage of your AI model. These tools can provide analytics, usage reports, and alerts based on predefined criteria.

2.2 Entities of Neura

- **Task Providers:** Individuals or entities that develop and wish to deploy Task (such as AI models or Zero knowledge Proof Request) onto the blockchain.
- **GPU Providers:** Entities that offer computational resources, specifically GPU power, to the network for AI computations.
- **Neura Blockchain:** The core platform facilitating transactions, smart contracts, and interactions between different parties.
- **Smart Contracts:** Automated contracts that manage the deployment, access, and usage of AI models, as well as the allocation and payment for GPU resources.
- **Offchain Storage:** The decentralized storage such as EigenDA, Celestia, Arweave or IPFS solution where AI models are stored.
- **Clients/Consumers:** Users or applications that wish to access and use the deployed AI models.

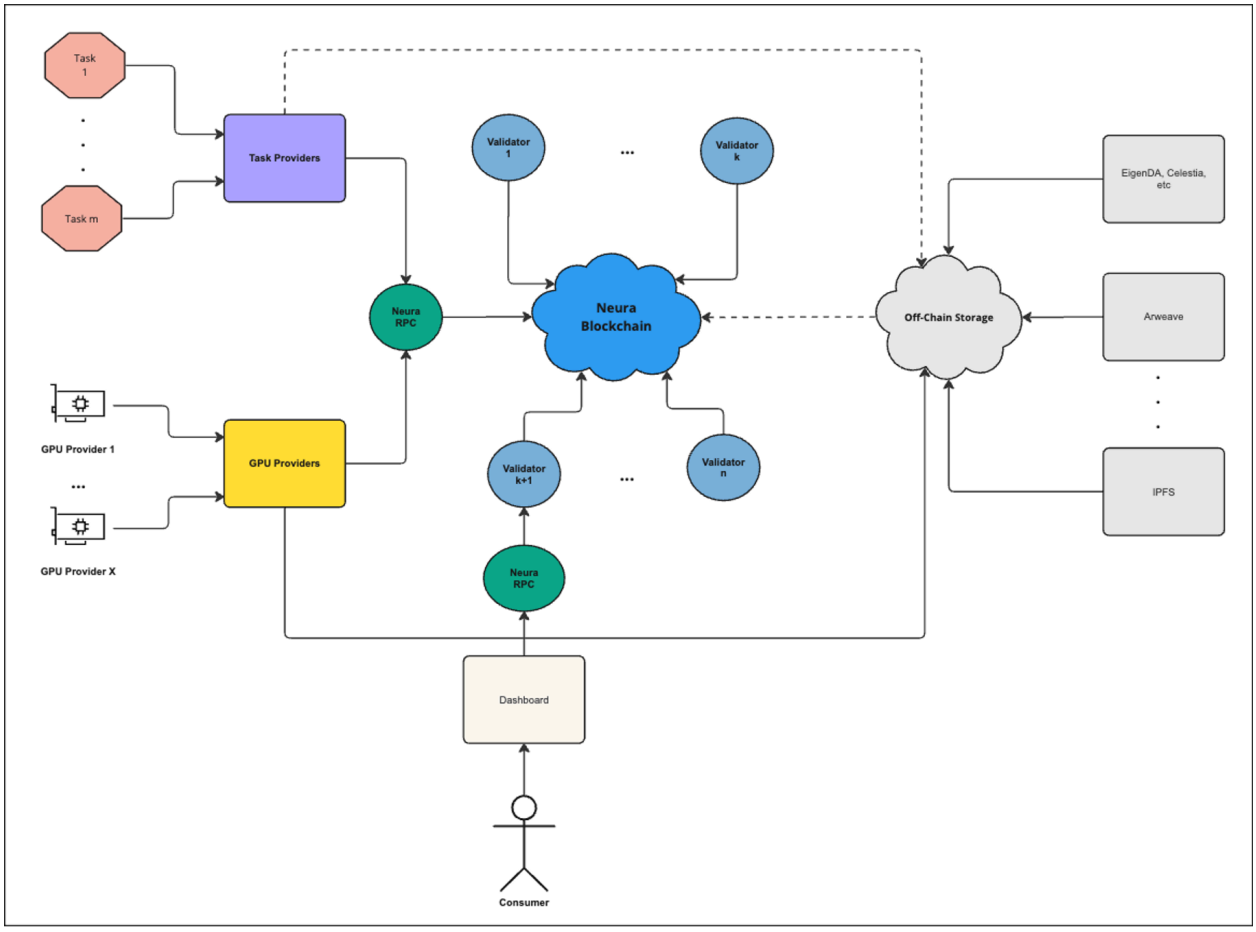

Figure 1. High-Level Architecture of Neura

2.3 Neura with Cosmos SDK

Neura is a cutting edge blockchain network which is sophisticated and flexible, utilizing advanced building blocks from CosmosSDK such as EVM and Babylon. Neura's strategy aims to achieve high transaction throughput, ensuring that the transactions are finalized swiftly, blocks are produced rapidly. All of this is powered by the CometBFT consensus engine, an enhanced version of the already robust Tendermint Core, which further strengthens the network's reliability and efficiency.

