The UNIVERSITY of OKLAHOMA
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Decentralized GPU Rental Platform

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Contents

1 Introduction

The Decentralized GPU Rental Platform is a blockchain-based marketplace designed to facilitate trustless GPU rentals with automated performance verification and fair payment distribution. By leveraging Ethereum smart contracts, Chainlink Functions, and IPFS (via Pinata), the platform addresses key challenges in traditional GPU rental systems, such as lack of transparency, trust issues, and manual verification processes. Users can rent GPUs through a web interface, with payments held in escrow until performance is verified, ensuring providers are compensated based on actual delivered performance while users are refunded for any underperformance.

The live platform is deployed and accessible at: `https://rent-gpu-phi.vercel.app/`

The complete source code for the platform is available on GitHub: `https://github.com/NNPhaniCharan/RentGPU`

A demonstration video explaining the platform's features and functionality is available at: `https://youtu.be/W3chPSaXrwQ`

This report outlines the project's background, methodology, technical implementation, results, and conclusions, providing a comprehensive overview of the platform's design and functionality.

2 Background

2.1 Problem Statement

Traditional GPU rental systems often rely on centralized platforms, which can lead to:

- Lack of transparency in GPU performance claims.
- Disputes over payment due to unverifiable performance.
- High fees and manual verification processes.

2.2 Solution

The Decentralized GPU Rental Platform introduces a trustless, automated system where:

- Payments are held in a smart contract escrow.
- GPU performance is verified using Chainlink Functions, comparing actual performance (uploaded to IPFS) against promised specifications.
- Payments are distributed proportionally based on a fulfillment percentage, ensuring fairness.

2.3 Relevance

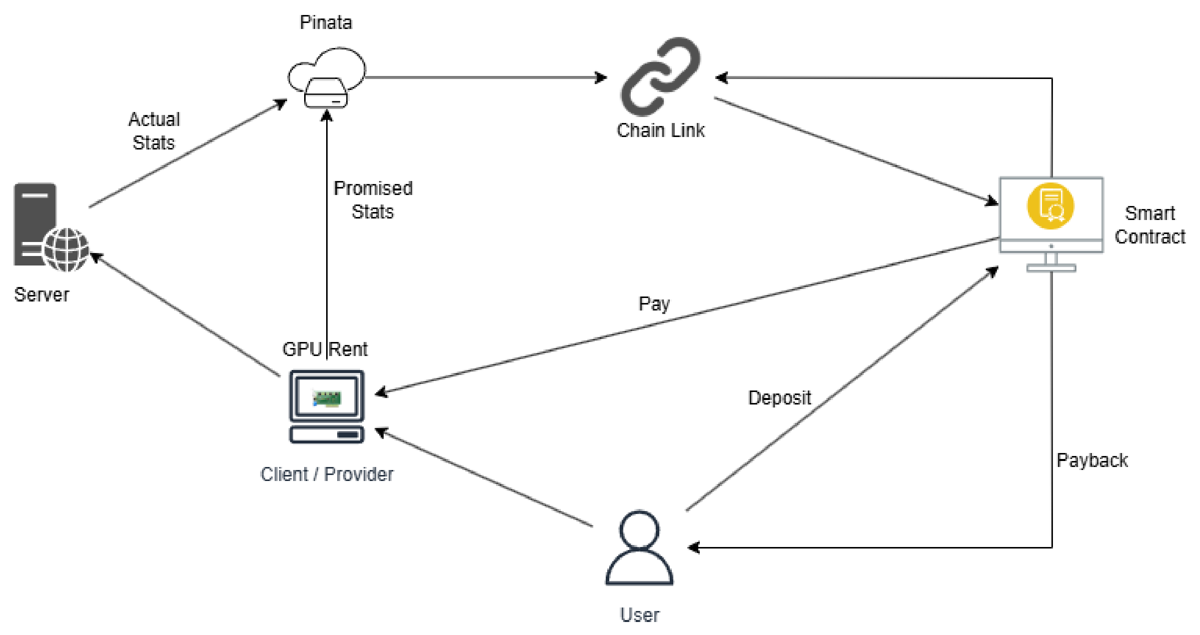
This platform is particularly relevant for industries requiring high-performance computing, such as machine learning, gaming, and cryptocurrency mining, where GPU performance directly impacts outcomes. By decentralizing the rental process, the platform reduces reliance on intermediaries and enhances trust through blockchain technology.

