BME
Digital Bond

Issuance and lifecycle of a corporate bond in a regulated market using Blockchain technology

July 2023

BME X
BOLSAS Y MERCADOS ESPAÑOLES
a SIX company

BBVA

GARRIGUES

ioBuilders

LACCHAIN

IDB

IDB | LAB

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

Over the past few years, the finance sector has been buzzing with transformative prospects of Distributed Ledger Technology (DLT). This pioneering technology pretends to overhaul traditional financial transactions, and one of its most promising applications lies in digital bond issuance. Utilizing the robust infrastructure of DLT for the issuance of digital bonds presents significant advantages, such as enhanced operational efficiency, unprecedented transparency, mitigated risks and potential cost reductions.

While DLT's technology-centric advantages are evident, its application in bond issuance raises important questions regarding compliance with existing legal norms and regulations. In fact, most experimental initiatives focusing on blockchain-enabled bond issuance primarily involve non-public and private securities. However, it is worth noting that the pioneering BME Digital Bond project surpasses these discussions. This initiative represents a historic first: the first-ever listed bond issuance executed via a DLT infrastructure that adhered to the prevailing legal statutes during its issuance phase, specifically Spanish and European regulations. The project effectively avoided the need for a regulated sandbox setting.

The BME Digital Bond project was a complex undertaking that brought together several key regulated entities with a formidable international financial footprint. This notable group included the Inter-American Development Bank (IDB) operating as the issuer, Banco Bilbao Vizcaya Argentaria (BBVA) acting as the sole dealer, custodian and cash tokenizer, Citi serving as the agent, and Iberclear (BME) fulfilling the role of the Spanish Central Securities Depository (CSD). The primary objective of the BME Digital Bond project was to state the feasibility of utilizing DLT for issuing digital bonds in a manner that was legally compliant, secure and fully capitalized on the benefits of DLT technology.

One of the key aims of the BME Digital Bond project was to keep the existing market roles and responsibilities while employing a hybrid model that melded the traditional systems of the Spanish CSD, Iberclear (BME), with blockchain technology. In addition, this initiative incorporated electronic money (acknowledged under CSD Regulation - CSDR -, commercial money). It is crucial to observe the significant potential for future monetary models, such as central bank digital currencies (CBDCs). These offer vast possibilities for further augmenting efficiency and security in digital bond issuance and trading.

The technical solution developed within the BME Digital Bond project introduced several innovative features that enabled the successful implementation of a Delivery versus Payment (DvP) model. Leveraging the ERC-1400 security token standard and its customized extension to capture all bond details, a comprehensive management of the bond lifecycle was achieved, covering from primary and secondary markets to corporate events. The solution was built on a robust and secure blockchain network, configured as an Enterprise Ethereum network utilizing the Hyperledger Besu client. Its private-permissioned nature ensured enhanced security by allowing access only to authorized nodes and accounts; this technical solution establishes a resilient infrastructure that ensures the integrity and efficiency of a digital bond issuance and trading within the framework of European regulations.

INTRODUCTION

The primary goal of the project was the pioneering issuance of a listed digital bond, denominated in fiat money used in a digital format, under financial markets´standards and authentic conditions, leveraging a blockchain network steered by Iberclear (BME), the Spanish Central Securities Depository (CSD). This innovative endeavor was deployed within the Iberclear participants' secondary register tier, the custodians, highlighting the feasibility of applying the existing regulations to accommodate DLT in specific financial contexts. With DLT at its heart, the project's objective was to enhance efficiency, transparency and security throughout the bond issuance process.

The involvement of regulated institutional entities and competent authorities such as the CNMV (Comisión Nacional del Mercado de Valores, the Spanish securities market supervisor) ensured regulatory compliance. Furthermore, using electronic money denominated in USD was guided by EU and Spanish laws, facilitating a real-time "delivery vs. payment" (DvP) process. Additionally, the integration of DLT infrastructure allowed to speed-up the bond issuance process, increasing accuracy and efficiency and showing potential for operational cost reduction, thus enhancing the overall investor experience.

The journey of issuing a bond, anchored by a private blockchain network (Hyperledger Besu), commenced with the issuer, the Inter-American Development Bank (IDB), crafting the bond within the parameters of its IDB Global Debt Program (GDP). Subtle alterations were made to the standard pricing supplement of this program to manage the bond's entire lifecycle, ensuring alignment with all legal stipulations and current regulations. As IDB's agent entity, Citi delivered all operational instructions to Iberclear (BME), the Spanish CSD, where the digital bond was brought into being.

Upon creating the digital bond, the subsequent stage was to list it on the AIAF Debt Market, BME's fixed-income market. Finally, the bond details underwent thorough validation by the same consortium of authorized parties who usually engage in an ordinary listed bond issuance, including regulatory bodies, banks, and other market participants.

This process guaranteed legal adherence and accuracy of bond details, fostering heightened transparency and immutability throughout the bond issuance process.

The BME Digital Bond was presented for acquisition to qualified investors via BBVA, which served as a sole dealer under the IDB Global Debt Program for this occasion. Investors were empowered in the secondary market to purchase the digital bond using electronic money issued in line with EU electronic money regulations. This electronic money, strengthened by the blockchain network and offered by BBVA as an electronic money entity and cash tokenizer, facilitated transactions.

Over the lifecycle of the digital bond, the project leveraged the two-tier level system structure of the Spanish Book-entry Register[1]. This approach streamlined the process by shortening the lifecycle to one custodian's second tier, thereby avoiding interactions with the General Register in Iberclear-Target2 Securities (T2S)[2]. This resulted in a simplified model, closely aligning with the primary objective of the BME Digital Bond project.

Therefore, similar to any other bond in the legacy systems, the issuance was recorded at the CSD level on the Custodian's CSD account, in this case, BBVA, as an Iberclear Participant. Simultaneously, BBVA managed the initial settlement at the investor level on the blockchain network, an exceptional achievement supported by Iberclear (BME).

Throughout the bond's lifecycle, the blockchain network provided unquestionable transparency and immutability, ensuring all parties had access to a single, unalterable source of truth; this feature boosted efficiency and mitigated errors and fraud risks. Additionally, the involvement of regulated institutional actors and the Inter-American Development Bank added credibility and legitimacy to the process, paving the way for broader adoption of DLT in the finance industry.

[1] For detailed information regarding the Book-entry Register in Spain, please refer to Appendix 1.

[2] T2S (TARGET2-Securities) is an European securities settlement engine which aims to offer centralized DvP settlement in central bank funds across all European securities markets. It is important to note that T2S is not a CSD, but a platform intended to enable CSDs increase their competitiveness.

BME Digital Bond Project's main characteristics

Blockchain Use	The project introduced a digital bond issuance, leveraging a blockchain network licensed by Iberclear (BME), the Spanish Central Securities Depository (CSD), and used by a participant of Iberclear, BBVA.
DLT Benefits	The project employed Distributed Ledger Technology (DLT) to increase efficiency, transparency and security throughout the bond issuance process.
Regulatory Compliance	The project involved regulatory institutions such as the CNMV and followed the EU and Spanish laws, ensuring legal compliance.
Use of Electronic Money	Tokenized electronic money was used for the bond settlement process in the secondary market, facilitating a real-time "delivery vs. payment" process, as well as for the management of corporate events.
IDB's Role	The Inter-American Development Bank (IDB) issued the bond under its Global Debt Program parameters, with Citi delivering operational instructions to Iberclear (BME).
Bond Listing	The bond was listed on the AIAF Debt Market, BME's fixed-income market and was validated by authorized parties for accuracy and compliance.
BBVA's Role	BBVA served as a dealer under the IDB Global Debt Program, offering the bond to qualified investors in the primary market. As a participant in Iberclear (BME), it also provided investors custody services and acted as cash tokenizer of the market infrastructure.
Spain's Book-entry Register System	The project leveraged the two-tier system of Spain's Book-entry Register, simplifying the process by reducing the use of DLT strictly to one custodian's second tier.

2. PROJECT OVERVIEW

2.1 Project objectives

- The BME Digital Bond project embarked on a quest to preserve the existing roles and responsibilities within the Spanish market structure while simultaneously striving to incorporate as much of the bond lifecycle as possible on the blockchain. These objectives included the innovative application of on-chain Delivery versus Payment (DvP) for transaction settlements. This ambitious endeavor remained true to the prevailing market structures and regulations in the Spanish market, thoughtfully integrating regulators, custodians, and other market players in the design and execution stages. The ultimate aspiration was to showcase the transformative potential of DLT technology, accentuating efficiency and identifying areas for cost reduction, all while ensuring seamless compliance with established legal frameworks and market structures.

- The BME Digital Bond project put regulatory alignment at the forefront of its goals, adhering to all pertinent regulations and requirements, ensuring a project that fully complied with regulatory expectations. This strategy was geared towards achieving a harmonious balance between regulatory compliance and the advantageous features of DLT technology.

- Operating on the supposition that digital bonds issued on a permissioned DLT network could foster increased efficiency, transparency, risk reduction and cost-cutting benefits, the BME Digital Bond project seamlessly merged with the current bond market structure to uphold market stability. Consequently, all standing roles and responsibilities within the Spanish bond market structure remained undisturbed.

- Implementing the bond lifecycle on-chain paved the way for amplified automation. Tokenized money facilitated on-chain atomic DvP in line with current standards and market practices. Keeping the implementation-specific expedited delivery times while programming, controlling and monitoring events and operations.

- Constructive collaboration with regulators and market players was pivotal to the project's success. Stakeholders such as regulators, custodians and other market participants played key roles in the project's design and execution, ensuring its adherence to existing market structures and regulations.

- The BME Digital Bond project envisioned itself as the first of many milestones, laying the groundwork for future regulated digital bond issuances. It demonstrated the potential of DLT technology to increase efficiency, minimize costs and uphold compliance with established legal frameworks and market structures, all while ensuring institutional investors' accessibility.

BME Digital Bond Project's main objectives

Pioneering the issuance of a listed digital bond using a blockchain network.

Implementing the project within existing financial regulations to show the potential of DLT integration.

Ensuring regulatory compliance by involving regulated entities and complying with EU and Spanish laws for the use of electronic money.

Increasing efficiency, identifying areas for potential cost reduction and enhancing the investor experience through DLT integration.

Streamlining the bond issuance process, from creation to listing and validation, while maintaining legal adherence.

Using electronic tokenized money for the management of cash throughout the term of the issuance.

Simplifying the bond issuance lifecycle by leveraging the use of DLT solely to the second tier system of Spain's Book-entry Register.

Ensuring transparency, immutability and efficiency throughout the bond's lifecycle using blockchain network.

Setting a precedent for broader adoption of DLT in the capital markets.

2.2. Legal and Regulatory considerations

As previously mentioned, the central focus of the BME Digital Bond project was to showcase the practical application of blockchain technology in managing the lifecycle of a financial instrument, while assuring compliance with established regulations and market structures within the legal framework pertinent to securities registration in Spain at the time of issuance. This legal framework traditionally distributed roles between the Central Securities Depository (CSD) and its participants. The project also ensured a significant collaboration with regulators and market participants, providing credibility and integrity to each process stage.