Neura also supports the Inter-Blockchain Communication protocol (IBC) through the Cosmos SDK. This critical feature enables Neura to seamlessly integrate with the wider Cosmos network, including the influential Babylon module. Babylon's inclusion escalates Neura's security infrastructure, implementing advanced protective measures such as BTC restaking and precise timestamping. This mutual relationship not only reinforces Neura's security but also strengthens its potential, initiating for a more interconnected and robust blockchain ecosystem.

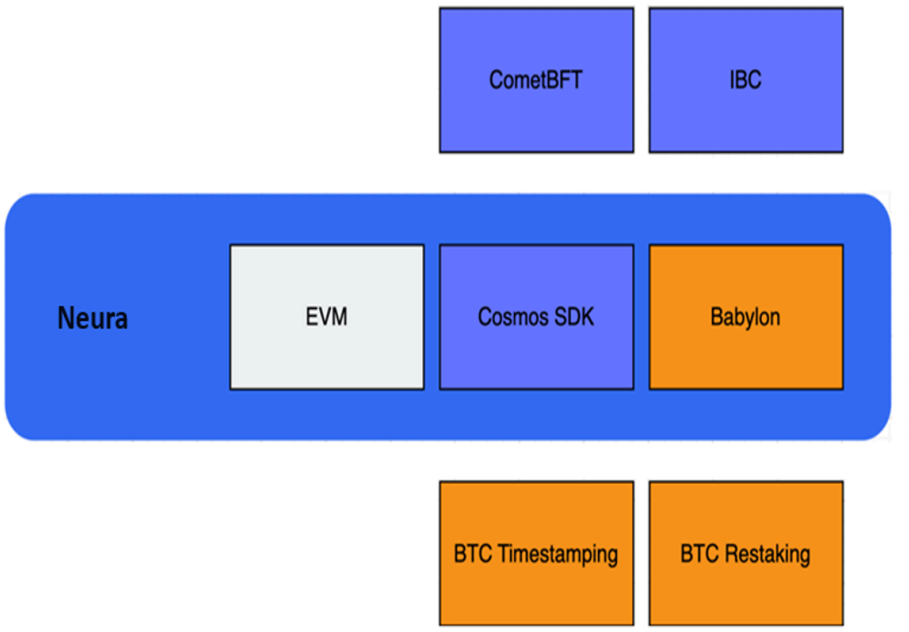

Figure 2. Main Components of Neura

At its core, Neura leverages a collection of modular components built on the Cosmos SDK framework. These components provide essential functionalities that empower developers and contribute to the network's overall performance and security. Let's focus on some of these key elements:

- **EVM**
  - This Cosmos SDK module (x/evm) provides EVM compatibility and interoperability. It allows developers to deploy smart contracts, interact with the EVM state machine, and utilize existing EVM tooling.
  - The x/evm module is part of the ethermint library.
- **Fee Market**
  - This module (x/feemarket) supports EIP-1559 within the Cosmos SDK framework.
  - The x/feemarket module is part of the ethermint library.
- **Finality Gadget**
  - Following the Babylon architecture, the restaking protocol will be activated in the future.

2.4 Decentralized Storages for Neura

Given the large size of AI models, storing the entire model directly on the blockchain (i.e., onchain storage) would be impractical and expensive due to the high cost of storage. Instead, Neura allows the use of a combination of onchain and offchain storage solutions.