3 Methodology

3.1 System Architecture

The platform's architecture integrates multiple components to ensure a seamless rental and verification process. The key components are:

- **Frontend:** A React.js-based web interface for user interaction, built with Bootstrap for responsiveness.
- **Smart Contract:** Deployed on the Ethereum Sepolia Testnet, manages escrow, verification, and payment distribution.
- **Chainlink Functions:** Provides oracle services to fetch and compare GPU performance statistics.
- **IPFS (Pinata):** Stores immutable GPU specifications and performance metrics.
- **Client/Provider:** Supplies GPU resources for rental.
- **User:** Rents GPUs and provides ETH deposits.



System architecture illustrating the interaction between components.

3.2 Technology Stack

- **Blockchain:** Ethereum (Sepolia Testnet) for decentralized transaction management.
- **Smart Contracts:** Written in Solidity, deployed at address `0xE590ff0E4FB5fCE671053ED5091F215204F49433`
- **Frontend:** React.js, Web3.js/Ethers.js for blockchain interaction.
- **External Services:**
  - Chainlink Functions (Subscription ID: `4553`) for performance verification.
  - IPFS via Pinata for decentralized storage.

3.3 Workflow

The platform operates in three phases:

1. **Rental Process:**
   - User selects a GPU from all of the listed GPU's.
   - Then selectes how many Hours the user wants the GPU and pays in ETH.
   - Payment held in smart contract escrow.
   - Provider uploads promised performance metrics to IPFS.
2. **Verification Process:**
   - Provider runs GPU, uploads actual stats to IPFS.
   - Chainlink compares promised vs. actual stats.
   - Smart contract records fulfillment percentage.
3. **Payment Distribution:**
   - Payment disbursed based on fulfillment percentage.
   - Refunds issued for underperformance.

3.4 Setup & Installation

1. Clone the repository: `git clone https://github.com/NNPhaniCharan/RentGPU.git`
2. Install frontend dependencies: `cd frontend && npm install`
3. Configure environment variables in `frontend/.env`:

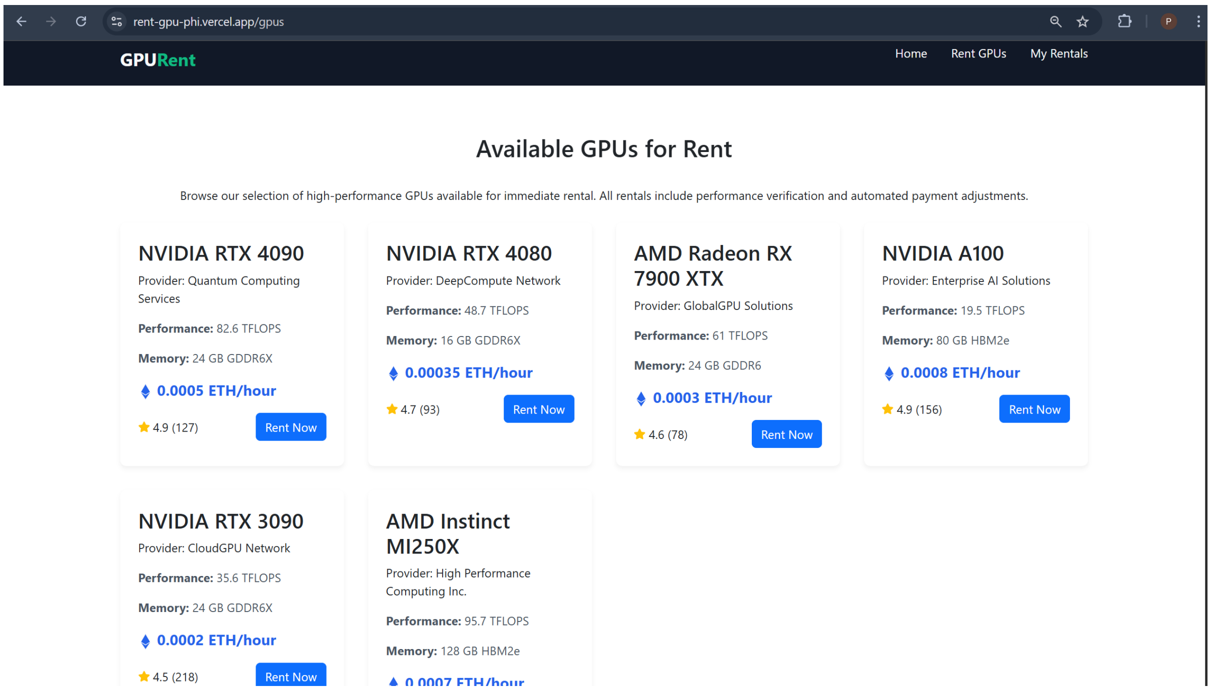
```
REACT_APP_GATEWAY_URL=your_pinata_gateway_url
REACT_APP_PINATA_API_KEY=your_pinata_api_key
REACT_APP_PINATA_SECRET_KEY=your_pinata_api_secret_key
REACT_APP_CONTRACT_ADDRESS=0xE590ff0E4FB5fCE671053ED5091F215204F49433
```

4. Start the development server: `npm start`
5. Connect MetaMask wallet with Sepolia ETH.

4 Step-by-Step Execution

This section describes the detailed step-by-step process of how a GPU rental is executed on the platform, from initiation to payment settlement.