It is noteworthy that the project was executed outside the scope of the Pilot Regime. This regime offers a sandbox environment for experimenting with innovative financial technology products and services under regulatory supervision. Despite the Pilot Regime holds several benefits, including reduced regulatory barriers, exemptions and a flexible regulatory environment, the BME Digital Bond Platform (DBP) evolved independently and was implemented before the Pilot Regime was even etablished. Being fully compliant with applicable securities laws in Spain during July - November 2022, the bond did not need to rely on any sandbox scheme.

The primary aspiration was to launch an actual issuance with full legal and financial implications and to list the bond in a regulated market.

The project ensured compliance with existing regulations and market structures by the following strategies:

- Capitalizing on the project under the legal structure opportunities, embracing a regulatory historical distribution of roles and responsibilities.

- Relying on the second tier of the register system in Spain.

- Ensuring robust collaboration with regulators and market participants to guarantee compliance, security and efficiency.

In accordance with this commitment, the BME Digital Bond project team pledged to uphold the current roles and responsibilities within the Spanish market structure while introducing innovative technology into legal functions. This technology was carefully chosen to avoid colliding with the applicable regulatory frameworks. In order to guarantee regulatory compliance, the team evaluated the exemptions of the Pilot Regime for DLT Settlement Systems and concluded that none of the exemptions were deemed necessary or optional.

The blockchain-based platform acted as a registration mechanism for managing lifecycle of the financial instrument, operating within the secondary tier of the listed book-entries securities registration system. Additionally, the blockchain-based platform served as tool for tokenizing electronic money; on the other side, the Central Registry of the CSD remained unaltered. Thus, the project did not entail a blockchain transformation of the financial market infrastructure but rather a technical tool infrastructure transformation for its participants. This innovative approach allowed for a more efficient registration process without compromising the security and integrity of the bond issuance.

Legal framework key factors

Practical Blockchain Implementation	The BME Digital Bond project showcased the practical use of blockchain technology in managing the lifecycle of a financial instrument while ensuring compliance with existing regulations and market structures.
Regulatory Compliance	The project was executed within the legal framework of securities registration in Spain and ensured collaboration with regulators and market participants, adding credibility and integrity.
Independence from the Pilot Regime	Despite the benefits of the Pilot Regime, a sandbox environment for fintech innovation under regulatory supervision, the project was executed independently of this regime and adhered to existing securities laws in Spain.

Legal framework key factors

Strategies for Compliance	The project ensured compliance by utilizing the legal structure opportunities, focusing on the second tier of the register system in Spain and collaborating with regulators and market participants.
Role Upholding and Tech Integration	The project team upheld the existing roles within the Spanish market structure while introducing innovative technology that did not conflict with regulatory frameworks.
Blockchain as a Registration and Tokenization Tool	The blockchain platform served as a registration tool for the financial instrument's lifecycle and as an electronic money tokenization tool, not altering the Central Registry of the CSD.

2.2.1. Issuance in Main Terms

The securities register for the project was implemented utilizing Iberclear's two-tier book-entry register model, comprising the Central and Detailed book-entry registers. The Detailed Register, also known as the Second Tier Register, was operated by the Iberclear market participant, BBVA, employing blockchain technology supplied by BME under a licensing agreement. This mechanism guaranteed the security, efficiency and adherence to regulations of the securities register. An essential aspect of the project was the adaptation of the issuance process to the bond issuance, ensuring full compliance with all pertinent regulations and enabling the secure and efficient issuance and distribution of bonds.

The core focus of the project centered on the issuance of USD-denominated bonds by the Inter-American Development Bank (IDB), conducted through its Global Debt Program (GDP). Being an AAA-rated supranational and multilateral organization listed on the Spanish Regulated Market (AIAF) and settled through Iberclear (BME), IDB stood as a model of global adaptability. As a supranational organization, IDB is exempt from the obligations of public offerings and admission to listing within the European Union and the corporate law formalities; the flexibility allowed by these features was instrumental in configuring the securities as book entries under Spanish Law, while maintaining other ancillary agreements under the GDP under New York Law.

The settlement process for the project was bifurcated; in the primary market, the settlement of bond trades was conducted by Iberclear (BME) and the settlement of corresponding USD movements undertaken bilaterally; in the secondary market, after the execution of the trades in AIAF Divisas, settlement took place DvP in the Digital Bond Platform, using electronic tokenized money. This approach ensured an efficient, secure and compliant settlement of trades.

Summarizing the main market concepts:

Regulated Market	AIAF, the regulated market where the BME Digital Bond project's bonds are listed.
Issuer	The Interamerican Bank of Development, the organization that issued the bonds in the BME Digital Bond project.
Contractual Terms	The issuance terms of the bond were instrumented by configuring the securities as book entries under Spanish Law, while maintaining other ancillary agreements under the GDP under New York Law.
Book-Entry Register	Iberclear's two-tier book-entry securities register system, consisting of the Central and Detailed book-entry registers, facilitates the circulation of securities in the BME Digital Bond project.
Spanish Law	The set of laws that governs the circulation of the bonds in the BME Digital Bond project.
Iberclear (BME)	The central securities depository system in Spain, responsible for instructions settlement and maintenance of the Central book-entry register.
Blockchain Implementation	A permissioned distributed ledger technology that records transactions in a secure, transparent and efficient manner, which is used by Iberclear (BME) in the Detailed book-entry register for the BME Digital Bond project.
Settlement	The process of transferring ownership of securities and money between parties involved in a trade, which is distributed between Iberclear (BME) and its participant.
AIAF Divisas segment (BME)	A market segment of AIAF where trades in USD-denominated securities, including those of the BME Digital Bond project, are traded.

The project team meticulously assessed various alternatives before opting for digital-native bonds. Digital-native bonds allow enhanced transparency, efficiency and security. Additionally, the project utilized digital fiat money based on EU regulations, which enabled the secure and compliant settlement of trades -amplified by the blockchain network- for increased efficiency and transparency in the bond lifecycle management.

In sum, compliance, security and efficiency were the guiding principles to perform regulated digital bond issuance. As a result, the project adhered strictly to current regulations and market structures, facilitating a compliant and secure digital bond issuance solution that catered to the needs of all stakeholders.

2.2.2. Regulatory Framework

Upon careful examination of the Securities Market Act and Royal Decree 878/2015, in force until March 2023 (specifically from July to November 2022, the lifecycle of the digital bond), it became evident that employing a book-entry form harmonized with the application of blockchain technology. This compatibility applied particularly to a permissioned network complying with the existing register structure and regulatory framework. This network was customized to align with the traditional roles and functions prescribed by law during this period. The legal construct of the book entry did not require a specific technology for maintaining the previous book entries by Iberclear (BME) and its participants, as long as the structure of the Spanish registration system was respected. Consequently, a blockchain network was deemed feasible for this purpose, provided it was calibrated to align with the legal taxonomy of the book-entry form and limited in scope. In addition, the conventional distribution of roles and responsibilities within the Spanish-listed securities registration system was particularly suitable for employing a blockchain network.

BBVA, as a core participant and, therefore, able to manage Spain's second-tier register, was included in the initiative to assure regulatory compliance. This inclusion guaranteed the proper assignment and execution of legally mandated functions, typically distributed between the Central Securities Depository (CSD) and custodians. This ensured the participant's appropriate maintenance of the Second-tier book-entry register under Iberclear's oversight and regulations.

Consequently, blockchain technology was limited to the Second tier of the registration system, leaving the First tier and the CSD unaltered. The incorporation of blockchain neither interfered with the CSD's and custodian's regular operations, nor necessitated alterations.

The BME Digital Bond project team worked closely with regulators and market participants to guarantee full compliance with all applicable Spanish and European Union regulations, pointing out the potential of tokenized securities and the opportunity to revolutionize financial transactions within the EU.

In order to ensure regulatory adherence, the team analyzed the exemptions enumerated in the Pilot Regime for DLT Settlement Systems and concluded that none of these were necessary:

- The exemptions stipulated in Section 5.2 of the Pilot Regime Regulation were not necessary, given that the principles of book-entry form, asset segregation, securities account and integrity of the issue were fully adhered to, in a similar manner to other bond issuances fully registered in a custodian's legacy systems.

- Section 5.4's exemptions were unrequired, given that no retail customers were onboarded.

- Exemptions regulated in Section 5.5 were unnecessary, given as the use of electronic money complied with Section 40.2 of CSDR.

- Finally, the exemption outlined in Section 5.6 was not applicable, given that no migration of CSD accounts and systems to a blockchain solution was undertaken and connections were maintained via regular communication channels with AIAF.

In parallel, tokenized securities, when constituted as financial instruments, fall outside the scope of the proposed Markets in Crypto-assets Regulation ("MiCA").
In the European Union, securities are typically issued as physical certificates or represented in book-entry form, in accordance with national securities regulations. To enable the inclusion of securities on a DLT network it is necessary for the securities laws of individual countries to permit such digital representation alongside physical certificates and book-entries. While France, Luxembourg and Germany have authorized the representation of securities on a DLT network, Spain is on the verge of finishing a full process of adaptation to the Pilot Regime sanctioning the tokenization of assets as a new form of securities representation Spanish law. Consequently, the BME Digital Bond project team devised a scheme of limited tokenization, enabling bonds to operate following the current Spanish law without having to await for the outcome of the legislative process.

The regulated digital bond issuance project emphasized adherence to regulatory frameworks in both Spain and Europe.

Topic	Brief Description
Book-Entry Compliance	The project utilized a book-entry form, in alignment with the existing regulatory framework. This allowed the use of a permissioned blockchain network that was tailored to match the traditional roles and functions prescribed by law.
BBVA Involvement	BBVA, a key participant managing the second-tier register in Spain, was included in the initiative to ensure proper assignment and execution of legally mandated functions between the CSD and the custodian, and to facilitate the cash tokenization following the E-Money Directive.
Blockchain Application	Blockchain technology was delimited to the second tier of the registration system, leaving the first tier and the CSD unaffected. This ensured that the CSD's and custodian's regular operations were not disrupted.

Topic	Brief Description
Compliance with Spanish and EU Regulations	The project adhered to the prevailing regulations in Spain, including the Ley del Mercado de Valores (LMV) and the Ley de Servicios de Pago (electronic money), as well as other relevant regulations in the EU.
Non-Application of Pilot Regime	The project did not utilize the Pilot Regime, which offers a sandbox environment for trialing innovative financial technology products and services under regulatory supervision; the Digital Bond Platform evolved independently before the Pilot Regime was even established and was fully compliant with the applicable securities laws in Spain at the time of issuance
Non-Application of MiCA	When constituted as financial instruments, tokenized securities fall outside the purview of the proposed Markets in Crypto-assets Regulation ("MiCA"), a critical distinction for the project.

