

FAST DATA: A FAIR, SECURE AND TRUSTED DECENTRALIZED IIOT DATA MARKETPLACE ENABLED BY BLOCK CHAIN.

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Abstract- As the world calls it, data is the new oil. With vast installments of Industrial Internet-of-Things (IIoT) infrastructure, data is produced at a rate like never before. Similarly, artificial intelligence (AI) and machine learning (ML) solutions are getting integrated to numerous services, making them “smarter”. However, the data remains fragmented in individual organizational silos inhibiting data value extraction to its full potential. Digital marketplaces are emerging to allow data owners to monetize this data. Yet concerns like privacy, security and unfair payment settlement deter adoption of such platforms. In addition, the state-of-the-art platforms are under the control of large multinational corporations with no transparency between buyer and seller in terms of payment details, listing, data discovery and storage. In this work, a novel decentralized platform of digital data marketplace for IIoT data has been proposed. The platform leverages a decentralized data streaming network to host IIoT data in a reliable and fault tolerant manner. The platform ensures fair trading, data storage and delivery in a privacy preserving manner and trust metric calculation for actors in the network. In order to study the feasibility of the proposed platform, an open source library is developed using Hyperledger Fabric and data network layer built on VerneMQ, the library is deployed on a real-time Google cloud platform. The library is tested and results are analysed for throughput, overheads and scalability.

Keywords: . ITS-G5, C-V2X, LTE, 5G and, in the future, 6G)

I. INTRODUCTION

Sensing-as-a-Service has emerged as a rapidly growing industry spurring interest of enterprises that invested heavily in installation of Industrial Internet-of-Things (IIoT) infrastructure for past few decades. They have realized that data generated in their siloed environment is a trade able commodity with resale value. With proliferation of AI based solutions in the market, data has garnered commercial value to train novel machine learning models. Federated machine learning models require IIoT data frequently in large volume. On the other hand, there are companies that are not inclined to invest in setting up IIoT infrastructure but are willing to pay for reliable data streams from heterogeneous domains like weather, population density, soil type etc. They find it profitable to buy data from corporations that have such sensors installed. Such scenarios demand for a platform which makes it feasible to sell and purchase data seamlessly. However, wide-scale adoption of this idea still remains a challenge due to uncertainties around trust, cross-domain trading facility, fair transactions and security. Vendors willing to exchange data as a commodity are looking for assurance on validity of IIoT devices and enterprises engaged in business. Siloed identity verticals, unauthorized malicious entity posing as data producers, centralized control of platform and fear around equitable payment settlement are challenges that require a new approach to make IIoT data trading a reality.

In this work, a model is presented that is based on the principle of data sovereignty in which independent IIoT business ventures can sell and purchase data reliably and in a trust-worthy manner with undisputed compensation to all the parties. We argue that such an effort requires a platform that disintermediates the central storage operator. In order to achieve transparency, accountability and fairness it is necessary to forgo centralized control from trusted third party (TTP) in terms of fair listing and seller discovery, identity validation and payment settlement. Therefore, the proposed digital marketplace uses block chain platform as a decentralized trusted party that facilitates fair listing of data streams, identity verification and payment settlement using smart contracts. According to GDPR Articles 16 & 17 (Right to Rectification and Erasure), data modification/erasure must be possible to comply with legal requirements. Hence, critical data should not be stored on an immutable storage such as block chain, which does not allow for modification of data, to ensure data integrity and trust.

Therefore, in the proposed framework no private data is stored on block chain. Moreover, block chain is not a viable option for bulk data storage. Hence, the proposed platform leverages a decentralized data storage layer which is replicated across participating nodes to provide data delivery in a fault tolerant manner.

ii RELATED WORK

The FAST DATA project tackles a growing concern in the IIoT data landscape: the need for a secure, fair, and trusted marketplace. To understand how FAST DATA positions itself within existing solutions, a literature survey is crucial. Here's a breakdown of what you might find in relevant research:

1. Limitations of Centralized Marketplaces:

- Look for research highlighting the drawbacks of current IIoT data marketplaces, particularly those controlled by centralized authorities.
- This could involve studies on lack of transparency in pricing, data ownership disputes, and limited control for data sellers .

