

## SECTOR IN-DEPTH

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Decentralized Finance and Digital Assets – Cross Region

# Digital bonds' features could transform debt markets over time

## Summary

Digital bonds – bonds issued and managed on distributed ledger technology (DLT), a collection of systems that record transactions in multiple places almost simultaneously – are one of DLT's most promising applications. This emerging technology could lower transaction costs, enhance liquidity, facilitate access to capital markets, and reduce settlement times.

- » **Digital bond issuances are accelerating, led by public entities and banks.** Although there has been only \$3.9 billion of digital bonds issued so far, compared to \$118 trillion of conventional bonds outstanding as of Q3 2023,<sup>1</sup> the number of transactions is growing. Public entities have been among the first to test this technology. Some banks have also issued digital bonds to enhance their technological expertise and offer new services to their customers.
- » **Digital bonds could transform debt markets.** Blockchains, a type of DLT, are programmable, so they can automate many steps in a bond's life cycle. In addition, their content cannot be changed and is accessible to all participants, reducing the need for participants to maintain duplicate databases. These attributes could allow digital bonds to reduce the number of intermediaries involved in the bond issuance process, diversify issuer and investor bases, and offer new features.
- » **More scrutiny is still required, given the platforms' limited track record.** Although conventional bond infrastructure has a multi-decade track record, digital bond platforms are relatively new and therefore require greater scrutiny. As the digital bond ecosystem matures, we expect the risks of these new instruments to converge gradually with those of conventional bond infrastructure.
- » **Creating a fully functional digital bond market will take time.** Assembling the building blocks necessary to create a fully functional primary and secondary DLT bond market will take time. For example, the lack of DLT-compatible wholesale central bank digital currency<sup>2</sup> hinders on-chain payment processing. Some incumbents may be reluctant to invest in a technology that may disintermediate them, even though it has the potential ultimately to make bond markets faster, cheaper, and more efficient.

## Digital bond issuance is small but accelerating, led by public entities and banks

Although there has been only \$3.9 billion in digital bonds issued so far, compared to \$118 trillion in conventional bonds outstanding as of Q3 2023, the number of transactions is growing. There were 10 digital bond issuances over the six-month period ended 31 May 2023, compared to 12 in all of 2022.

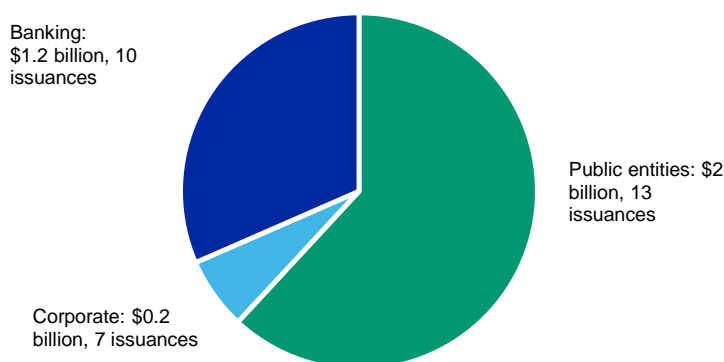
Most digital bond issuances have occurred in developed markets, especially in Europe and Southeast Asia, where intermediaries have invested heavily in developing and testing solutions. However, there have been only a few digital bond issuances in the US because of the uncertain regulatory environment.<sup>3</sup> We expect this region to catch up if Congress passes legislation bringing more visibility to DLT infrastructure operators, although the lack of political consensus makes the timeline unclear.

So far, public entities have been the number one user of this technology — they account for 62% of the total value of all digital bonds issued (see Exhibit 1).

Exhibit 1

### Public entities have been the largest issuers of digital bonds

Breakdown of digital bonds issued by sector



Source: Moody's Investors Service

Some public entities issue digital bonds to encourage the adoption of DLT. The [European Investment Bank](#) (Aaa stable) has been the most frequent issuer, with at least one digital bond launched each year since 2021, because its management views digitalization of capital markets as potentially beneficial for all market participants.<sup>4</sup> In 2023, the [City of Lugano](#) (Aa3 stable) in Switzerland and the [Government of Hong Kong SAR, China](#) (Aa3 stable) also issued digital bonds as part of their blockchain strategy.

