



REDWOOD
TRUST

Building a Mortgage Blockchain Ecosystem

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Introduction

The residential mortgage industry has a mixed record on adopting new technology. To be sure, there have been important innovations at the borrower interface level (e.g., application process; ability to convert document images to editable data) and at the GSE level (e.g., automated decisioning on underwriting and property inspection). Nevertheless, the mortgage industry remains a highly complex and interdependent ecosystem still characterized by manual processes and redundant data verification. The resulting duplication of effort delays timelines to originate, securitize and invest in mortgage loans. These inefficiencies are particularly evident in the non-Agency sector of the mortgage business, which has a distinct set of regulatory, rating agency and market-driven requirements compared to the government-sponsored Agency market.

At Redwood Trust, we work in close coordination with originators, servicers, trustees, third-party due diligence firms, rating agencies, warehouse lenders, securities investors, and whole loan investors. Our business is focused on the non-Agency mortgage sector and, as a result, we believe we are in a unique position within the mortgage ecosystem to evaluate and implement actionable improvements across the non-Agency space. The core objective of this work is to make non-Agency mortgages faster and cheaper to originate, underwrite and securitize, thereby increasing liquidity for investors without compromising production quality and, ultimately, enabling borrowers to access more competitive risk-adjusted rates.

For over 25 years, Redwood Trust has been a leader in the non-Agency RMBS market, both as a non-bank issuer and credit investor. We have transacted with over 200 institutional investors in our Sequoia securitizations, and over 60 distinct whole loan investors. We have issued over 100 securitizations and bought loans from over 190 discrete mortgage originators. As a result, we care deeply about making the process of securitizing and investing more transparent, including through reduced friction and redundancy, which we believe will ultimately increase liquidity for homeowners and expand the private sector's role in the housing finance industry.

Blockchain technology has received great fanfare across the financial technology world, but efforts to incorporate blockchain into the world of residential mortgages have run into the practical divide between exciting theory and what is actionable. This paper reflects Redwood's view of the potential for blockchain technology to improve the mortgage ecosystem and to shape the next generation of workflows. We are not proposing to re-invent the entire mortgage ecosystem in one fell swoop, as ours is a more incremental approach that we feel is realistic, feasible, and in many ways inevitable.

Purpose and Scope

Due to the slow adoption of technology across the industry, costly and manual processes continue to plague many key mortgage workstreams. Adopting new technology and methods can reduce inefficiencies, increase data integrity, and provide future economic benefits throughout the ecosystem. As other industries evolve and implement cutting-edge solutions, so must the mortgage industry.

This white paper will introduce a long-term vision for the mortgage ecosystem by highlighting current inefficiencies, introducing new technology solutions, and providing a roadmap for the current and future evolution of the industry. By sharing this vision with investors, industry participants, and technology providers, it is our goal to create awareness of the opportunities to deploy technology into the current ecosystem while simultaneously building infrastructure for the future. As such, we highlight specific areas we believe can benefit more readily from blockchain technology against the backdrop of broader industry changes that will likely take longer to implement.

The goal of this white paper is to highlight potential benefits of blockchain technology on post-close purchase, servicing, securitization, and secondary trading (for both whole loans and private-label RMBS). Most blockchain efforts within the mortgage industry have made slow progress industry-wide due to the mindset of “everything must change before the benefits are realized.” By initially refining our focus to the post-origination investor market, unique advantages of the technology can be used more quickly to improve underlying infrastructure for the entire industry. Furthermore, an originator-agnostic approach allows greater participation across the industry to grow the mortgage ecosystem.¹

¹ For a discussion on the full possibilities of blockchain technology across a broad spectrum of structured finance applications, we encourage you to read a piece co-authored by Deloitte & Touche LLP, SFA and Digital Chamber of Commerce (2017), *Applying Blockchain in Securitizations: Opportunities for Reinvention*.
<https://www2.deloitte.com/content/dam/Deloitte/us/Documents/regulatory/us-sfig-report-applying-blockchain-in-securitization-opportunities-for-reinvention.pdf>

Key Takeaways

Investment and Due Diligence Efficiencies

We believe blockchain technology may eliminate the need for every potential buyer of a whole loan to verify the completeness and integrity of the origination documents, including by verifying that the data they are analyzing is the same as in the original loan documents.

