BLOCKCHAIN: HOW DISTRIBUTED LEDGER TECHNOLOGY WILL SUPPORT THE IOT

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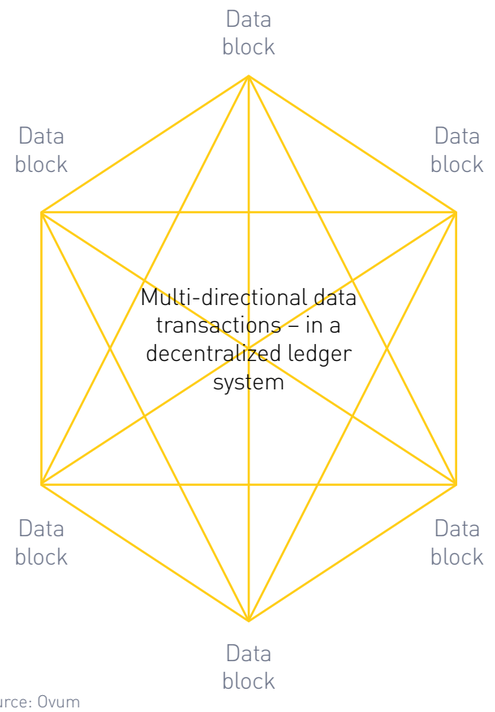
TZ Wong is a senior analyst providing strategic analysis of the challenges and threats facing IoT service providers and vendors, and advising on market trends and opportunities. His focus areas include IoT in Asia, and emerging IoT technologies.

Blockchain technology (also called distributed ledger) is commonly associated with Bitcoin, Ethereum, and other digital currencies. These digital currencies established the viability of distributed ledger as a means of conducting, verifying, and permanently recording transactions without the need for a trusted third party. Beyond digital currencies, blockchain has many other potential applications. Many players are now starting to explore opportunities to apply blockchain in IoT scenarios.

What is blockchain?

Ovum defines blockchain technology as "a database technology that allows data to be shared among users without the need for a centralized authority by using a consensus mechanism." Essentially, it works through a peer-to-peer network of computers that share and record information in a distributed ledger (see Figure 1).

Figure 1: Decentralization and consensus are key criteria for blockchain technology



Source: Ovum

Blockchain consists of data structure blocks, with each block containing batches of individual transactions and the results of any blockchain executables. Each block holds a timestamp and information linking it to a previous block, forming a chain of blocks. A transaction represents a unit of value between two (or more) people. This unit of value will go from owner X to owner Y by broadcasting to the network the changes in amount, status, or activity. Network nodes timestamp and keep track of changes after transactions are made, and changes are verified through links to previous transactions, which are called inputs.

Blockchain use in IoT

Blockchain is fundamentally a horizontal technology. It can potentially benefit any transaction-centered business activity where the integrity of data records is essential, offering lower cost and increased efficiency. Wider applications for the core timestamping technology that underpins Bitcoin and other cryptocurrencies include financial services, supply chain management, healthcare, and government. In addition, blockchain's distributed ledger capability could prove useful wherever the inviolable nature of anything inserted into a chain could provide data with evidential weight about who did what and when.

In the IoT context, Ovum sees strong potential for the use of blockchain for security, identification/authentication, verification, and record-keeping. Early use cases are likely to include IoT applications in transport and logistics, and agriculture. We have seen particular interest in using blockchain to enable 'smart contracts' (also called self-executing contracts) created between machines as IoT-enabled machine-to-machine transactions take place. Smart contracts are a series of if-then statements defining a set of conditions that must be met to authorize payment for a transaction. This contract is written into the blockchain, and when the conditions are met – verified by the blockchain itself – payment is issued automatically.

Transport and logistics

In international trade, moving physical assets or goods across countries involves customs declaration and clearance. This process requires authenticating the identities of the shipper and receiver, and verifying the declared quantity and type of physical assets or goods, and the source and authenticity of these when they are shipped. It is a paperwork-heavy process. Many trade and legal documents must be submitted and processed, and many intermediaries are involved, such as freight forwarders, and customs brokers. The process requires timely submission of accurate documents and timely payments among parties. Errors in documentation or delay in payments can result in delayed customs clearance, which then cascades down the line and often results in operational loss.