2.3 Bond Taxonomy

The key market terms underlying the bond were as follows:

- The entity issuing the bond, referred to as the Issuer, was the Inter-American Development Bank (IDB). The issuance was conducted through its IDB Global Debt Program (GDP). The securities were configured as book entries under Spanish Law, while maintaining other ancillary agreements under the GDP under New York Law.

- The securities, catalogued as Series 838 under the GDP, were brought to market per the Pricing Supplement dated July 14, 2022 (ISIN ES0313681001). The aggregate nominal value was USD 10,000,000, with a specific denomination of USD 100,000 per security, furnished with a bi-monthly payable coupon of 2.205 percent per annum and a maturity date of July 21, 2024. The issuance price of the security was 100%. The option of Issuer Optional Redemption was exercised on November 21, 2022, at Par.

- The securities were listed on the Spanish Regulated Mercado de Renta Fija (AIAF) and underwent settlement through Iberclear (BME).

- BBVA played several roles, such as arranger, dealer, cash tokenizer or custodian. As the dealer, BBVA facilitated the placement of the securities with investors, ensuring compliance with MiFID2 regulations. BBVA's target Market was strictly limited to Professional Clients and Eligible Counterparties.

3. FUNCTIONAL SCOPE

3.1. Bond lifecycle in scope

Several innovative initiatives leverage cutting-edge technologies to enhance the capabilities of products functionalities in the evolving technological landscape. However, the BME Digital Bond project took a distinct path, demonstrating the applicability of these technologies within legacy systems' specific use cases, and without requiring regulatory modifications, thereby accentuating their potential benefits.

Furthermore, this project underscored the potential for DLT's application within the parameters of existing legislation, specifically in the context of use cases such as the bond lifecycle.

As previously mentioned, during the initial issuance of the bond, distribution, negotiation in the secondary market, coupon payments, and early redemption in the second coupon payment, the BME Digital Bond project employed the structure of the Book-entry Register in Spain, characterised by its two-tier level system. This approach limited the scope of the Minimum Viable Product (MVP) and simplified the process, thereby reducing the lifecycle to the Second tier of a single custodian. Moreover, this approach eliminated the need for any interaction with the General Register in Iberclear-T2S, resulting in a notably streamlined MVP.

The BME Digital Bond project leveraged two separete tokenization modules to manage both the securities and cash legs, thus enabling all settlement operations to be conducted on a blockchain-based delivery-versus-payment (DvP) basis. Specifically, the BME Digital Bond Platform comprised two Ethereum-based components: the Digital Bond Platform, governed by the CSD, and the Asseto Digital Money Platform, overseen by the Cash Tokenizer Entity. Both platforms were supported by a private and permissioned blockchain network built on Hyperledger Besu, an Ethereum client designed for enterprise-grade applications.

In its initial implementation, the BME Digital Bond Project showcased several notable features:

- Similar to conventional bond issuances, the Spanish Central Securities Depository (CSD) issued the bond within the Eurosystem. Consequently, the issuance took place within T2S and the responsibilities and actions within the General Register tier remained unaltered.

- Since the bond was denominated in dollars, the movement of cash occured outside the scope of T2S.

- The bond was initially allocated to the custodians via Iberclear's General Register and subsequently distributed to the clients of the custodians through the BME Digital Bond Platform.

- The negotiation in the secondary market occurred within the AIAF market, BME's fixed income market, through SEND, AIAF's electronic platform. Due to the MVP's design, which involved a single custodian to keep simplicity, the negotiation and settlement process exclusively impacted the Second-Tier register through the BME Digital Bond Platform. Though, the BME Digital Bond Platform has been designed to accomodate the participation of multiple custodians as needed, enabling atomic Delivery-versusPayment (DvP) transactions and utilizing tokenized digital money.
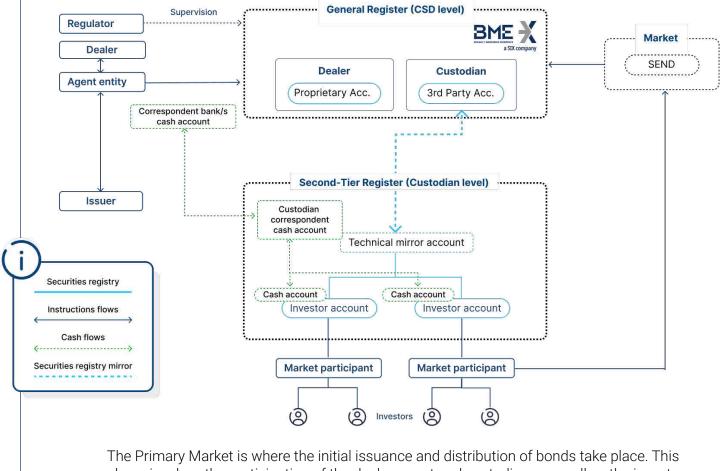
- To speed-up the duration of the MVP, the issuer called the bond before the maturity date stipulated in the prospectus. The early redemption of the bond took place both within General Register (and T2S) and the BME Digital Bond Platform (i.e., in the Second-Tier Register) by Iberclear (BME). The cash movements were settled atomically on the BME Digital Bond Platform, using again tokenized digital money.

The BME Digital Bond project stood-out due to its compatibility with conventional bond lifecycle processes, its magnitude and its usage of cash tokenization. Moreover, it exemplified the potential of Distributed Ledger Technology within a regulated market environment, duly considering all pertinent legal and regulatory elements.

3.2. Bond Platform

To provide a comprehensive overview of the functional architecture of the BME Digital Bond project it is necessary first to outline the current model for bond negotiation within the Spanish Market.

In the Spanish marketplace the lifecycle of bonds denominated in a currency distinct from those approved by the Eurosystem for settlement purposes can be illustrated as follows:

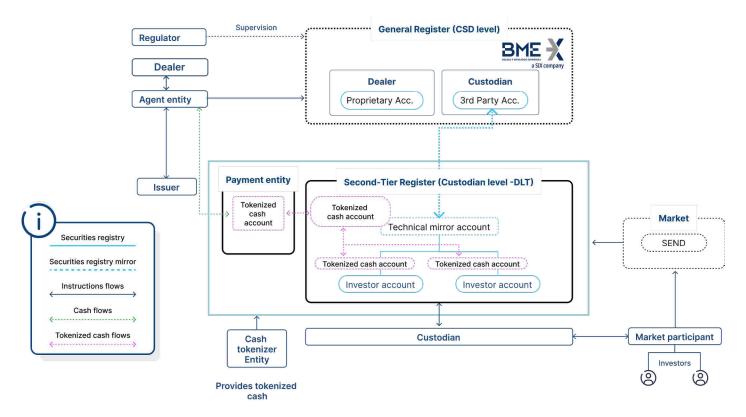The Primary Market is where the initial issuance and distribution of bonds take place. This phase involves the participation of the dealer, agent and custodians, as well as the investors. Following the issuance, market actors can negotiate bond transactions in the Secondary Market, bilaterally or within a regulated marketplace.

In cases where a regulated marketplace is required, the AIAF market—BME's fixed-income market— is utilized through its electronic platform SEND. When the transfer of bond ownership takes place between Iberclear participants or between an Iberclear participant and a custodian client, these movements are recorded in General Register. On the other hand, if the transfer of bond ownership occurs solely between the clients of a single custodian, the movement is exclusively recorded in the Second-Tier Register.

The proposed model for the BME Digital Bond project diverges slightly from this traditional configuration, in order to accommodate cash movements outside of Iberclear's scope; this allowed for the issuance of bonds in a currency other than the Euro or the Danish Krone, specifically US Dollars in this case. As a result, the initial issuance of the bond could take place in a Free of Payment (FoP) mode within the General Register, same behaviour as in any other bond of this nature. This means that the necessary sequence for initial cash movements, starting from investors and flowing to the agent entity (and potentially to the issuer), as well as transactions in the secondary market, could be facilitated utilizing tokenized digital money.

The Second-Tier Register was developed as a DLT-based platform in the BME Digital Bond project model. This platform was offered as a service to custodians and payment entities to speed-up all processes involved in the bond lifecycle and post-trading settlement. Participants still placed orders via secondary market methods (AIAF/SEND). The custodians performed Securities movements on behalf of their clients (investors), registering these actions on the BME Digital Bond Platform. In cases where custodianship would be transferred, settlement instructions would be dispatched to Iberclear (BME) to initiate the requisite changes to custodian accounts within the General Register. In the pilot, the movements between clients were limited to those retained under the same custodian.

All secondary market transactions and bond lifecycle corporate events were registered and settled on the BME Digital Bond Platform utilising tokenized cash. The role of the payment entity in this model was designed to facilitate the flow of tokenized money to and from the agent entity and custodian[3]. The agent entity, custodian, or even an external entity could have fulfilled this role.

---

[3] Within the specific context of the project, the Payment Entity role was played by BBVA under the figure of Custodian Control.

3.3. Cash-leg intro

As previously mentioned, the primary objective of the BME Digital Bond project was to perform settlement operations on a blockchain-based Delivery versus Payment (DvP) model. To achieve this objective, the securities and cash components required tokenization, with the register maintained on the blockchain. Ideally, Central Bank Digital Currencies (CBDCs) would have been used for these operations. However, at the time of the project's implementation CBDCs were not yet available in the market, so alternative tokenized digital currencies were utilized instead.

In order to address this limitation a regulated form of Tokenized Electronic Money[4] raised as an alternative, which could be issued by either a regulated Electronic Money entity or a credit institution/bank. In this case the Electronic Money was issued by a bank, BBVA. Following this model, full collateralization of the electronic money was secured in a reserve account in BBVA; this account was structurally separated and independent from the balances of the bank, and the balances of the individual electronic money accounts within the system underwent tokenization. These were subsequently segregated on the blockchain, with each account bearing an independent ID and a unique DLT address. The system permitted interoperability exclusively among whitelisted DLT addresses, thus ensuring the security and integrity of all transactions.

The model for settlement was designed to replicate the current T2S model, with Tokenized Electronic Money substituting for central bank money and the transaction scope being restricted to those within the Second-Tier Register under the same custodian; this restriction served to minimize complexities and risks. In addition, this architecture is readily modifiable, facilitating the incorporation of CBDCs and similar forms of tokenized fiat money as these become available.
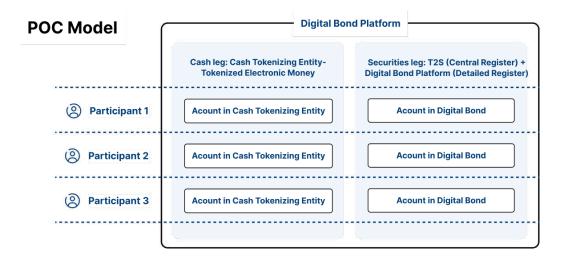
Operational integrations in the Tokenized Cash Accounts could be achieved via API or smart contract, rendering the system interoperable with other smart contracts and enabling atomic DvP against tokenized assets. This configuration facilitated a more efficient and streamlined settlement process, reducing counterparty risk and assuring the secure and timely transfer of assets and funds. In conclusion, the use of Tokenized Electronic Money in the BME Digital Bond project represents a progressive step towards adopting CBDCs and analogous forms of digital money, demonstrating the potential of blockchain technology to revolutionise the financial industry.