1. **User Browses Available GPUs:**
   - User visits the web application and connects their MetaMask wallet to the Sepolia Testnet.
   - The platform displays a list of available GPUs with specifications and hourly rental rates.



Available GPUs for Rent

Browse our selection of high-performance GPUs available for immediate rental. All rentals include performance verification and automated payment adjustments.

NVIDIA RTX 4090
Provider: Quantum Computing Services
Performance: 82.6 TFLOPS
Memory: 24 GB GDDR6X
0.0005 ETH/hour
4.9 (127) Rent Now

NVIDIA RTX 4080
Provider: DeepCompute Network
Performance: 48.7 TFLOPS
Memory: 16 GB GDDR6X
0.00035 ETH/hour
4.7 (93) Rent Now

AMD Radeon RX 7900 XTX
Provider: GlobalGPU Solutions
Performance: 61 TFLOPS
Memory: 24 GB GDDR6
0.0003 ETH/hour
4.6 (78) Rent Now

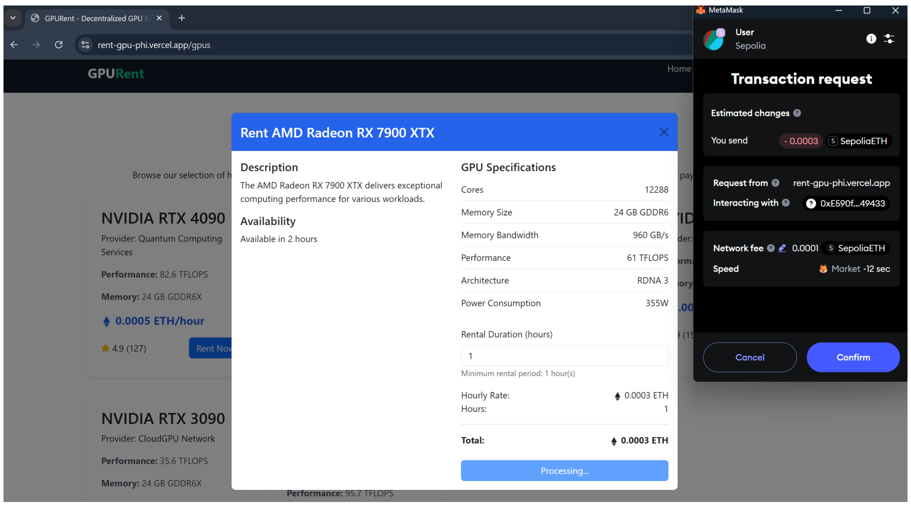
NVIDIA A100
Provider: Enterprise AI Solutions
Performance: 19.5 TFLOPS
Memory: 80 GB HBM2e
0.0008 ETH/hour
4.9 (156) Rent Now

NVIDIA RTX 3090
Provider: CloudGPU Network
Performance: 35.6 TFLOPS
Memory: 24 GB GDDR6X
0.0002 ETH/hour
4.5 (218) Rent Now

AMD Instinct MI250X
Provider: High Performance Computing Inc.
Performance: 95.7 TFLOPS
Memory: 128 GB HBM2e
0.0007 ETH/hour

Step 1: User views available GPUs and pricing details

2. **Initiate Rental:**
    - User selects the desired GPU and rental duration.
    - The required ETH deposit is calculated and a MetaMask transaction is prompted.
    - The ETH is held in the smart contract escrow.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rent-gpu-phi.vercel.app/gpus
GPURent
Home

Browse our selection of h

NVIDIA RTX 4090
Provider: Quantum Computing Services
Performance: 82.6 TFLOPS
Memory: 24 GB GDDR6X
0.0005 ETH/hour
4.9 (127)
Rent Now

NVIDIA RTX 3090
Provider: CloudGPU Network
Performance: 35.6 TFLOPS
Memory: 24 GB GDDR6X
Performance: 95.7 TFLOPS

Rent AMD Radeon RX 7900 XTX

Description
The AMD Radeon RX 7900 XTX delivers exceptional computing performance for various workloads.

