

# Toward Trust in Internet of Things (IoT) Ecosystems: Design Principles for Blockchain-Based IoT Applications

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## Abstract

The Internet of Things (IoT) describes the concept of physical objects equipped with identifying, sensing, networking, and processing capabilities being connected to the Internet. Architectures for the IoT typically rely on transmitting data to centralized cloud servers for processing. Although cloud services are supposed to enhance the IoT in storage, computation, and communication capabilities, this approach often generates isolated data silos and requires trust in third parties operating the cloud servers, which become single points of failure. In addition, centralized cloud-based applications lack transparency and allow for undetected manipulation and concealment of IoT data. To overcome these downsides, we develop and evaluate a blockchain-based IoT sensor data logging and monitoring system, employing a design science research (DSR) approach. We show that such systems should provide modularity, data parsimony, and availability in addition to domain-specific principles. The prototype improves data integrity and availability but uncovers challenges like high operating costs through smart contract computation fees. Further, semi-structured interviews with practitioners allowed us to derive insights for developing blockchain-based IoT ecosystems and reveal that cooperation with organizations is key for transferring solutions into production. We contribute to the IoT knowledge base by providing design principles as well as managerial and technological recommendations.