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Case Study: Santander's Latest Bond Issuance on Ethereum

What are the main benefits of issuing bonds on blockchains?

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KEY TAKEAWAYS

- **Santander**, one of the leading European banks, **tokenized bonds** on the Ethereum blockchain with a total value of **USD 20 million** on September 12th, 2019.
- It followed the recent tokenization of blockchain bonds from financial and public institutions like Societe Generale (2019) and the Austrian government (2018).
- Specifically, this Santander bond issuance was put on the blockchain through **a two-token process** conducted over two wallets:
    - **Investor wallet:** it mints the tokenized money which is received once the real money is transferred to the off-chain custody account. After the investment, this wallet receives the tokenized bond units.
    - **Issuer wallet:** it receives the tokenized money from investors participating in the bond purchase. After its bond issuance, the tokenized money is redeemed to real money from the off-chain custody account.
- Fixed-income issuances on the blockchain provide **several benefits** for both investors and issuers such as:
    - A **drastic reduction of counterparty risk** owing to atomic hashed time-locked contracts.
    - **Operational improvements,** resulting in reduced issuance costs and faster execution.
    - **Added-value services** such as easier taxation for and improved oversight about current debt holders.

- However, Santander still held off-chain legal documents with a trusted custodian and was not issuing “native” securities on Ethereum. **Instead of being a bond ‘issuance’ it was thus rather a bond “tokenization”**.
- Moreover, they did not publicly release the contract source code, outweighing some of the presumed benefits from the use of blockchain technology.
- Yet, one of the most interesting aspects main aspects was illustrated by t**he possibility for unrestricted networks**, like Ethereum, **to be used for regular operations** by large traditional financial institutions.
- Eventually, blockchain bonds should gradually **become a new standard in the fixed-income industry**. It remains uncertain whether Ethereum (and private EVM-compatible blockchains like Quorum) have already captured the edge for future financial security issuances.

On September 12th 2019, the Spanish bank Santander announced that they issued a bond on Ethereum. This report aims to explore past blockchain-based bonds, along with an in-depth analysis of the latest Santander issue and how to classify it within broader industry efforts.

1. A look at blockchain-based bonds

1.1 Description

Bonds are units of corporate debt[1] that are created (in jargon “issued”) and subsequently securitized as **tradable assets**. While the issuance of debt securities is a highly **regulated** and **restricted** process, multiple parties[2] have publicly experimented with **issuing or tokenizing securities**.

In order **to tokenize securities**, a **respective legal document must exist** - or first be created - off-chain and subsequently be moved to a dedicated account of a trusted custodian. Once the underlying security is locked and safeguarded, a representative token can be created on a blockchain.

On the other hand, issuing securities natively on the blockchain would require the issuer not to have any off-chain legal document, yet **comply with the current legal framework**. Admittedly, native issuance may not suffice of existing legal requirements.

Naturally, this is a simplification of the process, but it clarifies the fundamental difference between actually creating a bond on-chain and creating an on-chain representation thereof.

[1] Bonds can also be issued by government entities.
[2] For further information on this please refer to chapter 1.3.

Once a security has been created it can be traded on secondary markets. The trading of debt securities usually follows a two-step **"delivery-versus-payment" (DvP)** process. Firstly, the owner of a security agrees to transfer the asset (in jargon "delivery leg") to the buyer, who must, secondly, reimburse the owner with cash (in jargon "cash leg"). Usually, this process requires both parties to trust each other or make use of another trusted third-party.

1.2 Benefits and potential risks

In this subsection, benefits and potential risks are discussed in comparison with traditional systems with potential risks. Furthermore, some pros and cons between private and public distributed ledgers are analyzed.