Availability
Available in 2 hours

GPU Specifications

Cores	12288
Memory Size	24 GB GDDR6
Memory Bandwidth	960 GB/s
Performance	61 TFLOPS
Architecture	RDNA 3
Power Consumption	355W

Rental Duration (hours)
1
Minimum rental period: 1 hour(s)

Hourly Rate:	0.0003 ETH
Hours:	1
Total:	**0.0003 ETH**

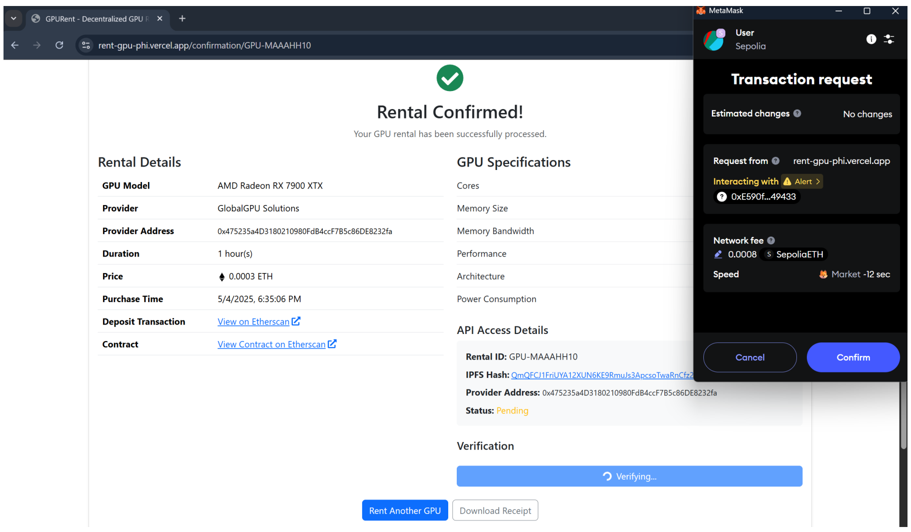
Processing...

MetaMask
User
Sepolia
Transaction request

Estimated changes	
You send	- 0.0003 SepoliaETH
Request from	rent-gpu-phi.vercel.app
Interacting with	0xE590f...49433
Network fee	0.0001 SepoliaETH
Speed	Market ~12 sec

Step 2: User initiates rental and confirms payment via MetaMask

3. **Verification Process:**
    - Once the provider executes the task, actual performance is uploaded to IPFS.
    - Chainlink Functions compare promised vs. actual metrics.
    - Verification result and fulfillment percentage are recorded on-chain.


GPURent - Decentralized GPU R
rent-gpu-phi.vercel.app/confirmation/GPU-MAAAHH10

Rental Confirmed!
Your GPU rental has been successfully processed.

Rental Details

GPU Model	AMD Radeon RX 7900 XTX
Provider	GlobalGPU Solutions
Provider Address	0x475235a4D3180210980FdB4ccF7B5c86DE8232fa
Duration	1 hour(s)
Price	0.0003 ETH
Purchase Time	5/4/2025, 6:35:06 PM
Deposit Transaction	View on Etherscan
Contract	View Contract on Etherscan

GPU Specifications
Cores
Memory Size
Memory Bandwidth
Performance
Architecture
Power Consumption

API Access Details
Rental ID: GPU-MAAAHH10
IPFS Hash: QmQFCJ1FriUYA12XUN6KE9RmuJs3ApcsoTwaRnCfz
Provider Address: 0x475235a4D3180210980FdB4ccF7B5c86DE8232fa
Status: Pending

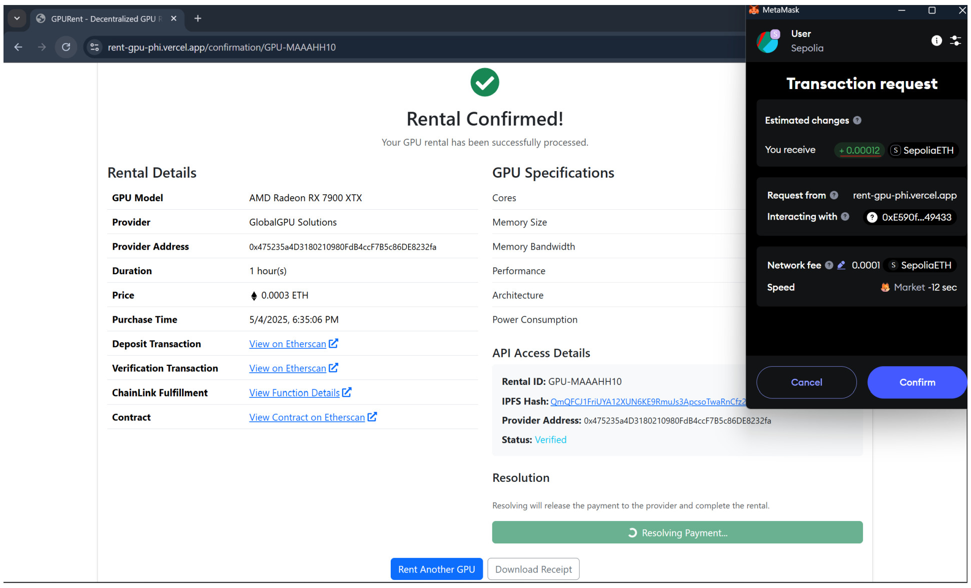
Verification
Verifying...