In the US, three local governments issued small digital bonds in December 2022.<sup>5</sup> The largest digital bond issuance to date was from Thailand's central bank, which sold \$1.6 billion of savings bonds in October 2020.<sup>6</sup> Some financial institutions have issued digital bonds to enhance their technological expertise and offer new services to their customers, such as the German bank [Kreditanstalt fuer Wiederaufbau](#) (KfW, Aaa stable).

Most transactions are still proof-of-concepts, with small amounts issued and a limited number of investors. However, some are beginning to resemble genuine transactions. For example, in November 2022, the Swiss bank [UBS AG, London branch](#) (Aa2/Aa3 negative, a3)<sup>7</sup> issued a CHF375 million digital bond.

Although digital bond issuances will progress, we expect conventional bonds to continue dominating fixed income markets for many years. Our survey of sovereign and sub-sovereign issuers indicates that the vast majority is only starting to explore the field, gathering information and conducting research to better understand the implications of digital finance.<sup>8</sup>

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## Digital bonds could help modernize debt markets

Like a traditional bond, a digital bond is a debt instrument used by borrowers to raise money from investors. However, what sets a digital bond apart is that its ownership register is stored using DLT instead of traditional databases. Although this difference may seem trivial, it has the potential to transform the bond financing ecosystem by lowering transaction costs, enhancing liquidity, facilitating access to capital markets, and reducing settlement time.

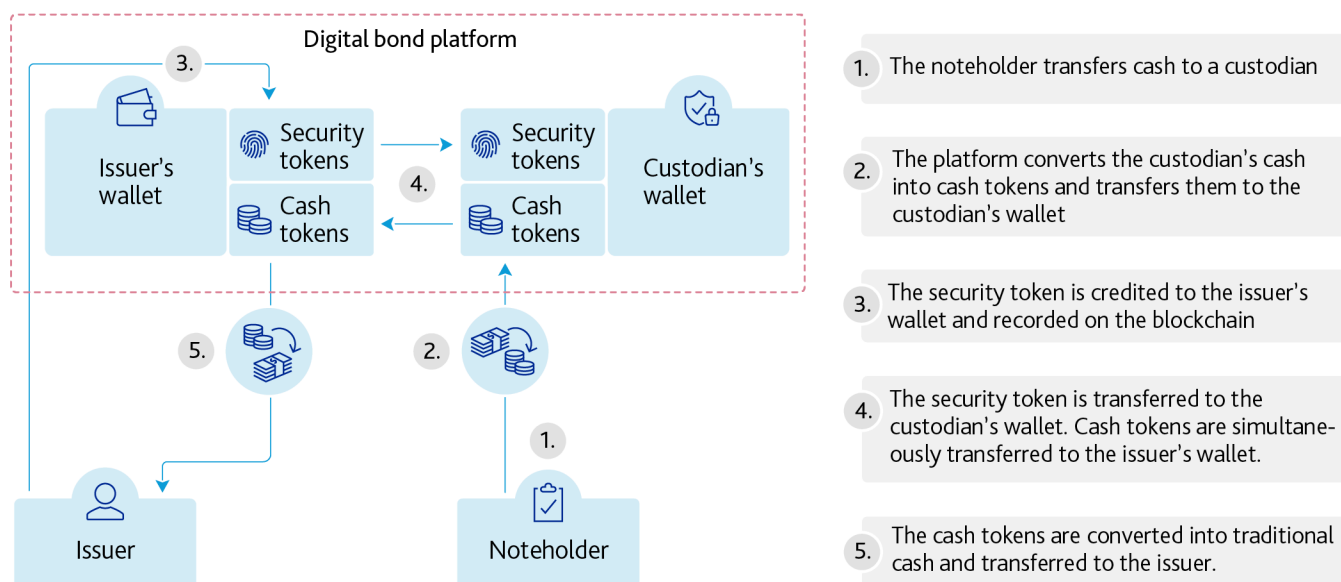
One of the components of DLT is blockchain, a technology consisting of a list of records called blocks that are securely linked together using cryptography. Blockchains are often programmable and can automate many steps in a bond's life cycle, such as coupon payments. Moreover, the content of a blockchain is often immutable and accessible to all participants, which fosters trust among network participants and reduces the need for maintaining duplicate databases.