At least three generic advantages of using blockchains for security handling can be identified:

- First and foremost, the usage of blockchains comes with the ability to **reduce counterparty risk** for DvP settlements. By using smart contracts (such as hashed time-locked contracts), it is possible to **settle atomically** with any other party, without needing a trusted intermediary.
- Simultaneously, smart contracts could **automate**, currently labor-intensive manual issuance processes and drive up execution speed.
- Lastly, the creation of security tokens or blockchain native securities may give **rise to derivatives** building on top of (tokenized or blockchain native) securities and make it possible to streamline multiple other added-value services[3].

However, using blockchains for security handling also generates uncertainty and may create several risks that are predominantly stemming from the current legal landscape:

- A recent working paper from the Bank of International Settlements indicated a growing **awareness of potential clashes between an outdated securities law and new technology**[4]. However, respective laws currently still in place continue to pose significant challenges to innovators. A good example for exactly such a law is the German securities law where it is required to store a physical representation (i.e., a paper certificate) of every issued security with a designated custodian[5].
- A second, often mentioned hurdle is the **absence of a universal 'cash on ledger'**. The payment leg of DvP requires some sort of tokenized money as a means to pay for the (tokenized) security. Generally, the payment leg could be either provided by the private

[3] Greatly aligned with a report by the European Central Bank, the Association of German Banks, for example, identified the following additional use cases for blockchain-based securities: proxy voting, shareholder identification, corporate actions, taxation, others.
[4] C.f. Auer (2019).
[5] The original law in German language can be found online at: https://www.gesetze-im-internet.de/wphg/WpHG.pdf. It should, however, be noted that current industry efforts are pointed towards updating particularly controversial parts. For further information thereon refer to the previously mentioned report of the Association of German Banks.

sector (bank coins such as JPM Coin, fiat-collateralized stablecoins such as Tether or Fnality) or the public sector (Central Bank Digital Currency).

Table 1 compares different types of databases in regards to their methods of handling securities. For this analysis, some examples are chosen: Ethereum for public blockchains, Corda for private blockchains, and T2S as a 'regular database'[6]. This may contribute to answering the question of whether private blockchains are better positioned to handle securities than public ones.

Table 1 - Comparing the suitability of databases for handling securities

	Public blockchain	Private blockchain	'Regular' database
Use	Testing use[7]	Testing use[8]	Production use
Smart contract support	Yes	Yes	No
Control information sharing	No	Yes	Yes
Settlement finality	No	Yes	Yes
Reliance on a trusted party	Medium	Medium	High

The **prior use of databases** for handling securities can deal as a starting point for this assessment. Other important features are whether the database **supports smart contracts**, the possibility to **control the sharing of data**, the presence of **settlement finality** and the need for a **trusted third party**.

- As it is impossible to track what happens within a private blockchain, it is likely that there is an information asymmetry in regards to the actual use of private blockchains for security handling. Nonetheless, according to press releases by banks and trading exchanges, **both public and private blockchains have already been used** for handling securities in testing purposes.
- As mentioned before, **smart contract support** is crucial for reducing the counterparty risk in delivery-vs-payment settlements. Generally, **both public and private blockchains offer this functionality**.

[6] For more information about these databases please view: (1) Ethereum: https://github.com/ethereum (2) Corda: https://github.com/corda/corda (3) T2S: https://www.ecb.europa.eu/paym/target/t2s/html/index.en.html
[7] For example: Santander (2019).
[8] For example: Commerzbank (2019).

- Additionally, it can be crucial for financial transactions, such as bond issuances and purchases, to **have deliberate information sharing**. Some transaction details may be sensitive and may need to stay private. This is currently not possible with Ethereum, yet is possible with Corda and T2S.
- Settlement finality defines a transfer that has become irrevocable and unconditional. If large amounts of money would be issued or managed on a blockchain in the form of blockchain-native securities or security tokens, the current probabilistic or economic[9] 'settlement finality' of Ethereum may open up attack vectors. For this reason, **real settlement finality is crucial and currently not present on Ethereum**. This is, however, not an inherent feature of public blockchains and might change with the introduction of Eth 2.0. Linked to the consensus mechanism is the throughput and thus scalability. This potential issue will not be examined herein as it would exceed the scope of this case study.
- Lastly, it can be assessed to what extent the current database structure requires a trusted party for the handling/issuance of securities. Under current law, it is required to enforce transfer and ownership restrictions. In order to comply with this on Ethereum, a trusted intermediary must be whitelisting known entities. In the case of the private blockchain Corda that operates with known participants, such restriction could already be enforced at the entrance.

