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RESEARCH NEWS STORY

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Making Blockchain Fast Enough for IoT Networks

Researchers develop a lightweight algorithm that reorganizes network connections to enable secure, low-latency data sharing

Blockchain is a promising solution for secure data sharing in the Internet of Things (IoT) networks, but existing systems often suffer from high latency that limits time-sensitive applications. Now, researchers from Japan have investigated how the structure of peer-to-peer blockchain networks affects IoT-blockchain performance. They developed Dual Perigee, a lightweight peer-selection algorithm that significantly reduces data propagation delays without increasing resource usage on IoT devices.

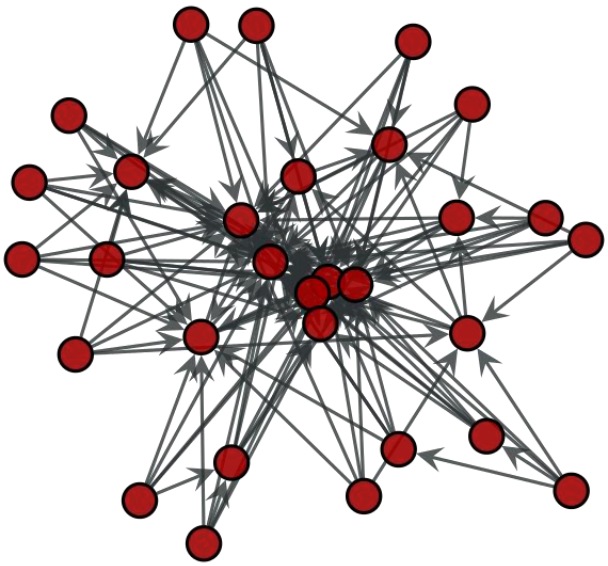

Image title: Network Topology Can Cause Major Delays in Blockchain Operations
Image caption: Conceptual illustration of peer-to-peer connections in an IoT–blockchain network. The proposed Dual Perigee algorithm can dynamically reorganize these links to improve data transmission efficiency.
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The vision of a fully connected world is rapidly becoming a reality through the Internet of Things (IoT)—a growing network of physical devices that collect and share data over the Internet, including everything from small sensors to autonomous vehicles and industrial equipment. To ensure this data is secure and not tampered with, engineers are increasingly turning to blockchain as a promising solution. While often associated with cryptocurrencies, blockchain is essentially a decentralized digital ledger; instead of one company controlling the data, it is shared and maintained collectively across a network of computers.

Unfortunately, existing blockchain systems can be too slow for the split-second decisions required in real-world IoT environments. The primary cause of this sluggishness is not the blockchain protocol itself, but the disorganized way the nodes within peer-to-peer networks communicate. Most previous research has ignored how the overarching shape of these connections—referred to as the 'network topology'—impacts speed in IoT-blockchain systems.

To address this knowledge gap, a research team led by Associate Professor Kien Nguyen from the Institute for Advanced Academic Research/Graduate School of Informatics, Chiba University, Japan, investigated how to streamline operations in IoT-blockchain networks. Their study, published in the journal *IEEE Transactions on Network and Service Management* on December 17, 2025, examines the impact of different network topologies on performance and introduces a new method to keep data moving efficiently. "*We aimed to bridge the gap between theoretical design and practical deployment of IoT-blockchain systems by identifying the fundamental causes of their high latency and proposing a decentralized solution that is both simple and effective,*" says Dr. Nguyen. The study was co-authored by Koki Koshikawa, Yue Su, and Hiroo Sekiya, all from Chiba University.

First, to understand the root cause of the delays, the researchers implemented a method to generate different network topologies and connect simulated blockchain clients. After analyzing various representative cases, they showed that the decentralized nature of IoT networks often leads to redundant data transmission. Specifically, they found that the current protocols for sharing 'transactions' (the individual data entries) and 'blocks' (the larger bundles of verified records) can cause an exponential increase in data copies. This results in network congestion and queuing delays, particularly when nodes are connected in a way that creates too many overlapping paths.

In response to this problem, the researchers developed "Dual Perigee," a lightweight and decentralized algorithm that allows each node to intelligently choose its preferred 'neighbors' in the network. Instead of sticking with a series of random connections, a node using Dual Perigee assigns scores to its peers based on how quickly they deliver both individual transactions and full blocks. If a neighbor is consistently slow, the node automatically disconnects and tries new peers. Over time, the entire network self-organizes into a high-speed configuration without needing a central controller.

After testing in a simulated 50-node IoT environment, the Dual Perigee algorithm reduced block-related delays by 48.54% compared to the standard approach used in the widely known Ethereum blockchain. It also outperformed state-of-the-art methods, such as the original

Perigee algorithm, by over 23%. Notably, the researchers achieved these gains without adding extra computational strain to the IoT devices themselves, as the algorithm relies on 'passive' measurements of data that the devices were already receiving and requires only minimal calculations.

This work has significant implications across many technological fields. By minimizing the time it takes for a blockchain to confirm and share data, the system becomes responsive enough for time-sensitive tasks. "*The proposed decentralized latency-aware peer-selection mechanism can serve as a foundation for future blockchain platforms that support real-time, mission-critical IoT services, ultimately enabling more secure, responsive, and trustworthy digital infrastructures*," explains Dr. Nguyen.

As IoT networks continue to grow in size and complexity, the need for decentralized, trustworthy means of communication will only increase. The research team believes Dual Perigee could play a key role in the near future, as Dr. Nguyen remarks: "*Our approach can be applied to emerging IoT-based services that require fast and reliable data sharing, such as smart cities, smart homes, industrial monitoring, healthcare systems, and supply-chain tracking.*"

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About Associate Professor Kien Nguyen from Chiba University, Japan

Dr. Kien Nguyen obtained a B.E. degree in Electronics and Telecommunications from the Hanoi University of Science and Technology (HUST), Vietnam, in 2004, and a Ph.D. degree in Informatics from the Graduate University for Advanced Studies, Japan, in 2012. He joined Chiba University in 2018, where he currently serves as an Associate Professor. His research covers a wide range of topics in networking and distributed systems, including the Internet, the Internet of Things technologies, and distributed ledger technologies. His research achievements have been disseminated through three patents, several IETF Internet drafts, and more than 160 publications in peer-reviewed journals and conferences.

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