We believe blockchain technology will allow third party due diligence firms to scale their businesses more efficiently, which will greatly benefit the industry.

Transparency & Timeliness

By implementing blockchain payment tracking from servicers at the loan-level, securitization investors may receive closer to real-time payment information, creating greater transparency and efficiencies for investors.

By implementing blockchain tracking of certain servicing notes, we believe the industry would gain more timely, granular insight into the impact of economic, social and environmental events on borrowers (e.g., COVID hardship, catastrophic weather events).

Current Progress

In late 2020, Redwood Trust entered into an exclusive agreement with Liquid Mortgage to design a roadmap for potential blockchain implementation and ecosystem development focused on data integrity, transparency, and post-close processes. Following this engagement, Redwood Trust has recently made an investment in Liquid Mortgage with the objective of building a mortgage blockchain ecosystem.

Liquid Mortgage is a patent-pending start-up that provides infrastructure to digitize loans, track documentation, facilitate payments, and record additional information on a blockchain over the life of a loan.

As an initial pilot, Redwood Trust and Liquid Mortgage placed all loans in a recent Sequoia securitization on a blockchain in a test environment.

Potential Impact and Benefits for Existing Ecosystem Players

Blockchain provides the potential for making existing ecosystem participants more efficient and can facilitate the delivery and application of information at greater scale. Like any technology, it is a tool to be used by our servicers, trustees, paying agents, underwriters, and third-party due diligence firms. In Redwood Trust's view, it does not replace any of these functions.

Current Market Inefficiencies

The size and scope of the U.S. residential mortgage market make it an enticing ecosystem in which to enact change. Housing, whether rented or owned, is a basic human need that the mortgage market plays a key role in fulfilling. However, the mortgage “manufacturing” process is full of complexity stemming from the diversity of regulations, laws, market guidelines, product options, and inherent credit risk. A mortgage transaction is vastly different from transactions in other financial asset classes, such as credit card receivables and auto loans. Many systems and processes have been in place for decades and have not kept up with current technology and evolving industry standards.

The result of a complex, diverse, and non-standardized mortgage process is perhaps most apparent within the non-Agency RMBS market. Loan assets (represented with data and document images) are constantly reviewed and repeatedly verified by prospective buyers, in part due to lack of transparency in source data systems and the original underwriting processes. The validation process is inefficient, time-consuming, and costly to all participants.

While most mortgage blockchain discussions focus on how to change the industry, we believe initially that the scope should be limited to allow the introduction of technology without requiring an industry-wide transformation that would take years (if not decades) and billions of dollars of investment. Specifically, we believe introducing blockchain technology into the post-close process could benefit all non-Agency RMBS participants, as well as the end investor of these assets. To understand how the technology will benefit this segment of the market, it is helpful to understand the underlying drivers of this redundancy.

Integrity of Closing Documents

Despite the increased adoption of electronic signatures, the vast majority of closings are still performed with paper documents, ink pens, and notaries. While this continues to be the preferred process for legal reasons, it creates an inherent dependency on human behavior at the closing table that is not easily verifiable by technology. A missed signature or a missing document can create a significant legal problem for a loan or security investor downstream. Consequently, the completeness of the legal documents and wet signatures is verified by others after closing. The chance of a mistake related to the paper closing ensures that every potential buyer of the loan asset will be compelled to perform a document completeness and accuracy validation for the life of the loan.

Integrity of Loan Data

The next area of inefficiency arises in the data verification process. Even if the document package is accurate and complete as a representation of the in-person closing process, there is a chance the loan data an investor receives does not match the information within the operative legal documentation. This is because loan data is often keyed in manually or is disseminated in a way that divorces it from the host documents. As such, any time a loan changes hands, data must be verified

against the loan documents in a process that can occur several times over the life of a loan, including up to 2-3 times within the course of several weeks.