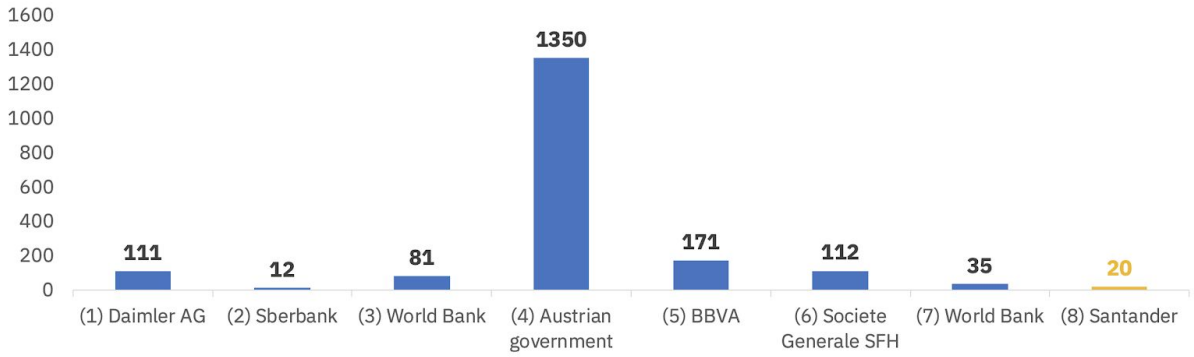
In summary, the public blockchain **Ethereum currently has three major disadvantages that are, however, not inherent problems**. These issues could be overcome with second-layer solutions (deliberate, modular information sharing), changed consensus mechanisms (settlement finality) and digital identity solutions (whitelisting). It is therefore important to note that private blockchains may currently be at an edge, but that also public blockchains could be used for issuing and handling legacy financial products.

1.3 Historical bond issuances with blockchains

As discussed in one of our previous short insights[10], this Santander blockchain-bond **does not represent a first** in the tokenization of fixed-income instruments, as illustrated by the chart below.

[9] For further information on these concepts view Buterin (2016).
[10] https://mobile.twitter.com/binanceresearch/status/1121432374493900801

Chart 1 - Past blockchain-bond issues and tokenization (in USD million)



Sources: Binance Research, CoinDesk

Here is an exhaustive list of past blockchain issuances.

(1) **June 28th, 2017:** Daimler AG issued a 1-year corporate bond using a private Ethereum blockchain.
(2) **May 18th, 2018:** Russian Sberbank conducted a commercial bond transaction using Hyperledger Fabric.
(3) **August 24th, 2018:** the World Bank issued a 2-year AUD-denominated bond using a private Ethereum blockchain.
(4) **October 2nd, 2018:** the government of Austria notarized the auction of a government bond using a permissioned version of Ethereum.
(5) **November 7th, 2018:** BBVA partnered with co-lenders MUFG and BNP Paribas to arrange a syndicated loan using both Hyperledger and Ethereum's Rinkeby testnet.
(6) **April 18th, 2019:** Societe Generale SFH, a subsidiary of Societe Generale, used "OFH tokens" (i.e., a security token) to issue a 5-year covered bond on the Ethereum public blockchain.
(7) **August 16th, 2019:** the World Bank issued its second tranche of the AUD-denominated blockchain bond, through Bond-I[11].
(8) **September 12th, 2019:** Santander issued its first "end-to-end" blockchain bond using the Ethereum public blockchain.