3.4. Cash Tokenizer Platform

A Cash Tokenizer Platform is a digital infrastructure designed to facilitate the creation and management of Tokenized Electronic Money, serving as a digital representation of traditional fiat currencies. The platform is governed by a Cash Tokenizer Entity (role played by BBVA), an autorized and regulated entity responsible for issuing electronic money and ensuring compliance with relevant legal and regulatory requirements.

---

[4] Electronic money (e-money) is defined by its EU legal framework, in general terms, as the monetary value stored in an electronic medium that can be used to make payments to entities other than the issuer.

The primary purpose of a Cash Tokenizer Platform is to issue tokenized electronic money, which represents real-world currencies. These digital tokens are backed by actual funds held in a reserve account within a regulated banking institution. The platform allows blockchain-based payments, thus enabling users to dispatch and receive tokenized electronic money in a fast and secure way. Additionally, it also allows the management of user accounts and movements, facilitating the monitoring of the ownership and transfers of tokenized electronic money in the blockchain.

A Cash Tokenizer Platform serves a secure and efficient solution for the tokenization of electronic money, thereby unlocking new possibilities and applications in the digital economy and pointing to a transformative shift in how financial transactions may be conducted. The implications of this innovation are far-reaching, as it showcases the potential of Distributed Ledger Technology (DLT) to revolutionize conventional financial systems and processes. Furthermore, the platform's capability to execute real-time secure transactions holds the promise of significantly enhancing the efficiency of the global payment ecosystem.

The Cash Tokenizer Platform exhibits relevance to a range of business scenarios, such as the speed-up of cross-border transactions or the reduction of settlement times. Moreover, it could also enable real-time payments and micropayments, creating new possibilities for e-commerce and digital services.

Within the context of the BME Digital Bond project, the Asseto Digital Money Platform was designed to manage settlement operations on a Delivery vs. Payment (DvP) basis on the blockchain. In order to achieve this objective both the asset leg (in this case, the bond) and the cash leg were tokenized, keeping, as mentioned, the register located in the blockchain.

Asseto Digital Money, as an autonomous tool for cash tokenization, was operated by BBVA as the Cash Tokenizer Entity, enabling transactions with fiat currency on the blockchain. The platform leveraged the features and capabilities of the Ethereum blockchain while maintaining integration with the traditional monetary system.

While initially designed in connection with the BME Digital Bond Platform to manage the cash leg of the settlement layer, Asseto Digital Money was purposely developed as a multifunctional tool for the tokenization of cash. Its intended scope extends beyond this specific use case, allowing for effective management of the cash component in conjunction with a wide range of digital assets, such as equities, loans, investment funds or structured bonds, among others.
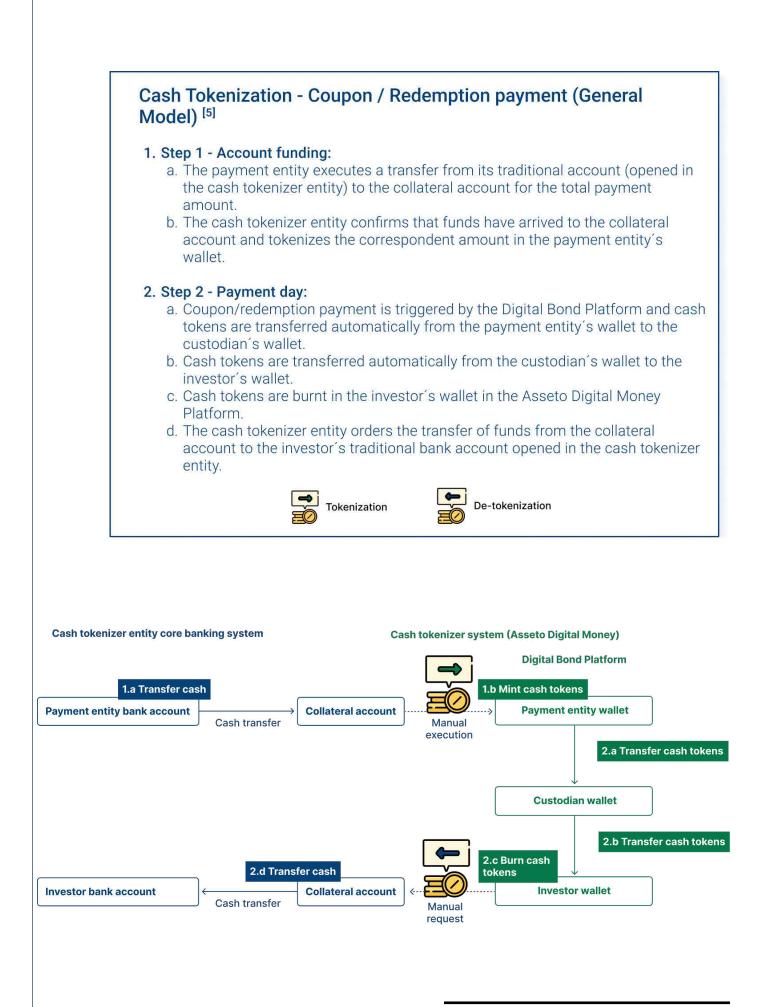
To enable these functionalities, Asseto Digital Money established a functional linkage between the traditional cash accounts and the cash accounts of market participants in the blockchain. Asseto Digital Money facilitated the efficient tokenization and detokenization of funds from BBVA's accounts, where actual funds were held in a collateral account.

Each separate account in the system was assigned an independent ID and a unique DLT address, with the balances of these accounts tokenized and segregated on the blockchain; in parallel, the collateral was preserved in a reserve account in BBVA.

Asseto Digital Money enabled cash tokenizer entities to offer several services:

- Provision of e-money cash accounts for participants.

- Cash tokenization to fund the e-money cash accounts, thereby facilitating the management of cash-related transactions in any business domain, such as DvP.

- Execution of payments triggered either directly by a business domain or by the participant's actions.

- Cash detokenization, enabling the release of the cash amounts held at the collateral account.

- Cash-related compliance and reporting, including tools to facilitate transaction checks in the DLT via block explorer.

In essence, Asseto Digital Money marks a significant step forward in cash management and settlement, introducing innovative solutions with the potential to revolutionize financial transactions. By bridging the traditional banking system with the Ethereum blockchain, Asseto Digital Money delivers unparalleled efficiency, speed and security in conducting financial transactions.

Cash Tokenization - Coupon / Redemption payment (General Model) [5]

1. **Step 1 - Account funding:**
   a. The payment entity executes a transfer from its traditional account (opened in the cash tokenizer entity) to the collateral account for the total payment amount.
   b. The cash tokenizer entity confirms that funds have arrived to the collateral account and tokenizes the correspondent amount in the payment entity´s wallet.

2. **Step 2 - Payment day:**
   a. Coupon/redemption payment is triggered by the Digital Bond Platform and cash tokens are transferred automatically from the payment entity´s wallet to the custodian´s wallet.
   b. Cash tokens are transferred automatically from the custodian´s wallet to the investor´s wallet.
   c. Cash tokens are burnt in the investor´s wallet in the Asseto Digital Money Platform.
   d. The cash tokenizer entity orders the transfer of funds from the collateral account to the investor´s traditional bank account opened in the cash tokenizer entity.

Tokenization

De-tokenization

Cash tokenizer entity core banking system

Cash tokenizer system (Asseto Digital Money)

Digital Bond Platform

1.a Transfer cash

1.b Mint cash tokens

Payment entity bank account → Cash transfer → Collateral account ┈ Manual execution ┈> Payment entity wallet

2.a Transfer cash tokens

Custodian wallet

2.b Transfer cash tokens

2.d Transfer cash

2.c Burn cash tokens

Investor bank account ← Cash transfer ← Collateral account <┈ Manual request ┈ Investor wallet

4. TECHNICAL OVERVIEW

4.1. Network characteristics

The BME Digital Bond project utilizes a resilient and secure blockchain network to guarantee the secure and efficient settlement of transactions. The network was designed as an Enterprise Ethereum-based network, leveraging the Hyperledger Besu client to provide a range of powerful features and capabilities. A fundamental characteristic of this network is its private-permissioned nature, limiting access to designated nodes and accounts. This approach enhances security measures by ensuring that only authorized parties can participate in transactions on the network.

In addition to its private-permissioned nature, the BME Digital Bond network has been designed with a limited number of nodes to optimize transaction processing times. This optimization is crucial, given the substantial volume of transactions that require regular processing. By limiting the number of nodes on the network the BME Digital Bond project aims to speed-up transactions processing, ensuring efficient and timely execution without compromising the security or integrity of the network.

Another key characteristic of the BME Digital Bond network is its free-gas nature, similar to the LACNet networks. This means that any DLT address is able send transactions to the network without requiring any balance or any other type of restriction; this design choice ensures that the network is accessible to as many users as possible, fostering a smooth and efficient settlement process.

Lastly, the BME Digital Bond network implements the QBFT[6] proof of authority consensus algorithm. This consensus algorithm was specifically chosen for its ability to provide a high level of security and integrity while maintaining efficient transaction processing times. By using this robust consensus algorithm the BME Digital Bond project achieved a balance between security and efficiency, making it a robust and reliable platform for bond settlement and transaction processing.

4.2. Architecture

The architecture of the platform, which encompasses the BME Digital Bond Platform and the Asseto Digital Money Platform, was developed with a focus on incorporating modern enterprise architecture patterns and best practices. To this end, a number of techniques were employed, such as Domain Driven Design (DDD), Command Query Responsibility Segregation (CQRS) and Event-Driven Architecture (EDA).
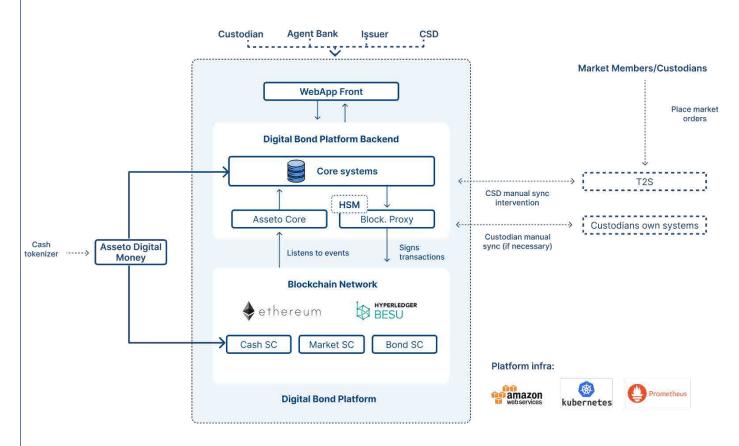
The platform also utilized a variety of specific technologies, including JVM and Micronaut for microservices architecture, Postgres for database management and AMQP and Async API for message queueing and asynchronous communication. Additionally, the MVP leveraged React for the user interface and Infrastructure as Code (IaC) techniques through the use of Terraform.