- **Decentralized Storage Networks**: The actual AI model could be stored offchain (e.g., IPFS (InterPlanetary File System), Arweave) in a secure, decentralized storage that is linked to Neura. Only references to the model (such as hashes or URLs) and other necessary metadata would be stored onchain. This approach significantly reduces the costs while maintaining the integrity and accessibility of the model through the blockchain.
- **Access and Execution:** When a client wants to use an AI service, they would interact with a smart contract on Neura, which then facilitates access to the AI model stored offchain. The computation tasks could be performed by the GPU providers which are already connected to the Neura network. The results of these computations can then be securely transmitted back to the client or stored onchain/offchain (depending on the requirements).
- **Cost Considerations**: By leveraging offchain storage for the bulk of the data and onchain mechanisms for verification, access control, and transaction logging, you can mitigate the costs associated with deploying large AI models on Neura. The cost the consumers pay would primarily be for GPU usage during the model's execution and the minimal onchain storage and transaction fees for managing access and integrity of the model.

In summary, to track the usage of AI models on Neura, we would rely on blockchain transactions, smart contracts, and possibly external monitoring tools. For storage, leveraging a combination of onchain for metadata and smart contract logic, with offchain solutions for storing the actual model, allows for cost-effective and scalable deployment of AI services on the blockchain. This hybrid approach ensures that your model is secure, accessible, and economically viable to deploy on Neura.

3. Flows of Neura

3.1 GPU Provider Subscription

During the initialization, GPU providers obtain the public keys of the validators from Neura. Next, they embed these public keys to grant permissions to them through their respective dashboards. Consequently, these validators will have authorized access to connect to their GPUs remotely.

1. Each GPU provider maintains a profile with specific attributes, including RAM size, CPU/GPU specifications, IP address, and a security deposit value in ANKR tokens.
2. A provider creates and submits a transaction that includes their profile and GPU information to Neura via RPC service.
3. Upon confirming that a transaction is valid, the corresponding smart contract on Neura is updated, meaning that the provider has indeed become a legitimate GPU provider for Neura.
4. Validators on Neura periodically verify the availability and authenticity of the provider's GPU resources to ensure the provider meets the computation and communication requirements.
5. If the provider passes the requirements, each validator of Neura independently creates a transaction that updates the provider’s status on Neura.
6. Concurrently, the GPU providers' dashboard service actively monitors for contract events. Specifically, if a transaction related to the provider’s service commitment is detected, the dashboard service promptly initiates a connection with the provider to confirm the current availability of the GPU resources

