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Structured Finance Industry Group

CHAMBER OF DIGITAL COMMERCE

Applying blockchain in securitization: opportunities for reinvention

Deloitte.

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Chapter One:
Why blockchain?

> "Blockchain Will Become the 'Beating Heart' of the Global Financial System."
>
> — World Economic Forum[1]

The global financial system is betting on blockchain to revolutionize many aspects of its business, and we (the Structured Finance Industry Group and the Chamber of Digital Commerce) believe that securitization is one of the areas in the capital markets that could most benefit from this transformation. Janet Yellen, Chair of the Board of Governors of the Federal Reserve System, recently called blockchain "a very important new technology" that "could make a big difference to the way in which transactions are cleared and settled in the global economy."[2] Financial services institutions have already invested over a billion dollars in the technology, with most big banks likely to have initiated blockchain projects by the end of 2017.[3] There are already hundreds of use cases, ranging from international payments to securities processing, while technology firms including Amazon, Google, and IBM are offering a host of blockchain services aimed at the financial industry.[4]

Why are all of these companies investing in blockchain? This new technology has the potential to dramatically disrupt the role of intermediaries—including that of banks—in financial transactions. Traditional activities performed by intermediaries might be changed or even replaced. Blockchain can also bring significant advances in efficiency, security, and transparency to many of the financial sector's activities. In the appendix, we look in more detail at some of the recent developments and use cases in the financial industry that extend beyond securitization, but, for now, the following example may help explain this technology's potential.

Imagine being able to send money to a friend in a different country without ever having to use a financial institution or any other third party to transfer or convert currencies. Imagine too that you and your friend will then have a reliable, traceable, and immutable record of the transaction. Finally, imagine the ability to not only transfer currency without using any intermediary, but also to execute the most complex financial transactions more quickly, safely, and cheaply than current systems permit. Such is the future that blockchain offers.

This scenario of near-complete disintermediation may seem distant, but the technology is advancing quickly. The Internet showed that new technology can move with surprising speed from the realm of specialists to everyday users. Not too long ago, transferring files and making purchases over the Internet was thought risky, and creating interactive web pages was enormously expensive. Now this technology is user friendly, inexpensive, and ubiquitous. Consider how often most people shop or bank online. Consider how easy these transactions are to execute, and how much confidence we have in their results. Then consider how little time has passed since such transactions were rare.

Blockchain, sometimes called Internet 2.0 or the Internet of Value, may follow this trajectory and quickly become a seamless part of the global financial system and economy. Even though a new technology's potential is not always realized, and it is rarely realized exactly as its first proponents predict, the magnitude of blockchain's potential makes it important for the financial world in general—and the securitization industry in particular—to proactively consider the challenges and opportunities that this technology will likely create.

The Structured Finance Industry Group and the Chamber of Digital Commerce commissioned Deloitte & Touche LLP (Deloitte) to explore how blockchain might reinvent securitization—and how the securitization industry should consider preparing for this rapidly approaching future. This industry is exploring this nascent technology's potential benefits and costs. Firm answers on blockchain's likely use cases are not yet available, but discussions with securitization and blockchain experts have led to some key observations and insights about implications and possible paths forward.

One thing is clear: Blockchain and smart contracts could catapult the securitization industry into a new digital age.

The technology's potential to streamline processes, lower costs, increase the speed of transactions, enhance transparency, and fortify security could impact all participants in the securitization lifecycle—from originators, sponsors/issuers, and servicers to rating agencies, trustees, investors, and even regulators. Such is this paper's premise.

In later chapters, we will explore how blockchain and smart contracts might be applied to the securitization lifecycle, but we will first take a closer look at what blockchain is. Even if you are already familiar with blockchain, we encourage you to at least skim the next chapter, which will be fundamental for our later arguments.

Chapter Two:
Blockchain basics

Blockchain is a distributed ledger that records digital transactions in a secure, transparent, immutable, and auditable way, without necessarily using a trusted intermediary to perform these transactions. The technology of blockchain is evolving quickly, and there are many variations among blockchains, but all share some fundamental characteristics, including the following:

Digital distribution/disintermediation. A blockchain distributes data recording and transaction execution across the different computers, called "nodes," that participate in a given network. It is not necessary for a central authority (such as a central bank or clearinghouse) to act as an intermediary or as a repository of data.

Cryptography. Blockchain uses highly sophisticated cryptography—mathematical techniques and algorithms to securely store, transmit, and process information—to ensure the reliability of data and transactions across the different nodes. Cryptography, which the military has long used for secure transmission[5], makes it possible to solve data access and privacy issues in blockchain, where information is shared among network participants by design.

Consensus. Blockchain requires some or all of its nodes (depending on how the blockchain is designed) to reach a consensus to validate information and accept new transactions. This consensus process or mechanism, which varies among different blockchains, eliminates the need for a central authority to confirm and maintain a ledger of all transactions.

Immutability. Blockchain bundles transactions into "blocks." Each block contains the previous block's "hash" or digital signature, so each block is linked to the prior one, and together they interlock to form a chain. It is therefore extremely difficult—and for practical purposes impossible—to change one block without changing all the others that followed it. Each block and the data it contains are essentially immutable. The Bitcoin blockchain, for example, has worked since 2009 without any outside changes to blocks after they have been created. This immutability is one of blockchain's most unique and powerful properties, helping to create the trust necessary for different parties to conduct business safely over the Internet.

Time-stamps. Blockchain time-stamps every new transaction or data entry. These digital time-stamps on the front of the block (the block header) make it easy to track and verify information.

Resilience. A distributed database by its nature is more resistant to accidental failures or malicious attacks than a centralized system. If one or more nodes on a blockchain fail or are hacked, the rest of the system can still function reliably. In a centralized (non-blockchain) system, if a single server and its backup go down, the whole system may fail.

Security. The above characteristics all increase security. With data distributed among blockchain participants, a hacker can only corrupt a blockchain if he seizes a majority of nodes—a tougher task than attacking a single, central server. Encryption and multi-step verification procedures add protection, as do time-stamped transactions, data that cannot be altered without leaving a record, and the need for consensus to accept transactions. Most instances of security breaches of blockchains have exploited poorly-designed applications on the blockchain, not the blockchain structure itself.

Security and blockchain

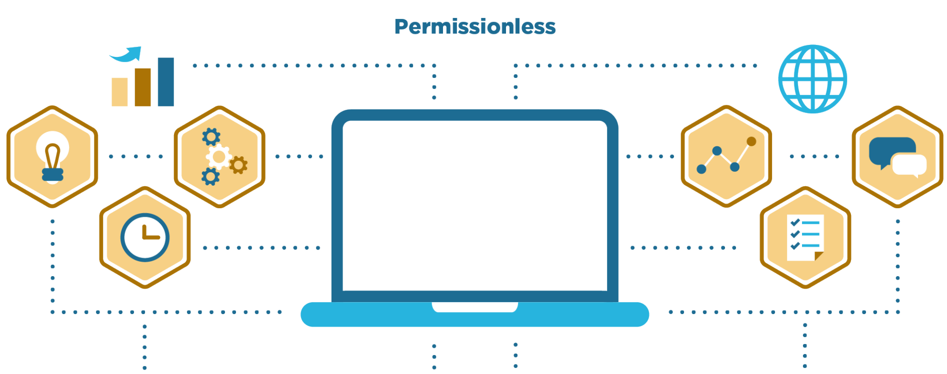
The issue of security has become an increasingly important topic in the digital world. There have been some well-publicized security breaches related to blockchain applications, including Bitcoin, but these breaches have involved human error, not a systemic deficiency of blockchain. In some cases, such as The DAO (distributed autonomous organization) attack, poorly coded smart contracts were to blame.[6] In other cases, such as Mt. Gox and Bitfinex, Bitcoin users chose to entrust their private security keys (a highly sophisticated kind of password based on cryptography) to a third-party provider that failed to secure them. An analogy could be made to bank ATM machines: If a user fails to safeguard his or her card and PIN number (perhaps entrusting them to a third party who lets others see the PIN number and access the card), it is not the ATM technology that is at fault for the subsequent security breach.

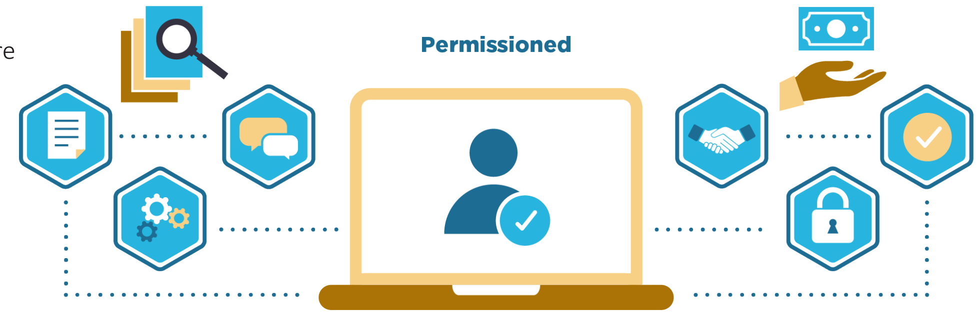
Two types of blockchain

Although blockchains share many common characteristics, it is useful to categorize them into two types: "permissionless" and "permissioned."[7]

Permissionless blockchains (also called *public blockchains*) are open to anyone in the world to read, write transactions to, and participate in the consensus process. Permissionless blockchains have several advantages. Entry costs for new participants are minimal, and since no participant or group of participants has exclusive control over a permissionless blockchain, disintermediation is close to complete. Since permissionless blockchains are designed to be open to all participants, they can easily grow across industries, allowing them to settle a broad range of transactions. These advantages have allowed one permissionless blockchain (e.g., Bitcoin) to rapidly gain millions of users.

However, permissionless blockchains have limits on their potential uses in financial services. They tend to be relatively slow. Bitcoin, for example, can only execute a theoretical maximum of seven transactions per second,[8] and in practice only functions at about half that speed.[9] The number of transactions and the amount of data contained in a transaction are also potentially not scalable in permissionless blockchains. Permissionless blockchains, because they are designed for heightened data transparency, also have limited ways to provide data privacy. These limitations are serious problems for most financial services applications, including securitization, where participants in a transaction may wish to keep information about it hidden from others.





