SMART WATER WATCH

Hashing out the future of blockchain for the water industry

Bitcoin's underlying technology, blockchain, is lining up for its first use cases in the water industry. Is this the beginning of a chain reaction or a wave of investor folly?

With Bitcoin's share price contunuing to capture attention even while swinging wildly, the underlying technology, blockchain, is traversing uncharted territory in the water sector. Exploring applications in water rights trading, water treatment contracts and data sharing to name a few, blockchain-based solution providers are branching out from cryptocurrencies and finding footholds in non-financial spaces.

Blockchain is a digital ledger system where digital files, such as lists of transactions or contractual agreements, are combined into blocks and stored in a distributed database (*see diagram, below*). Complex cryptographic layers ensure a high level of cybersecurity, making records of transactions immutable and enabling peer-to-peer trading without the need for trusted central authorities such as banks.

Anna Poberezhna, blockchain expert and founder of technology solutions developer Smart4tech, explained to GWI how blockchain compares to cloud technologies. "The cloud is controlled by a central party such as Amazon or Google. The control of data is done by a third party which immediately draws questions about trust, security and privacy of the data," she said. "On top of that, data is usually unencrypted." The distributed nature of blockchain means that data is shared throughout the network, whilst complex encryption techniques add an extra layer of security. "Blockchain doesn't require a central party to own or control data," continued Poberezhna. "Once information is written in the database there's no way to delete it or change it."

The block party

While most people are wrapping their heads around what blockchain is and how it works, a few intrepid water industry players have begun incorporating the disruptive technology into their portfolios. Earlier this month, OriginClear, a US-based water treatment technology provider, announced that it was developing the blueprint for a blockchain protocol called WaterChain. The protocol aims to create transparency and efficiency in the water treatment industry by using smart contracts and cryptocurrency. A smart contract is a piece of code built into the blockchain network which automatically transfers digital currencies between parties when certain conditions are met.

Riggs Eckelberry, chief executive officer of OriginClear, explained to GWI how water utilities and industrial users outsource water treatment projects, not wanting to take on responsibility for projects themselves. Inconsistency of performance-measuring methodologies used to calculate payments to service providers, the challenge of working across international borders, and the necessity of making payments through central authorities slows down processes and creates risk.

"Smaller service providers have difficulty expanding because capital isn't readily ▶

SHARING THE BURDEN

While cloud-based protocols rely on a central server to store data, blockchain relies on a distributed system of nodes. Network decentralisation and distribution enhance cybersecurity as multiple copies of data exist across different servers, however high energy requirements and system complexity create new challenges.

Centralised   Decentralised   Distributed

● Centralised server
● Server connected to central server
• Individual Node
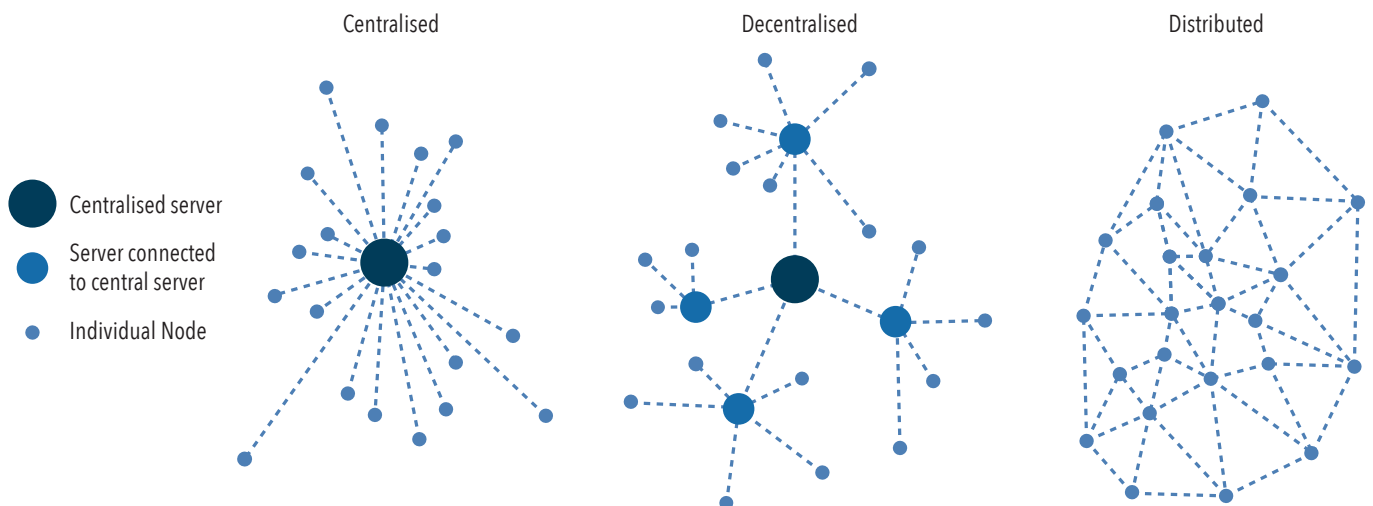
Source: GWI

available due to verification slow-downs," explained Eckelberry. "With fiat currency there has to be this whole accountancy. Blockchain creates a zone where coins can move much more rapidly, in much fewer steps. If we overlay smart currency, you can plug in smart contracts without any currency barriers or country barriers. It tremendously de-risks the finance of water projects."