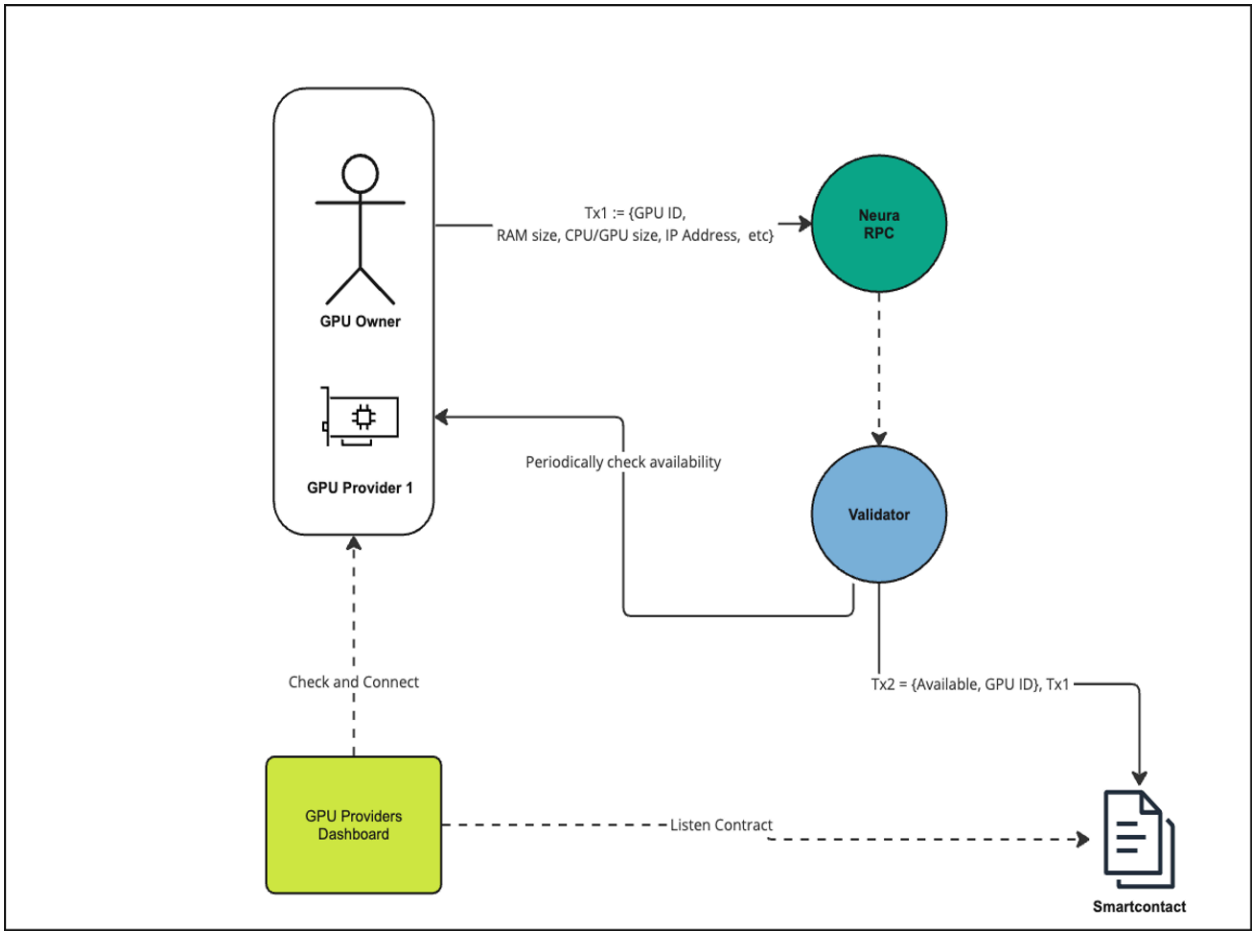

Figure 3. GPU Provider Subscription

3.2 Task Submission

In the Neura platform, Task (e.g., AI model) owners can issue ERC-7641 tokens to share revenue from their creations. These tokens entitle holders to a fraction of the income generated, ensuring an equitable reward distribution system for contributors and investors alike. This mechanism leverages blockchain transparency to foster trust and support a sustainable AI and cloud computing ecosystem.

1. Task Owners select the most suitable GPU providers for their tasks. Task owners obtain the public keys of their selected GPU Providers.
2. They encrypt their task using the GPU Provider's public key.
3. The encrypted task is then submitted as a transaction to an offchain storage, such as Arweave, EigenDA.
4. Next, the Task Owner creates a new transaction that includes the ID of the previous transaction, the ID of the selected GPU Provider, the duration for which the task should be maintained, and specific requirements for the GPU/RAM/CPU.
5. This transaction is then submitted to Neura via an RPC call.
6. Once the transaction is validated and verified, the corresponding smart contracts on Neura are updated.
7. Concurrently, the selected GPU Provider, who is expected to be monitoring the contracts, detects a relevant transaction, validates it, and retrieves the task from the offchain storage.
8. The GPU Provider then prepares (e.g., decryption, formatting) and executes the task.
9. Once processed, the result is uploaded to the offchain storage as a transaction. The result can be in either plain form or encrypted, depending on the privacy and confidentiality requirements.
10. Once uploaded, the GPU Provider creates another transaction to Neura to update the task status and provide the reference ID of the result.

