Banking on the blockchain

An in-depth look at the world's first cryptocurrency denominated, blockchain settled bond, its execution process, how this differs from a traditional bond and why this development has the potential to change the way capital markets function

1 MINUTE READ

Last year saw an explosion in interest in blockchain infrastructure and how it might be employed in financial markets. This article provides an overview of the efficiencies gained by using this infrastructure for bond issuances, focusing on one case study. Allen and Overy (A&O) recently supported fintech company Nivaura with the world's first cryptocurrency denominated, blockchain settled bond for LuxDeco, an online retailer of luxury furniture. The transaction took place in A&O's tech innovation space, Fuse, and was part of the Financial Conduct Authority's regulatory sandbox, which allows businesses to test innovative products, services, business models and delivery mechanisms in the real market, with real consumers.

Blockchains and smart contracts – a layman's run through

Blockchains

Over recent months there has been a proliferation in the number of very interesting seminars and articles on what blockchain is and why it's important. But for those without a tech background, it can take a while to figure out how it all works. The first section of this article is therefore a basic explanation of what a blockchain (or a distributed ledger) is. If terms like nodes, mining and hashing are all familiar to you then please skip to the next section.

Blockchain is part of the technology that underpins cryptocurrencies such as bitcoin and ether. Specifically, it is a collection of existing technologies that are used to synchrosise and secure a data structure. Distributed ledger technology (DLT) is a general term that describes blockchains and similar data structures. The terms blockchain and DLT tend to be used interchangeably.

What is a blockchain and why are blockchains important to financial markets?

A blockchain is a list or, rather, ledger that records ownership or state. The ledger is available to everyone that has permission to access it (which, in the case of public blockchains such as the bitcoin blockchain or ethereum, is anyone that runs software to access the network) and is copied to and verified by every computer (referred to as a node) that also has access to the network and runs the application. It utilises a consensus mechanism among its constituents to enable them to reach a shared single source of truth which proves the ownership or state of the particular thing being recorded. Nodes verify each transaction broadcast to the network – verified transactions are periodically bundled up into a new block and added to the blockchain, with each new block referencing the block before it. The result is a shared record that cannot easily be changed or hacked and that represents the truth of each particular transaction.

It's for this reason that blockchain offers huge potential in banking and finance. The world's financial system works through the keeping

Figure 1
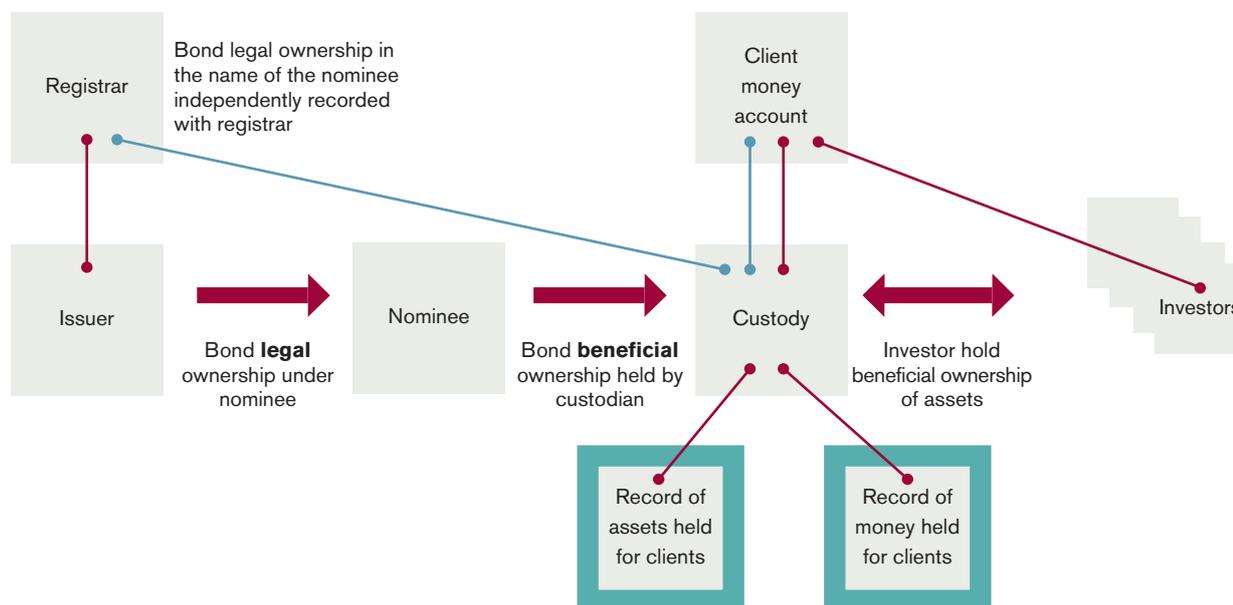
of ledgers. For example, let's say Jenny banks with HSBC and wants to transfer £100 (approximately $137) to Brian who banks with Lloyds. For this to happen Jenny issues an instruction to HSBC, HSBC then adjusts its ledger to show that Jenny has £100 less, and Lloyds then adjusts its ledger to show that Brian has £100 more. Both banks will also make corresponding adjustments to their accounts with each other, or indeed with the Bank of England. HSBC's ledgers, Lloyds' ledgers and the Bank of England's ledgers all need to agree with each other to show the truth of this particular transaction. This happens millions of times a day, with thousands of databases being adjusted and being required to agree with each other to show who owns what.