Blockchain use cases in the water industry remain sparse with only a couple of technology companies making it off the starting blocks thus far. In Western Australia, after receiving an A$80,000 (US$60,400) federal government grant, civic-focused Australian blockchain company Civic Ledger developed 'Water Ledger,' a blockchain enabled peer-to-peer trading platform that leverages smart contracts and a token management system to monitor water trading and automatically update state registries.

Katrina Donaghy, co-founder of Civic Ledger, explained that Australia's water market is mature but "complicated and opaque," with five state government departments sharing responsibility for water resources management. The system's complexity dissuades smaller irrigators from participating in the market and creates the need for intermediaries, resulting in time delays and costly fees. Donaghy said the integration of blockchain with water trading cuts out middlemen to "streamline business processes, save money and reduce the potential for fraud".

Although Australia is one of the few countries to have implemented clear regulations on blockchain technologies, it is also making moves to embrace blockchain innovation. Donaghy told GWI that Civic Ledger has secured a contract to explore the potential of a "blockchain based microtrading platform for the trading of rainwater" within a new residential development in Melbourne, Australia, in partnership with utility South East Water. The Australian government is also providing an A$2.57 million (US$2.04 million) grant towards an A$8 million (US$6.07 million) project through its Smart Cities and Suburbs Program, with the remainder of funding coming from project partners. The project

"Blockchain tremendously de-risks the finance of water projects.

Riggs Eckelberry, OriginClear

A guide to blockchain

Bitcoin: a type of cryptocurrency.

Blockchain: a digitised and decentralised public ledger of transactions. It constantly grows through the addition of blocks which are recorded and added in chronological order.

Block: a record of some or all of the most recent transactions that have not been previously recorded in prior blocks. New blocks are added to the end of the blockchain.

Cryptocurrency: a digital currency in which cryptography is used to regulate and verify the transfer of funds.

Cryptography: the act of writing or solving codes.

Decentralisation: the storage of data across multiple servers as opposed to one single server.

Distributed Ledger: a ledger in which data is stored across a network of decentralised nodes. Participants at each node can access all data in the shared ledger.

Fiat Currency: a currency which the government has declared to be legal tender but is not backed by a physical commodity.

Initial Coin Offering: a means by which funds are raised for new cryptocurrency ventures based on a white paper.

Malware: software that is specifically designed to disrupt, damage or gain authorisation to a computer system.

Mining: the process by which transactions are verified and added to the blockchain. This involves collecting transactions into blocks and solving complex computational problems.

Monero: a type of cryptocurrency.

Node: any computer connected to the blockchain network. Each node automatically receives a copy of the blockchain.

Token: the digital identity of something which can be owned.

aims to develop a blockchain platform that will integrate distributed energy and water systems to create efficiencies in Fremantle, Western Australia.

In the US, water rights traders face similar challenges to those experienced in Australia. Christopher Peacock, chief executive officer and founder of AQUAOSO, a water rights management platform and water trading marketplace, said that it is also exploring blockchain's potential in the water trading space, though they have yet to put it into practice. "We've been architecting blockchain around water markets and leveraging blockchain to track who owns what water rights," he told GWI. "In the US, we've had discussions with a number of states that are interested in leveraging blockchain technologies."

Peacock said that AQUAOSO will look to incorporate smart contracts into its existing platform by combining blockchain with IoT-enabled sensors, which will monitor the movement of water, acting as "gates" to confirm delivery to buyers and automatically release payments to sellers. Peacock added that AQUAOSO will be piloting blockchain technologies later this year.

In China, Newater Technology partnered with NW Blockchain Limited (NWBL), a blockchain developer focused on environmental projects. NWBL intends to use blockchain technology to raise capital for industrial wastewater projects through sale of asset-backed tokens, similar to a private equity fund. One project NWBL plans on funding through token sales is a RMB30 million ($4.77 million) 20-year build-operate-transfer contract for a wastewater treatment plant in an industrial park in Inner Mongolia. Newater Technology will supply equipment for the project, funded by the token sales, as well as managing and operating the plant.

Showcasing the technology's humanitarian potential in the water sector, South African blockchain solutions provider Bankymoon launched a blockchain platform that enables donors to top-up selected African schools' water meters from anywhere in the world. Blockchain technology could be incorporated into domestic smart meters in the future, enabling water consumers to pay utility bills using cryptocurrencies and incentivise customers to adopt sustainable water practices. ▶

> " Once information is written in the database, there's no way to delete it or change it.