Borrower Credit Risk and Product Guidelines

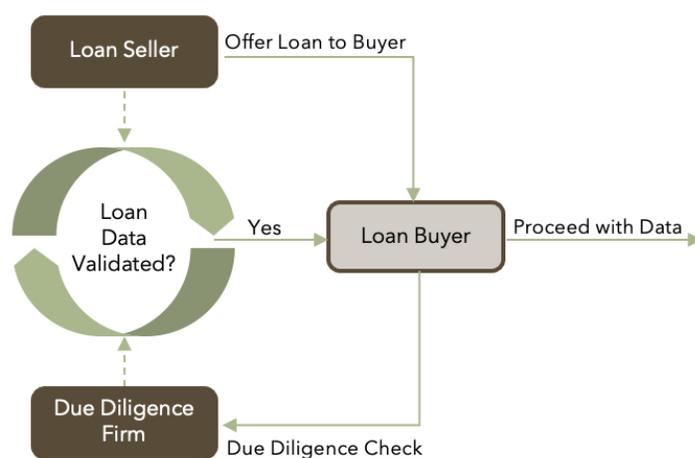
The final and most important focus of verification (which arguably should be the main reason for an investor to perform due diligence) is to ensure that the borrower’s credit profile and assets match the lender product guidelines created to ensure a good fit between borrower and loan parameters. This process is time consuming and costly for loan investors, but with accurate loan data and document integrity this process should be easier to perform.

Role of Due Diligence Providers

Within the private RMBS market, these areas of uncertainty drive the use of third-party due diligence providers. Typically, this process begins with a loan seller delivering a loan to a prospective investor. The loan investor (buyer) hires an independent third-party due diligence firm to review all documentation, borrower credit, and appropriate information to compare with the loan investor’s purchase parameters. The due diligence provider deals directly with the seller (or in our case, through Redwood Trust) to clarify any outstanding issues or incomplete data. Once the review is finalized, a report is issued to the loan buyer, which also includes clarified loan data, ratings as to each loan’s production quality, and other certifications.

While this process is inherently necessary to provide an independent verification of the credit and production quality of a mortgage loan, it could be much more efficient than it is in the current environment. As we will describe in the remainder of this white paper, the injection of a verified blockchain ledger after an initial purchase of an asset can streamline the validation process for the remainder of the loan’s life.

Loan Buying Process



Servicing Costs, Transfers, and Payment Delays

The final point of inefficiency we will cover is the servicing process. A mortgage servicer is the entity responsible for collecting payments, escrowing funds, managing loan modifications or foreclosures, and providing overall borrower support. An annual servicing fee based on the outstanding loan balance is typically charged and deducted from the borrower’s monthly payment. In most cases, this entity is chosen by the holder of the loan or the firm responsible for managing the vehicle in which the loan is held.

A significant pain point in the post-origination process is the transfer of servicing. All documentation, data, and information relating to the loan is required to be sent from the previous servicer to the new servicer. This includes all payments and payment data. Additionally, while there exist certain notification obligations upon a servicing transfer, it is ultimately the responsibility of the borrower to direct future payments to the new servicer when the transition occurs. Often, the borrower will forget to change payment location and the previous servicer will continue to collect monthly payments for several months. The previous servicer then has the responsibility for redirecting those funds to the new servicer over the transition period.