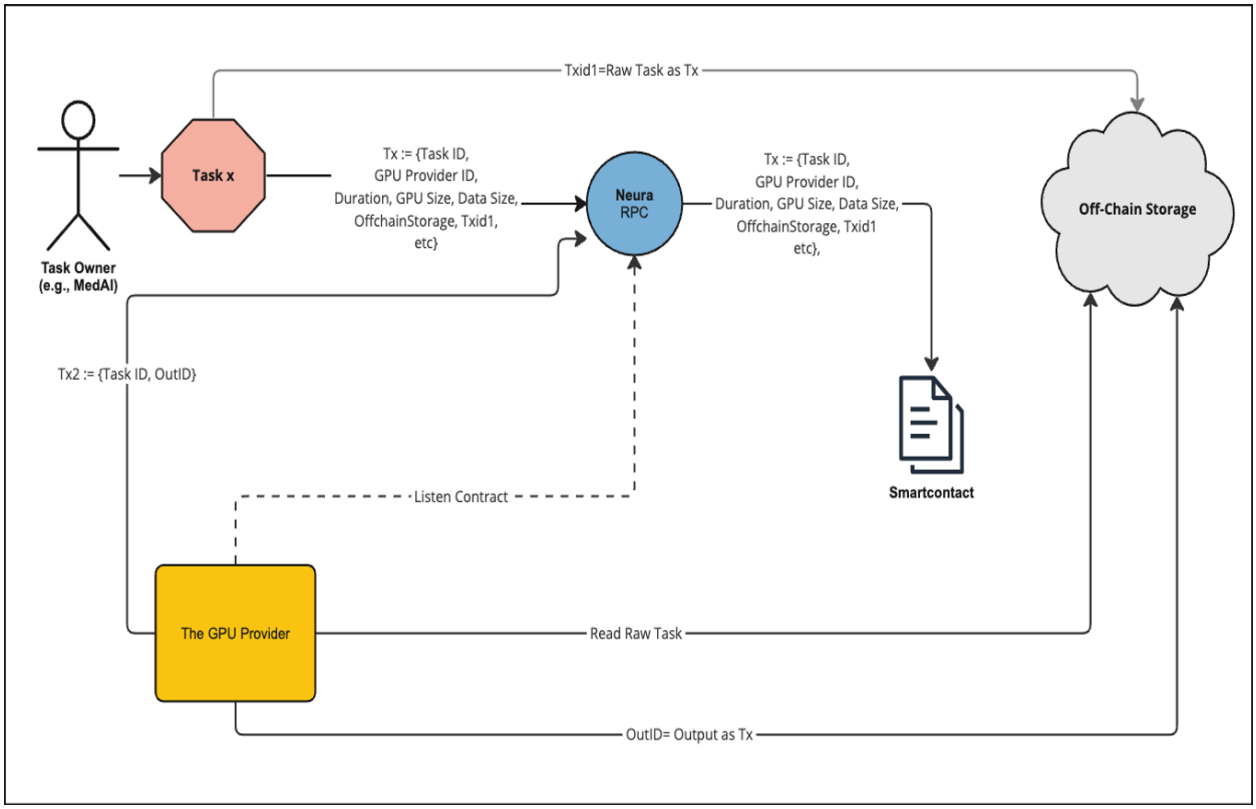

Figure 4. Task Submission

4. The Economic Model of Neura

4.1 Utilization of ANKR Token

The ANKR token fuels the Neura IMO ecosystem. It serves as the sole currency for all transactions, including AI model usage, IMO token purchases, and network staking for security and consensus. This streamlined approach fosters a thriving community of developers, investors, and users. All contribute to and benefit from the ecosystem's growth, powered by the ANKR token.

More importantly, the ANKR token goes beyond just a currency. It is central to Neura's economic strategy, incentivizing active participation and platform development. The tokenomics structure rewards both AI developers and GPU providers, creating a balanced marketplace. GPU providers receive ANKR tokens for their computational power, ensuring a steady flow for AI and cloud endeavors. This not only strengthens the platform's processing capabilities but also fosters a competitive environment where resources efficiently meet demand. For developers, ANKR tokens simplify access to these resources, enabling project expansion. They're also rewarded for innovative models, fostering a community that values creativity.

Neura's economic system, powered by ANKR, aims to achieve self-sufficiency. Namely, transaction fees, resource allocation, and rewards all occur within the ANKR ecosystem, creating a circular economy that reinvests value back into itself. As the demand for AI and cloud computing resources rises, so too does the value of the ANKR token, benefiting all participants.

In summary, the ANKR token will have the following properties:

- **Fixed Maximum Supply:** The maximum supply of ANKR tokens will be maintained as it is, with no new ANKRs being issued.
- **One-to-One Token Mapping:** A corresponding amount of ANKR tokens on the Neura chain will be locked on Ethereum.
- **Defined Supply on Neura:** A specific, pre-set number of ANKR tokens will be available on the Neura chain.
- **Rewards for Block Proposers:** Block proposers will receive a specific number of ANKR tokens from a reserved pool, in addition to transaction gas fees, for each block they propose.

4.2 Innovating AI Funding with Dual Token Standards

Neura revolutionizes AI project funding and deployments through IMOs, leveraging the unique capabilities of ERC-7641 and ERC-404 token standards. This dual-standard integration supports the IMO framework, enabling sophisticated mechanisms for ownership, revenue sharing, and fractional asset management within the AI and blockchain ecosystem.

- **Fractional Ownership via ERC-404 Integration:** Within the IMO context, ERC-404 standard integration allows for the fractionalized ownership of AI models, a novel concept that broadens participation and investment in AI projects. This standard facilitates the division of a single NFT into multiple ownership stakes, held across various wallets, thereby enhancing liquidity and accessibility for investors within the Neura ecosystem.
- **Revenue Sharing and Model Ownership through ERC-7641:** The ERC-7641 standard is pivotal in the IMO ecosystem for creating tokens that encapsulate both ownership in AI models and rights to revenue shares. This mechanism ensures transparent and equitable distribution of earnings from AI model usage and content generation, aligning perfectly with the IMO's goal of fostering a collaborative and financially sustainable environment for AI development on Neura.