Thanks to these two features, DLT could reduce the number of intermediaries involved in the bond issuance process. Theoretically, an issuer could bypass banks to interact directly with a digital bond platform, which would integrate some of the roles performed today by agents<sup>9</sup>, exchanges, and central security depositories (CSDs)<sup>10</sup>. Clearing houses<sup>11</sup> may no longer be necessary because the exchange of cash and tokens materializing the bond ownership would occur simultaneously (see Exhibit 2).

Exhibit 2

### A digital bond issuance may involve a limited number of actors

#### Simplified digital bond issuance process



The architecture of each platform may vary. For instance, SDX security tokens are not issued and credited to the wallet of the issuer but are held by an issuer agent (typically a bank or a custodian) acting on behalf of the issuer

Source: Moody's Investors Service

However, most recent digital bond issuances have been more complex and have involved many more actors. Even if some of these intermediaries remain, efficiency gains could be significant for financial markets, given the high volume of bonds issued each year – in 2022, global debt issuance amounted to \$8.3 trillion.<sup>12</sup>

Digitalization could not only generate savings but also expand and diversify debt markets. Lower issuance costs and automated processes can enable new actors, such as small and medium-sized enterprises, to issue bonds. Additionally, tokenized assets<sup>13</sup> could collateralize new debt instruments.

Digitization could also enhance market liquidity over time. For example, blockchain technology allows bonds to be split into smaller portions, a process known as fractionalization. Under appropriate legal and regulatory frameworks, this technology would lower

investment minimums and enable smaller investors to buy bonds. With a mature market infrastructure, transactions would be highly automated, reducing costs and shortening settlement periods. Automation could enable investors to trade 24/7/365.

Lastly, digital bonds offer new features. For instance, they could pay cash flows daily or even hourly or provide some ESG information about the issuer or the collateral.

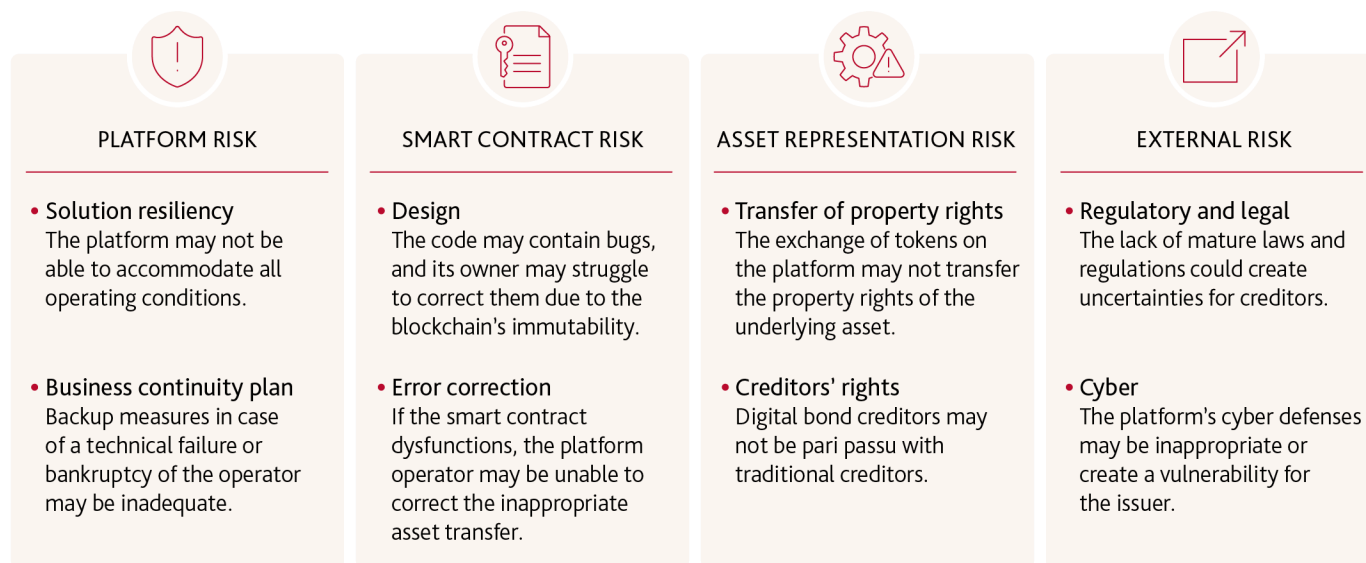
### More scrutiny is required given digital bond platforms' limited track record

