

TITLE OF PAPER

DECHAIN: PRIVATE BLOCKCHAIN-BASED DIGITAL EVIDENCE MANAGEMENT SYSTEM

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AGENDA

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- Proposed Framework
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INTRODUCTION

1. **Challenges in Traditional Evidence Management:** Traditional systems face issues like tampering, unauthorized access, inefficient storage, and lack of scalability, making it difficult to maintain the integrity of digital evidence in legal processes.
1. **Proposed Solution - DEChain:** DEChain, a private blockchain-based system using Hyperledger Fabric and Composer, addresses these challenges by ensuring scalability, security, and transparency in managing digital evidence.

PRELIMINARIES

Digital Evidence and Challenges: Digital evidence includes files, system logs, IoT data, and social media interactions, playing a critical role in investigations. However, challenges like tampering risks, data overload, and ensuring legal admissibility require robust handling and authentication processes.

2. Blockchain and Hyperledger Tools: Blockchain ensures immutability, transparency, and secure management of digital evidence, while Hyperledger Fabric and Composer provide flexible, permissioned systems and efficient tools for developing scalable and secure blockchain applications for evidence management.

PROPOSED FRAMEWORK

- **1. Purpose and Workflow:** DEChain, a blockchain-based framework, ensures secure, tamper-proof digital evidence management, covering processes like evidence submission, validation, and review. It upholds chain-of-custody integrity, transparency, and accountability across six key stages: Registration, Transfer, Verification, Report Generation, Legal Review, and Access Control.
- **2. System Components and Key Features:** DEChain integrates a blockchain network, smart contracts for automation, secure storage, and an audit module for compliance tracking. Algorithms ensure reliable evidence handling, with cryptographic verification for integrity, efficient custody transfer, and comprehensive system governance to maintain transparency and security.

ARCHITECTURE (Stakeholders)

The *DEChain* system engages four key stakeholders:

- **Administrative Staff:** Manage operations and assign permissions.
- **Law Enforcement Agencies:** Input and authorize evidence transfers.
- **Forensic Experts:** Validate evidence authenticity and prepare reports.
- **Legal Professionals:** Access verified evidence and reports to ensure its admissibility in court proceedings.

ALGORITHMS

DEChain employs efficient algorithms for managing evidence-related processes:

1. **Evidence Registration Algorithm:** Ensures secure and tamper-proof recording of evidence metadata, utilizing blockchain hashing and cryptographic signatures.
2. **Evidence Transfer Algorithm:** Implements consensus mechanisms for secure and transparent handover of evidence between stakeholders.
3. **Evidence Verification Algorithm:** Performs chain-of-custody validation and checks cryptographic integrity to authenticate the evidence.

Each algorithm is optimized for low latency and computational cost, leveraging the capabilities of Hyperledger Fabric's smart contracts and distributed ledger technology.

SIMULATION AND PERFORMANCE

Key Observations

1. Performance Stability Across Key Processes:

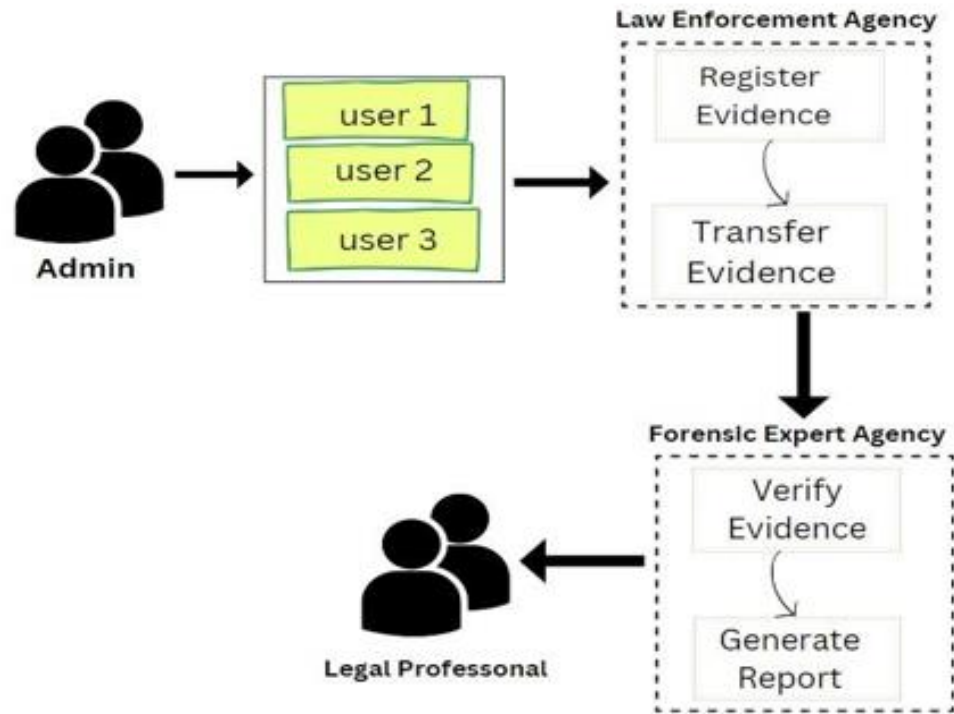
- Register Evidence: Stabilizes at ~18.58 ms.
- Transfer Evidence: Stabilizes at ~12.04 ms.
- Verify Evidence: Stabilizes at ~8.25 ms.
- Generate Report: Stabilizes at ~2.48 ms.
- Demonstrates scalability, low latency, and high throughput even under repeated operations.

2. System Efficiency and Security:

- Utilizes Hyperledger Fabric for secure, immutable storage and encrypted communication.
- Outperforms traditional systems in processing efficiency, security, and computational cost, ensuring robust and reliable evidence management.

SIMULATION AND PERFORMANCE

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PERFORMANCE ANALYSIS

The performance of *DEChain* is evaluated on:

- **Efficiency:** Operations complete within milliseconds, ensuring high throughput.
- **Security:** Blockchain ensures immutability and protection against tampering and replay attacks.
- **Scalability:** Modular design handles increased workloads with minimal resource overhead.

DEChain surpasses traditional systems in speed, security, and scalability for digital evidence management.

CONCLUSION

Key Insights

1. DEChain's Impact on Digital Evidence Management:

- **Blockchain Integration:** Revolutionizes digital evidence management through decentralization, immutability, and enhanced security.
- **Improved Judicial Processes:** Reduces risks like unauthorized access and evidence tampering.

2. Efficiency and Future Potential:

- **Performance Evaluation:** DEChain is efficient, low-latency, high-throughput, and reduces computational costs.
- **Future Research:** Opportunities to enhance scalability and privacy with advanced cryptographic techniques.

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