MetaMask
User
Sepolia
Transaction request

Estimated changes	No changes
Request from	rent-gpu-phi.vercel.app
Interacting with ⚠ Alert	0xE590f...49433
Network fee	0.0008 SepoliaETH
Speed	Market ~12 sec

Step 3: Chainlink verification with fulfillment and contract update

4. **Payment Distribution:**
   - Smart contract calculates and releases provider payment.
   - Refunds are automatically sent to the user based on fulfillment percentage.



GPURent - Decentralized GPU R

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Verification Transaction	View on Etherscan
ChainLink Fulfillment	View Function Details
Contract	View Contract on Etherscan

GPU Specifications

Cores
Memory Size
Memory Bandwidth
Performance
Architecture
Power Consumption

API Access Details

Rental ID: GPU-MAAAHH10
IPFS Hash: QmQFCJ1FriUYA12XUN6KE9RmuJs3ApcsoTwaRnCfz2
Provider Address: 0x475235a4D3180210980FdB4ccF7B5c86DE8232fa
Status: Verified

Resolution

Resolving will release the payment to the provider and complete the rental.

MetaMask

User
Sepolia

Transaction request

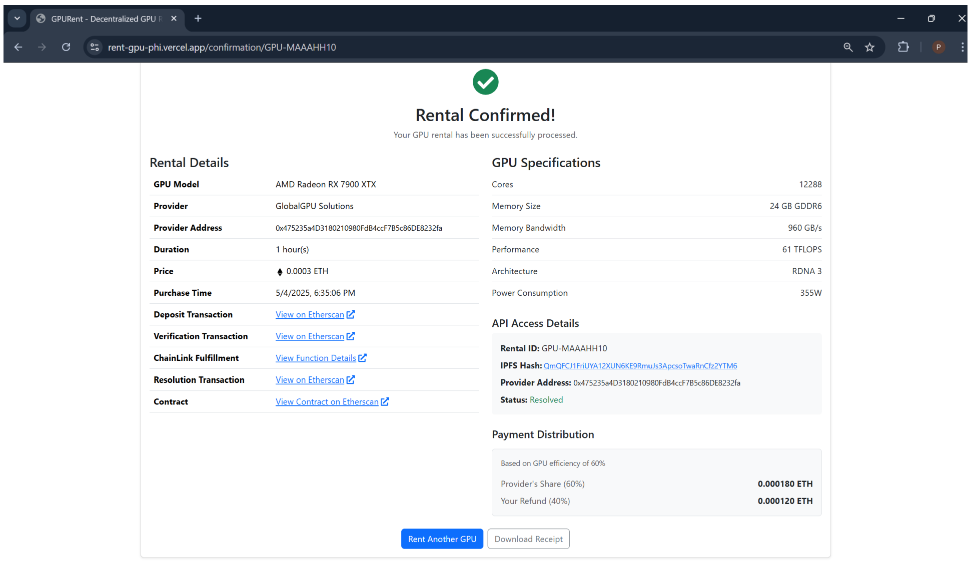
Estimated changes
You receive + 0.00012 SepoliaETH

Request from rent-gpu-phi.vercel.app
Interacting with 0xE590f...49433

Network fee 0.0001 SepoliaETH
Speed Market ~12 sec

Step 4: Final transaction showing refund and providerâs share

5. **Rental Summary:**
   - User can view all rental and transaction details.
   - Includes on-chain verification links, performance results, and final receipts.



GPURent - Decentralized GPU R

rent-gpu-phi.vercel.app/confirmation/GPU-MAAAHH10

Rental Confirmed!