Permissioned blockchains (also called *consortium* or *private blockchains*) have more applicability for financial services. With permissioned blockchains, a single administrator or a consortium administers the system, vetting participating parties and deciding the criteria for validating and recording information and transactions. Permissioned blockchains generally only permit consortium members to access information and transaction history, although outsiders can sometimes make limited inquiries. To verify data and transactions, a subset of the nodes—depending on the blockchain, either i) a majority of the blockchain, ii) a majority of a particular segment of the blockchain, or iii) only the transaction's counterparties—reach a consensus based on pre-defined criteria. Participants in the consortium can agree to change the criteria for verifying and recording transactions.

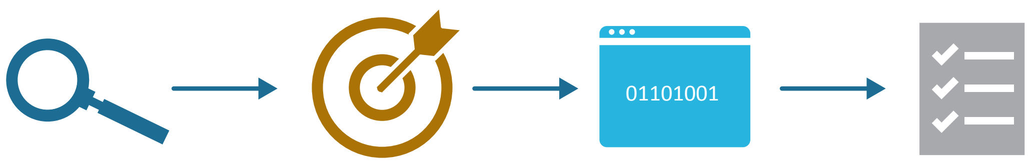
There are many reasons to prefer permissioned over permissionless blockchains for financial services. These reasons include the ability to keep certain information and transactions private, with different levels of access for different parties; faster transactions and the ability to scale up transactions and data; and the ability to modify the structure if members agree. The option of different levels of permitted access is particularly appealing for securitization, where participants may want to take advantage of how a permissioned blockchain could allow them to reveal certain data to some parties and hide it from others. A securitization blockchain could be designed, for example, to permit an originator to hide proprietary data and methodologies from competitors who may be on the same blockchain, reveal selected parts of this data to a targeted subgroup of investors, and offer full access to regulators. To give an even more specific example, to demonstrate that Qualified Mortgage loans were made in accordance with Ability-to-Repay rules, lenders could grant regulators access to the underlying factors that went into determining the borrower's ability to repay, without sharing this information with the rest of the nodes on a blockchain.

Given their advantages for securitization, in the body of this paper we will exclusively discuss permissioned blockchains.

Smart contracts—automated transactions on a blockchain

Many blockchains are also taking advantage of "smart contracts." In 1996, the computer scientist and legal scholar Nick Szabo described a smart contract as "a set of promises, specified in digital form, including protocols within which the parties perform on these promises."[10] A simpler way of looking at a smart contract is as an "if, then" statement; if a condition is met, then a result is executed. Mr. Szabo uses a vending machine as a pre-digital example: If currency is inserted, then a product is automatically released.[11]

Figure 1: How smart contracts work



Identify terms and conditions	Define external sources or systems	Code the contract and record it on the blockchain	Self-execution when the defined conditions are met
The different parties agree on the terms of the transaction, the conditions, and the desired outcome. These conditions may be derived from existing legal agreements or templates.	Some smart contracts require access to data sources outside of blockchain to function or to verify if the agreed upon conditions are met.	A computer program is written to produce a desired outcome when conditions are met. The code is placed on the blockchain where it cannot be modified without agreement of the relevant parties.	The computer program self-executes when the agreed upon conditions are met. The outcome is recorded on the blockchain, which creates an immutable audit trail.
Example: a securitization waterfall.	Example: LIBOR on floating rate notes.	Example: the waterfall tie-out process between accountants and banks.	Example: the distribution of payments to investors based on waterfall rules.

Source: Deloitte Development LLC, 2017

Once participants agree to terms, conditions, and outcomes, the smart contract is coded and recorded on a distributed ledger (see Figure 1). The code typically contains references to external data sources that the smart contract needs to work. Once a smart contract is recorded, it cannot be modified without the participating parties' permission. This last characteristic ensures that a smart contract will always produce the desired outcome when agreed-upon conditions are met, but it also makes it hard to modify a contract if circumstances change or a programming error is found.[12] Current smart contract development efforts are mostly focused on these three areas:

1. **Security:** Developers are aiming to ensure that only participants with the right permission status can view or modify smart contracts.
2. **Accessibility:** Smart contract technology is becoming more seamless and standardized, to make it more accessible to users who are not IT experts.
3. **Legal certainty:** Even though smart contract proponents recognize the inherent enforceability of code-based contracts, more judicial decisions will be needed to give parties greater certainty.

Some securitization transactions today, in which investor reporting and the generation of wire transfer instructions are coded based off the interpretation of the underlying documents, have already taken an important step in the direction of smart contracts, though these transactions are not (yet) on a blockchain.

How can blockchain and smart contracts benefit securitization?

We will explore in detail how potential benefits could play out at the different stages of the securitization lifecycle, but for now, here are some common themes to keep in mind:

One version of the truth. Blockchain enables a single, consistent source of information for all participants in the network. In an industry that currently faces inefficiencies around the storage, reconciliation, transfer, and transparency of data across multiple independent entities, this feature could be highly beneficial.

A complete, immutable, and traceable audit trail. From loan origination to primary issuance, servicing, and changes in ownership in the secondary market, blockchain can create a chronological and immutable audit trail of all transactions. With this capability, regulators and auditors could finally get a systemic view of the ownership of the underlying securitized assets. An issue that troubled the industry during the global financial crisis—determining who owned the title to some underlying assets—could be more easily resolved.

Better valuation and price discovery. The transparency facilitated by blockchain could reduce the information asymmetry and network disadvantages that some entities, especially smaller ones, currently face in the securitization industry. The resulting market efficiency could raise the investment appeal of securitized assets and deepen the potential pool of investors.

Speed and certainty. Blockchain, through its disintermediation and simultaneous recording of information across the system, can virtually eliminate time lags in information and payment flows throughout the securitization process, including in the secondary market. This increase in speed and certainty could significantly reduce counterparty risk, release capital, and reduce the return thresholds that investors demand.

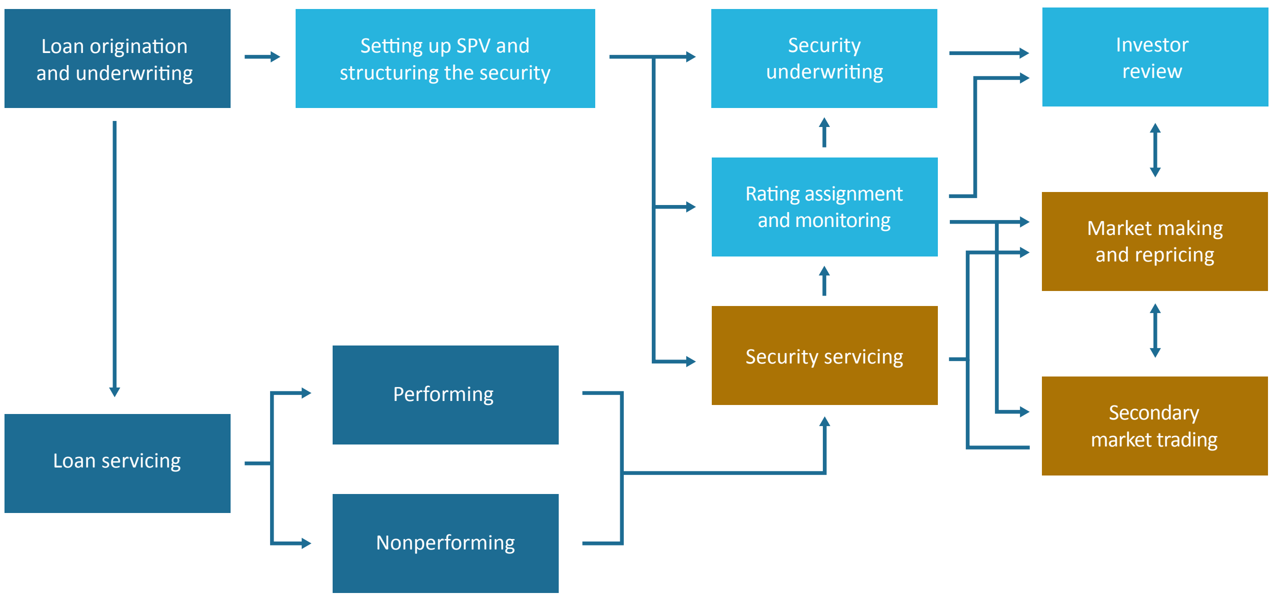
Security. Blockchain's capacity to increase the security of transactions and data, and mitigate fraud could be appealing to the securitization industry, where integrity of data is paramount. Blockchain's immutable audit trail, for example, could permit every asset (and every transaction involving that asset) to be linked to a particular security, facilitating asset perfection and eliminating the risk of double-pledging assets.

The combined impact of all the above advantages—greater efficiency, speed, transparency, and safety for data and transactions—could lower risks in the securitization market as a whole and lead to greater investor interest. This in turn could improve prices, volume, and spreads. With better and more transparent information, regulatory compliance could also be simplified and market failures could become less likely.

With these general points in mind, we will now take a more detailed look at the specific places where blockchain could impact the securitization process, ranging from loan origination and loan servicing through the structuring, review, and initial sale of the security, to the servicing of the security, ongoing ratings monitoring, and secondary market trading. At each stage, we will look at some inefficiencies in the current process, then explore how blockchain is likely to change how the industry handles certain questions around its core functions and obligations, including data recording and dissemination, transaction execution, receiving and making payments, and regulatory compliance.

We will also look at why, despite the likely advantages, implementing a blockchain in the securitization industry may be challenging. We will conclude with a vision of a possible future state and with ideas about possible next steps.

Figure 2: Simplified securitization lifecycle



Source: Deloitte Development LLC, 2017 and Structured Finance Industry Group, Inc.