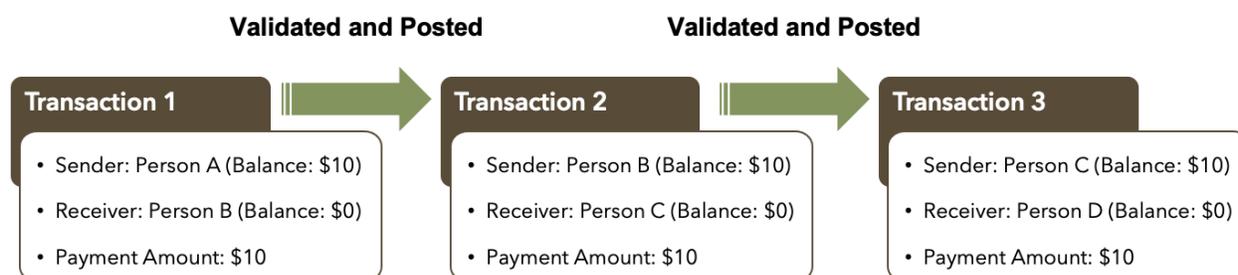
A key piece of information for investors pertains to a loan's payment history. This data allows investors to make decisions on expected borrower outcomes (prepayments, defaults, forbearance, etc.). If an investor holds a whole loan on balance sheet, this data is usually produced timely by the servicer. However, if the loan is held in a securitization, the data is typically not received by investors for 30-45 days. In a scenario where the borrower makes a payment on May 1st, the securitization investor will not receive funds or payment data until June. This delayed process – which has been in place for decades and results from an accepted status quo of sequential processes within the securitization architecture – hinders the decision-making abilities of investors.

Benefits of Blockchain Technology

There has been no lack of hype surrounding blockchain technology. However, in recent years a more constructive approach has been taken to certain use cases, particularly within financial services. Some firms have succeeded (and many have failed) trying to upend entire industries using a single technology. We believe a more practical approach is to use the technology within the current environment to make processes and systems more efficient, transparent, and cost effective.

Blockchain Defined

An overly simple approach to explaining a blockchain is to think of it as a permanent record of transactions in the exact order in which each happened. For example, Person A pays Person B, Person B pays Person C, Person C pays Person D. These transactions are stored in order, validated by certain parties, and permanently posted onto a ledger. The validators check if Persons A, B, C, and D exist, if the asset they are interested in purchasing exists, if accounts have enough to make payment given previous transactions, and finally if signatures match appropriate values. For permanency, these transactions are encrypted and stored on globally available servers. When new transactions are confirmed, all servers are updated with the new ledger transaction history. The underlying technology is inherently more complex, but this definition is sufficient for purposes of the current impact the technology can have within the mortgage ecosystem.



Distributed and Verifiable Transactions (Trustless)

Blockchain technology is important because it provides an objectively verifiable record of transactions and therefore removes the need to trust any one party. If a transaction were in question, any interested party could point to the record on the blockchain, prove it happened (or did not happen, as the case may be), and see the parties involved (anonymously, but verifiably). Contrary to a transparent blockchain environment, a typical database environment is dependent on the owner or administrator of that database being a trustworthy party and correctly storing and retrieving data on a timely basis. As information changes in the legacy environment, the owner has the sole responsibility of updating records correctly and displaying those records for users. As discussed earlier, such an environment is inherently not trusted by counter-parties due to the lack of transparency and exposure to human or processing error.

Digital Assets

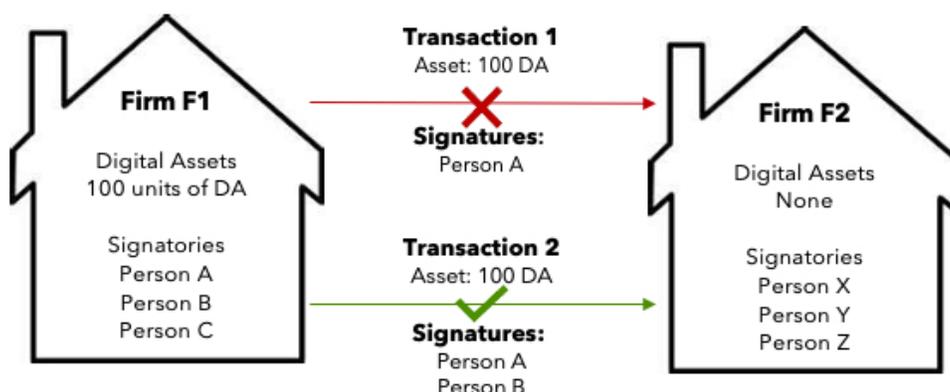
In addition to permanent, transparent recording on a blockchain, there are other benefits to the technology, including digital asset creation. Digital assets are simply replicas of real-world assets on a blockchain where payments, balances, historical transactions, and other information may be tracked in real-time. For example, a digital asset representing a mortgage may be created on a blockchain with the outstanding balance equal to the principal balance of the loan. As the borrower pays down principal over time, the balance on the blockchain is updated instantly to reflect this payment. One important attribute of digital assets is they are easily divisible, creating opportunities to develop new products based on fractional interests in the original asset.