[6] https://consensys.net/blog/quorum/consensys-quorum-21-7-0-product-update-london-hard-fork-qbft-and-more/

Furthermore, Asseto Digital Money embraced a range of cutting-edge technologies, including REST APIs and OpenAPI specifications. These technologies played a crucial role in facilitating smooth integration with external systems and establishing an easily accessible interface for users to interact with the platform.

In summary, the architectural design of these platforms shows a sophisticated and effective strategy for the development and deployment of blockchain-based systems, incorporating a comprehensive range of best practices and cutting-edge technologies to ensure optimal functionality and successful outcomes

An eagle-eye diagram portraying the platform's architecture for a detailed visual representation of these components:
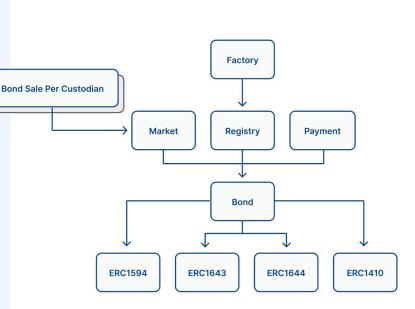
4.3. DLT Architecture

As an integral part of the platform's development, a set of smart contracts were created to implement diverse functionalities related to bond management. These smart contracts were deployed on the blockchain to guarantee transparency, traceability and security of any bond-related activities. To ensure interoperability and extensibility, these contracts followed standard enterprise and Ethereum design patterns such as Upgradable, Proxy, Eternal Storage or Factory; this design approach facilitates the integration of new features and capabilities into the platform, allowing for future expansion and adaptability.

Quality and security were primary considerations during the design and development process of these smart contracts. To ensure that the contracts were robust and error-free, a rigorous testing process was put in place with 100% test coverage. Moreover, a vulnerability detection process was integrated into the build level to ensure that no vulnerabilities were present in the smart contracts. This meticulous approach significantly enhanced the security and reliability of the platform, fostering a high level of trust and confidence among its users.

4.3.1 Bond Smart Contracts

The BME Digital Bond Platform was meticulously engineered by deploying a suite of smart contracts. These contracts served a dual purpose: primarily, these facilitated the management of various bond issuances, and secondly, they effectuated the functionalities that span the entire bond lifecycle, incorporating elements from both primary and secondary markets, as well as from corporate events. Consequently, this comprehensive approach enabled total traceability of all activities related to the bond, effectively recorded on the blockchain.
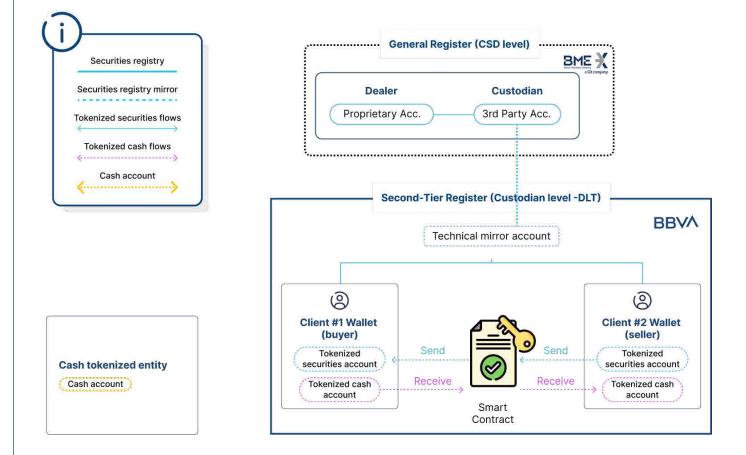
- **Bond Instrument Smart Contract:** The Bond Instrument Smart Contracts were specifically created for each bond issuance and were based on the ERC-1400 security token standard; . This standard was extended to encompass all details pertinent to a bond. Partitions enabled the bond to register the two-tier requirement, allowing a global picture per custodian (aka partition) and a detailed balance per investor. Each bond smart contract was completed with the related casuistic such as RBAC (Role Based Access Control), status or extra data when deployed to allow the adaptation to the bond lifecycle.

- **Bond Lifecycle smart contracts**: ad hoc smart contracts were specifically developed to manage the different stages during the lifecycle of a debt financial instrument. These smart contracts were generic and interacted with each specific bond smart contract.

Three primary smart contracts were responsible for the management of the bond lifecycle:

- Smart Contract for Bond Sale/Primary Market, which includes all the logic, steps and checks for each distributor, bond issuance, and correct token distribution and assignment.

- Smart Contract for Secondary Market, covering all the rules, processes and capabilities related to the instrument trade, settlement and market functional requirements.

- Smart Contract for Payment Events Management, allowing the management of Principal and coupon events, ensuring the auditable, transparent, certified and accurate calculation and execution of the associated payments.

Overall, this structured design of smart contracts allowed the BME Digital Bond Platform to effectively manage various bond issuances and their associated lifecycle events, showcasing the potential of blockchain technology in regulated financial markets.

4.3.2 Cash Smart Contract

ERC-2020 (the E-Money Standard Token) was used for the management of the cash leg; this strategic choice enabled the secure and efficient issuance of tokenized money within the platform.

This standard token, based on the ERC-20 standard, provides the necessary features to enable the tokenization of cash for use in the platform. One of the key features of ERC-2020 is the ability to put token balances on hold, which ensures that the held amount is not available for further use until the hold was resolved, either through execution or release. This is a critical function during the lifecycle of a bond, as it secures the cash commitment associated with each financial instrument transaction.

Moreover, on-chain whitelisting was enabled to facilitate closed-loop payments and compliance checks, enhancing the security and reliability of the Digital Bond Platform. The ERC-2020 standard token balances were segregated and assigned independent IDs and unique DLT addresses to ensure traceability and accountability throughout the platform's lifecycle.

By leveraging the benefits of ERC-2020, the BME Digital Bond project achieved secure and efficient tokenization of cash, simplifying the issuance and management of financial instruments. Moreover, this standard facilitated interoperability and extensibility, ensuring the platform's ability to adapt and evolve to meet future requirements and challenges in the rapidly changing digital landscape.

4.4. Security

The implementation of the platform's private networking setup baseline brought a high level of security to the platform. All participants were required to configure an IPsec VPN to connect to the network and platform, ensuring that access was limited to authorized individuals and establishing a timer for automatic disconnection of services. Further bolstering security, participant IPs were only whitelisted on necessary endpoints, ports and services.

The platform also featured an admin panel, a vital component that was equipped with Role-Based Access Control (RBAC) capabilities. This allowed participants to be assigned specific roles per issuance, providing an additional layer of security. RBAC ensured that only authorized personnel could perform critical actions within the platform, and avoided multiple connections by a single user. Users and company representatives could access the admin panel via user credentials, following OAuth2 standards.

Moreover, the platform incorporated an identity-based encryption and secrets management tool (HashiCorp Vault) along with hardware security modules that process cryptographic operations and provide secure storage of cryptographic keys (CloudHSM) on AWS. This ensured that all sensitive information was securely stored and remained inaccessible to unauthorized persons. This secure configuration helped safeguard participants' information and transactions against potential threats or attacks.

In summary, the platform's robust security measures including a private RBAC network, identity authorization protocols (OAuth2) and secure platform configuration through HashiCorp Vault and AWS CloudHSM ensured a high level of security and confidentiality.These elements worked collectively to ensure all transactions on the platform were secure, reliable and trustworthy.

4.5. Privacy/Confidentiality

While the project did not incorporate an on-chain privacy or confidentiality setup, the platform was specifically designed to ensure secure access and management throughout the bond issuance process. The usage of pseudonymous identities and a web admin panel facilitated efficient tracking and management of the different actors engaged in the bond issuance process while maintaining high-security standards.

In order to ensure that all transactions were tracked and recorded correctly, the platform implemented a reflection of the main register and a second register. This tactic enabled the solution of one physical book keeping of the bond, which was logically divided into a second-tier register per custodian. The partitions or trenches of the ERC-1400 security standard were utilised in the implementation of the second-tier register to provide a more detailed balance per investor and a global picture per custodian. This tiered approach balanced detail and consolidation, maintaining an overarching view while tracking individual investor balances.

5. CONCLUSION

Considering the ongoing evolution and progress of Distributed Ledger Technology (DLT) in the domain of financial transactions, it is expected that the integration of blockchain technology within the financial industry, particularly in the issuance of digital bonds, will experience significant expansion.

The BME Digital Bond project showcases the potential of DLT for issuing digital bonds in a compliant and secure fashion while reaping the benefits intrinsic to DLT technology. The on-chain implementation of the bond lifecycle promotes increased automation and clearly reduces settlement times. Furthermore, the tokenization of money facilitates on-chain atomic Delivery versus Payment (DvP) consistent with current standards and market practices. The simplicity of the implementation accelerates delivery times, and the programmed, controlled and monitored events and operations provide enhanced transparency and accountability. At the same time, DLT technology carries the potential to provide access to institutional investors while concurrently facilitating a more secure and streamlined financial industry.

In a nutshell, the approach pioneered a practical and compliant framework for future regulated digital bond issuances. DLT technology brings the potential to increase efficiency, reduce costs and grant transparency and accountability while maintaining regulatory compliance and existing market structures.

The BME Digital Bond project constitutes a significant step forward, evidencing the potential of DLT for regulated financial transactions. Moreover, its success could catalyze future innovation and adoption of DLT within the financial industry.

With the goal of creating a feasible and compliant model for future regulated digital bond issuances, the project leverages the capabilities of DLT technology to bring forth these advantages; the recent introduction of the Pilot Regime amplifies these premises, undeniably setting the stage for a more secure and streamlined financial industry.

With the context of the Pilot Regime, the project's potential is positioned to expand remarkably. The Regime offers a regulatory framework conducive to testing innovative solutions within a controlled environment. This will equip the BME Digital Bond project with the means to assess the feasibility and efficacy of utilizing DLT technology for securities registration. Simultaneously, it will facilitate the identification of necessary enhancements prior to a full-scale implementation. Moreover, the Pilot Regime will foster greater collaboration with regulators and market participants, enabling a more supportive and favorable environment for future blockchain-based initiatives.