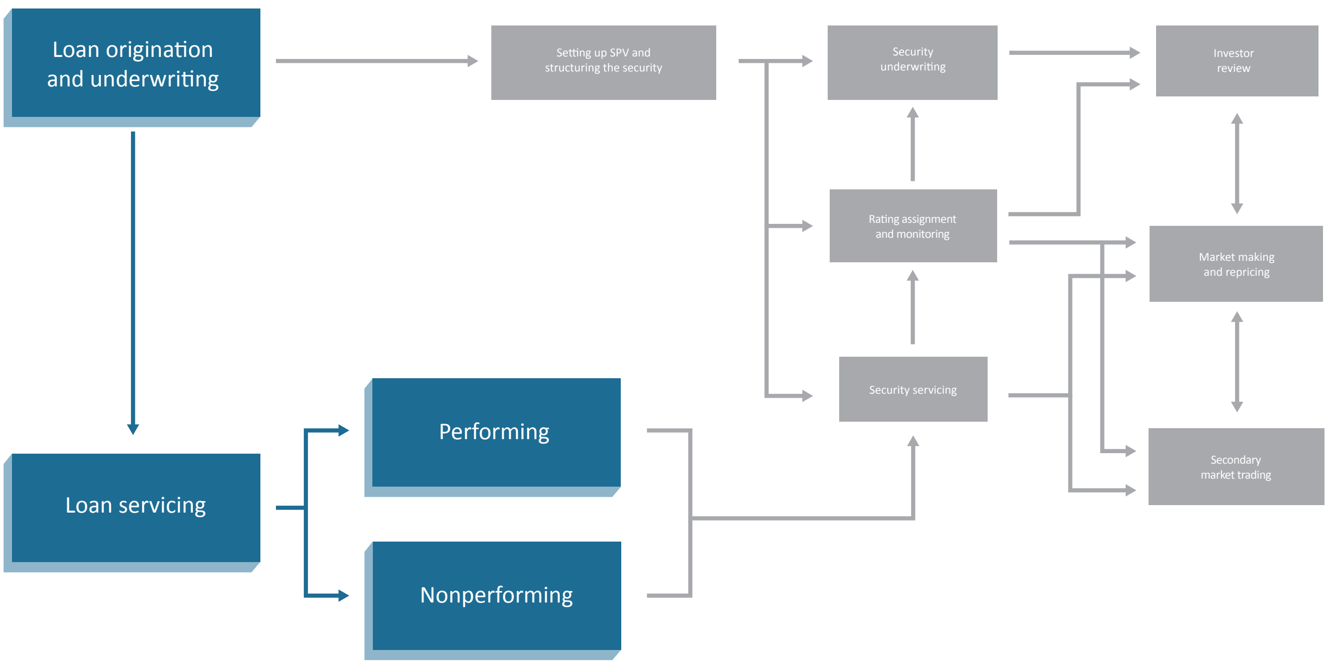
The current securitization lifecycle

Before we go into detail on how blockchain may change the securitization lifecycle, a brief high-level review (Figure 2) may be helpful. It begins with originating and underwriting loans, which are then serviced regularly, similar to traditional bank lending. An issuer or originator pools together many loans, places them in a bankruptcy-remote trust or special purpose vehicle (SPV), and structures the securities. An auditing firm reviews the pool and provides a pool audit letter and an agreed-upon procedures letter covering the pool statistics provided to investors. Rating agencies may be asked to express an opinion on the securities' credit-worthiness by providing a credit rating. Underwriters work with counsel and the transaction sponsor to prepare an offering document containing pool and transaction disclosure.

The underwriters then price and bring the securities to market, where investors make purchases based on their risk-reward preferences. Trustees manage the trust entity and represent investor interests. A servicer collects borrower repayments, pools them, and forwards them to a trustee, who allocates distributions to security holders based on the payments waterfall defined in the transaction documents. Rating agencies monitor the securities' performance and update ratings if needed. In secondary markets, investors continue to review and reassess the securities based on performance. Broker-dealers make markets among investors trading the securities and establish new prices.

Chapter Three:

Loan origination, underwriting, and servicing



Data needs, servicing requirements, and costs

While loan origination and securitization have rebounded since the financial crisis, many inefficiencies persist throughout the securitization lifecycle, adding to time lags, costs, and opacity. Home mortgages, for example, take an average of 50 days to close.[13] In all asset classes, basic loan underwriting data (such as a loan's contractual terms, borrower credit profiles, and collateral information) is rarely standardized and sometimes not centralized even within the originating institution. Some originators still do most of their work on paper, and even digitally-savvy ones are sometimes obliged to use certain paper documents, such as appraisals, broker price opinions, and deeds.

Lenders use different formats to record data, and digital records are often just scanned copies of paper contracts. These records reside in servers, data warehouses, and government offices scattered across the country. Separate storage provides extra security for proprietary data, but it increases the difficulty of access or reconciliation and raises the likelihood of inconsistencies among sponsors/issuers, underwriters, investors, regulators, and rating agencies. This information asymmetry reduces market efficiency.

Accessing and reconciling data is costly, but regulators are demanding increasingly more data from loan originators. Regulation AB II added loan-level disclosure requirements not just for residential and commercial mortgages, but also for automobile loans. Since 2014, the Consumer Financial Protection Bureau (CFPB) requires lenders making Qualified Mortgage loans to make a good-faith determination that borrowers will have the ability to repay (ATR) the loans. The ATR rules require residential mortgage lenders to consider and verify a number of data points, such as a borrower's assets or income, debt load, and credit history.[14]

Commercial mortgages have heterogeneous qualities that usually keep originators from standardizing promissory notes, loan agreements, and deeds of trust, resulting in high due diligence needs and costs. Since it is the property cash flow (and not the borrower's income) that provides cash flow on commercial mortgage loans, underwriting requires reviewing a significant amount of property data, both on the income and the expense side. Among other requirements, commercial mortgage servicers have to report certified rent rolls, operating statements, budgets, and lease updates, but many borrowers lack reporting systems that can easily provide this data.

All these inefficiencies in origination naturally limit the extent of automation possible in loan servicing. Reliance on manual intervention for reconciliation and updates not only creates costs, but also increases the likelihood of errors. Each error is now more costly as regulators have increased scrutiny of servicers in recent years. Between 2008 and 2013, for example, the cost of servicing a performing residential mortgage loan increased 264 percent, and the cost of servicing a non-performing loan rose 489 percent.[15] Compliance costs for mortgage loan servicers could continue to rise, as the CFPB at the end of 2016 amended its previous servicing rule with a 900-page final rule that added several new obligations, including a requirement to provide periodic statements to borrowers in bankruptcy.[16]

In other asset classes too, the pressure for better and timelier data is growing. In student loans, the CFPB is calling for market-wide reforms to improve the servicing market and provide more timely information to borrowers. The current process of providing up-to-date loan information to student loan borrowers and co-signers, including notices of missed payments and the associated accrued fees and penalties, suffers time lags. Such delays can be especially significant after loans have been transferred from one servicer to another, in part due to difficulties in reconciling data, and the CFPB wants these delays reduced.[17]

Across all asset classes, loan origination and servicing may well be functioning smoothly, but costs are high and pressures are growing.

Easy access to better data and greater automation

Blockchain and smart contracts could create seamless integration among the various securitization functions. If this technology were effectively deployed at the stage of loan origination and servicing, structural gains in efficiencies through the whole lifecycle would become possible.

Imagine the following scenario: A borrower and lender agree to the terms of a loan agreement on a digital screen and provide representations about the accuracy of the related information, including the repayment schedule, credit scores, income verification, and tax records. Once they digitally seal their agreement, this digitally originated loan (or a token representing it) is placed on a distributed ledger (i.e., the blockchain.) Next, a bank is designated the (temporary) owner of the loan. The appropriate information needed for servicing is automatically entered into a smart contract and other ecosystem partners such as credit bureaus and the county records office are notified.

The newly-created loan file contains important underwriting information including (for example) the borrower's FICO score (for individuals) or credit ratings (for organizations) at the time of origination, debt-to-income ratio, and documents presented for underwriting such as W-2s, bank statements, tax records, or balance sheets, as well as pertinent information on underlying collateral values. (Note: special measures will be needed to protect personally identifiable information (PII) and only permit parties with the appropriate permission to access it.) As the borrower begins to make payments on the loan, the track record of payments is also attached to the loan token, making payments reconciliation frictionless.

All of these data points, once placed on the blockchain, become immutable and are time-stamped within a verifiable audit trail. This immutability could vastly reduce the downstream costs of due diligence. There might no longer be a need to consult different data silos for different pieces of relevant underwriting and servicing information. Additionally, since data on a blockchain is traceable through an indelible audit trail, the risk of information loss or of an alteration that does not leave a record would be minimal.

To continue with our (for now) imaginary scenario, let us imagine that our borrower misses one or more payments. In response, the smart contract implemented by the servicer of the loan automatically sends out notices to the borrower, the owner of the loan (who by now could be different from the originator), and the credit bureaus. If the delinquency persists, the smart contract automatically engages a special default servicer who takes over the recovery process. If any loan adjustments are made, the loan token is updated appropriately with representations by the borrower. Should repossession and resale be necessary, the cash proceeds from the transaction are relayed through the smart contract to the appropriate beneficiary.

In the case of auto loans, the default process could be even more automated. After a previously specified number of consecutive missed payments, a smart contract could automatically transfer title, electronically shut off the car, and—if self-driving cars become a reality—direct the car to drive itself to a location designated by the servicer. For this scenario, integration with the legal system would prove challenging, but the necessary technology already exists.