The integration of ERC-404 and ERC-7641 within our IMO framework enables fractionalized ownership and equitable revenue sharing. Therefore, Neura sets a new standard for collaborative and economically viable AI ventures, ensuring a vibrant future for AI and blockchain integration.

5. A Working AI Example: MedAI

As part of the IMO process, let's consider a fictional company "**MedAI"**, an AI startup aiming to revolutionize healthcare diagnostics. MedAI decides to leverage Neura for an IMO to secure funding and computational resources for their project.

- **Participate in Engagement with ANKR Tokens:** AI enthusiasts interested in MedAI's vision, acquire ANKR tokens, the currency fueling the Neura ecosystem, and use them to participate in the MedAI IMO. This initial investment is facilitated by the seamless and integrated experience Neura offers through its native token.
- **Token Minting for Equity and Revenue Sharing:** MedAI mints its unique model tokens via Neura, symbolizing both equity in the startup and entitlement to future revenue streams. The token minting process is underpinned by a transparent and secure smart contract, meticulously outlining the terms of engagement, revenue distribution, and the overarching dynamics of the IMO. This strategic move ensures clarity and trust and solidifies participant confidence in the project's governance and financial model.
- **Distribution of Model Tokens:** MedAI IMO participants are allocated MedAI's model tokens following the token minting, directly correlating their contribution with fractional ownership and reward allocation rights. This distribution helps a robust community, supporting MedAI's journey and success, thereby creating a collaborative ecosystem of support and anticipation for the project's outcomes.
- **Leveraging GPU Resources for Scalability:** Leveraging the funds raised through the IMO, MedAI can access Neura's vast pool of GPU resources. This eliminates the high costs and complex setup of traditional infrastructure, significantly accelerating MedAI's AI model development and time to market. This demonstrates the clear advantages of Neura's resource ecosystem.

Now, let us look at how the MedAI application will be initialized and executed through Neura. The high-level algorithm for the AI model is given in the next sections.

5.1 AI Model Submission

AI model owners securely outsource their models to compatible GPU providers through Neura. This involves encrypting the models, specifying execution requirements, and submitting them via transactions. GPU providers then retrieve the models, execute them, and upload the results while Neura manages the entire process through secure transactions.