Key conclusions

Adoption and Growth	With the continuous development of Distributed Ledger Technology (DLT), the adoption of blockchain technology in the financial industry, specifically in digital bond issuance, is expected to expand.
Accessibility and Security	DLT technology could provide access to institutional investors while enabling a more secure and streamlined financial industry.
Feasibility and Compliance	The project aims to provide a feasible and compliant model for future regulated digital bond issuances, using DLT to increase efficiency, reduce costs and improve transparency while maintaining regulatory compliance.
Impact of Pilot Regime	The recent approval of the Pilot Regime will allow further exploration of DLT technology in a regulated environment, fostering innovation and potentially transforming the financial industry.
DLT Advantages	The on-chain bond lifecycle implementation of DLT allows increased automation and dramatically reduces settlement times, while tokenized money enables on-chain atomic DvP compliant with current market practices.
Practicality and Efficacy	The Pilot Regime will allow the project team to assess the practicality and efficacy of using DLT technology for securities registration and to identify necessary improvements before a full-scale implementation.
Collaboration and Innovation	The BME Digital Bond project illustrates the potential of DLT in bond issuance, providing a model for future digital bond issuance. At the same time it encourages greater collaboration with regulators and market participants, fostering a supportive environment for future blockchain-based initiatives.
Institutional Adoption	This project serves as a tangible use case for institutional participants and investors. It demonstrates how a listed security can effectively meet the rigorous requirements, restrictions, and limitations of eligible assets for portfolio investments through the use of DLT, thus encouraging institutional adoption of this technology.

5.1. Participants' Reflections and Prospective Insights

There is a consensus among participants regarding the transformative potential of Distributed Ledger Technology (DLT) showcased in the BME Digital Bond Project. The BME Digital Bond project has demonstrated the power and efficacy of DLT in revolutionizing the traditional bond issuance process. Furthermore, there is a recognition for the increased efficiency, improved security and transparent processes achieved by integrating blockchain technology and smart contracts.

Collectively, the participants acknowledge the invaluable lesson learned from this project, emphasizing the critical importance of aligning advanced technology with the dynamics of regulatory compliance. The harmonization of technological innovation with the prevailing regulatory framework emerges as a pivotal factor for the successful digital transformation of the financial sector.

Furthermore, the insights gained from the BME Digital Bond Project are positioned to significantly impact future implementations of DLT in other domains of the financial sector; scalability and user experience offer a template that can be replicated in the digital transformation of other critical areas, such as stock exchanges, derivative markets and banking services

At the same time, the project has the potential to stimulate regulatory authorities to develop comprehensive frameworks for the deployment of blockchain technology, thereby promoting the broader adoption of DLT within their respective jurisdictions.

BME X (a SIX company) **(Project's Promoter):**

- **Reflections:** BME considers the success in implementing an innovative solution as a milestone, potentially opening new formulas for bond issuance process.

- **Insights:** The experience has reiterated the importance of synchronizing technological innovation and regulatory compliance. It has emphasized the need for scalability and user experience optimization.

IDB (Issuer):

- **Reflections:** At the IDB's Treasury Division, we are constantly striving to innovate by exploring new financial instruments and services that advance the social and economic development agenda of our member countries.

- **Insights:** The rapid growth we have seen in the use of blockchain technology and smart contracts is proof of this technology's potential in terms of transparency, programmability and redundancy in financial transactions.

BBVA (Cash Tokenizer, Custodian, Sole Dealer):

- **Reflections:** BBVA has shown its capacity of being in the forefront of the tokenized assets innovation landscape, performing roles along the full value chain, from the digital structuring of the deal to the digital custody of assets and the tokenization of e-money.

- **Insights:** The project has showcased the possibility of executing blockchain transactions with the current market infrastructure in terms of trades and system interconnectivity for underwriters and institutional investors. In addition, this pilot shows the potential for issuance time and cost reduction, which opens up opportunities for smaller issuers and less developed economies.

Citi (Issuer Agent):

- **Reflections:** Citi might view the process's security and efficiency as a testament to DLT's potential to revolutionize financial operations.

- **Insights:** The project has likely underscored the importance of integrating innovative technology while maintaining regulatory compliance and highlighted the benefits of tokenized electronic money.

ioBuilders (Technical Provider):

- **Reflections:** The BME Digital Bond project has validated the feasibility of using DLT to manage the lifecycle of a bond while adjusting to the current market infrastructure. This achievement serves as a solid foundation for comparing and evaluating upcoming models that will emerge in the context of the Pilot Regime.

- **Insights:** ioBuilders has successfully demonstrated that smart contracts have the capability to automate the economic lifecycle of any digital asset, providing a blueprint for streamlining processes across different asset types. As we move forward, we are excited to explore the broader applications of our technological advancements and contribute to the ongoing transformation of the financial industry.

GARRIGUES (Issuer´s legal Advisor):

- **Reflections:** At Garrigues, we are delighted to have lent our legal expertise to the BME Digital Bond Project supporting the IDB. We firmly believe in the potential of blockchain technology to bring about a more efficient, transparent and compliant financial industry.

- **Insights:** This project marks an important milestone in our ongoing commitment to support and shape the financial industry, a significant stride in marrying technology and law.

5.2. Proven benefits and key values

The BME Digital Bond project has introduced a range of transformative benefits to the bond market. These benefits include:

- **Shared and Trustworthy View:** By creating a unified, trustworthy perspective accessible to all participants, the project ensures heightened transparency and minimizes the risk of errors or fraudulent activities. This consolidated viewpoint simplifies processes and enhances overall market efficiency.

- **Efficient Settlement Servicing:** Utilizing Distributed Ledger Technology (DLT), the project facilitates rapid and efficient settlement servicing. This reduced settlement risk and expedited trade execution is crucial in today's fast-paced financial markets, where timing is everything.

- **Immediate Bond Distribution:** The project leverages DLT for the accelerated distribution of bonds to investors, which increases efficiency in settlements and makes the issuance of bonds smoother. In addition, the project leverages DLT technology to create an ecosystem where market participants could have real-time access to the same information, encouraging transparency and minimizing risks of errors and fraud.

- **Implementation of Delivery vs. Payment (DvP):** Through tokenized money and DLT infrastructure, the project provides seamless and secure trade settlement. By minimizing back-office processes, settlement risk is reduced and overall efficiency is increased, strengthening the security and efficiency of bond issuance and trading.

- **Cost Reduction:** By leveraging DLT, the project would be able to reduce costs linked with traditional bond issuance processes while ensuring compliance with legal and regulatory norms. This potential decrease in price would make bond issuance and trading more attainable for a broader range of investors.

- **Blockchain Adoption for Institutional Investors and Capital Market Participants:** The project successfully illustrates the practicality and viability of blockchain technology for institutional investors and capital market participants. The project highlights how this technology can meet the rigorous requirements and constraints of eligible assets for institutional portfolio investments by issuing fully compliant, listed securities on this platform. This broadens the acceptance of such technology in the capital market and sets a precedent for the future digitization of securities issuance. In addition, it expands the opportunity for institutional investors to invest in assets that leverage advanced technology, fostering a more diverse and inclusive financial ecosystem.

- **Compliance:** Adherence to legal and regulatory requirements is of paramount importance to maintain the integrity of the digital bond issuance process.

In essence, the BME Digital Bond project has achieved substantial gains in terms of efficiency, transparency and security. These advancements hold the potential to revolutionize the bond market by expanding its accessibility to a wider range of investors and reducing costs associated with traditional bond issuance methods.

5.3. Why is this different from other bonds using blockchain technology?

The BME Digital Bond project utilized a permissioned DLT infrastructure that implemented rigorous participant, identity management and access controls. These measures were put in place to ensure strict compliance with Spanish and European Union regulations. The automation of the bond issuance process and the tokenization of money, in compliance with EU directives, were successfully achieved through the utilization of smart contracts. However, despite the project emphasized transparency, its scope was limited to the detailed book-entry register to comply with Spanish regulation, thus excluding complete process tokenization; other alternative bond projects based in blockchain technology utilize a public blockchain infrastructure, incorporate full tokenization and employ cryptocurrency for settlements. Nevertheless, these solutions are not deployed in financial market infrastructures.

The BME Digital Bond project sets itself apart from other DLT-oriented bond initiatives through several notable distinctions. A prominent aspect that set the project apart was the active participation of regulated stakeholders assuming diverse roles within the ecosystem. These included the issuer of the bond, regulated institutional actors acting as participants and the involvement of regulated financial market infrastructures such as a regulated secondary market and a Central Securities Depository; this introduced an additional layer of complexity to the project while simultaneously demonstrating the potential applicability of DLT technology within a secure, compliant and regulated market environment.

Furthermore, the project was conceived to integrate harmoniously with traditional market bond lifecycle processes, thus ensuring seamless integration with existing market infrastructure. This total integration with legacy systems stood in notable contrast with other DLT-based bond projects, which necessitated the construction of new market infrastructures from the ground up.

Moreover, the BME Digital Bond Project constituted a pioneering landmark in Spain, the first bond listed on the Official Secondary Market that uses DLT technology. This achievement underscored the potential applicability of DLT technology within a regulated market environment, ensuring compliance with all relevant legal and regulatory stipulations.

Another relevant distinction of the project was the employment of cash tokenization. This feature facilitated a swifter, more secure and more efficient settlement of trades, thereby presenting a substantial advantage over conventional settlement methods.

While there exist comparable projects such as the World Bank's bond-i initiative or the European Investment Bank's bond issuance utilizing Ethereum, the BME Digital Bond project differentiates itself by its significant scale, alignment with established bond lifecycle processes in traditional markets, listing on the Official Secondary Market and implementation of cash tokenization. These factors collectively establish a unique and distinct position for the project, setting it apart from others in the industry.

BME Digital Bond Project	Other Bond Projects on Permissionless Networks
Regulatory compliance: The BME Digital Bond project operates within Spanish and European Union regulations, assuring that all transactions comply with current laws. This gives institutional investors confidence that they are operating within a secure and legally sound framework.	**Regulatory uncertainty:** Other bond projects on permissionless networks may not strictly adhere to specific regulations due to the decentralized nature of these networks. This may create potential regulatory risk for investors.
Suitability for Institutional Investors: The BME Digital Bond project accommodates all regulated roles, updating their functions to take advantage of technology advancements. This provides a familiar structure to institutional investors, fostering confidence in its stability and reliability.	**Variable Suitability:** Bonds on permissionless networks often simplify roles, which could pose a challenge for traditional institutional investors who are accustomed to specific roles and structures in the financial industry.
Listing in a Regulated Market: Bonds issued via the BME Digital Bond project are listed on a regulated market, ensuring visibility and credibility while offering a broad base of potential investors.	**Limited Market Visibility:** Bonds on permissionless networks may not have the opportunity to list on regulated financial markets, which may limit their visibility among potential investors.
Use of Electronic Money: The BME Digital Bond project employs tokenized real regulated fiat money (electronic money under EU regulations), ensuring secure and compliant transactions.	**Use of Non-Regulated Stablecoins:** Other projects often utilize non-regulated stablecoins for transactions, which may pose potential risks due to the lack of regulatory oversight.
Structured Settlement: The BME Digital Bond project ensures electronic money-based settlement as per EU regulation, making it more reliable and secure.	**Cryptocurrency Settlement:** Permissionless network-based bonds often settle transactions using cryptocurrencies, which could expose investors to the volatility and unpredictability associated with these digital assets.
Risk Management and Insurance: The BME Digital Bond project could implement standardized risk models, including insurance coverage, providing a safety net for investors and fostering trust.	**Risk Management:** Other bond projects on permissionless networks might lack standardized risk measures such as insurance, increasing potential risk for investors.