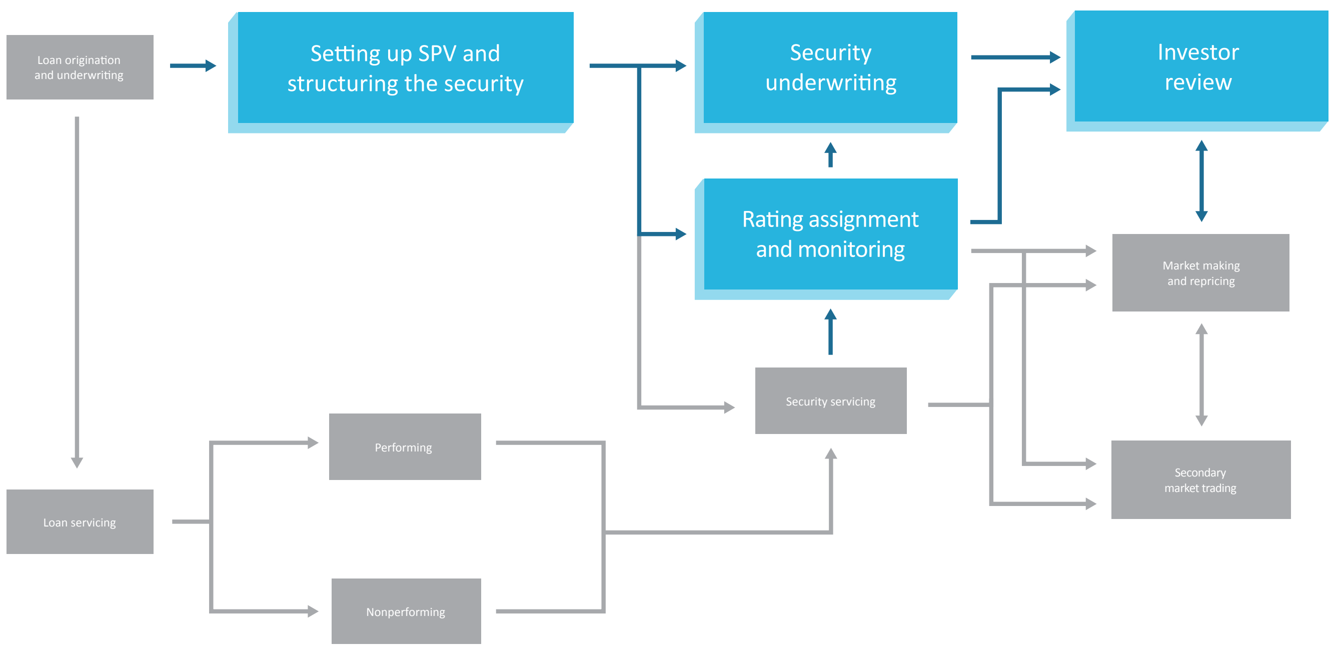
For all asset classes, a key advantage of blockchain in loan origination and servicing is that downstream participants, such as investors, could easily follow a loan or pool of loans from issuance through maturity, be alerted to any modifications, and—if desired—easily model servicing behavior. The audit trail, by making any change easily visible and traceable, could reduce the chance of fraudulent modifications. Loan and pool-level data would become not just more complete and easy to access, but more reliable too. This faster and easier access to more reliable loan-level data could potentially increase the number of loans that originators can sell. Some loans that might previously have fallen out of the pool due to a lack of loan-level data, or to concerns about the accuracy of this data, might now be appealing to purchasers.

The benefits of superior quality data for regulatory compliance could be just as important. With loan-level data entered into a blockchain at origination and automatically updated, as described above, compliance reporting for Regulation AB II would be much simpler.

All of these advantages to loan origination and servicing are appealing, and they are not limited to securitization. They could also benefit origination, servicing, and eventually whole loan trading. However blockchain can specifically benefit the structuring of loans into securities, and our next chapter will examine how.

Chapter Four:

Structuring the security



Old inefficiencies and new burdens

Structuring securities is a complex process that involves a great duplication of efforts. For example, as the attorneys write the offering document, trustees, servicers, accountants, rating agencies, underwriters, and investors (or outside vendors on their behalf) create their own, independent models to calculate the waterfall of payments for the upcoming securitization transaction. These models may not be in alignment with each other, as different parties may interpret the terms of the transaction differently, use different software systems to implement them, or focus on unique aspects of the transaction, depending on each participant's needs. Therefore a trustee's model, for example, which will be used to calculate payment distributions, may differ from the rating agency's model or the model on which investors run their analytics. Moreover, since these models are typically created simultaneously with the offering document, they frequently require revision when the document is finalized.

Great efforts are also needed to protect against the risks of fraud. Double-pledging of assets, and the pledging of non-existent assets, was revealed to be a problem during the global financial crisis, when they contributed to failure of a major non-bank mortgage lender and a major regional bank[18]. Today lengthy and costly due diligence efforts are performed to reduce the risk of such problems occurring again.

Regulatory scrutiny also adds complexity and costs to the structuring process. Regulation AB II has raised due diligence and reporting obligations for issuers of publicly-offered asset backed securities in many key asset classes, including residential mortgage-backed securities (RMBS), commercial mortgage-backed securities (CMBS), and auto loans and leases.[19] Among other changes, the law now requires a single, integrated prospectus. It requires asset-level disclosures at the time of the offering for both the preliminary prospectus and the final prospectus, and for ongoing reporting on Form 10-D. It also requires the chief executive officer of the depositor entity to certify personally the securitization's documents and asset quality.[20]

SEC regulations based on Section 941 of the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010[21] (Dodd-Frank Act) also now require issuers to retain at least five percent of the credit risk of the assets in the securitization.[22] For issuers that are part of systematically important financial institutions (SIFIs), which face higher capital and liquidity requirements and heightened scrutiny, the combination of risk retention rules and these requirements may further complicate their securitization efforts. Other entities in the securitization process have also had to grapple with new regulatory requirements. For instance, Rule 17g-5 has imposed additional disclosure and conflict of interest requirements on rating agencies to counter the potential for "ratings shopping."

Despite these issues, and the inefficiencies that they may often create, the current process is working, as the growth and stability of the post-crisis securitization industry demonstrates.[23] However, blockchain's ability to streamline the origination and servicing of underlying loans and to create an environment where sharing information is simple and all changes leave an immutable audit trail could facilitate every aspect of structuring the security. It could create a single source of truth, which all participants could use for analysis and forecasts.

Faster, easier, and safer

If loan origination and initial servicing has taken place on blockchain, then when the structuring process begins, the securitization trust could have seamless access to information about the available pool of underlying assets, with each asset's modifications and payment history permanently linked to it. During structuring, a smart contract could be used to monitor new assets and automatically flag loans for consideration that meet predefined criteria, and each loan that is transferred into the securitization trust would be tagged. This tag or token, immutably linked to the loan on the blockchain, could prevent the loan from being assigned to another security, thus making the double-pledging of collateral impossible.

As the different parties finalize the securitization transaction's details, including the underlying collateral, tranches, and payment distributions, these terms would be modeled as smart contracts. All parties would approve this model before it is recorded on the blockchain. This consensus could eliminate the duplication of efforts and the potential misalignment among different parties' models. In other words, each securitization transaction could have a single "governing" model or version of the truth on the blockchain.

Trustees could use this model to automatically track loan-level payments, calculate and make distributions to investors and generate investor reports. The other participants including rating agencies, servicers, regulators, and investors, could also have access to the model, which they could use to run their own independent analytics. Investors, for example, could reference the model to run more complex cash-flow prediction forecasts using customized scenarios, with their proprietary data and strategies protected. Rating agencies, as a result of this single model and seamless access to the underlying data, would potentially be able to devote fewer resources to duplicating earlier due diligence. They could instead increase their focus on those areas where they add most value: their ratings methodologies and criteria and their analytical skills. The time needed for rating-agency review would likely decrease, especially if rating agencies placed software on the blockchain to automatically provide a preliminary assessment of securitization transactions.

Regulatory compliance could also become easier, as blockchain could automatically share and analyze data in line with regulatory requirements. Underlying loans, for example, could be easily and automatically matched against the securitization's proposed structure. While investors and regulators would likely still demand the CEO certification to build accountability, their ability to audit loan-level information (and perhaps even the original documents) and more precisely model the securities' behavior could dramatically increase transparency. With this transparency on assets and price discovery, it could also be far easier to create tranche structures that match issuers' risk retention and other regulatory requirements. Those issuers who currently hold far more than the required five percent of the security assets might be able to hold closer to five percent, if they choose.

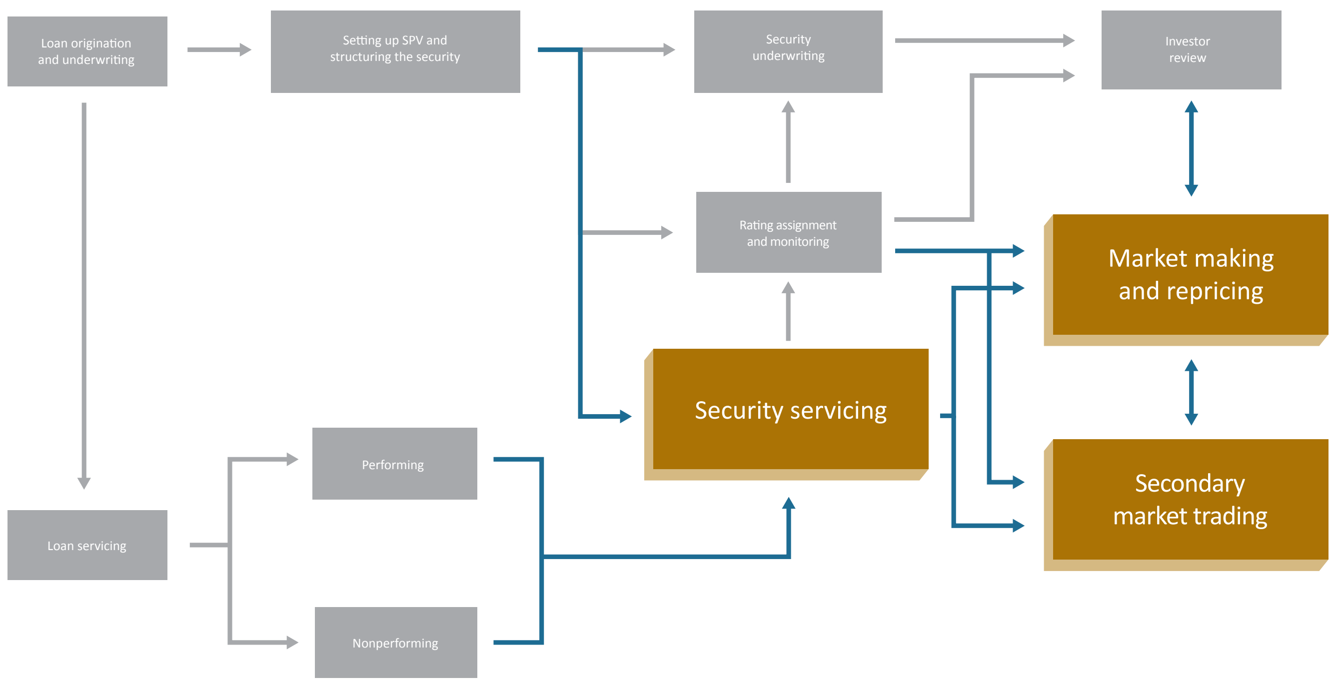
These advantages could lead to easier, faster, and more transparent selection of loans from a wider pool. Sponsors/issuers could pool loans more frequently and bring more securitizations to market, adding transparency and liquidity to the capital markets. They could also potentially offer securities (micro-structuring) tailored to investors' unique needs.