Although conventional bond infrastructures have a multi-decade track record, digital bond platforms are relatively new and untested. Therefore, they require greater scrutiny. Exhibit 3 summarizes their main risks.

Exhibit 3

#### Digital bonds are subject to different versions of conventional bonds' risks

##### Key risks of digital bonds



Source: Moody's Investors Service










As the digital bond ecosystem matures, we expect risks to converge with those of conventional bonds over time.

Digital bonds' features are not yet standardized. For example, although most use DLT to register holding information and track ownership transfers, only a few use it to process principal and interest payments. Additionally, some digital bonds are issued on private blockchains, which are controlled by a single entity, while others are processed by public blockchains, which are entirely decentralized (see Exhibit 4).

Exhibit 4

**Digital bonds have diverse features**

Comparison of selected digital bond issuances

Date	3 <sup>rd</sup> Nov 2022	29 <sup>th</sup> Nov 2022	10 <sup>th</sup> Jan 2023	31 <sup>st</sup> Jan 2023	14 <sup>th</sup> Febr 2023	19 <sup>th</sup> Jun 2023
 Issuer	UBS	European Investment Bank	City of Lugano (Switzerland)	European Investment Bank	Siemens AG	European Investment Bank
 Amount (in \$ million)	374	121	109	62	65	94
 Instrument rating	Aa3	Aaa	Aa3	Aaa	A1	Aaa
 Blockchain type	Private	Private	Private	Private	Public	Public
 Platform operator	SDX	Goldman Sachs	SDX	Orion (HSBC Continental Europe)	Hauck Aufhäuser Lampe Privatbank	Credit Agricole Corporate and Investment Bank
 Payments processed on blockchain	Yes	Yes	Yes	No	No	No
 Option to replace the bond	No	Yes	No	Yes	No	Yes
 Grace period (in days)	30	30	10	30	30	30
 Governing law	Switzerland	Luxembourg	Switzerland	Luxembourg	Germany	Luxembourg

Exchange rate at the time of issuance. Amounts issued in local currency: UBS/CHF375 million, EIB (November 2022)/€100 million, City of Lugano/CHF100 million, EIB (January 2023)/€50 million, Siemens/€60 million, EIB (June 2023)/SEK1 billion. The option to replace the bond refers to the ability of the issuer to substitute a conventional bond to the digital bond.

Source: Moody's Investors Service

Public blockchain poses different risks than private blockchains. For instance, third parties can sometimes see smart contracts' codes on public blockchains. Platform operators also need to implement identity checks to ensure that unauthorized third parties cannot connect to the platform.

Therefore, the risk exposure of digital bond platforms can vary substantially, as illustrated by the examples below.