BME Digital Bond Project	Other Bond Projects on Permissionless Networks
Certified Technology Stack: The technology stack used in the BME Digital Bond project is certified by eligible auditors, ensuring compliance with regulatory requirements. This reduces technical and security risks associated with the bond issuance and trading.	**Uncertified Technology Stack:** The technology stack used by other projects on permissionless networks may not be certified by recognized auditors, potentially exposing investors to technological and security risks.
Roles maintained: Traditional roles and regulated participants adapted to technology advancements.	**Roles simplified:** Roles are often simplified, and traditional participants may not be included in the process.

5.4 Potential Impact

In the rapidly evolving financial industry, the implementation of distributed ledger technology (DLT) opens a range of potential benefits that stand to revolutionize the way the bond market operates. The BME Digital Bond project, through its use of DLT, has has showcased the potential for enhanced efficiency, transparency and security in the bond issuance process. These advancements hold the promise of transforming traditional bond markets.

- **Streamlined Processes:** The utilization of DLT in bond issuance is expected to bring about a substantial simplification and increase in operational efficiency, leading to a reduction in complexities and faster transaction processing.

- **Reduced Settlement Risk:** Swift and efficient settlements are facilitated by DLT, reducing settlement risk associated with delayed transactions.

- **Improved Accessibility:** The cost reductions reachable through this project have the potential to democratize bond issuance and trading, making it accessible to a wider array of investors.

- **Increased Efficiency:** Processes streamlining and automation via smart contracts might lead to time savings and operational cost reductions.

- **Deeper Compliance:** The project serves as a benchmark for future digital bond issuances, compliant with regulatory standards, fostering greater trust and confidence among market participants.

- **Demonstration of Feasibility:** Acting as a proof-of-concept, the project encourages the broader adoption of DLT in the financial industry by demonstrating its practical applicability in the bond market.

- **Adoption for Institutional Investors:** By facilitating the issuance of fully compliant securities using DLT, the project paves the way for institutional investors and capital market participants to adopt this technology.

- **Pilot Regime Expansion:** Building upon the initial experimental phase of the Pilot Regime, future considerations should include expanding the scope of the pilot to involve a broader range of participants and test additional functionalities. This will allow for a more comprehensive evaluation of the project's capabilities and potential risks in a controlled environment, facilitating the refinement of the platform before broader implementation.

- **CBDC Experimentation Program:** The BME Digital Bond project would be a suitable candidate to participate in a CBDC experimentation program, in line with the European Central Bank's digital euro initiative. This program would allow the project to integrate CBDCs into its platform, assessing their benefits and impact on the bond market. By actively participating in CBDC experiments and collaborating with stakeholders, the project can shape the future of digital currencies in the Eurosystem, driving innovation and enhancing efficiency, security and transparency in bond transactions.

The BME Digital Bond Project thus stands as a prime example of innovation, showcasing the extensive potential of integrating cutting-edge technologies in the financial systems.

6. FUTURE CONSIDERATIONS

6.1. Future Money Models

The utilization of tokenized digital cash within the same ledger where securities are represented offers significant advantages in terms of settlement processes embedded in any security lifecycle. By enabling atomic execution, this setup ensures that settlement processes are completed seamlessly and without the need for multiple separate transactions. This capability opens up a wide range of possibilities for payment coordination and orchestration, allowing for the implementation of streamlined and intricate processes that can be executed and audited in a trustless manner. With a single source of truth for all participants, transparency and accuracy are enhanced throughout the entire process.

Furthermore, the inclusion of asset holds adds an additional layer of operational assurance. By ensuring that collateral is available and directly linked to the ongoing transaction, the risk of misalignment or incomplete transactions is minimized. This strengthens the overall reliability and integrity of the settlement process.

As previously mentioned, in the absence of any implementation of Central Bank Digital Currencies (CBDCs) or wholesale central bank money, tokenized electronic money has been used for the purpose of this project. However, the emergence of CBDCs or private initiatives tokenizing central bank money presents an opportunity to leverage central bank-backed implementations for digital asset settlement.

In summary, the usage of tokenized digital cash within the same ledger as securities not only enables atomic settlement processes and payment coordination but also enhances operational assurance and minimizes settlement risks. As the financial landscape evolves and CBDCs and others tokenized fiat money solutions gain traction, the potential for more secure and efficient settlement mechanisms in the digital asset space becomes increasingly promising.

In order for the BME Digital Bond project development, it would be key to consider various future-focused aspects to ensure its success and relevance in the changing landscape of the financial industry, such as the regulatory evolution, technology integration with other emerging technologies or even interoperability with other systems, platforms or networks. Given these reasons, it will be crucial to continuously monitor market trends and adapt the BME Digital Bond strategies and functionalities accordingly; in addition, future updates would consider user feedback to continually enhance the platform's usability and user-friendliness. By giving careful consideration to these factors the BME Digital Bond project can maintain a competitive edge and continue to drive innovation and transformation within the bond market.

6.2. Next steps in Legal Framework

After nearly two years in the making, on 18 March 2023 the new Spanish Securities Market Act (Ley 6/2023, 17 March, de los Mercados de Valores y de lo Servicios de Inversión) was enacted. With this legislative milestone, financial instruments such as shares and bonds can be issued, registered, transferred or stored using DLT technology. This first step needs to be complemented by a Royal Decree setting forth the specific requirements mentioned in the Act relating to such as the continuity plan or the measures that need to be in place to assure the integrity and immutability of the DLT network.

This Royal Decree will be thus key in defining how DLT securities will need to work under Spanish Law and thus how the Spanish market infraestructures authorised by CNMV under the Pilot Regime will work in practice, but it is not expected to become a reality until Q3 2023.

The Digital Euro initiative of the European Central Bank is still in its Investigation phase since July 2021, prioritizing the use cases of a Digital Euro, defining the business model and functional design and identifying the legislative changes and potential service provider that will be needed for the initiative to pass on to its Realization phase (expected around October 2023). Before the adoption of the Digital Euro, Pilot Regime solutions might be leveraged under the possibility of using e-money tokens regulated under MiCA Regulation.

These delays only show how important it was the decision to leverage on the existing legal framework at project inception instead of waiting for the legislators to finish their work.

7. APPENDIX

7.1. Structure of the book-entry register in Spain

The book-entry register system in Spain follows a dual-tiered structure overseen by Iberclear (BME), which includes the General Register and the Second-Tier Register. Here is a breakdown of the two levels:
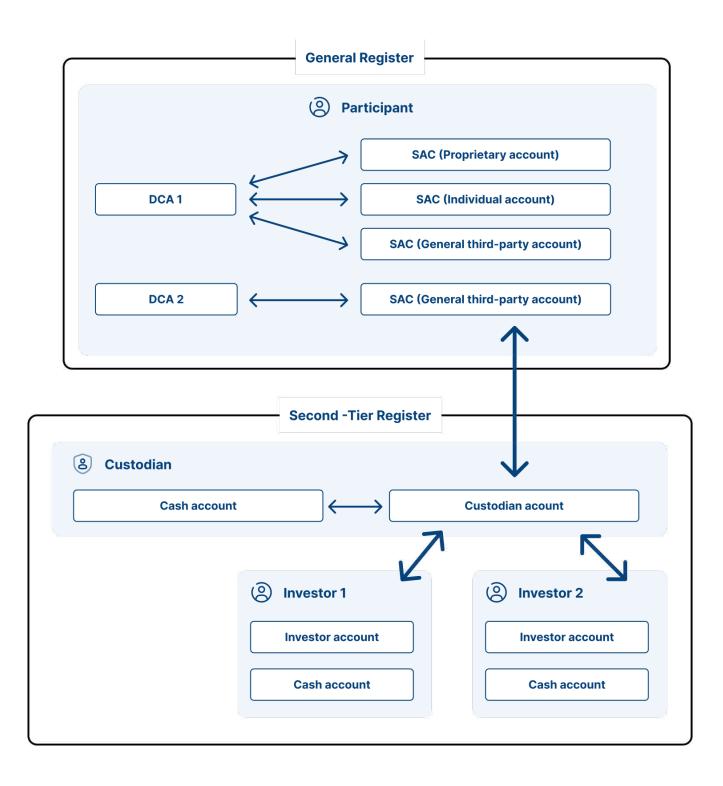
1. General Register: Managed by Iberclear (BME), the General Register consists of three types of accounts:

- Proprietary Accounts: These accounts represent the positions held directly by the Iberclear participants.

- Individual Third-Party Accounts: These are created on behalf of specific clients of the Iberclear participants.

- General Third-Party Accounts: These represent the collective balance of securities that Iberclear participants register on behalf of their clients within their Second-Tier Register accounts.

Each of these securities accounts is connected to at least one dedicated cash account at a Central Bank, provided that the Central Bank allows the currency associated with the account for settlement.

2. Second-Tier Register: This register is maintained by custodians that are Iberclear participants, and includes the ownership detail of the custodian general third-party account in the General Register. These accounts mirror the total positions which are further segregated into one or more client accounts. Each investor's account is tied to one specific custodian general account, and every client account is connected to at least one cash account at a commercial bank for cash transactions.

As per regulations, all Iberclear participants must maintain securities in the Central Register if they are the holders, either in proprietary accounts or individual accounts opened in their name. Iberclear' participants can keep several investor accounts that belong to the same custodian general account.

This is visually represented as follows:

General Register

Participant

SAC (Proprietary account)

DCA 1

SAC (Individual account)

SAC (General third-party account)

DCA 2

SAC (General third-party account)

Second -Tier Register

Custodian

Cash account

Custodian acount

Investor 1

Investor account

Cash account

Investor 2

Investor account

Cash account

7.2. Glossary

- **AIAF:** The fixed-income market operated by BME, where secondary market negotiations for the bond took place in the BME Digital Bond Project.

- **Asseto Digital Money Platform:** The second main component of the BME Digital Bond Project, managed by the Cash Tokenizer Entity, responsible for managing the cash leg of transactions.

- **Blockchain:** The distributed ledger technology utilized in the BME Digital Bond Project to record transactions, enhancing transparency and reducing operational complexities.

- **Book-entry Register:** The structure employed in the BME Digital Bond Project, consisting of the General Register and the Second-Tier Register, for managing bond ownership.

- **Cash Tokenizer Entity:** A credit institution, bank or e-money entity issuing electronic tokenized money. This entity manages Asseto Digital Money Platform for the tokenization and detokenization of money, holding actual funds in a collateral account.

- **CSD (Central Securities Depository):** In the context of the BME Digital Bond Project, Iberclear (BME), the CSD responsible for bond issuance within the Eurosystem in the BME Digital Bond Project.