Even the printing and execution of legal documents could become more streamlined and efficient. Some legal documents, such as offering documents, could be continuously updated with current collateral information through the use of smart contracts. Smart contracts for payment rules could be stored on the blockchain, where they would reflect any changes to the model made during the structuring process.

With the security structured to use smart contracts on a blockchain, costs would fall, speed would rise, and inconsistencies and errors would be reduced.

Chapter Five:

Servicing and trading the security



Security servicing: costs, responsibilities and risks

Participants involved after the transaction is concluded in the primary market—servicers, trustees, rating agencies, broker-dealers, and investors—currently incur a multitude of due diligence and research costs due to the data limitations and absence of a single source of truth described in the above chapters. These costs and inefficiencies carry into the regulatory reporting and compliance processes as well. Due to time lags, investors and rating agencies frequently have to make decisions based on imperfect and out-of-date information, while loan servicers may be able to provide trustees complete information only after payments have been made to investors.

All of these costs and delays may not be large for individual entities, but they are meaningful for the securitization industry in aggregate. Currently low default rates in most private-market asset classes may also be masking the eventual costs of imperfect and late information. For example, should another downturn occur, with rising defaults and volatile portfolio performance, servicers may have to look at tens of thousands of individual loans, stored in multiple locations and formats, as they seek to monitor and resolve defaults for residential mortgages. In such situations, trustees may also have to devote resources to hiring special servicers, engaging third parties to audit or enforce issuers' representations and warranties, and managing investor concerns. Should the market downturn be severe enough, information delays for investors could contribute to a wider loss of confidence in asset quality and reduce market liquidity for all asset classes. Even in calm markets, legal risk has grown for servicers,[24,25] trustees[26], and rating agencies[27] in the wake of the financial crisis. As a result, all parties have been increasing their efforts to monitor originator compliance and loan performance. Their need to have faster access to better data is growing.

Cash reconciliation currently also requires time and effort, since the payments process is separate from the flow of information. Traditional payments systems, while highly reliable, have settlement delays, which require participants to incur additional capital and liquidity costs. Investors often receive distributions only several weeks after borrowers have made their payments on the underlying collateral.

Security servicing is functioning smoothly within the confines of the current system, but there is room for the process to work faster and to be more cost efficient.

More automation, lower costs, and greater reliability

Building on the potential of blockchain in earlier stages of the securitization process, security servicing activity could be materially streamlined, while the integration of cash flows and information through a blockchain-based system could lead to a structural increase in efficiencies. Smart contracts applications would once again be critical in achieving these gains. Smart contracts that form part of the transaction documentation could collect the stream of payments emanating from loan servicing activity. These smart contracts could reference the consensus-verified payments waterfall model specified in the trust, channel cash flows to each security's beneficiary investors, and automate many fiduciary and regulatory functions inherent to the security servicing process.

The use of blockchain to gather and distribute both information and payments could greatly reduce or even remove the need for parallel reconciliation processes in the entire securitization ecosystem. Information related to the pooled payments, such as the break-out of regular payments, pre-payments, defaults, and recoveries, could be immediately tagged to the securities that the trust created. Investors and rating agencies could thus easily gain access to underlying loan-level information, with PII removed to satisfy privacy and regulatory concerns, and also to security-level information. Where some backup reconciliation may be performed as a safeguard, with so much activity streamlined and automated, time lags could decrease and investors might receive their distributions within days, rather than weeks. With an immutable audit trail, which the appropriate parties would have permission to access, it would also be possible to verify the security's current and past behavior at nearly any level of granularity.

If data is standardized across issuers, blockchain could let investors monitor whole asset classes with consistency. Even if issuers chose to report certain data elements on non-industry-standardized basis, the availability of each component of that data on the blockchain could allow investors to adjust all issuers' numbers to a consistent basis of calculation.

Rating agencies and regulators could be given access to this entire audit trail, permitting the rating agencies to monitor rated securities more quickly and efficiently and facilitating regulatory compliance. Rating agencies could also place their own monitoring software on a blockchain-based platform. Rating agencies' smart contract software could function in different ways, depending on how data access among participants is determined, but in all cases it could perform important functions. This software could, for example, trigger automatic ratings reviews when cash-flow patterns deviate sufficiently from expectations, or alert rating agencies about relevant macroeconomic factors, such as when the unemployment rate in a region to which a security is heavily exposed rises above a certain level.

It is important to note that this rather utopian system would require several new levels of verification. For a start, loan-level data would have to be thoroughly verified before they enter the blockchain, since if they must be re-verified later, the system would lose some of its potential efficiencies. Secondly, the smart contracts—which would run automatically and close to instantly—must be verified to ensure that they are correctly coded and that all transactions are taking place as the prospectus defines. One possibility for verifying smart contract operation would be to engage an independent third party to construct a parallel smart contract, to replicate and confirm the original smart contract. Lawyers with a strong understanding of blockchain technology would also be needed to provide comfort that the smart contract code would deliver the commercial parties' intended result.

In addition to these verification measures, this automated system would probably need structures to trigger manual intervention to correct and reverse errors if they occur and to deal with the consequences of the insolvency of one or more of the parties. These structures could include a process to renegotiate and reprogram the smart contract if it is not functioning correctly. Even with this overlay of additional safeguards, a blockchain-based system would gather and distribute information and payments far faster than the current system. These safeguards may also offer opportunities to securitization participants whose current verification and due diligence services might be disrupted by blockchain. They could offer a similar service to what they now provide, but tailored for blockchain.

Reliable and transparent information on underlying assets and security structures might also, with time, reduce the burdens that regulators place on the industry. If all participants have access to accurate information (without violating the confidentiality that proprietary models and investment decisions require), the industry would in essence have become self-regulating when it comes to data transparency. Anti-money laundering checks could also be built into a blockchain, whose immutable audit trail and capacity to link real-world identities to cryptographic ones could help reduce costs of AML verification.[28]

Blockchain could fundamentally transform the work of originators, trustees, servicers, accountants, lawyers, rating agencies, and regulators to make security servicing more efficient, more reliable, and less expensive, while investors could receive their distributions more quickly.

Shallow, over-the-counter markets

Secondary trading for the securitization industry is a giant market in one sector: Agency mortgage backed securities had well over $200 billion in daily trading volume in 2016. Secondary markets for most other asset classes are much smaller: ABS (auto loans, collateralized debt obligations, credit card loans, equipment, student loans and other asset-backed securities other than MBS) had just above $1 billion in daily trading volume in 2016. These markets are also relatively shallow—the average daily traded volume of ABS in 3Q16 was less than 0.2 percent of ABS outstanding;[29] the ratio stood at nearly three percent for agency MBS and CMOs in the same period.[30]

Constraints in liquidity and significant information asymmetry are common problems in over-the-counter markets with limited depth. Without a transparent, intermediary institution such as a stock exchange to collate volume and facilitate price discovery, in some asset classes, big investors with close relationships to broker-dealers and other network advantages may gain information faster or more accurately than others. Although these institutions benefit from these network advantages, the market as a whole is less efficient as a result. The need for sophisticated networks to collect and analyze data and the resulting perception of opacity may also keep these assets from gaining wider acceptance and restrict the overall pool of investors. In addition, even for the biggest and most successful traders, a fragmented, over-the-counter market may contribute to poorer price discovery.

For all investors, the difficulties and delays in accessing information on the underlying loans in the securities contributes to some uncertainty about asset quality. This limitation is less important for agency-backed instruments, which carry an explicit or implicit government guarantee. But for ABS, private label RMBS, and other securitizations, especially those with higher risk and yields, delays and limitations in information access may be keeping certain investors away from securitized assets and it may be encouraging participating investors to demand a larger risk premium.

In addition, the inherent complexities and information asymmetries in the current securitization markets, may well be presenting entry barriers to new investors. Blockchain may be able to reduce or eliminate these issues, thereby expanding the size of the potential investor pool and thus the overall size of the industry.

Better volume and prices while maintaining privacy

The potential of blockchain for securities trading is well-recognized: NASDAQ,[31] the Australian Securities Exchange,[32] overstock.com,[33] the DTCC,[34] Bank of America Merrill Lynch, Citi, Credit Suisse, and JPMorgan[35] are developing a wide spectrum of secondary market use cases, including managing share issuance, trading complex derivative instruments, and clearing and settling trades across a range of asset classes. Blockchain's capacity to streamline intermediaries and lower costs while increasing speed, transparency, and security is clearly valuable to upgrading the efficiency of capital markets.

In the specific case of securitized assets, and especially those ABS asset classes where markets have suboptimal levels of liquidity and transparency, a blockchain could fundamentally improve pricing efficiency and deepen the market. Security pricing could become more accurate with a potential narrowing of spreads as investors gain the ability to make real-time assessments of security values by tracking shifting patterns in loan-level payments. The pool disclosure—the loans, with their performance and yields—in the security's offering documentation could also be automatically and almost instantly updated to reflect the very latest portfolio performance.

Direct data feeds from the blockchain could also make it easier to automate analytics and develop more sophisticated investment strategies and risk-management techniques. For

instance, investors, rating agencies, and regulators could model concentration risk factors in asset portfolios by examining the interconnections between cash-flow models pertaining to different securities. At a systemic level, this capability could drive down the likelihood of "fire sales" during periods of acute market stress.