Imagine then, that there was just one ledger providing a clear record of who owns what and one can see how blockchains offer an opportunity to make finance a lot simpler and cheaper. If assets can be owned by virtue of records of ownership represented on a blockchain, this offers the opportunity for a faster and less complex settlement process.

While blockchain records provide pseudoanonymity, as all on-chain ownership is tracked via abstract public addresses, the ownership and provenance of assets can be easily tracked and overtime particular users may be identified. While privacy may be challenging to manage, for certain applications such transparency aspects can be helpful – for example from a regulatory and compliance perspective. However, enabling individual privacy on open public blockchains is an ongoing area of research and development in the industry.

There are currently limitations to the technology though and current blockchains face a key challenge related to scalability. In particular this is related to latency (time taken to include blocks into the blockchain) and throughput (number of transactions that can be included in a block at any one time). For example, bitcoin latency is 10 minutes and has an average throughput of ~five transactions per second (tps), while ethereum has latency of 14 seconds and an average throughput of ~20tps. However, latency can be even longer during peak times. As a benchmark, these throughput numbers pale in comparison to Visa's ~2,000 tps. The electricity required to power a blockchain can also be enormous. Currently the bitcoin blockchain uses approximately the same amount of electricity annually as Ireland. This is a big hurdle to its being used as a commercial solution for the world's trade or capital markets. It's only very early stages: imagine trying to deploy Netflix on the internet in 1994.

Smart contracts

What about the role of smart contracts? A smart contract is a piece of code within a blockchain record that is executed by each node on the network to automate (potentially) a particular state resulting from a contractual deliverable without further human interaction. For example, in the context of a loan or a bond you could put in place a smart contract at the time of issue that automates the payment of interest to each investor on the given due dates. Accordingly, the bond or loan would service itself when triggered by the borrower sending funds to the smart contract. It is therefore a very useful tool to automate operative parts of normal legal contracts, but all the regular contractual protections such as representations, warranties and indemnities drafted in natural language are still needed. These cannot currently be replaced with code.

It's fair to say there is some confusion and concern about smart contracts among lawyers with many concerned that regular natural language contracts will be replaced by code. This is not currently viable or realistic. Smart contracts are not a replacement for normal legal contracts but rather sit behind and augment a legal contract where by snippets of code replicate and automatically perform certain terms of the contract.

A tale of two bonds

Nivaura is a new fintech company that has devised a platform which completely automates the entire life cycle of a financial instrument; from agreeing commercial terms

