Ocean Track

SOLANA

Real-Time Maritime Traceability with Blockchain: A Case Study Using DePIN on the Solana Network

Table of Contents

1. Introduction

Maritime navigation, especially in competitive events and private vessels, depends heavily on tracking systems for safety, auditing, and logistics control. However, most available solutions remain centralized, expensive, and inaccessible to small or amateur vessels.

This project proposes the development of a real-time maritime tracking system based on blockchain, using the Solana network to register geolocation data. The prototype will be tested during the 52nd edition of the International Sailing Week of Ilhabela (SIVI 52), one of Latin America's largest nautical events.

The solution is anchored on three core pillars:
- Time Precision: Position updates every 30 to 60 seconds.

- Security: Encrypted signature and safe data transmission.
- Data Storage: Immutable, verifiable records in decentralized networks.

The competitive environment of SIVI 52 justifies the test due to the demand for transparency and precision. Collected data can serve as a historical registry for vessels that lack navigational records, aiding in asset valuation, maintenance, or resale.

Furthermore, the project opens a path for a DePIN-based ecosystem where vessels become active nodes in a decentralized data network, supporting future communication, gamification, and interoperability in the maritime world.

2. Theoretical Framework

2.1 Blockchain and the Solana Network

Solana is a high-performance public blockchain known for low fees and high scalability. Capable of processing thousands of transactions per second, Solana is well-suited for applications that demand real-time data streams such as GPS tracking.

2.2 DePIN: Decentralized Physical Infrastructure Networks

DePINs are composed of physical devices that transmit data into decentralized systems. Instead of relying on central servers, these networks incentivize individuals to maintain infrastructure. This project aims to establish a maritime DePIN layer, where boats serve as active data contributors.

2.3 IoT and Maritime GPS

GPS trackers connected to microcontrollers like ESP32 or Raspberry Pi enable real-time data capture at sea. Using 4G, satellite, or hybrid networks, data can be continuously transmitted to the blockchain.

3. Methodology

The MVP follows a practical implementation strategy:
- Select GPS devices compatible with technical specifications.
- Integrate with microcontrollers and back-end data transmission systems.
- Develop smart contracts on Solana using Rust and Anchor Framework.
- Build a front-end dashboard with real-time visualization.
- Conduct live testing during the SIVI 52 sailing event.

4. MVP Development

4.1 System Architecture

The system includes:
- GPS and communication modules (ESP32/Raspberry Pi).
- API for data collection and validation.
- Smart contract layer on Solana.
- Real-time visual dashboard (3D map).
- Optional off-chain storage (IPFS/Arweave).

4.2 Technical Pilots at SIVI 52

Selected vessels during the event will run the system live, transmitting performance and navigational data. This real-world scenario provides reliable feedback on the system's capabilities.

4.3 Storage, Security and Synchronization

All transmitted data will be cryptographically signed. Records are written on-chain using Solana's PDAs (Program Derived Addresses). Complete data histories may also be archived on decentralized file systems.

5. Expected Results and Scalability

The project aims to:
- Prove feasibility of real-time maritime tracking via blockchain.
- Test precision and performance under competitive conditions.
- Validate the Solana network's scalability for frequent GPS data storage.

Future extensions include private vessel integration, asset history management, resale platforms, and DePIN community growth with interactive features.

6. Conclusion

This project introduces a new model of maritime traceability built on the principles of decentralization, security, and transparency. By leveraging blockchain and DePIN infrastructures, it lays the foundation for a robust nautical data ecosystem.

The pilot test at SIVI 52 demonstrates not only technical feasibility but also the social and economic value of blockchain-integrated navigation systems, potentially transforming how vessels interact, communicate, and build trust in the digital sea of Web3.