Better and more stable pricing in deeper secondary markets would naturally filter back to the primary markets: Sponsors/issuers and underwriters could have readily available benchmarks and greater certainty about the investor pool for upcoming securitizations, and they could optimize tranche structuring decisions to cater to market trends.

Since blockchain encourages common or compatible data standards, it could be far easier to create market information platforms, including on the blockchain itself. To prevent the danger that all this information, available close to instantly, could create technical "runs" on the market, market makers operating on these platforms could provide liquidity while circuit breakers could potentially dampen extreme price swings. Trading securities directly on a blockchain could also enable near-immediate clearing and settlement, and the platforms could use smart contracts to automatically fulfill regulatory reporting obligations. A smart contract associated with an asset-backed security could, for example, automatically funnel appropriate information to the Trade Reporting and Compliance Engine (TRACE).

Using blockchain's capacity to partition information access, when beneficiaries change as result of securities traded on the blockchain, trustees and regulators could instantly receive this information while it remains hidden from other market participants. Blockchain could thus maintain the confidentiality needed to protect proprietary trading, while trustees could instantly receive the information needed to pass payments on to new holders. Regulators could have a continuously updated snapshot of systemic asset ownership.

A blockchain-based secondary market for asset-backed securities could be deeper, broader, more efficient, and safer.

Chapter Six:

Challenges to implementation

Blockchain's potential risks

As we hope we have demonstrated in the previous chapters, blockchain offers the securitization industry the potential for significant gains in efficiency, costs, transparency, compliance, and safety. Nevertheless, this new technology also creates new risks. Securitization is an important source of capital not just for the financial sector, but also for the wider real economy. Any change in the industry's market structure, including the supporting technology infrastructure and safeguards, should only be taken with extreme care.

Consultations with industry experts and blockchain specialists have helped identify a range of issues that need to be resolved before the industry can successfully transfer operations to a blockchain. These potential risks broadly fall under the following three categories:

I. Questions about data security and privacy

With so much information on the same technology platform, a successful cyberattack could be systemically devastating. Privacy issues may arise since blockchain's distributed structure shares and stores sensitive data on multiple nodes. Aside from the danger of unauthorized external breaches, a blockchain system will have to be designed with appropriate restrictions on information access among parties on the blockchain, some of whom will be competitors.

Some of blockchain's characteristics inherently address this risk. Blockchain's many security features (discussed earlier in this paper) make its underlying structure more resistant to hacking than a conventional centralized database. Blockchain by its nature creates an immutable audit trail when information is updated. Coupled with encryption, which allows

regulated access to information, blockchain participants should be able to address the challenge of protecting proprietary data once they form appropriate agreements. It also may be possible to limit data sharing on a blockchain to non-sensitive data and simply keep PII and other sensitive data on external storage platforms.

With data privacy and security on blockchain systems becoming a top priority for the industry, we expect new proposals in this space in the near future.

II. Technology that is not yet fully vetted

Blockchain is still a relatively new technology, and although several blockchains have multi-year track records, many smart contracts and other blockchain applications have not yet reached a demonstrably bullet-proof level of reliability. For all its inefficiencies, the present securitization ecosystem, with multiple parties each performing due diligence, allows for repeated confirmation of data and transactions. The industry will need evidence that a near-instant and automated system will receive the right inputs and have the right tools to produce outputs that are even more reliable.

The industry will also have to proactively identify potential technology failures, define adequate controls to mitigate them, and prepare contingency plans. A back-up technology infrastructure might merit investment, especially in the first years of implementation, to protect the ecosystem against unforeseen technology lapses and to ensure business continuity.

Furthermore, since not every securitization function can be automated, the transition points between automation and human input may be a source of risk. This intersection between automated data analysis and transactions and human intervention would have to be carefully policed and calibrated.

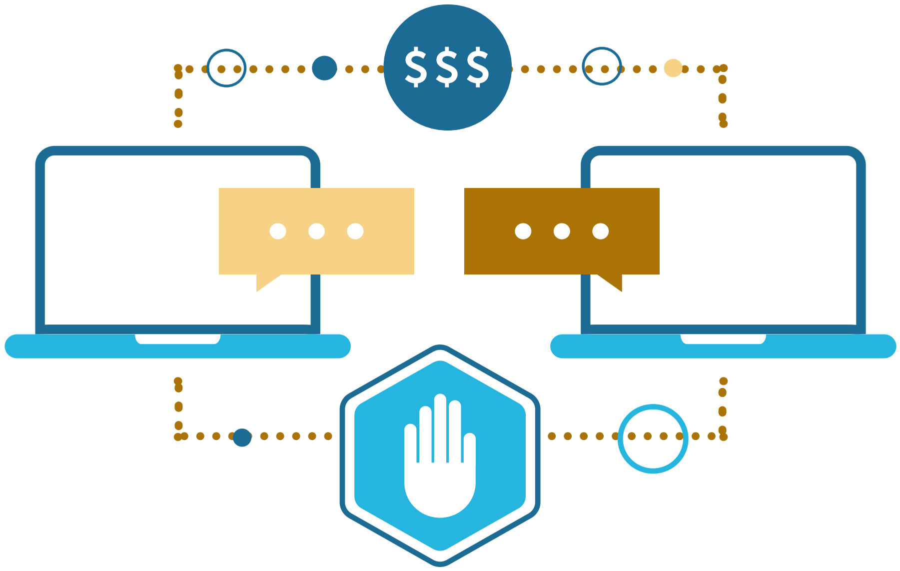
III. Legal and regulatory uncertainty

Depending on the type of offering involved, regulators, starting with the SEC for public offerings, would have to accept and approve blockchain's use for securitization, including (but not limited to) blockchain's methods for entering, verifying, and protecting data. One possibility is that a new monitoring environment could be developed with a regulatory presence on the blockchain: a "supervisory" node with far-ranging permission to access data. Regulators might also have to consider how financial institutions should integrate blockchain into regulatory reporting.

Legal shifts may have to occur for smart contracts to be deployed. The Uniform Electronic Transactions Act (UETA) and other similar state laws aim to facilitate the use of electronic records and electronic signatures in any transaction. By rectifying the need to retain paper copies of contracts and by giving legally binding status to electronic documents and signatures, UETA offers the capability to structure an authoritative electronic contract.[36] With smart contracts used to automate portions of the transaction documentation, courts may still need to develop parameters to give parties comfort in knowing how basic contract law questions will be resolved, such as when or whether a contract has been formed, whether a party has performed its obligations, and whether a party has breached the contract.

Blockchain, with its popular connection to cryptocurrencies, may also face a problem of perception when it comes to laws and regulations. Despite the system's inherent potential advantages to fight money laundering through its immutable audit trail and its capacity to cement real-world identities to cryptographic ones, the possibilities for secrecy and automation may reinforce fears of a lack of transparency. Might there be a regulatory or legal problem if a blockchain permits counterparties to remain anonymous, so that the trustee does not know who is receiving a payment or an originator does not know the sponsor/issuer? Who would be liable if a blockchain, following automated processes, releases data to the wrong place or executes a transaction that breaks the law?

Securities markets have dealt with some of these problems in other asset classes before, but coupling them with a still-developing technology will probably demand a consensus among stakeholders. Clarity on regulation may also need to be accompanied by clearly laid-out dispute resolution mechanisms, including arbitration and judicial recourse.



Additional obstacles to implementation

None of the previous risks are unresolvable, but even if they have been addressed, the industry would still face hurdles before blockchain can start to live up to its potential to reinvent securitization as a safer, faster, and more cost-efficient process. Here are some of the most important ones:

I. Agreeing on data standards

To bring benefits, blockchain does not need for every industry participant to use the same standard. However, there would be advantages for efficiency if originators within each asset class eventually moved to comprehensively standardize electronic loan records. And to create interoperable blockchains that permit maximum efficiencies across the full securitization lifecycle, data and security standards might need to span each major asset class in the industry. Reaching agreement on these standards might be difficult and time consuming, and could require delicate negotiations, since some standards would benefit some participants more than others. Regulatory buy-in would also be essential to creating industry-wide data standards.

All participants, and rating agencies in particular, are likely to insist that blockchain data standards be no less comprehensive than they are today. If data standardization means adopting the lowest common denominator, it would exclude additional data that some originators currently provide and that rating agencies find useful to make assessments. If the rating agencies had to go back to issuers to request this additional data that the blockchain would not include, a portion of blockchain's efficiencies would be compromised.

However, should agreement be reached, blockchain technology could hasten the shift to new data standards. Note that some blockchain platform operators already offer services to digitize and standardize records.

II. Getting to scale and dividing costs

If a critical mass of industry participants starts using blockchain, others might then have strong incentives to join to have access to the system's data and market; everyone involved could see gains in speed, efficiency, and pricing. However, at present many participants may hesitate before spending money to change a system that works adequately. Many participants, after all, are still recovering from the global financial crisis and have had to devote significant resources to complying with the post-crisis regulatory environment. More challenging still, incentives are unequal: companies who have developed deep networks and sophisticated digitized processes in the current system would want to carefully evaluate how and whether blockchain could maintain, dilute, or extend their competitive advantages. To commit, all stakeholders would have to see a clear demonstration of value, certainty around execution, and evidence that the end result would be a more efficient system that would benefit them.

Should a decision be made to go forward, it would be possible (see below) for a small group of companies or even a single one to begin with blockchain adoption. Still, the various players would find it advantageous if they agreed to share a significant financial investment. But many of these companies are competitors, and in some, it might be hard to obtain the necessary resources even with a strong business case. These required resources may be significant, because blockchain talent is currently scarce and in high demand. Although starting small is a possibility, it may require technological innovation. The industry might have to find technology partners who understand both the industry's risks and its regulatory constraints. It may be necessary to create incentives for these technology partners to share upfront costs and be invested in the success of the system.