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Duration	1 hour(s)
Price	0.0003 ETH
Purchase Time	5/4/2025, 6:35:06 PM
Deposit Transaction	View on Etherscan
Verification Transaction	View on Etherscan
ChainLink Fulfillment	View Function Details
Resolution Transaction	View on Etherscan
Contract	View Contract on Etherscan

GPU Specifications

Cores	12288
Memory Size	24 GB GDDR6
Memory Bandwidth	960 GB/s
Performance	61 TFLOPS
Architecture	RDNA 3
Power Consumption	355W

API Access Details

Rental ID: GPU-MAAAHH10
IPFS Hash: QmQFCJ1FriUYA12XUN6KE9RmuJs3ApcsoTwaRnCfz2YTM6
Provider Address: 0x475235a4D3180210980FdB4ccF7B5c86DE8232fa
Status: Resolved

Payment Distribution

Based on GPU efficiency of 60%

Provider's Share (60%)	**0.000180 ETH**
Your Refund (40%)	**0.000120 ETH**

Step 5: Complete rental summary and payment breakdown

5 Results

5.1 Implementation Outcomes

The platform was successfully deployed on Sepolia Testnet. Key outcomes:

- **Automated Verification:** Chainlink Functions enabled trustless verification.
- **Fair Payments:** Payments/refunds based on fulfillment percentage.
- **Decentralized Storage:** IPFS ensured transparent data storage.

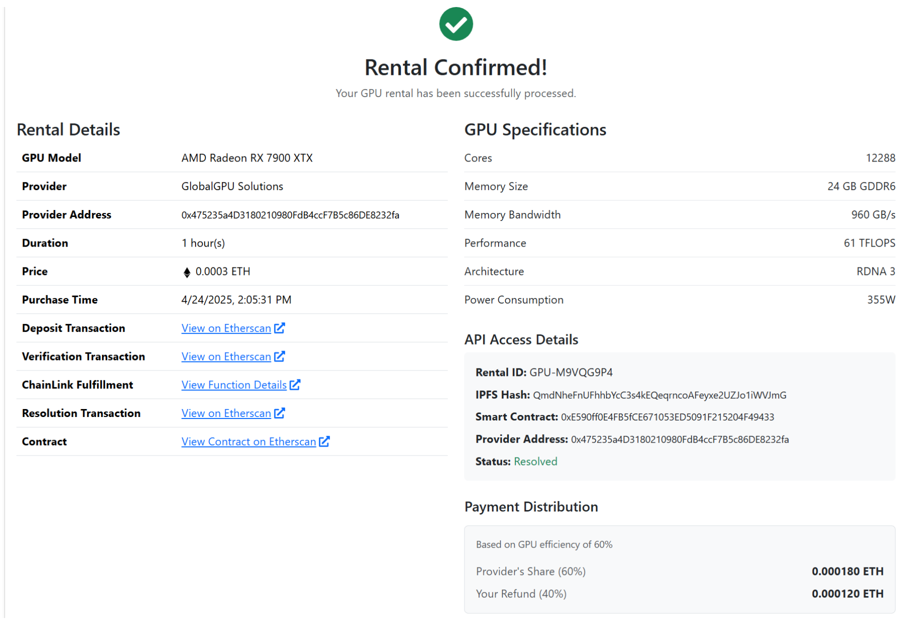
5.2 Performance Metrics

The following table summarizes GPU rental test cases, showing how the platform calculates fulfillment percentages and distributes payments based on actual GPU efficiency.
The following table summarizes GPU rental test cases, showing how the platform calculates fulfillment percentages and distributes payments based on actual GPU efficiency.

Test Case	GPU Model	Fulfillment %	Payment Distributed
1	AMD Radeon RX 7900	60%	60% to Provider
2	NVIDIA RTX 4090	50%	50% to Provider
3	NVIDIA RTX 4080	70%	70% to Provider

Table 1: GPU Rental Test Cases and Payment Distribution

Below are the transaction confirmations for each test case:



Rental Confirmed!

Your GPU rental has been successfully processed.

Rental Details

GPU Model	AMD Radeon RX 7900 XTX
Provider	GlobalGPU Solutions
Provider Address	0x475235a4D3180210980FdB4ccF7B5c86DE8232fa
Duration	1 hour(s)
Price	0.0003 ETH
Purchase Time	4/24/2025, 2:05:31 PM
Deposit Transaction	View on Etherscan
Verification Transaction	View on Etherscan
ChainLink Fulfillment	View Function Details
Resolution Transaction	View on Etherscan
Contract	View Contract on Etherscan

GPU Specifications

Cores	12288
Memory Size	24 GB GDDR6
Memory Bandwidth	960 GB/s
Performance	61 TFLOPS
Architecture	RDNA 3
Power Consumption	355W