Multi-Signature Validation

Another feature of specific blockchains is the concept of smart contracts. Smart contracts are simply a set of rules put onto a blockchain to determine how a transaction may occur. These contracts may be as simple or complex as the person writing the contract chooses. For purposes of this white paper, a simpler smart contract approach is sufficient, which is called multi-signature validation. In a multi-signature validation approach, the focus is on signatures authorized and necessary for a transaction to be approved. Signatures are fully transparent, auditable, and permanently attached to each confirmed transaction.

For example, Persons A, B, C all work for the same Firm F1, and they would like to send digital asset DA to another Firm F2. However, Firm F1 has controls in place which state 2 of 3 people must sign off on every transaction prior to transaction completion. With a simple multi-signature contract, the blockchain can require 2 of 3 people from Firm F1 to sign off on the transaction prior to completion. If any individual person attempts to send the transaction on the blockchain without requisite signatures, it will be denied. Once two signatures are obtained and the transaction is sent, digital asset DA will be sent to Firm F2. Smart contracts in this case allow the blockchain to control asset flows, manage approvals, and reduce operational risk.

Sample Multi-Signature Transaction



Immutability and Security

A cornerstone feature of blockchain technology is the inability to reverse or change confirmed transactions, also known as immutability. Once a transaction is posted, the transaction and history of the ledger is updated across all entities supporting the blockchain infrastructure. Unlike with traditional databases, in blockchain no one single party is responsible for updating and storing a history of the ledger. If any transaction is not confirmed by the network, it is simply not added to the ledger history. The redundancy and confirmation processes prevent bad actors from retroactively altering transactions and transaction data on the blockchain.

Additionally, each transaction contains signature validations of the parties involved. This may include one or multiple signatures on each transaction, but the transaction may only be confirmed by the network if the signature(s) match those on the account to which the transaction originates. Knowing which accounts are authorized to sign transactions, the blockchain may also be used as an authentication system for related data off-chain. In the traditional environment, access to data and validity of data are the responsibility of the database owner, which requires trust by end-users.

Liquid Mortgage Partnership

Liquid Mortgage is a patent-pending digital asset and payments platform for traditional debt instruments. The company provides infrastructure to digitize loans, track documentation, facilitate payments, and record additional information on a blockchain over the life of a loan. Additionally, Liquid Mortgage provides blockchain consulting services for financial services clients.

In late 2020, Redwood Trust entered into an exclusive agreement with Liquid Mortgage to determine how blockchain could be used throughout the residential mortgage loan ecosystem and to execute a pilot program with loans on a blockchain. The primary objective of this partnership is to develop a roadmap for potential blockchain implementation and ecosystem development focused on data integrity, transparency, and post-close processes.