Beyond the costs of the blockchain itself, companies might have to overhaul internal data systems and work processes to prepare for integration with a network of interoperable blockchains. That too would involve an unequal distribution of costs, as some companies' systems are better prepared for this shift than others. Companies unable to come up with the necessary investment may find themselves trailing behind better-capitalized market leaders if blockchain-based systems, with their speed and efficiency, become the norm.

III. Ensuring interoperability

For blockchain technology to integrate and optimize the securitization industry, it would work best if it operated across all of the different stages in the securitization lifecycle. Aside from the data challenges described above, interoperability would require a sufficient number of players to work together on basic questions of structure and security. This interoperability is particularly important for downstream participants, who constantly interact with participants across the securitization lifecycle.

It may be especially challenging to involve ABS investors in the creation of interoperable blockchain networks. Unlike in other stages of securitization—there are only a handful of credit rating agencies, for example—the investor community is very fragmented and may contain a wide range of competing interests. However, if the securitization industry is to be a successful bridge between end-borrowers and investors, it will be crucial for the latter to have a seat at the table during discussions to determine the evolution of a structural upgrade to the industry.

The use of blockchain in securitization will likely begin on a prospective basis with the issue of a new asset-backed security which simply records new information on the underlying assets once it goes live. However creating the highest level of value may require at least partial interoperability both with legacy systems (for market and reference data) and with other securities markets infrastructure, including central counterparties who are becoming ever more crucial to trading, clearing, and settlement.

Like the risks, these obstacles can be addressed, if the industry sees a sufficient motivation and a plausible path forward. Our next chapter, by giving a notion of how the full blockchain-based securitization cycle might work, and by suggesting practical steps toward implementation, will try to provide steps toward both that motivation and that path.

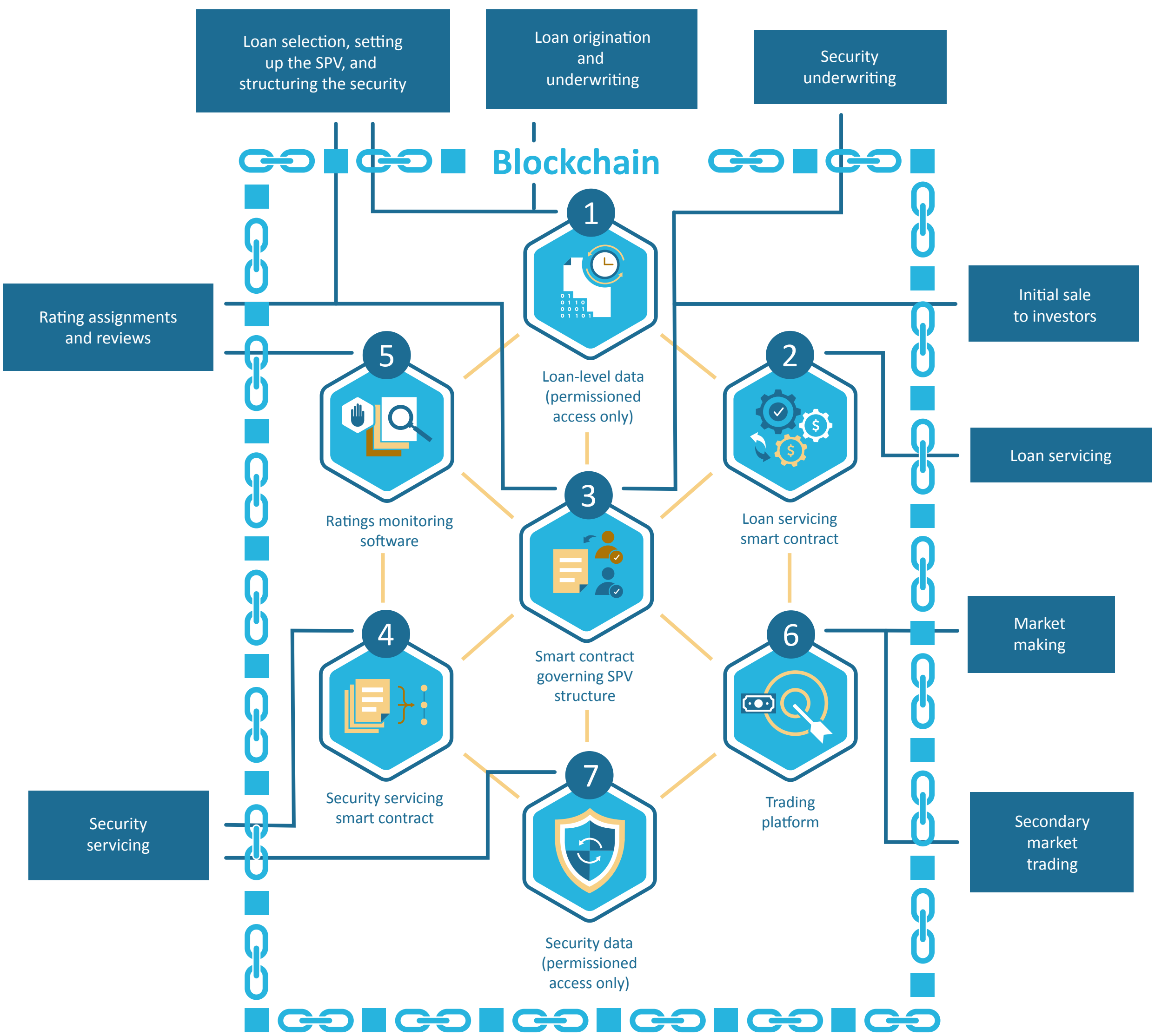
Chapter Seven:

Blockchain and securitization—the road ahead

Greater safety and volume, lower costs, and better prices

This paper has presented ideas for how, stage by stage, blockchain could reinvent the securitization lifecycle. How might this lifecycle look, if the industry successfully applies blockchain to provide maximum benefits to the securitization industry, its consumers, and the economy as a whole? The new securitization lifecycle might look something like this:

Figure 3: Blockchain and securitization, a possible look at the future



Source: Deloitte Development LLC, 2017.

Step-by-step, here's how the process would work, with each step below referring to Figure 3.

1. As a borrower and lender agree to the terms of a loan, a new electronic asset is created on the blockchain and time-stamped. Ownership information and other pertinent underwriting data, such as supporting documents or FICO scores, are attached to the loan. This information cannot be altered without a new consensus between the borrower and loan owner.

2. Relevant information about the loan is automatically coded onto a smart contract which governs the automated portions of servicing the loan. As the borrower makes or fails to make payments, this history is added to the loan-level data and supports future servicing decisions, such as the possible need to engage a default servicer. Ownership rights of the asset are also automatically recorded, immutably and with a time stamp.

3. The sponsor/issuer pools together loans and transfers them to an SPV, which records the transfer and the related loans on the blockchain. With every loan linked to an individual borrower and with all modifications and servicing history permanently recorded, double-pledging and many other kinds of fraud become far more difficult and perhaps impossible. The automatable portion of the transaction's terms, including its cash-flow model, are written in a series of smart contracts, which the sponsor/issuer, underwriter, rating agencies, trustees, and other relevant third parties verify and agree to. This consensus creates a single governing model for the transaction. Rating agencies, investors, and other relevant stakeholders reference this model and, if desired, also the underlying loan-level data to perform their assessment of the newly-created securities. In addition, relevant portions of the offering and legal documents are also automatically created with smart contracts. Regulatory compliance is largely automated, as smart contracts are programmed to immediately note any potential irregularities.

4. A separate smart contract to service the securities is layered on top of the SPV and the smart contract developed for the transaction itself. This new contract collects payments from loan servicers, references the cash-flow model specified in the contract governing the SPV, and distributes payments to the beneficiary holders of the security with only minimal delays for settlement. This information stream is relayed to rating agencies and the secondary markets.

5. Ratings monitoring software is placed on the blockchain to match the security performance with expected cash flows and trigger rating reviews when discrepancies arise.

6. Trading or market information platforms are constructed with blockchain technology to interoperate with the blockchains used for the transactions and enable market makers to create robust secondary markets in securitized assets. With the help of market makers, securities trading on the blockchain is near-instant and low cost, with regulatory compliance close to automatic, as data on asset ownership is reported in real-time to regulators while it remains hidden from competitors. Large investors could potentially directly trade on these platforms without having to go through broker-dealers.

7. As the securities are created and traded, beneficiary information is stored and updated in a separate repository, which acts as a custodial entity. This updated beneficiary information is referenced to facilitate future security servicing. To maintain confidentiality, only relevant trustees and regulators possess full access to this information. Less sensitive data such as ratings or underlying payments information could be made available to all secondary market participants.

What would be the result of this new system? With perfect data, lower costs, increased safety, and quicker payment streams, investor interest would grow even in securities that previously were considered opaque and therefore high-risk. Trading volume could rise, spreads fall, prices improve, and the growth in safe and stable securitization may increase the supply and lower the cost of credit to the broader economy. Should a scenario of extreme stress arise because of macroeconomic conditions, servicers, rating agencies, and investors could all take measures based on verified, real-time data, while blockchain's immutable records would drastically reduce the issues of poor documentation and fraud that troubled the industry during the last downturn.

The securitization industry would be lower cost, more efficient, larger, and more resilient to fraud and downturns.

From here to there

The above vision is, we believe, appealing, but we recognize that even if the industry makes the necessary effort to minimize the risks and overcome the hurdles that adopting blockchain would require, the transition from the current securitization system to one based on a blockchain will be gradual. Big changes can start with small, controlled, affordable, and low-risk steps.

What follows is a necessarily inconclusive list of ideas and guidelines for getting started.

Any change is easier when fewer participants need to come to an agreement. So one possible approach is to start with a small number of institutions in a small slice of the securitization lifecycle. An early blockchain, for example, might just connect a few originators and issuers that already have strong relationships. These might see a "first mover" advantage since, as part of the consortium that designs the blockchain, they could have a greater influence on the choice of data standards. Once proven successful, this blockchain could open to other upstream participants, and then eventually expand downstream too. For that approach to function, designers would have to overcome an existing technological challenge and create a blockchain ready for interoperability and scale.