Figure 2
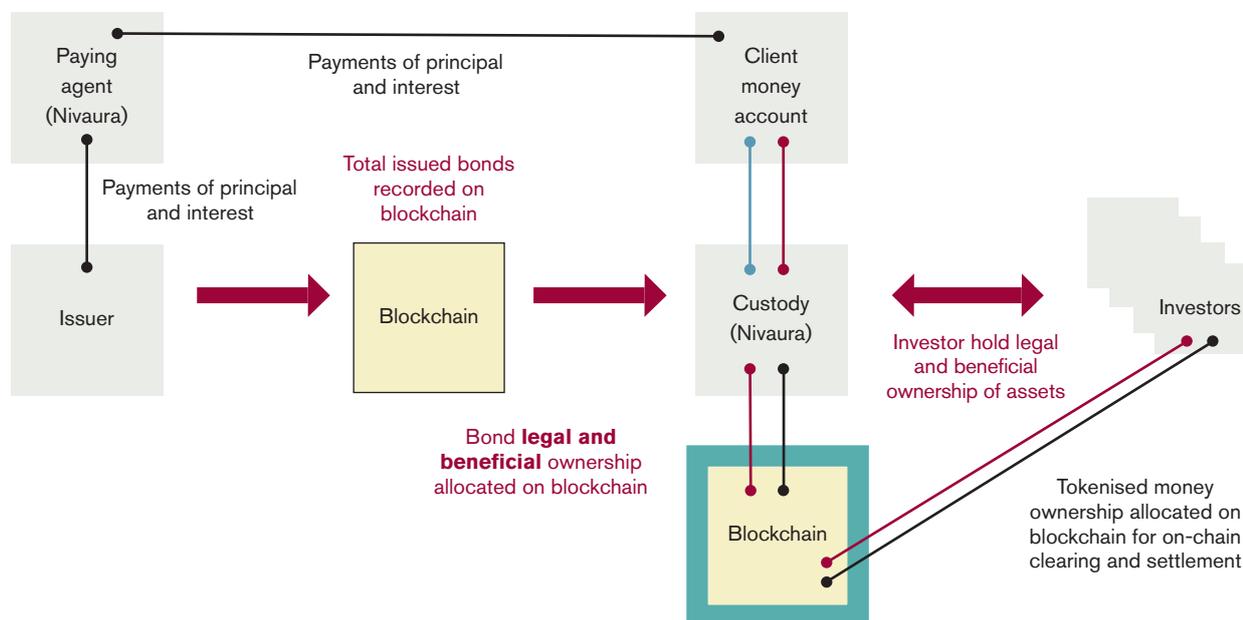
through to maturity. It has been part of both Financial Conduct Authority (FCA) regulatory sandboxes, the only company to do so, and lately has been working with LuxDeco as issuer and with Allen & Overy, J.P. Morgan, Moody's and Link Asset Services as partners to issue two bonds using blockchain.

While the transactions were real deals, they also represent experiments to see what can be achieved using blockchain. In this experimental scenario, there was a control bond and an experimental bond. The control bond was a regular registered sterling bond, structured in the normal way. The experimental bond was the world's first cryptocurrency denominated bond, fully cleared and settled on an open public blockchain.

The control bond

This was structured like a regular privately placed registered eurobond that clears through the clearing systems.

In this structure, legal and beneficial title are split. Legal title rests with a nominee, whose name is entered into a register maintained by a registrar. The nominee holds the bond for the clearing systems, and account holders in the clearing systems have beneficial title to the bond. There is often a chain of custody whereby the ultimate beneficial holder holds their bonds through a custodian who is the accountholder in the clearing systems.

In order to make payments of principal and interest under the bonds, the issuer will appoint a paying agent, typically a large international bank. When it is time to pay bondholders, the issuer will make the payment to the paying agent who will pay it into the clearing systems, where it will trickle down to the ultimate beneficial owner. Accordingly, payments will need to go from the issuer to the paying agent to the clearing systems and then possibly to one or more custodians before it *eventually* arrives at the person entitled to it. Some market participants also opt to have a trustee represent the bondholders and protect their interests.

Documenting this is relatively complex. The split between legal and beneficial title to the bonds is achieved by entering the name of a nominee into the register, evidenced by the issue of a global certificate, which represents the entire issuance. This is then held by the nominee for the clearing systems. The terms of the global certificate make clear that while the nominee holds legal title, the

accountholders in the clearing systems hold beneficial title. The documents also make full provision for the issue of definitive certificates

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For the control bond, the clearing systems were substituted for Nivaura's platform and the role of paying agent was played by Nivaura

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which would be issued to individual investors in certain circumstances, including if the clearing systems ceased to function. This would need to involve each accountholder being entered into the register. The relationship between the issuer and the registrar, and the issuer and the paying agent, also needs to be agreed and documented. For those used to operating in the capital markets every day this is all standard, but for an issuer that has never done a bond before and that wants to understand what it is signing up to, it can be a time consuming and costly process.

The structure used for the control bond was very similar to the one above, except that the clearing systems were substituted for Nivaura's platform and the role of paying agent was played by Nivaura. This is because Nivaura will make the payments through the platform and ultimately, in the real world, via its client money bank account. Link Asset Services (previously Capita Asset Services)