Initial Mortgage Use Cases

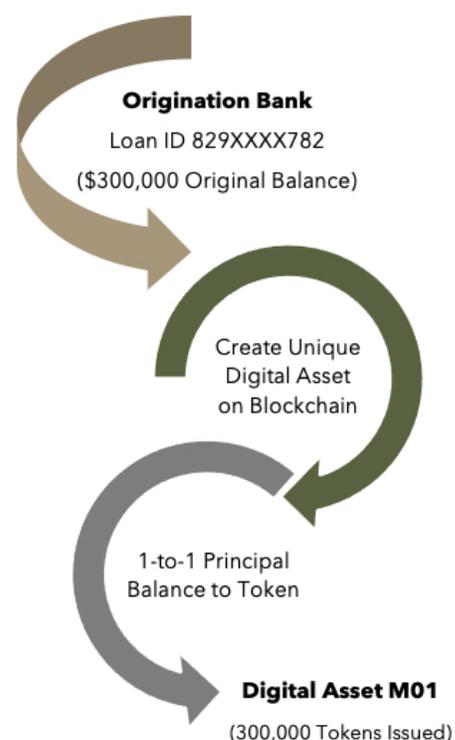
The best way to introduce blockchain technology is to do so within the current ecosystem structure to create cost efficiencies and increase transparency at the loan-level. By working in this manner, current processes and systems can run parallel to a new underlying infrastructure until full adoption is feasible.

Loan-Backed Digital Assets

The first step to implementing blockchain technology in the mortgage ecosystem involves creating a digital asset backed by a single loan. By creating a loan-backed digital asset, any documentation, payments, and transactions may be digitally tracked permanently over the life of the loan. Loan information is tracked without traceability to actual loan information, loan holder, or borrower unless authenticated as one of the counterparties involved in the transaction.

Creating a loan-backed digital asset is important because it allows all future payments, documentation, and transactions to be tied to that specific loan on a blockchain. Without the digital asset, there is no account in which to record the specific loan information. Additionally, blockchain records may be used to authenticate users authorized to view off-chain information related to the digital asset.

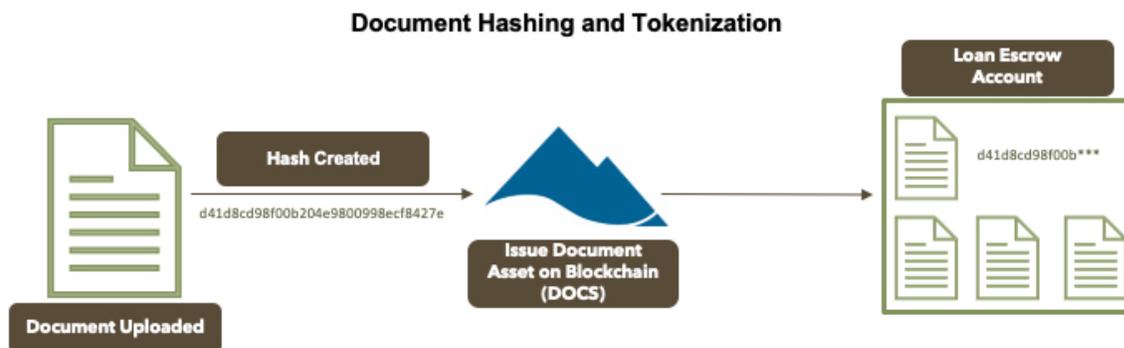
As an example, assume a mortgage loan with a \$300,000 current principal balance. A digital asset named “M01” is created on a blockchain backed by 300,000 units corresponding to the outstanding principal balance of the underlying loan. Over the life of the loan, as principal payments are received, the balance outstanding on the blockchain will decrease in real-time, proportionately with the current balance of the loan. These assets sit in respective blockchain accounts, or wallets, owned by institutions, trusts, individuals, or other parties. Over time, the ability to track these loan-backed digital assets leads to significant opportunities to evolve the mortgage landscape through fractionalization, unique risk structuring, and new ownership models.



Document Tracking

Once a loan-backed digital asset has been created, transactions and information related to the underlying loan may then be assigned to the asset on the blockchain itself. One piece of the process, which is beneficial to all parties, is documentation. To be clear, no documents or personally identifiable information are actually stored on a blockchain. Often loan documents include personal or confidential information, and therefore it could be impractical to store this information in such a domain. Rather,

when a document is completed, a digital footprint of the document is created (known as a hash – a combination of letters and numbers), which is unique to that individual document. If any change is made to this document over time, the hash will change as well. Likewise, the digital footprint cannot be reverse engineered into the actual document.