A Santander blockchain issuance is not the first. However, unlike some of these precedent cases, the overall process was well documentated by Santander.
Hence, this process is the key focal point for the rest of this report, which is discussed and analyzed in-depth the next section.

[11] For more details about the bond-I platform.
https://www.commbank.com.au/business/business-insights/project-bondi.html

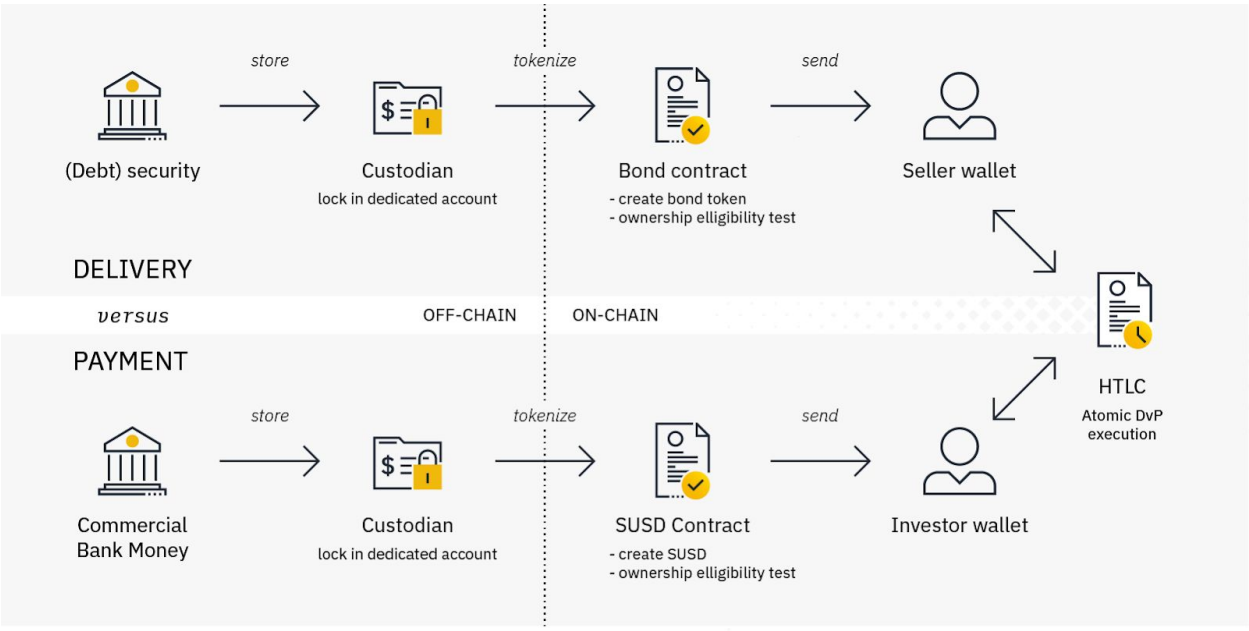
2. Santander's September tokenized bond "issuance"

2.1 Overview of the bond process

Santander's bond tokenization issuance and exchange process rely on a **Delivery vs. Payment system (DvP).**

A high-level overview of the entire process can also be seen in the chart below, which illustrates the various process flows.

Graph 1 - Illustration of the Delivery versus Payment process



Based on data provided by Etherscan, all wallets and smart contracts were created by the same wallet address, presumably being Santander's team in charge of this blockchain-bond handling of all involved wallet addresses. This highlights once again that this was merely **done for testing purposes**.

2.2 Description of the bond tokenization steps

The actual bond sale of Santander consists out of four different steps:

(1) A tokenization of the bond
(2) A tokenization of commercial bank money
(3) An exchange of the bond token for money token
(4) A reverse tokenization (i.e. redemption) of money token for fiat money.

2.1.1 Tokenized bond

Once the off-chain legal documents for the bond have been created and stored with a custodian, this bond would be ready for tokenization. The respective bond token is created in this smart contract and sent to the bond owner (seller).