Figure 3
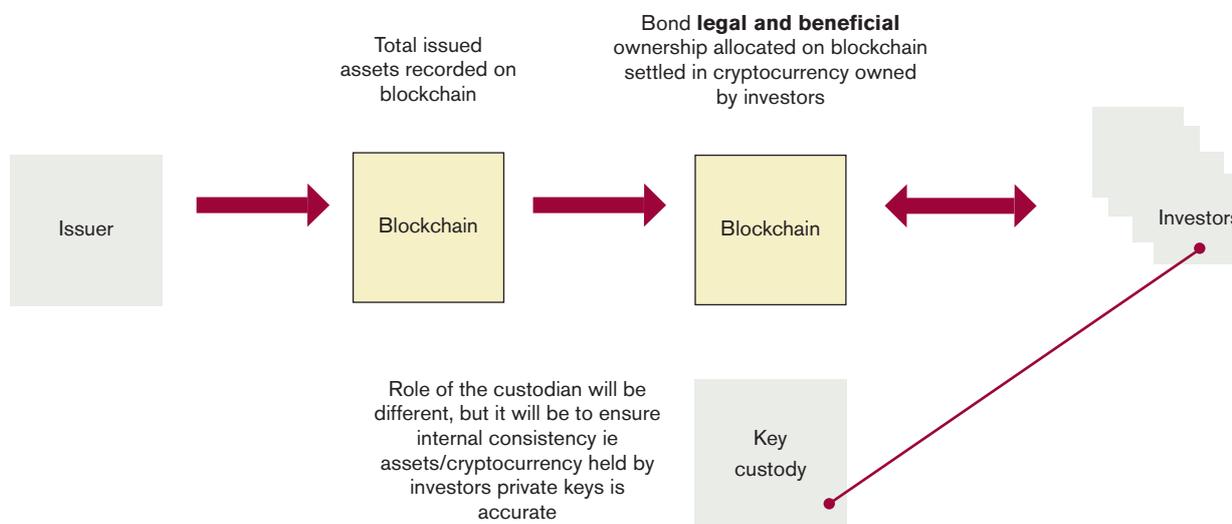
were the registrar and also the trustee.

Nivaura is authorised and regulated by the FCA and – for the purposes of the sandbox – has the appropriate client assets sourcebook permissions to hold both client money and assets. As part of this test all the money invested by investors in LuxDeco was paid into Nivaura's client account. The transaction was therefore documented and structured in a conventional way, but Nivaura also mirrored this on a blockchain to show how a blockchain based bond would work.

Here investors paid the cash they wished to invest to Nivaura by way of an ordinary bank transfer into Nivaura's client account.

to show a clear record of ownership, and, as part of the issue Nivaura demonstrated to the FCA that the blockchain was recording this. From a regulatory perspective, the FCA was satisfied that the public permissionless blockchain constituted an independent third party, which fulfilled the requirement for third party reconciliation of the register. This is because Nivaura has no direct control over the allocation of assets and money held on that register. Blockchain therefore offers the opportunity to simplify the structure by removing the registrar; saving complexity, time and cost.

From a compliance perspective, this is also

applications that use it should be able to track exactly who owns what and in a clearer way than is currently possible through the clearing systems.

The approach used here also provides a model for the tokenisation of fiat currency. Sterling was paid by investors into Nivaura's client account for LuxDeco. The cash was immobilised in the client account and then tokenised on the blockchain, ie on receiving cash in a real-world bank account Nivaura credited LuxDeco's blockchain wallet with that cash. In a world where there is widespread commerce on blockchain, LuxDeco would be able to spend that cash on things it needs for its business and then make sales which generate more tokenised cash for payments of interest and, ultimately, principal. When the time comes to repay the bond, LuxDeco will pay cash from its blockchain wallet to investors' wallets. The real world cash is still sitting in the Nivaura client account, and at this point investors could keep their blockchain representation of it and buy other things or have it paid from Nivaura's client account into their real-world bank accounts.

There is a lot of talk about cryptocurrency at the moment and it may well be part of the future, but currently the tokenisation of fiat currency looks like a more mainstream use case. In the context of the sandbox test this was very small scale, but it is worth pointing out that the model would work for central or commercial banks as a means to tokenise fiat currency on an open public blockchain and thereby enable more blockchain-based commerce, be that in the capital markets or elsewhere in the economy.

> ## Although the blockchain itself is pseudoanonymous, the applications that use it should be able to track exactly who owns what

On receipt of this the investors' cash accounts on Nivaura's platform were credited with the relevant amount. On settlement, the bonds were issued into Luxedeco's securities account and then transferred to investors on a typical delivery versus payment basis. Securities passed from Luxdeco's securities account to the relevant investors' securities accounts, as cash passed from the investors' cash accounts to LuxDeco's cash account.