- **Custodian General Accounts:** Accounts in the Second-Tier Register reflecting total positions segregated into client accounts for bond transactions in the BME Digital Bond Project.

- **DBP Platform:** The Digital Bond Platform, one of the main components of the BME Digital Bond Project, responsible for managing the securities leg of transactions under the governance of the CSD.

- **Dealer:** Entity who is actively involved in the issuance process; this includes structuring, pricing, and allocating the new issuance.

- **Delivery-versus-Payment (DvP):** The model implemented in the BME Digital Bond Project using tokenized money and DLT infrastructure to ensure secure settlement of trades, enhancing security in bond issuance and trading.

- **Distributed Ledger Technology (DLT):** The BME Digital Bond Project employs DLT to record and manage the lifecycle of bonds, ensuring traceability, security, and efficiency in bond transactions.

- **ERC-2020 - The e-money token standard:** proposed standard for e-money tokens with extended functionalities such as holds, clearance, compliance, funding, and payout (Emoney Token Standard).

- **Fixed-Income Market (Mercado Renta Fija):** Referring to the AIAF market, BME's fixed-income market, where secondary market negotiations for the bond occurred in the BME Digital Bond Project.

- **General Register:** The first level of the Book-entry Register system, managed by Iberclear (BME), handling bond issuance and early redemption in the BME Digital Bond Project.

- **Hyperledger Besu:** An enterprise-grade Ethereum client utilized in the BME Digital Bond Project, running on private permissioned networks to ensure secure DLT implementation.

- **Iberclear (BME):** The Spanish Central Securities Depository (CSD) responsible for bond issuance within the Eurosystem in the BME Digital Bond Project.

- **IDB Lab:** The innovation area of IDB Group promoting LACChain ecosystem, the blockchain alliance supporting the development and adoption of the technology in the LAC region.

- **Individual Third-Party Accounts:** Accounts created for specific clients within the General Register by Iberclear participants in the BME Digital Bond Project.

- **Issuer:** The entity initiating bond creation in the BME Digital Bond Project, such as the Inter-American Development Bank (IDB).

- **General Third-Party Accounts:** Accounts in the General Register representing the collective balance of securities registered by Iberclear participants on behalf of their clients.

- **Markets in Crypto-assets (MICA):** A proposed EU regulation aimed at mainstreaming crypto assets, potentially influencing the legal and regulatory compliance of tokenized assets in projects like the BME Digital Bond.

- **Minimum Viable Product (MVP):** The approach adopted in the BME Digital Bond Project, constraining the project's scope to the second tier of a single custodian to simplify the lifecycle.

- **Permissioned DLT:** The private and permissioned DLT, Hyperledger Besu, utilized in the BME Digital Bond Project, providing a secure Ethereum client for the blockchain network.

- **Pilot Regime:** A provisional regulatory framework to test innovative technologies or business models in a controlled environment, potentially referring to the experimental phase of DLT for bond transactions in the project.

- **Proprietary Accounts:** Accounts held directly by the participants in the General Register managed by Iberclear (BME).

- **Smart Contract:** The BME Digital Bond Platform incorporates a set of smart contracts that govern various aspects of bond issuance and implement functionalities throughout the bond lifecycle.

- **Second-Tier Register:** Within the BME Digital Bond Project, the participant entity manages the Second-Tier Register, which handles the distribution, negotiation, and early redemption at the second coupon payment of the bonds.

- **Securities:** Refers to the bonds that are issued, managed and transacted using DLT.

- **SEND:** AIAF's electronic platform utilized for secondary market negotiations in the BME Digital Bond Project.

- **Tokenization:** Tokenization is employed within the BME Digital Bond Project to manage both the securities and cash aspects of transactions. It enables a blockchain-based delivery-versus-payment (DvP) model.

7.3. Replication of BME Digital Bond project in Latin America and Caribbean Region

The successful implementation of the BME Bond Project provides a blueprint that could be adapted to various jurisdictions across Latin America and the Caribbean region, leveraging the LACChain blockchain infrastructure orchestrated by LACNet[7]. Here is a functional and technological vision for such an endeavor.

Functional Perspective:

1. **Identify the Legal and Regulatory Framework:** Each country in the LATAM and Caribbean region has its unique legal and regulatory environment. Therefore, it's crucial to identify and understand the specific rules and regulations governing bond issuance and trading in each jurisdiction.

2. **Define the Operational Processes:** Detailed operational processes need to be defined, including bond issuance, trading, settlement, and redemption. These processes should align with the local market practices and regulatory requirements.

3. **Engage Stakeholders:** Engage all necessary stakeholders, including issuers, investors, central securities depositories, financial intermediaries, regulators, and technology providers. Their involvement is crucial to ensure that the project meets the needs of all participants and complies with local regulations.

Technological Perspective:

1. **Leverage LACChain Infrastructure:** The LACChain blockchain infrastructure orchestrated by LACNet, committed to providing an inclusive, efficient, and secure blockchain network, is a perfect foundation for such a project. It offers comprehensive capabilities for tokenizing bonds and facilitating their seamless trading as digital assets.

2. **Customize the BME Blueprint:** Tailor the functional and technical design of the BME Bond Project to align with local requirements and constraints, ensuring optimal adaptation. The blueprint should serve as a flexible guideline, providing the overarching structure and process flow, allowing necessary adjustments to suit specific local conditions.

3. **Develop and Implement Smart Contracts:** Engage in the development and implementation of smart contracts to automate the bond issuance, trading, settlement, and redemption processes. These smart contracts should undergo rigorous design and testing to ensure flawless and secure functionality.

---

[7] LACNet is an international non-profit association with a primary objective of orchestrating a robust, production-ready blockchain infrastructure for Latin America and the Caribbean, ensuring neutrality and inclusivity for all stakeholders involved. This is achieved by leveraging the neutral and distributed nature of its managing entities, LACNIC and RedCLARA, as well as the collaborative spirit of LACChain-initiative led by IDB Lab. Together, these three entities create a truly exceptional digital ecosystem that stands apart on a global scale.

4. **Ensure Interoperability:** Design the system to seamlessly interoperate with existing financial systems, enabling smooth integration and widespread adoption. This interoperability will facilitate streamlined communication and data exchange between different networks.

5. **Implement Robust Security Measures:** Due to the sensitive nature of the transactions involved, it is crucial to implement robust security measures to ensure utmost integrity and confidentiality of the data. Incorporate state- of- the -art security protocols, encryption techniques, and access controls to safeguard the systems from unauthorized access and potential threats.

6. **Consider Scalability:** Anticipate future growth and increasing transaction volumes by prioritizing scalability. The platform should be designed to accommodate growing user base and handle substantial transaction loads without compromising performance and reliability.

Key Features of LACChain blockchain infrastructure:

- Robust blockchain network designed for corporate use.

- Adherence to regulatory requirements for increased compliance.

- No transaction fees, ensuring cost-effective operations.

- Reliable support and consistent network performance guaranteed.

- Extensive ecosystem spanning across 17 countries, offering diverse projects and solutions in areas such as identity management, traceability, education, government services and more.

- Emphasis on neutrality and transparent blockchain governance.

- Advancements in Quantum: deliver a quantum-resistant web 3.0 infrastructure that hosts a secure digital wallet ecosystem to address quantum challenges.

The successful replication of the BME Bond Project in LATAM and the Caribbean region, leveraging the robust LACChain infrastructure, holds immense potential to ignite a transformative era of digitalization within the bond market in the area. However, it is crucial to emphasize that undertaking such endeavor requires a comprehensive understanding of the local conditions, extensive collaboration among all stakeholders, and an unwavering dedication to harnessing cutting-edge technology while upholding stringent regulatory compliance. By carefully navigating these crucial factors, we can pave the way for a groundbreaking advancement in the bond market, driving forward innovation, efficiency and transparency throughout the region.

7.4. About the authors

BME X
a SIX company

- **Diego García Novillo, Legal Counsel**

- **Lara Cortés Sánchez, Senior Innovation Project Manager**

BBVA

- **Francisco Navarro Gancedo-Rodríguez, Legal Counsel**

GARRIGUES

- **Moisés Menéndez Andrés, Digital Transformation Director**

- **Gonzalo García Fuertes, Partner**

ioBuilders

- **Carlos Contreras del Río, Senior Product Manager**

- **Carlos Matilla Sanz, Co-CEO**

- **Fernando París Huertas, Founder & Co-CEO**

Disclaimer

This document and its contents do not constitute an offer, syndication, an underwriting commitment, financing proposal, invitation, solicitation nor proposal of any other financial service, nor an invitation or solicitation to purchase, subscribe, place or underwrite any securities or other instruments, or to undertake or divest investments.

Any indicative prices shown do not constitute an offer, solicitation or bid to buy, unwind or repurchase or an offer to enter into or sell any security, derivative or financial instrument or a commitment by any party to make such a bid or offer.

None of Bolsas Mercados Españoles (BME), SIX Group Company., Banco Bilbao Vizcaya Argentaria, S.A., Garrigues SLP nor IoBuilders Blockchain & Tech Ventures S.L. (jointly, the "Entities") mentioned in this document, nor any of its affiliates, subsidiaries, members, officers, employees or directors or advisers accepts any responsibility, obligation or liability to any person whatsoever for any loss, damage or claim of any kind, arising from or in relation to the distribution, use, or possession of this document or any part thereof, or any action taken in reliance thereon, in or from any jurisdiction.

All statements, information and data in this document are merely indicative and may be amended, superseded or replaced without notice and the entities mentioned in it shall have no responsibility to notify you of such changes. The contents of this document shall not in any case be deemed to constitute investment advice or a recommendation to enter into any transaction or to trade, nor advice or any type whatsoever (legal, regulatory technological et al) nor shall they form the basis of any contract, commitment or investment decision of any kind.

You should be aware that the securities, instruments or investments to which this document refers may not be appropriate for you or your (or any other person's) specific investment goals, financial positions or risk profiles, as these have not been taken into account. You should perform your own independent evaluation and any decision taken in respect of such issues and any investment decisions taking into consideration your own particular circumstances and should be based on your own further investigation and specialist independent professional advice.

No part of this document may in any way, without the prior written consent of all of the Entities, whatsoever be copied, transmitted, quoted, conveyed, distributed or furnished to any other person or company and, in any case, in any country in which its distribution is prohibited by law. Failure to comply with these restrictions may breach the laws of the relevant jurisdiction. This document is the property and has been prepared jointly by the Entities mentioned in it. Any denominations, designs, and logos of said entities are their duly registered trademarks of said Entities.

Opinions included in this document exclusively reflect each author's criteria, and must not be attributed to, nor are deemed to be shared by those of any other person or any of the Entities, remaining each author's sole responsibility.

Generative artificial intelligence tools supported this document's drafting and phrasing. Human authors wrote, designed, structured, reviewed and approved the final text.

It is understood that all recipients of this document accept all of the warnings and conditions contained herein in its integrity.