### **EIB €100 million digital bond — conversion option, long grace period, and comprehensive business continuity plan offset technology risk**

On 29 November 2022, the EIB issued a two-year €100 million digital bond in collaboration with [Goldman Sachs Bank Europe SE](#) (A1/A2 stable, baa1)<sup>14</sup>, [Banco Santander S.A.](#) (A2/A2 stable, baa1)<sup>15</sup>, and [Société Générale](#) (A1/A1 stable, baa2).<sup>16</sup> For the security leg, the digital bond was issued, recorded, and settled using Goldman Sachs' private permissioned DLT platform, GS DAP.<sup>17</sup> For the cash leg, tokenized representation of euro central bank money were issued and distributed on a separate and independently operated private permissioned DLT platform, jointly operated by the Banque de France and the Banque Centrale du Luxembourg.<sup>18</sup>

Goldman Sachs plays a pivotal role here: it provides and operates the security DLT platform, and but also acts as a registrar, custodian, makes payments, and handles reporting requirements, among other responsibilities. The EIB's option to cancel and exchange the bonds for conventional bonds in case of technical issues offset technology risk. Although the EIB has no obligation to exchange the bond in case of malfunction, we believe that the reputational risk that a default would create makes an exchange likely in this scenario.

The notes also have a 30-day grace period, which provides ample time to remedy technical difficulties. Additionally, Goldman Sachs has established a comprehensive business continuity plan that allows transferring the holding database to a third party, although this plan has not been tested under actual conditions.<sup>19</sup>

### **UBS's CHF375 million and Lugano's CHF100 million digital bonds — stringent regulations and dual listing support the instruments' credit quality**

On 3 November 2022 and 13 January 2023, UBS<sup>20</sup> and the City of Lugano<sup>21</sup> issued digital bonds on a platform managed by Six Digital Exchange (SDX), a subsidiary of SIX Swiss Exchange, Switzerland's leading stock exchange. The main differentiating feature of these issuances is that they are listed, traded, and settled on a regulated digital exchange (SDX) that also can be traded, settled, and cleared in a traditional settlement system (SIX). Digital bonds issued in this setup can live in both the digital and the traditional world, making them future-proof while keeping them accessible to traditional market players. Like Goldman Sachs, SDX uses a private permissioned blockchain and processes settlements against tokenized Swiss francs or euros on-chain.

Although SDX's exchange and CSD have a relatively limited track record, they are subject to stringent regulations requiring them to meet the same quality standards as traditional infrastructure, which is positive from a bondholder's point of view. These requirements include ensuring that there will be no data loss and that operations will be restored within a maximum of four hours in the event of a failover scenario. The FINMA, the Swiss regulator, asks for evidence that failover measures are working correctly. Although current procedures do not consider that the traditional infrastructure backs up SDX, we think the operational link could facilitate a transition in case of a catastrophic failure. In addition, the grace period provides enough time to remedy possible disruptions.

### **EIB's £50 million and Siemens' €60 million digital bonds — off-chain payment processing limits disruption risk**

In contrast to previous examples, the EIB and Siemens bonds process principal and interest payments off-chain, reducing cash flow disruption risks for investors. On 31 January 2023, the EIB issued its third digital bond on Orion, a platform managed by [HSBC Continental Europe](#) (A1/A1 stable, ba1).<sup>22</sup> As with its previous issuance, the EIB can exchange and cancel the bond in case of technical issues or theoretical default of HSBC, offsetting the difference in credit quality between the issuer and the platform operator. Orion is a private permissioned blockchain, like Goldman Sachs's platform, but HSBC also transfers holding information on Ethereum, a public blockchain, for information purposes. That said, there is no linkage between Ethereum and Orion.<sup>23</sup>

On 14 February, 2023, [Siemens Aktiengesellschaft](#) (A1 stable) issued a digital bond on a platform operated by Hauck Aufhäuser Lampe Privatbank, a German bank. The platform used a public blockchain. Risks associated with the Siemens digital bond were similar to those of its conventional bonds. Firstly, payments were processed outside the blockchain. Secondly, Hauck Aufhäuser Lampe Privatbank's operations are supervised by the German Federal Financial Supervisory Authority (BaFin). Thirdly, a 30-day grace period on principal and interest payments left enough time to remedy potential issues.