Anna Poberezhna, Smart4tech

Donaghy said this would "de-risk water utilities in terms of cyber-attacks" as identity data would be decentralised and owned by its customers, improving privacy and security. This application is already well-developed in the energy sector.

Peacock identified data sharing as a significant market opportunity for blockchain. "I think that there is an appetite amongst multiple water utilities to share data and leverage the smart contract for that," he said. Via Science, a software creation company which combines artificial intelligence (AI) with blockchain for the energy sector, described how blockchain could be integrated with AI to improve how data is accessed during the AI learning process, without compromising cybersecurity.

Coin or con offerings?
Though the spectrum of blockchain's non-financial applications in the water sector is gingerly expanding, most current use cases revolve around initial coin offerings (ICOs) and tokenisation schemes. In late 2017, AQUA Rights attempted to fund its blockchain-based water rights trading system through sale of its AQUA Token, but the ICO flopped when it failed to meet its minimum fund requirement. Genesis Research and Technology Group plans to launch an ICO in February with the intent of upscaling the commercialisation of its chemical-free produced water treatment technology (see GWI January 2018, p.18).

During ICOs, investors purchase application-specific tokens which are cryptographically linked to the blockchain network. These tokens are required by anyone wanting to use the application. The number of tokens issued is finite, meaning that as the system grows in popularity, demand for the token will rise as more people want to access the system. This drives up the token's value and generates returns for investors.

Many investors remain sceptical of ICOs and tokenisation because of the lack of regulation and the questionable necessity of application-specific currencies. "There is a tremendous amount of fraud going on. One estimate puts the amount of fraud at 15% of the total number of coins in circulation," said Eckelberry. The extent of regulation varies between countries from entirely unregulated to totally prohibited. In September 2017, China banned ICOs, shortly followed by South Korea.

OriginClear plans to initiate an ICO for its WaterChain platform later this year. "We've decided to do it all under US Securities law so we're being extremely compliant," said Eckelberry. OriginClear will carry out its ICO under the JOBS Act, a law intended to help small businesses to raise funding by easing regulation of securities. "I'm a strong advocate of operating under the regulatory umbrella," asserted Eckelberry. OriginClear expects to release the WaterChain white paper by the end of March 2018.

Taking a step back
When discussing the future of Water-Chain, Eckelberry exercised caution, emphasising how the project was dependent on the success of the ICO. "ICOs take $600,000 to $800,000 to put together, so we've got to have a really good white paper. That's where our highest priority is right now," Eckelberry told GWI. In January 2018, consultancy EY published a report stating that investor demand for ICOs has decreased, with only 25% of projects meeting their fundraising goals in November 2017, compared to 90% of projects in June.

Although the water industry's interest in blockchain applications is growing, Peacock felt that it will be some time before widespread adoption is realised.

"I think blockchain still has a few months if not a year to fully evolve before really becoming commercially available," he said. Despite this, Peacock foresees accelerated development as he explained that integration with AI and IoT will drive blockchain's progress at a faster pace than is typical of the water industry. Poberezhna explained that business cases for blockchain have to be well-developed before conservative utilities will consider implementation.

Questions over the true level of security provided by blockchain are being asked after the first documented cryptocurrency malware attack on the supervisory control and data acquisition server of a water utility was recorded in February 2018 (see box, below). Bundled with a global lack of blockchain expertise, slow transactions with growing costs and high energy demand, blockchain has a way to go before it lives up to its revolutionary status. ∎

CRYPTOCURRENCY AND CYBERSECURITY

The darker side of blockchain

After malicious cryptocurrency mining malware was discovered on the servers of a wastewater plant, experts warn water utilities to ramp up cybersecurity or face attack.

In February 2018, cybersecurity solutions provider Radiflow reported that the water industry had experienced its first cryptocurrency mining attack when malware was discovered on the supervisory control and data acquisition (SCADA) system of a European wastewater treatment plant. The SCADA system is used to control operations of the plant.

The attack targeted a wastewater site where several servers became infected with the malware and the SCADA system was hijacked and used to mine the Monero cryptocurrency. "This malware consumes a lot of processing power and loads the network, which can impact on the normal operation of these servers by slowing responses times," said Radiflow CEO Ilan Barda.

Barda explained that as cryptocurrencies become more popular, the processing power needed to generate them becomes greater. "Some people don't want to buy processing power, so they try to use that of others."

Barda indicated to GWI that the malware was most likely downloaded accidentally when the server was used to browse the internet. Water utilities' SCADA systems are not typically up to date with the latest security upgrades. "Nobody wants to install updates all the time because industrial applications are very sensitive," observed Barda. "These types of malware are going to be very popular in the next few months. I think it's about time the water industry ramps up its activities in [the cybersecurity] area."

With unsavoury characters now innovating in the blockchain space, water utilities will have to step up their defences against cybercrime, or else face troubling consequences. ∎