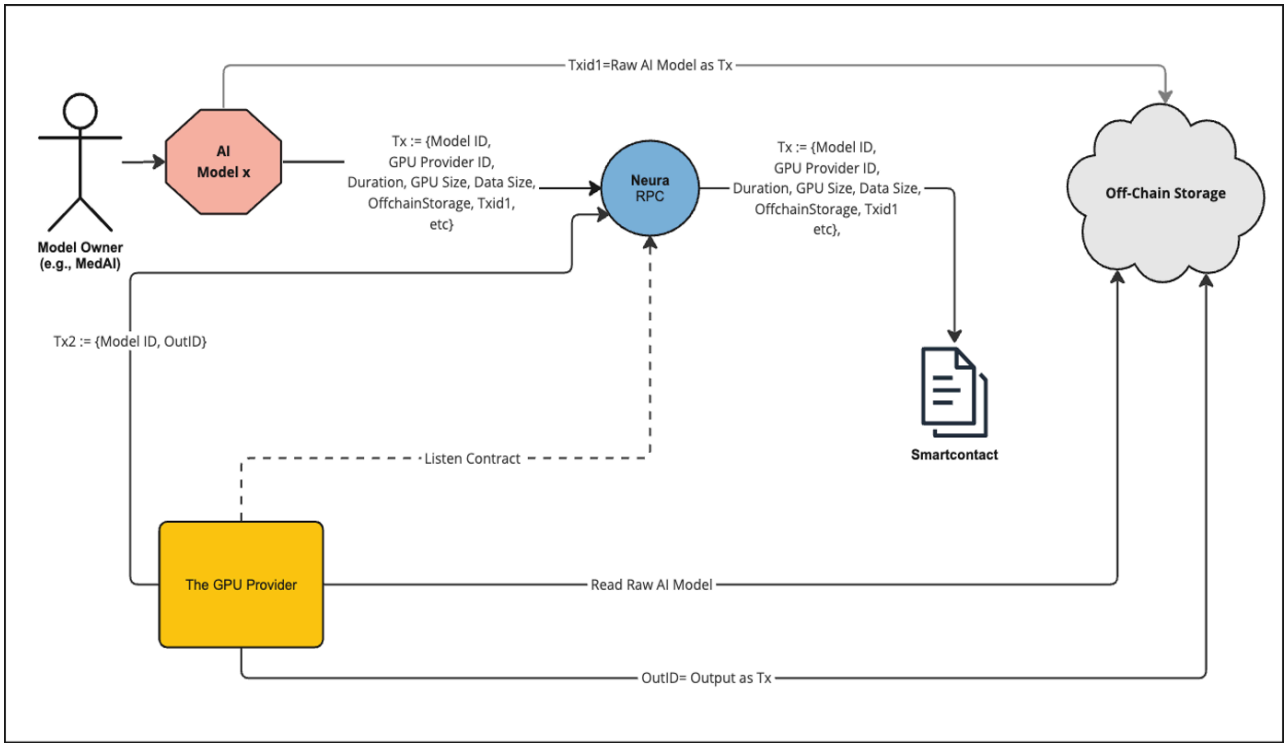

Figure 5: AI Model Subscription

5.2 Consumer Query about Medicine through MedAI

To ensure participant authenticity while preserving privacy, AI Model Owners will utilize a secure authentication channel with the MedAI UI. This can be achieved by verifying if the user's wallet holds a minimum ERC-404 NFT fragment corresponding to the desired AI Model. Once verified, the owner can submit inquiries to retrieve information about their illness or symptoms. The UI then transmits this inquiry to the MedAI backend server.

The server selects the appropriate AI model, called Task X, and constructs a new query combining the user's inquiry and the Task X identifier. This query is then forwarded to the GPU provider. The GPU provider is responsible for executing Task X. In this case, it will either utilize a cached version of the model, if available, or retrieve the model from offchain storage before executing the query. The outcome of the query is then sent back to the backend server. Furthermore, a transaction is immediately created on the Neura chain. Finally, the transaction ID and the response are sent back to the user, allowing them to access their results.

