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Blockchain-Driven Supply Chain Visibility with .Net and Azure Confidential Ledger: Design and Implementation Strategies

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Abstract: *The growing demand for transparency and trust in supply chain systems has accelerated the adoption of decentralized technologies capable of delivering tamper-proof and verifiable transaction histories. This paper presents a blockchain-integrated framework built on .NET and Azure Confidential Ledger to enhance supply chain visibility and traceability across distributed logistics networks. The proposed system leverages the immutability of blockchain and the confidentiality guarantees of trusted execution environments to securely record and validate every logistical event—from procurement to final delivery—without exposing sensitive operational data. By integrating Azure Confidential Ledger with ASP.NET Core microservices, the framework ensures secure data logging and access control while maintaining compatibility with enterprise-grade identity and authorization mechanisms. Data is ingested through RESTful APIs and processed using Entity Framework Core for transactional integrity. A modular architecture allows easy extension into existing logistics platforms while providing real-time dashboards and alerting via SignalR and Power BI. Experimental evaluation demonstrates the system's efficiency in handling concurrent events, maintaining low latency, and preventing unauthorized data modifications. This study offers a scalable and privacy-preserving design pattern for organizations aiming to modernize supply chain management using blockchain technology in secure cloud environments, establishing a foundation for future innovations in decentralized logistics infrastructure*

Keywords: Supply chain transparency, blockchain technology, Azure Confidential Ledger, .NET Framework, ASP.NET Core, secure data logging, trusted execution environments, logistics management, Entity Framework Core, RESTful APIs, confidential computing

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