The bond was issued under the German Electronic Securities Act legislation for digitally native electronic securities passed in June 2021. Siemens sold its digital bond without involving banks or CSDs, illustrating the disintermediation potential of this technology.<sup>24</sup>

### **Creating a fully functional digital bond market will take time**

Integrating blockchain technology into regulated financial infrastructures is challenging, as demonstrated by the Australian Securities Exchange's (ASX) failure. In 2015, ASX initiated a project to improve its systems with DLT. However, the project faced numerous delays, and in November 2022, ASX terminated it over concerns about complexity and scalability. This abandonment resulted in ASX recording an AUD 245-255 million (\$164-171 million) charge.<sup>25</sup>

Creating the building blocks necessary to establish a fully functional primary and secondary DLT bond market will take time. For example, the lack of off-the-shelf DLT-compatible wholesale central bank digital currency prevents many digital bonds from processing payments on-chain. Although some central banks are experimenting with this technology<sup>26</sup>, these initiatives will not materialize for several years in most countries. In the meantime, market participants may use alternatives such as tokenized deposits or stablecoins, which would introduce credit risk related to the bank issuing the tokenized deposits or the stablecoin operator. However, the Swiss central bank announced in June 2023 it would launch a DLT-compatible wholesale central bank digital currency.<sup>27</sup> The Brazilian central bank launched a pilot wholesale CBDC in March 2023.<sup>28</sup>

Similarly, only a few jurisdictions, such as [Switzerland](#) (Aaa, stable), [Germany](#) (Aaa, stable), or [Luxembourg](#) (Aaa, stable), have set up regulatory frameworks enabling the issuance of digital bonds. The lack of custodians able to manage digital bonds is another hurdle<sup>29</sup>, although prominent actors like the [Bank of New York Mellon](#) (BNY Mellon, Aa1/A1 stable, a1)<sup>30</sup> are entering the field.<sup>31</sup>

Another factor slowing change is that startups struggle to enter the heavily regulated bond market. As a result, change needs to come from the incumbents instead, even though some may be disintermediated in the process. Furthermore, incumbents need to integrate digital bonds into their legacy processes, which takes time and money. This creates a chicken-and-egg situation in which legacy integration involves cost, which is only justifiable with a sufficient volume of issuance. However, without integration, there is no incentive to issue large volumes of bonds because issuance still involves multiple manual steps, so savings are not yet significant.<sup>32</sup>

In addition, market participants have developed platforms that are often incompatible. This is partly because of their reliance on private permissioned blockchains, which are not easily accessible to third parties. Although interoperability solutions between programming languages have emerged<sup>33</sup>, they are insufficient to connect existing systems. However, achieving interoperability between conventional exchanges requires time, new technologies<sup>34</sup>, and regulatory support.<sup>35</sup>

Finally, DLT is a new and complex technology that some investors find difficult to understand. For instance, some believe, incorrectly, that digital bonds suffer the same problems as cryptocurrencies, which have been subject to multiple scandals in recent years. Although DLT underpins both instruments, digital bonds are often developed by traditional market participants and are subject to much more scrutiny.