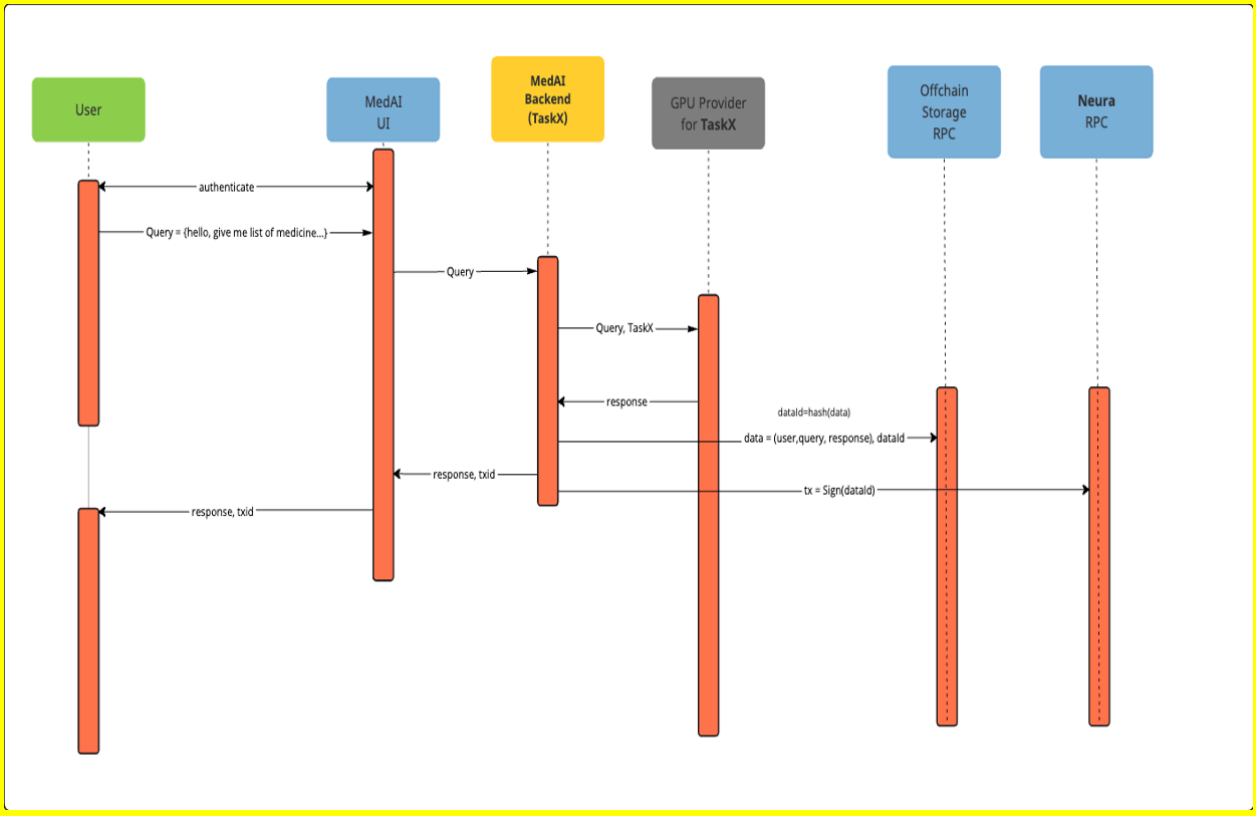

Figure 6: Consumer Query

6. Focusing on Neura's Innovation

Neura goes beyond meeting current demands for GPU resources in AI and blockchain. We anticipate future needs and continuously innovate to adapt our scalable GPU access solutions. This ensures Neura stays at the forefront of enabling AI and cloud breakthroughs.

Neura goes further by optimizing blockchain protocols for efficiency and reducing GPU access latency. This research fuels our vision: a seamless experience for developers, where accessing computational power is as intuitive as deploying code. We achieve this through a two-branched approach: technological advancements and user-friendly interfaces and tools. This democratizes GPU resources, empowering innovators of all levels.

6.1 Innovating Financial Scalability with IMO's

Neura is transforming the world of AI development with IMOs. IMOs bypass the limitations of traditional funding methods, which can be expensive and leave investors disconnected from the projects they support. Leveraging the power of Ankr's infrastructure and innovative token standards, Neura's IMO framework creates a level playing field. This means easier access to funding for AI projects, while ensuring clear ownership and fair revenue sharing for investors. IMOs address the challenge of limited liquidity in AI projects, providing a more efficient and

accessible funding model. This shift marks a significant move away from outdated methods, paving the way for a more collaborative and sustainable future for AI within the blockchain ecosystem.

6.2 Onchain AI Model Deployment and Verification

Neura's IMO strategy is the platform's architectural competence, optimized for high throughput and scalability, making it the ideal environment for onchain AI model hosting. This capability is critical for the operationalization of IMOs, ensuring AI models are not only accessible but fully functional within the blockchain realm. Neura benefits from its extensive background in decentralized physical infrastructure to offer a secure and efficient platform for AI model deployment and verification. By employing an optimistic-based Machine Learning (opML) approach, we can guarantee the authenticity and reliability of AI models, laying a solid foundation for developers and investors alike.

6.3 Facilitating Revenue Streams and Promoting Open-Source AI Model Development

Neura enables a fair and efficient economic model. Its automated platform distributes revenue directly to IMO token holders from AI model usage and content creation. This commitment extends to supporting diverse revenue models and open-source AI development. By helping innovation in these ways, Neura empowers AI projects on the blockchain for long-term success.

7.Tackling Interoperability: A Unified Ecosystem

7.1 EVM and Cosmos IBC Integration for Seamless Interoperability

Neura strategically aligns with the EVM and Cosmos IBC protocol, establishing a robust foundation for interoperability that significantly benefits AI and cloud computing applications. This dual compatibility positions Neura as an essential infrastructure, enabling applications to utilize Ethereum's comprehensive development tools and community support while facilitating seamless data exchange and interaction within the Cosmos network ecosystem.

7.2 Unleashing AI and Cloud Computing

The integration with EVM and Cosmos IBC grants AI and cloud computing applications unprecedented access to a wide array of blockchain functionalities and resources. Developers are empowered to deploy advanced AI models and cloud services on Neura, leveraging the robustness of the Ethereum ecosystem alongside the Cosmos network's capability for

interconnectivity. This synergy not only simplifies deployment but also increases the operational efficiency of AI services in conjunction with blockchain-based data sources and computational resources.

7.3 Expanding AI Horizons with Cosmos IBC

Neura unlocks the transformative power of Cosmos IBC for AI. This integration empowers AI applications to access and utilize data from a substantial network of decentralized sources. This is crucial for AI, as diverse datasets are essential for training and optimal performance. Similarly, cloud computing services benefit from Cosmos IBC's strong, cross-chain communication. By facilitating secure and efficient execution of complex algorithms across multiple blockchains, Neura eliminates data isolation and interoperability obstacles, allowing AI applications to reach their full potential.