If cross-industry data standards have been created, it would also be possible for different asset classes and industry segments to simultaneously develop their own blockchains which are both tailored to their own needs and interoperable. As data sets become increasingly standardized, integration among these different blockchain platforms would become more straightforward. As the different industry blockchains communicate and transact with each other, end users should have a seamless experience, similar to how investors in brokerage accounts can trade securities on multiple exchanges with a few mouse clicks.

Another possible approach would be for one of the financial industry consortiums working on blockchain to offer a proof-of-concept (POC) blockchain for securitization, which industry participants would be free to test. One of the many companies that have become blockchain vendors, whether technology giants or startups, might also find such an offering commercially attractive. Since the security of transactions and data is perhaps the biggest question of industry participants, this POC blockchain might usefully focus on security while also encouraging institutions to develop the necessary technological expertise to use blockchain. This approach could be relatively cost-efficient, since it would permit companies to perform a cost benefit analysis and take a gradual approach toward one of the costliest elements of a transition to blockchain: the need to reorganize their own talent pools and IT landscapes.

Yet another possible approach would be to leverage existing blockchain technology for limited use cases. Any blockchain not specifically designed for the securitization industry might have limitations in privacy, security, and the range of possible smart contracts. However, a blockchain with the confirmed capacity to create an immutable and nearly unhackable audit trail could be used for certain kinds of record-keeping—data that is already publically available but often hard to access, for example. This approach would probably be low cost and low risk, but it also offers limited possibilities for growth, so it might work best merely as a way to increase industry familiarity with the technology.

An approach with greater potential might be to indeed start with a focus only on non-sensitive data (for example, non-consumer data of the type relevant to CLOs or CMBS), while excluding proprietary information and transaction execution. Rather than using existing technology, the industry or a blockchain vendor could aim to develop a blockchain custom-made for securitization, which at a later stage could be expanded to cover first more sensitive data, then transactions. This expandability is crucial, since blockchain's real potential value to securitization lies in these later stages: easily offering different levels of access to different data and automating activities that currently have significant financial and manpower costs.

For all approaches, even those taken by individual companies or small subgroups, collaboration and communication from the start will be crucial. Industry bodies such as Structured Finance Industry Group and the Chamber of Digital Commerce could act as coordinators and aggregators of cross-industry efforts, with an eye to creating and adapting standard frameworks. These frameworks would permit test cases and knowledge growth now, prototypes and pilots later, and—if these efforts satisfy industry needs—the basis for a transition of more and more securitization activities onto blockchain.

Chapter Eight:

Conclusion

We began this paper with the objective of exploring the possible impacts blockchain could have on the securitization industry. We hope that the previous pages have successfully shown some of the many benefits and the challenges that a transition to blockchain technology might offer both the industry as a whole and its different participants.

We stand at an early stage in the evolution of blockchain for structured finance and recognize that some skepticism may exist. However, we hope that all readers will consider the possibilities that blockchain has to make every segment of the securitization lifecycle more efficient, reliable, and secure while lowering costs, increasing speed, and facilitating regulatory compliance. We would fervently encourage industry participants to treat this paper as an inspiration to look in more depth at the opportunities that blockchain offers to each of them. Given securitization's vital contribution as a source of liquidity for financial markets, businesses, and individuals, these opportunities could lead not just to a stronger securitization industry, but also to significant advantages for the wider real economy. It is our belief that the sooner the industry begins work on a transition to blockchain, the sooner the industry and the economy as a whole could benefit from this technology that promises to revolutionize the financial world.

Appendix:

Recent evolutions in blockchain and financial services

Financial services companies and blockchain

Many of the most important blockchain developments are currently taking place among consortia of financial services firms, which are working with blockchain companies to research and develop different use cases for blockchain applications in the financial system. Consortia can be helpful, since for permissioned blockchains to achieve interoperability, competitors generally need to cooperate. A recent list shows twenty-five significant global consortia (of which 22 were founded in 2016), with thirteen in financial services. Two, Hyperledger and ISITC, have one hundred members.[37]

Digital Asset Holdings is a technology start-up backed by major financial and technology companies, including Goldman Sachs and IBM.[38] Digital Assets' blockchain platform, which can integrate with Hyperledger, is designed for the financial services industry with privacy and interoperability at its core.[39]

The technology startup Symbiont also recently announced a permissioned blockchain, Assembly, meant to appeal to financial services companies.[40] Assembly is designed to permit different levels of access, to be optimized for the kind of smart contracts most applicable to financial services, and to execute transactions more quickly than rival blockchain frameworks. Assembly was recently clocked at 87,000 transactions per second.[41]

Ripple is yet another blockchain startup aimed at financial services, with backing from the CME Group, Google, and Standard Chartered among others.[42] Consortiums are active in other parts of the world too, including China, whose Financial Blockchain Shenzhen Consortium has over 30 members.[43]

While much important work is being done within consortia, some large financial institutions are also choosing to experiment with blockchain independently, without the restrictions and overhead that working in a consortium brings. It is also possible for a single entity to use a permissioned blockchain across various internal silos as a way to integrate data transfer or conduct transactions within the organization. The Bank of Ireland recently experimented with this kind of blockchain as a way to trace transactions to meet EU regulations such as the Markets in Financial Instruments Directive (MiFID II). The Bank of Ireland's trial blockchain took data from multiple systems across the bank's Global Markets division to create an immutable, distributed, searchable database across the full trade cycle.[44]

Financial services use cases

Here are a few areas where the financial services industry has focused on in developing and testing applications of blockchain technology:

Global money movement. Blockchain's ability to securely clear and settle transactions bilaterally could lower costs and increase speed and efficiency. Its near-instantaneous transfers of value could also reduce the amount of capital locked in the global trade settlement system. Banks including Bank of America Merrill Lynch, Santander, UniCredit, Standard Chartered, Westpac Banking Corporation, and Royal Bank of Canada recently joined with Ripple to create a possible alternative to SWIFT (the Society for Worldwide Interbank Financial Telecommunication) for sending and receiving information about financial transactions.[45]

Recordkeeping, regulatory reporting, and compliance. With its immutable audit trail recorded simultaneously on multiple nodes, blockchain can store financial information accurately, safely, and cheaply. It can also share it in real time with regulators. The system that the Bank of Ireland tested to facilitate regulatory compliance (above) is an example.

Issuing and servicing syndicated loans. Firms are exploring opportunities to issue and service loans on blockchains. Blockchain's disintermediation and methods for rapid data verification and dissemination could streamline many processes and decrease settlement times. State Street, US Bank, Wells Fargo, BBVA, Danske Bank, Scotiabank, and Société Générale recently collaborated with Symbiont to test such a system.[46]

Underwriting. Blockchain's ability to verify, securely store, and disseminate information could help underwriters verify identities, ensure the completeness of applications, evaluate risks, and complete quoting and binding. NASDAQ recently tested blockchain for private placements[47], and overstock.com has issued new equity shares through a blockchain.[48]

Trading. Securities can be coded as smart contracts that automate much of the trading process, including processing, payment, amendments, and clearing and settlement. Real-time information sharing could enable buy- and sell-side firms to agree on trade details rapidly, further lowering costs and risks. Publicly announced proof of concepts span asset classes: Bank of America Merrill Lynch, Citi, Credit Suisse, and JPMorgan have tested a blockchain for trading credit default swaps[49]; Symbiont has developed "smart securities" to issue, manage, trade, clear, settle and transfer financial instruments on a blockchain[50]; and eight firms led by JP Morgan, Barclays, Credit Suisse, and Citi have tested equity swaps post-trade transactions using a blockchain from Axoni.[51]

Proxy voting. Blockchain-based proxy voting systems could drive significant benefits for all participants, including investors, issuers, brokers, and regulators, through blockchain's capacity to rapidly, securely, and simultaneously record and distribute information. The US's largest provider of electronic proxy voting, Broadridge Financial Solutions, has made significant investments in developing blockchain applications, including the late 2016 acquisition of Inveshare's technology assets for $135 million.[52]

Anti-fraud. Blockchain's potential to verify transactions and create an immutable audit trail and digital identities[53] could enable financial institutions to more efficiently fight identity theft, money laundering, and fraud.[54] Standard Chartered, Bank of America, and HSBC are some of the banks who recently announced efforts to fight fraud in trade finance by using blockchain to reduce the use of fake invoices and purchase orders to secure loans.[55]

Government interest in blockchain

Governments too are paying attention to blockchain. In the US, the Office of the Comptroller of the Currency (OCC) released in late 2016 polices aimed at regulating blockchain startups.[56] Other parts of the US federal government, including the SEC[57] and the Federal Reserve,[58] are also looking closely at blockchain.

On the state level, Delaware has launched its “Delaware Blockchain Initiative” to create a regulatory and legal environment to attract blockchain companies, and to use blockchain for government records.[59] Delaware, home to more than sixty percent of Fortune 500 firms,[60] has also partnered with Symbiont to encourage companies to use blockchain technology to store contracts and other essential corporate data.[61] The state of Illinois announced its own “Illinois Blockchain Initiative” in November 2016, aiming to use blockchain “to transform the delivery of public and private services.”[62] The Illinois Department of Financial and Professional Regulation is already looking into building blockchain applications to streamline the transaction of mortgages.[63]

Outside the US, the People’s Bank of China, the Bank of England, the Bank of Canada, and the Monetary Authority of Singapore are among the central banks looking at a blockchain driven system for interbank payments.[64] The Bank of Canada’s Senior Deputy Governor Carolyn Wilkins said in 2016 that the bank is aiming “to build a proof of concept wholesale interbank payment system using a distributed ledger.”[65] The United Kingdom’s government is experimenting with blockchain to make welfare payments.[66] The move came after the UK Government Office for Science issued a report saying that blockchain could help the government reduce fraud, corruption, error, and costs while increasing data sharing, transparency and trust.[67] National governments in Singapore, Sweden, South Korea, Russia, Estonia, Ghana, and the Republic of Georgia are some of the others experimenting with blockchain for various government services.[68] National governments including those of the UK, Singapore, Australia, Abu Dhabi, and Hong Kong have also either established or announced “regulatory sandboxes” meant to allow financial services companies and start-ups to have a “safe space” to test technologies such as blockchain.[69]

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