API Access Details

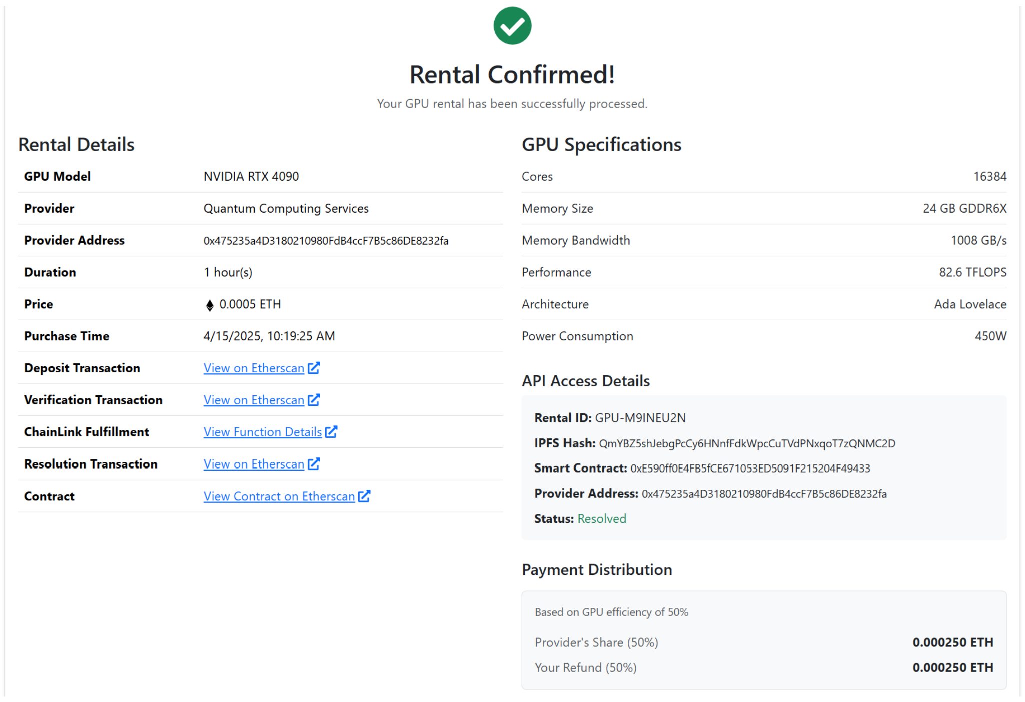
Rental ID: GPU-M9VQG9P4
IPFS Hash: QmdNheFnUFhhbYcC3s4kEQeqrncoAFeyxe2UZJo1iWVJmG
Smart Contract: 0xE590ff0E4FB5fCE671053ED5091F215204F49433
Provider Address: 0x475235a4D3180210980FdB4ccF7B5c86DE8232fa
Status: Resolved

Payment Distribution

Based on GPU efficiency of 60%

Provider's Share (60%)	**0.000180 ETH**
Your Refund (40%)	**0.000120 ETH**

GPU Rental Confirmation 1: AMD Radeon RX 7900 XTX (60% Efficiency)



Rental Confirmed!

Your GPU rental has been successfully processed.

Rental Details

GPU Model	NVIDIA RTX 4090
Provider	Quantum Computing Services
Provider Address	0x475235a4D3180210980FdB4ccF7B5c86DE8232fa
Duration	1 hour(s)
Price	⧫ 0.0005 ETH
Purchase Time	4/15/2025, 10:19:25 AM
Deposit Transaction	View on Etherscan
Verification Transaction	View on Etherscan
ChainLink Fulfillment	View Function Details
Resolution Transaction	View on Etherscan
Contract	View Contract on Etherscan

GPU Specifications

Cores	16384
Memory Size	24 GB GDDR6X
Memory Bandwidth	1008 GB/s
Performance	82.6 TFLOPS
Architecture	Ada Lovelace
Power Consumption	450W

