Truthful auction mechanisms for resource allocation in the Internet of Vehicles with public blockchain networks

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Overview

- Blockchain
- Transaction Management in Blockchain
- Vehicular Blockchain Network
- Consensus
- Need for Edge Resource Allocation
- Auction System
- Paper Details

Blockchain

🧾 **DISTRIBUTED LEDGER:**
DATA IS SHARED ACROSS MULTIPLE COMPUTERS (NODES) FOR TRANSPARENCY AND RELIABILITY.

🔒 **IMMUTABILITY:**
ONCE RECORDED, INFORMATION CANNOT BE CHANGED OR DELETED.

🌐 **DECENTRALIZATION:**
NO CENTRAL AUTHORITY — ALL PARTICIPANTS VERIFY TRANSACTIONS.

🧠 **SECURE BY CRYPTOGRAPHY:**
CRYPTOGRAPHY:
USES ENCRYPTION TO PROTECT PROTECT DATA AND ENSURE TRUST.

Advantage Of Blockchain

- High Security
- Transparency
- Fast and Efficient
- Cost Reduction
- Traceability

💰 Transaction Management in Blockchain

Refers to the **process of handling and verifying** transactions in the blockchain network.

Each transaction is **validated by miners or nodes** before being added to a block.

Ensures **accuracy, consistency, and security** of all recorded data.

Once confirmed, the transaction becomes **permanent and tamper-proof** in the ledger.

Vehicular Blockchain Network

Combines blockchain technology with moving devices.

Each vehicle acts as a node to store and verify data.

Enables secure, decentralized communication between vehicles.

Supports trusted data sharing and payments.

Consensus

- **Agreement process** among all blockchain nodes.
- Ensures **only valid transactions** are added to the ledger.
- Maintains **one shared and trusted version** of the blockchain.
- Provides **security and reliability** in a decentralized network.

Types of Consensus Mechanisms

1. **Proof of Works(POW):**
   - Miners solve **complex puzzles** to validate transactions.
   - **High energy consumption** due to heavy computations.
   - Rewards miners with **cryptocurrency**.
   - Used in **Bitcoin**; secure but slower.

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2. Proof of Stake(POS)

- Validators are **chosen based on the number of coins they stake**.
- **Energy-efficient**; no complex puzzles like POW.
- Rewards are distributed **proportionally to the stake**.
- Used in **Ethereum 2.0, Cardano**, and other modern blockchains.

🌐 Need for Edge Resource Allocation

- **Edge-level computing provider** delivering CPU, storage, and network.
- **Processes data locally**, reducing latency.
- **Supports blockchain and IoT applications** with resources.
- **Bridges users and cloud**, acting as a nearby mini data center.

Auction System

Bidding-based mechanism for buying or selling resources.

Participants place bids to compete for limited assets.

Ensures **fair, transparent, and efficient allocation**.

Widely used in **blockchain and IoV** for resource management.

🏷️ Types Of Auction System

1. English Auction
2. Dutch Auction
3. First Price Auction
4. Second Price(Vickrey) Auction
5. Double Auction

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ABSTRACT

Recording vehicle driving data into the blockchain can effectively solve problems of data authenticity and security, which is a focus of research on blockchain and the Internet of Vehicles. However, when using blockchain technology, the proof-of-work completed by vehicles may consume substantial energy and computing resources, which limits the application of blockchain technology in the internet of vehicles environment. Therefore, this paper considers deploying edge computing nodes to support blockchain technology and introducing an auction mechanism to encourage users to record vehicle driving data as miners. This paper proposes two auction mechanisms for the blockchain network formed by edge computing service providers and miners to maximize the social welfare. Specifically, one mechanism is used when the resource demands of the miners are the same, and the other is used when the resource demands of the miners are different. For resource allocation, the former uses the maximum cost maximum flow algorithm to achieve optimal allocation, and the latter uses a heuristic algorithm. For price payment, the former uses the Vickrey–Clarke–Groves mechanism, and the latter uses dichotomy. These two price payment algorithms use critical value theory to calculate the payment price. This paper demonstrates that both are truthful and individually rational. Through experiments, this paper evaluates indicators such as social welfare, satisfaction, and resource utilization. The experiments show that the proposed auction mechanism can effectively maximize social welfare in the blockchain network and provide an effective resource allocation strategy for edge computing service providers.

1. Introduction

attracted the attention of many people. A car owner complained about an accident due to a brake failure in a certain Tesla model.

Objective

- Efficient Resource Allocation
- Truthful Auction Design
- Weighted Resource Model
- Profit Optimization
- Blockchain Transparency

Experimental Parameters

1. Constant-Demand Auction Mechanism (CDAM)

- Designed for **blockchain-based IoV systems** where all miners have the **same demand (di = 1)**
- **Objective:** Maximize **social welfare** through efficient resource allocation
- **Allocation:** Uses **Maximum Cost Maximum Flow Algorithm** for optimal distribution
- **Pricing:** Applies **Vickrey–Clarke–Groves (VCG)** mechanism to ensure **truthful bidding**

2. Multi-Demand Auction Mechanism (MDAM)

- Designed for **blockchain-based IoV systems** where miners have **different resource demands ($d_i \neq 1$)**
- Objective: **Maximize social welfare** while handling **variable resource requirements**
- **Problem type:** NP-hard (cannot find exact optimal solution in polynomial time)
- Uses **heuristic approach** for near-optimal performance

Further Work

1. Implement CDAM and MDAM
2. Compare Their Social Profit

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Thank You!!