2. Decentralized Solutions with Blockchain:

- Explore existing research on blockchain-based decentralized marketplaces for IoT data.
- Papers discussing projects like Monetization using Blockchains for IoT Data Marketplace or Decentralized Blockchain-Based IoT Data Marketplaces would be relevant.
- Analyze how these projects leverage blockchain features like immutability, traceability, and security to address limitations of centralized models.

3. Specific Areas Addressed by FAST DATA:

- Look for research that explores solutions for specific challenges FAST DATA aims to tackle. This might include:
 - **Data Sovereignty** - Studies on user control and ownership of data within a decentralized marketplace
 - **Trust Metrics** - Research on reputation and trust mechanisms for participants in a decentralized network
 - **Privacy-Preserving Data Sharing** - Papers discussing techniques for secure data sharing while maintaining privacy

4. Technology Choices for FAST DATA:

- Investigate the rationale behind FAST DATA's choice of blockchain platform (e.g., Hyperledger Fabric).
- Research papers comparing different blockchain options for IoT data marketplaces might be helpful.

Here are some resources to get you started:

- FAST DATA: a fair, secure and trusted decentralized IIoT data marketplace enabled by blockchain
- Decentralized Blockchain-Based IoT Data Marketplaces
- **Monetization using Blockchains for IoT Data Marketplace**

Remember, this is not an exhaustive list. A comprehensive literature survey will involve exploring additional research papers and resources based on the specific aspects of FAST DATA that interest you.

- 1. User Authentication and Authorization:** Implement mechanisms for user registration, authentication, and authorization to ensure only authorized users can access the platform.
- 2. Data Listing and Discovery:** Enable users to list their IIoT data sets on the marketplace and provide tools for other users to discover and search for relevant data based on their needs.
- 3. Data Pricing and Billing:** Allow data providers to set prices for their data sets and facilitate secure billing and payment transactions between buyers and sellers.
- 4. Data Integrity and Security:** Utilize blockchain technology to ensure the integrity and security of the data exchanged on the platform, including mechanisms for data encryption, access control, and tamper-proof data storage.
- 5. Smart Contracts:** Implement smart contracts on the blockchain to automate and enforce the terms of data exchange agreements, including data usage rights, royalties, and dispute resolution.
- 6. Decentralized Governance:** Establish mechanisms for decentralized governance, including voting and consensus mechanisms, to ensure fairness, transparency, and community-driven decision-making on platform policies and updates.
- 7. Scalability and Performance:** Design the platform to be scalable and performant, capable of handling a large volume of data transactions while maintaining low latency and high throughput.
- 8. Interoperability:** Enable interoperability with existing IIoT systems and standards to facilitate seamless integration and data exchange between different platforms and devices.
- 9. Data Analytics and Insights:** Provide tools and APIs for data analysis, visualization, and insights generation to help users derive value from the data exchanged on the platform.
- 10. Compliance and Regulation:** Ensure compliance with relevant data privacy regulations, industry standards, and best practices to mitigate legal and regulatory risks associated with data exchange.

By addressing these functional requirements, the "FAST DATA" project can create a robust and effective decentralized IIoT data marketplace that meets the needs of its users while ensuring fairness, security, and trust in the data exchange process.

IV PROPOSE SYSTEM & IMPLEMENTATION

We propose a novel proof-of-concept decentralized solution to IoT data marketplace that supports actor verification, trust metric calculation and a secure and transparent transactional model for paying the sellers all in a decentralized manner by leveraging an innovative combination of blockchain, DID, peer-to-peer data stream storage and end-to-end encryption.

The proposed model guarantees (i) fair settlement of compensation to all the involved parties, (ii) unbiased content listing using calculated trust metric, (iii) security of the content from peers hosting and delivering data streams (iv) fault tolerance and assured data delivery in case of faulty storage network peers.