Shipping and logistics activities are a natural fit for IoT applications, with asset tracking being one of the fastest-growing areas of the IoT thanks to the clear value of being able to track the location and status of goods in near-real time. Incorporating blockchain technology into this process enables ongoing, highly

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reliable recording of the status and location of goods, of receipt of goods and the timing of receipt, and of other key elements of transactions as goods make their way from producer to buyer.

With blockchain's shared distributed ledger and smart contract functionality, business terms embedded in the blockchain database can be executed among multiple parties – shippers, customs officers, and receivers. IoT data about the goods as they move through the shipping process feeds into smart contracts, which can then automatically transfer payment when goods are received and all necessary conditions have been met (as verified via the distributed ledger). This can speed up the trade process, improve operational efficiency, and reduce the need for intermediaries. Moreover, blockchain provides shipping companies with tamper-proof records of the movement of the physical assets or goods from source to destination, thereby assuring their clients of the authenticity of those assets or goods.

Shippers such as Maersk Line, and logistics company UPS are among those applying blockchain to their shipping and logistics operations, alongside of IoT-enabling containers, packages, and means of transport.

Agriculture

Agricultural produce and livestock goes through a complex production and distribution process. It involves the producer (typically the farm), the processor, the distributor, and the retailer before ending up in consumers' hands. The end goal is to deliver quality food to consumers. IoT sensors are used by some parties in the supply chain to monitor the quality of produce and livestock. But no one has visibility of the entire supply chain as produce and livestock moves through it.

This is where blockchain comes in. By using a distributed ledger involving all parties in the food distribution supply chain, blockchain offers a traceable trail of tamper-proof records to all parties. Data transmitted by IoT sensors from the produce or livestock at the farm, processor, distributor, and retailer levels are permanently recorded and verified through blockchain. This gives all parties visibility and assurance of the authenticity of these records. Claims such as country of origin and quality can thus be easily verified. All parties in the supply chain benefit from increased trust, accountability, and transparency. Costs previously associated with the need for third-party verification services can be reduced or eliminated. Any quality issues with the food can now be traced back at each level, because the records are permanent and cannot be tampered with. Interest is high in this area. Leading retailers and food companies (Nestle, Walmart, Costco, Golden State Foods, McCormick and Co., and Tyson Foods) in August 2017 announced a major blockchain collaboration with IBM to "strengthen consumer confidence" in the foods they purchase.

Blockchain use caveats

While adding blockchain can assist identification and secure recordkeeping in IoT transactions, it is not an appropriate solution for all IoT transactions. The question is whether eliminating the friction point for a particular workflow in IoT is worth the investment in implementing a new technology and in dealing with new complexities.

Blockchain deployments are currently limited, mostly in proof-of-concepts, or small-scale experimentation. Service providers and vendors should not expect net new revenue from implementing blockchain in their IoT transactions. If they were to acquire or develop their own blockchain technology and know-how and become blockchain technology providers, they could potentially monetize blockchain by licensing or providing professional services to implement and apply blockchain in IoT transactions. Realistically, few communications service providers are likely to do this on their own. It is quite complex and, for most, well outside of their core business and capabilities.

For more widespread adoption of blockchain as part of IoT deployments, the technology needs to overcome two main technical challenges. The first is scalability. The longer a specific blockchain is in use, the longer its chain gets. This means a need to increase storage infrastructure across all nodes that store a copy of the chain. The costs of sustaining a blockchain can rapidly escalate, both in terms of storage required and the energy required to run the blockchain. The transactions supported must be of high enough value to make it worth the storage and energy costs, or there must be other factors involved that mean blockchain is the best choice. This is going to be an important barrier to wider adoption of blockchain as a general record-keeping technology.

Interoperability is a second major challenge for blockchain use in IoT. Though there are some technical and business standards for specific use cases such as international trade transactions and smart contracts, at present different versions or variants of blockchain are fundamentally incompatible with each other. Barring regulatory intervention, there is little likelihood that blockchain consortiums such as Enterprise Ethereum Alliance, Hyperledger Project, R3, Digital Asset Holdings, and others will make their blockchain technologies work with one another.

There is no doubt that service providers and vendors should keep an eye on blockchain, and consider investment and development of sensible use cases. But a new technology is not in itself a business strategy. While blockchain-based systems and applications could potentially provide more security and trustworthiness to IoT transactions, there must be concrete proof of the value of this over a significant period, and in multiple instances, to drive forward the use of blockchain as a competitive advantage in providing IoT solutions.

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