API Access Details

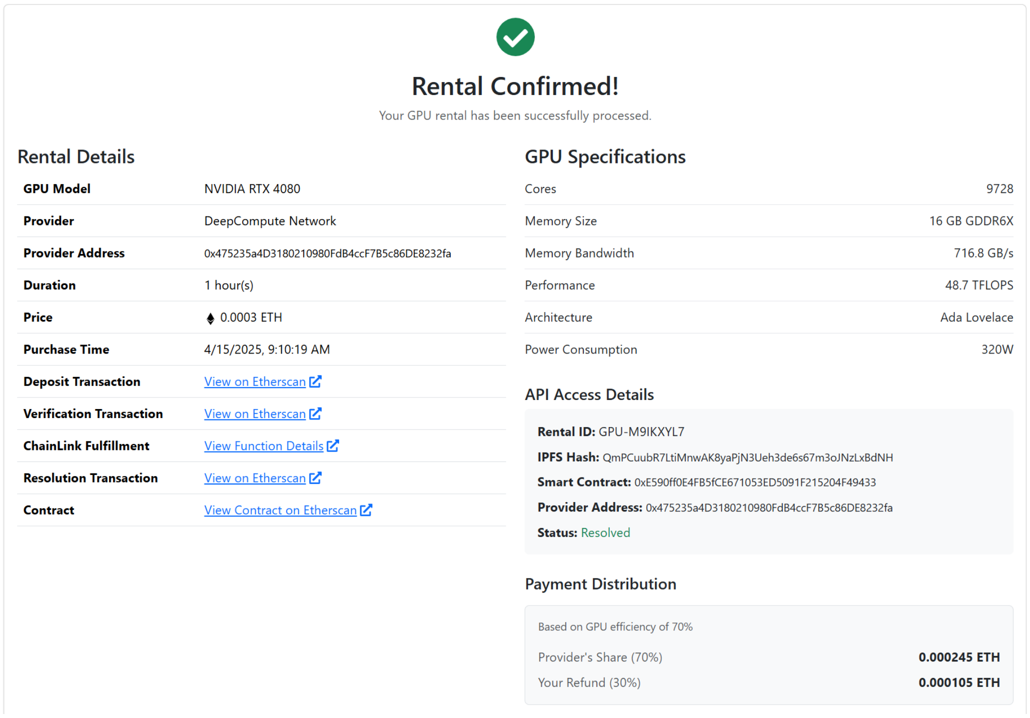
Rental ID: GPU-M9INEU2N
IPFS Hash: QmYBZ5shJebgPcCy6HNnfFdkWpcCuTVdPNxqoT7zQNMC2D
Smart Contract: 0xE590ff0E4FB5fCE671053ED5091F215204F49433
Provider Address: 0x475235a4D3180210980FdB4ccF7B5c86DE8232fa
Status: Resolved

Payment Distribution

Based on GPU efficiency of 50%

Provider's Share (50%)	**0.000250 ETH**
Your Refund (50%)	**0.000250 ETH**

GPU Rental Confirmation 2: NVIDIA RTX 4090 (50% Efficiency)



Rental Confirmed!

Your GPU rental has been successfully processed.

Rental Details

GPU Model	NVIDIA RTX 4080
Provider	DeepCompute Network
Provider Address	0x475235a4D3180210980FdB4ccF7B5c86DE8232fa
Duration	1 hour(s)
Price	⧫ 0.0003 ETH
Purchase Time	4/15/2025, 9:10:19 AM
Deposit Transaction	View on Etherscan
Verification Transaction	View on Etherscan
ChainLink Fulfillment	View Function Details
Resolution Transaction	View on Etherscan
Contract	View Contract on Etherscan

GPU Specifications

Cores	9728
Memory Size	16 GB GDDR6X
Memory Bandwidth	716.8 GB/s
Performance	48.7 TFLOPS
Architecture	Ada Lovelace
Power Consumption	320W

API Access Details

Rental ID: GPU-M9IKXYL7
IPFS Hash: QmPCuubR7LtiMnwAK8yaPjN3Ueh3de6s67m3oJNzLxBdNH
Smart Contract: 0xE590ff0E4FB5fCE671053ED5091F215204F49433
Provider Address: 0x475235a4D3180210980FdB4ccF7B5c86DE8232fa
Status: Resolved

Payment Distribution

Based on GPU efficiency of 70%

Provider's Share (70%)	**0.000245 ETH**
Your Refund (30%)	**0.000105 ETH**

GPU Rental Confirmation 3: NVIDIA RTX 4080 (70% Efficiency)

6 Team Contributions

The project was collaboratively developed with distinct roles and responsibilities:

- **Narayana Phani Charan Nimmagadda:** Frontend Development, Smart Contract Development, Chainlink Functions Integration, Project Coordination.
- **Sai Madhukar Vanam:** Frontend Development, IPFS Integration, UI/UX Enhancements, Testing & Documentation.

Both members actively participated in system design discussions, troubleshooting, and final deployment activities.

7 Conclusion

The platform demonstrates a trustless, automated GPU rental solution by integrating Ethereum, Chainlink, and IPFS. It ensures fair, transparent transactions and is scalable for high-performance computing applications.

Future enhancements:

- Integration with layer-2 solutions to reduce gas fees and improve scalability.
- Real-time performance dashboards for better user experience and transparency.
- Cross-chain compatibility to enable GPU rentals on other blockchain networks beyond Ethereum, enhancing flexibility and reducing dependency on a single network.
- Prototype data only: For this project we did not purchase any real GPUs; all performance data is simulated. Once access to actual GPU hardware is available, only minimal adjustments will be needed to make this platform production-ready.

8 References

1. Ethereum Foundation. (2023). *Ethereum Documentation.* Retrieved from `https://ethereum.org/en/developers/docs/`
2. Chainlink. (2023). *Chainlink Functions Documentation.* Retrieved from `https://docs.chain.link/chainlink-functions/`
3. Pinata. (2023). *IPFS Storage API Guide.* Retrieved from `https://docs.pinata.cloud/`
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