## Endnotes

- 1 See [SIFMA — Research Quarterly: Fixed Income – Issuance and Trading](#), 28 April 2023. Estimates may vary depending on the data provider.
- 2 A central bank digital currency (CBDC) is a digital liability of a central bank that can be used for payments. A wholesale CBDC is available only to eligible participants.
- 3 See, for instance, [Moody's — US: Stablecoin bill could bring regulatory clarity, but difficult negotiations lie ahead](#), 24 April 2023.
- 4 See [EIB — EIB issues its first ever digital bond on a public blockchain](#), 28 April 2021.
- 5 See [Moody's — Blockchain offers prospects for efficiencies, financial benefits in public finance](#), 22 March 2023.
- 6 See [IBM — Bank of Thailand Launches World's First Government Savings Bond on IBM Blockchain Technology](#), 5 October 2020.
- 7 Deposit and senior unsecured debt ratings and corresponding outlook followed by the BCA.
- 8 Email campaign between January and March 2023. 110 issuers were contacted, 29 responded. 90% of the respondents were rated at Baa3 and above. From a regional perspective, half were located in Europe, less than a third in America and the remainder in APAC and Africa.
- 9 agents are entities in charge of administrative functions. For instance, the paying agent distributes payments to the bondholders on behalf of the issuer
- 10 A central security depository (CSD) is an institution holding financial instruments and transferring ownership electronically by updating electronic records.
- 11 A clearing house acts as an intermediary between a buyer and seller that ensures that both parties honor their contractual obligations.
- 12 See [Refinitiv — Widespread capital markets retreat marks 2022](#), 20 January 2023.
- 13 A tokenized asset is a traditional asset converted into a token, which makes it storable and transferrable using blockchain technology.
- 14 Operating company deposit rating, parent holding company senior rating, and corresponding outlook, followed by the Baseline Credit Assessment (BCA).
- 15 Deposit and senior unsecured debt ratings and corresponding outlook followed by the BCA.
- 16 Deposit and senior unsecured debt ratings and corresponding outlook followed by the BCA.
- 17 A private permissioned DLT is controlled by a single entity and accessible with permission.
- 18 See [EIB — EIB innovates further with Project Venus, the first euro-denominated digital bond on a private blockchain](#), 29 November 2022.
- 19 See [Moody's - Moody's assigns Aaa rating to EIB's second digital bond](#), 29 November 2022.
- 20 See [UBS — UBS AG launches the world's first digital bond that is publicly traded and settled on both blockchain-based and traditional exchanges](#), 3 November 2022.
- 21 See [SDX — Benvenuta Lugano! The city of Lugano issues its first native digital bond on SDX with ZKB as Sole Lead Manager](#), 13 January 2023
- 22 Deposit and senior unsecured debt ratings and corresponding outlook followed by the BCA.
- 23 See [EIB — EIB issues its first ever digital bond in pound sterling](#), 31 January 2023, and [Moody's — Moody's assigns Aaa rating to EIB's third digital bond](#), 1 March 2023.
- 24 See [Siemens — Siemens issues first digital bond on blockchain](#), 14 February 2023.
- 25 See [Reuters — Australian stock exchange's blockchain failure burns market trust](#), 20 December 2022.]
- 26 See, for instance, [ECB — Eurosystem to explore new technologies for wholesale central bank money settlement](#), 28 April 2023, and [Federal Reserve Bank of New York — New York Fed Announces Phase I Results of the New York Innovation Center's Project Cedar](#), 4 November 2022.
- 27 See [Reuters - SNB to launch digital currency pilot](#), 26 June 2023.
- 28 See [Moody's - Pilot framework for Brazil's digital currency limits disintermediation risks](#), 8 March 2023.
- 29 See [Ledger Insights — EIB: What needs to happen for tokenized bonds to get traction?](#), 12 May 2023.
- 30 Operating company deposit rating, parent holding company senior rating, and corresponding outlook, followed by the Baseline Credit Assessment (BCA).
- 31 See [BNY Mellon — BNY Mellon Launches New Digital Asset Custody Platform](#), 11 October 2022.
- 32 See [Ledger Insights — Germany's 2nd largest bank DZ to launch crypto custody. Wants a wholesale digital euro](#), 4 October 2022.
- 33 See [Ledger Insights — Goldman, Deutsche Börse, 30 firms join Canton Network for institutional blockchain interoperability](#), 9 May 2023
- 34 Such as the [Financial Information eXchange \(FIX\)](#) protocol, which facilitates the real-time exchange of information related to securities transactions and markets.
- 35 For instance, the EU's MiFID II directive requires trading venues and central counterparties (CCPs) to provide non-discriminatory access to one another. See [European Commission — Markets in Financial Instruments Directive \(MiFID II\): Frequently Asked Questions](#), 14 April 2014.



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