We can further analyze the Santander bond 'issuance' through the lens of the blockchain-based token framework proposed by Binance Research in early September 2019[12].

Table 2 - Characteristics of Santander Senior Digital Bond 1-4

Aspect	Description
Blockchain	Ethereum
System	Account-based
Standard	ERC-20 / Constructed
Fungibility	Fungible token
Restriction	Security purpose with a restriction on transfers and ownership
Fixed Maximum Supply	100 units (each unit is worth USD 200,000 at face value)
Divisibility	Yes. 16 decimals
Privacy	No
Additional functions	Yes (the code is not public but some of it can be reinterpreted through a bytecode decompiler)

[12] See the proposal of the blockchain token framework.
https://github.com/Binance-Research/tokenStandardFramework/blob/master/description.md

2.1.2 Tokenized money

Simultaneously, money is supposedly stored with an off-chain custodian. The money tokens are minted in this smart contract and sent to the investor (buyer).

Table 3 - Characteristics of Santander USD

Aspect	Description
Blockchain	Ethereum
System	Account-based
Standard	ERC-20 / Constructed
Fungibility	Fungible token
Restriction	Security purpose with a restriction on transfers and ownership
Fixed Maximum Supply	No. Mintable through 0x00 address
Divisibility	Yes. 16 decimals
Privacy	No
Additional functions	Yes (the code is not public but some of it can be reinterpreted through a bytecode decompiler)

2.1.3 Token exchange

Allegedly, **at least two additional smart contracts should exist**. One of them serves the purpose of **whitelisting** eligible entities for token ownership while the other contract relates to the execution of the **delivery-versus-payment** settlement. However, no further information was provided. Known smart contracts can only be viewed through a **bytecode decompiler**, greatly limiting their readability from external parties.

Generally, the whitelisting contract should be referred to in the money token contract. The escrow contract - most likely being a hashed-time locked contract - is most likely similarly integrated and makes it possible to have an atomic settlement with zero or low counterparty risk.

2.1.4 Money token redemption

The last step of the process is the **reverse tokenization** (i.e., redemption) of these money tokens. Santander USD is subsequently burned, and the equivalent amount in fiat money is supposedly released off-chain.

As a result, this redemption process is still non-transparent to external parties and is beyond the scope of this report.

3. Conclusion

In summary, this initiative by Santander lines up **with ongoing industry efforts** to use the **blockchain for issuing and handling traditional securities**. Yet, it is important to note that the issuance and handling of securities are two related, yet separate processes. Hence, this space (i.e., traditional securities) remains highly **contingent on its respective legal environment** and requires compliance with existing (off-chain) standards.

These standards might need further amendements in order to bridge a systematic discrimination of DLT but they remain unlikely to sacrifice core elements. For instance, settlement finality is likely to be demanded for future blockchain-based security issuances. Similarly, business practices are likely to require a **deliberate and modular information-sharing process** and **trusted off-chain interfaces** are likely to continue to exist in the near future.

Until now, industry efforts seemed to predominantly focus on private blockchains. Prominent examples are coming from the widely used enterprise blockchain software provider **R3**, but also from financial institutions themselves. As already mentioned in our March 2019 report about JPM Coin, JP Morgan has been increasingly concerted industry efforts to build on **Quorum**, its permissioned version of Ethereum, reflected by **indirect positive network effects** on the public blockchain Ethereum.

However, not only the legal landscape drives these processes, but also the ongoing technical development that continues to move **respective boundaries on all fronts**. Ethereum 2.0, the ongoing upgrade of Ethereum, might not only increase the potential throughput of Ethereum but also create **real settlement finality**. Other initiatives like EY's Nightfall could potentially allow more privacy features, which could ultimately foster a greater use of permissioned networks by traditional financial institutions. Lastly, custodial key storage and other off-chain interfaces are also likely to play an **increasingly relevant role in enabling the move of traditional financial instruments from legacy databases to blockchains**.

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