We develop a proof-of-concept implementation with distributed applications (DApp) and blockchain layer using Hyperledger Fabric, and the decentralized real-time stream data storage layer using VerneMQ [4]. The work includes study and discussion of the performance of the system which demonstrate that the system scales well with rational overheads.

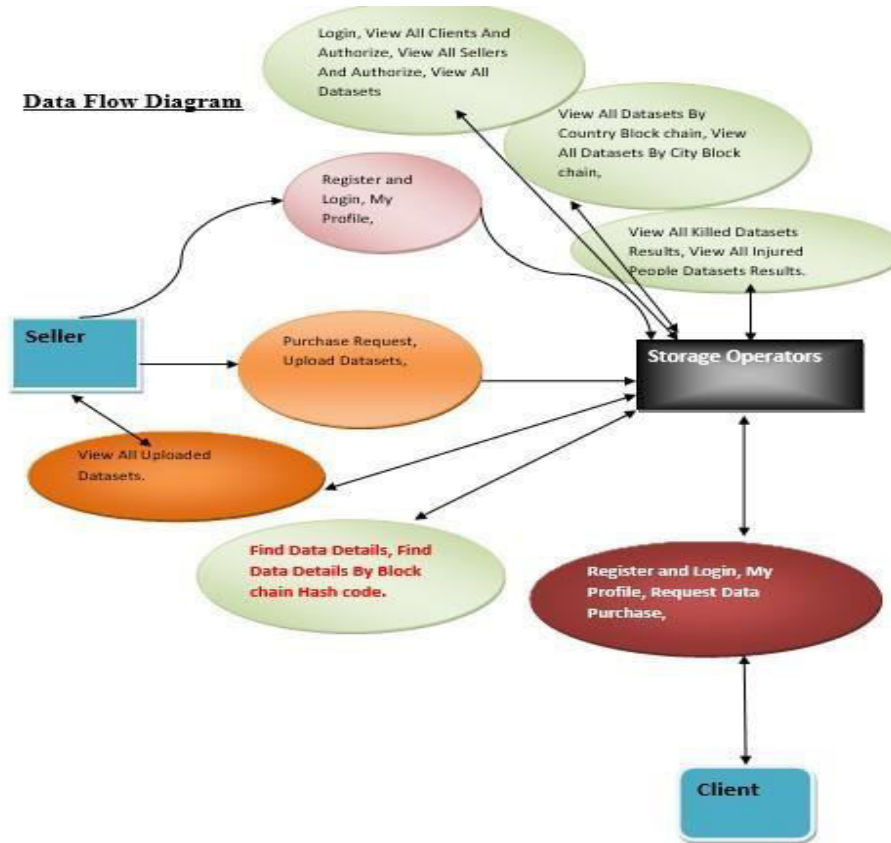


Figure 1: Proposed system architecture

V RESULT ANALYSIS



Fig 2. Home Page



Fig 3:-seller login page



fig 4:-client home page

VI CONCLUSION

In this work, we addressed the issue in real-time decentralized trading of IOT data which is a future reality owing to the massive progress in advanced AI algorithms that need bulk of data to make informed decisions. By leveraging an innovative combinations of block chain, peer-to-peer storage facility, decentralized applications, the proposed system guarantees fairness to all participants despite presence of maliciousness, privacy of data from peers involved in hosting content, fault tolerance and availability, all without reliance on a central facilitator.

While designing such a system, certain challenges were faced that can be taken up as future work in this research direction. The first challenge remains designing equitable payment methodologies between the two parties. The parties can agree to transact in either crypto currencies/native token or existing payment methods. Crypto-tokens can also act as incentive mechanism for early adopters of the platform. Designing a payment layer over such a system architecture is one of the future works. Yet another challenge remains to put a check on external sharing of platform IOT data in the long run. For that, game theory approaches can be taken to design, better pricing models and terms of data exchange. In the proposed work, we have proposed a basic incentivization mechanism, in future works, more robust and theoretically tested schemes can be designed to make unfair transactions economically unattractive. These directions are some of the

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