There are a few key points to note from this. This first is that the blockchain was able

significant. Much has been written about the compliance concerns that arise from blockchain, stemming chiefly from its pseudoanonymity. However, in a commercial context, anyone using blockchain to do large-scale transactions will likely need to use a platform or app. To use such a platform, users need to go through a proper know your customer (KYC) process, which is what LuxDeco and its investors had to do for this issuance. This means that although the blockchain itself is pseudoanonymous, the

The experimental bond

The experimental bond was also issued by LuxDeco through Nivaura's platform, but this one was denominated in ether. As such, it was the first ever cryptocurrency bond fully settled on an open public blockchain using smart contracts. While cryptocurrency bonds have been issued under laboratory conditions, and there have been some bonds issued where payment has been made in cryptocurrency, this was the first time a bond has actually been denominated in cryptocurrency, fully settled on a blockchain and issued on a commercial basis by a trading company in a regulated way. It is significant because we were able, for the first time, to issue and pay for a legally enforceable financial instrument without using any of the traditional existing financial infrastructure.

blockchain allows for legal and beneficial title to be united. This meant that the global/definitive note structure that underpins most securities issuance was dispensed with, removing a lot of the detailed language that first-time issuers often struggle with. Secondly, the absence of a registrar meant that the normal contractual relationships that needs to be created between issuer and registrar could be dispensed with, and the issuer does not need to pay a registrar to perform the function. Thirdly, payments could be made on a peer to peer basis ie the issuer pays interest and principal directly to investors automatically via the use of smart contracts. Accordingly, there was no need to have a paying agent, which again reduced the complexity of the documentation and also meant that the issuer did not need to pay a large bank to fulfil the role. Finally, on the

and, in the case of the courts, enforce.

A final point to note is that while the open public blockchain can act as an independent register and enable complete on-chain clearing and delivery versus payment settlement, transactions must be facilitated in line with key regulatory requirements. This includes investors undergoing appropriate KYC/anti-money laundering checks, and the proper safeguarding of client money and assets. Such aspects were managed through Nivaura's digital custody service that enables compliant onboarding and wallet management. In this case, Nivaura's regulatory responsibilities were performed through the provision of its key custody service. The need to safeguard assets was achieved through the safeguarding of keys, and all internal platform movements of money and assets could be reconciled with the external and independent records of the open public blockchain. In this way the key custody role can be seen as a critical function related to safeguarding of client assets, where the value being managed can be tracked by the public addresses for each key held and the value of cryptocurrency and securities at those addresses.

We need to remember, however, that blockchain is no panacea. Issues remain and there are limitations on its privacy, scalability and performance. There are also vulnerabilities in smart contract code. This sandbox test shows however what is possible and that in the future, blockchain is likely to ease and simplify the flow of capital. Anything that does that will drive economic growth.

> ## The FCA recognised the blockchain as an independent third party so there was no need for a registrar to keep a register of holders

So how did it work? The investors transferred Ether from their existing blockchain wallets, such as a Coinbase account, to their Nivaura cryptocurrency wallets. On settlement, ether passed from investors' cryptocurrency wallet addresses to LuxDeco's address, and the bonds passed from LuxDeco's securities wallet address to the investors' addresses. All of this is recorded on the ethereum blockchain and represented through the Nivaura blockchain interface on the Nivaura platform. From a securities perspective, the blockchain served as the register and denoted legal and beneficial ownership. Because the FCA recognised the blockchain as an independent third party, there was no need for a registrar to keep a register of holders: the register is the blockchain. Smart contract code was put in place behind the regular legal contracts to automate delivery of the bonds and payment flows, so LuxDeco issued the bonds and paid investors' interest and principal automatically, without further action.

This approach simplifies securities issuance and reduces cost in a number of ways. Firstly, it means legal fees and complexity are both lessened because the documents and structure are simpler. As described above, the use of

investor side, the ease with which someone can open a blockchain wallet means that there is less need for a long chain of custody.

As a result there were fewer parties involved and substantially shorter and less complex bond documents. This reduces the cost and time to market for issuers and it should be clear from the structure diagram below how much simpler this is than the traditional structures described above.

It is important to note too that any party can independently verify the allocation of cash and assets on the blockchain without using Nivaura's system. This is important, because if the system were to fall away for any reason, the contracts could still be enforced as between holders and the issuer. Enforcement would work in much the same manner as a regular bond issuance. For this issuance Link acted as trustee so if there were to be an event of default then holders would be able to enforce their rights via the trustee in the usual fashion and ultimately through the courts. On an issuance without a trustee, bondholders would be able to enforce rights directly. Smart contracts do not change or diminish enforcement rights, there were still regular legal contracts that any capital markets lawyer and the courts would recognise, understand

Richard Cohen
Senior associate
Allen & Overy

Avtar Sehra
CEO
Nivaura

Philip Smith
Partner
Allen & Overy

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