Knowing this information, a document-backed digital asset may be created to carry this digital footprint and deliver it to a blockchain account related to the loan. This account holds all relevant information related to a specific digital asset over the life of the loan, including the digital footprint of each document-backed digital asset. When a party chooses to validate the originality of a document in the future, it must re-create a digital footprint of the document, then compare it to the record on the blockchain. If a match exists, the document is the validated original. The goal of this process is to provide comfort the original documents are the documents being viewed by the authorized party. Any subsequent changes to documents may be reissued to the blockchain account and the previous document will be retired (although the transaction and hash are always visible on the blockchain for versioning purposes).

Actual physical documents are usually stored in a vault, servers, or elsewhere and pulled from storage during the validation process. This is often a significant “pain point” for loan trades, servicing transfers, and workout situations. The implications of permanent document tracking over the life of the loan should not go without notice. For borrowers, loan investors, servicers, regulators, and all relevant parties, this is a method to ensure a complete loan-level document package over the life of the loan. Additionally, loan-level documentation may continuously be added to the blockchain over the life of the loan with permanent versioning (e.g., FEMA, COVID-related documentation). Only authorized persons or entities may validate the number of documents in a loan file, in addition to the authenticity of such documents. Documents are never published publicly.

Data Memorialization

While any document may be represented on a blockchain through the document-backed digital asset, none may be as important as a document containing the original validated loan data. Often this data will be provided through a third-party due diligence provider and verified for accuracy. Once verified, the data may be placed in a usable file-format (JSON, for example) and include borrower, property,

loan, originator, and additional information. Once created, the file is hashed in the same manner as described in the previous section “Document Tracking” and then stored in a document repository or eVault. Next, the hash is attached to a document-backed digital asset and delivered to an account on the blockchain.

For any future loan sale or transaction, the receiving party need only obtain the original file and validate the hash to the record on the blockchain. If the hash matches, the document is the original and the data may be used as source data. This process is a time and cost savings for loan investors, due diligence providers, and any party authorized to view loan-level data.

Payment Tracking

Accurate, timely tracking of borrower payments and loan performance are extremely important to high-quality servicing and prudent loan investing. With a loan-backed digital asset, all borrower payments may now be tracked and confirmed on a blockchain. As payment information is received from mortgage servicers, the principal and interest paid is allocated to separate accounts and permanently recorded in the blockchain account related to the loan-backed digital asset; as principal payments on the underlying loan are received, the blockchain is updated to reflect a reduction in the balance of the related digital asset.

In the example of the “M01” loan-backed digital asset, assume a \$2,000 payment was received with \$1,500 of interest and \$500 of principal. With 300,000 units of “M01” outstanding on the blockchain (corresponding to principal balance outstanding), 500 units are paid down on the loan and the new outstanding balance on the blockchain is 299,500. All data is posted and timestamped in real-time when the payment information is received.

Over the life of the loan, all payments (e.g., curtailments, servicing fees, escrow amounts) may be tracked through the same process through the blockchain. As a result, servicers and loan investors have better data over the loan term, which increases transparency and effective loan management throughout the ecosystem.

Securitization Transparency

Currently, when loans are placed into a securitization, payment and performance data for the underlying loans are significantly delayed. If borrower payments are due on May 1st, for example, the securitization investor is unlikely to receive any payment data associated with those loans until at least mid-June. By implementing blockchain payment tracking from servicers on the loan-level, securitization investors may receive closer to real-time payment information. While the waterfall-based payments to securitization investors would still not be finalized until the following month by the trustee, investors may see underlying loan performance on a timelier basis. If this information were widely available to qualified investors, mortgage-backed securities markets would become more transparent and efficient.

Future Mortgage Use Cases

As the industry embraces blockchain technology to increase efficiency, transparency, and cost-effective transactions, numerous long-term effects will permanently impact the ecosystem. Some of the following use cases could be replicated through current, antiquated processes, but are made much more efficient through technology.

Real-Time Payments

Using a blockchain-based payments system, investors can access real-time portfolio data as payments are sent directly from borrowers. Borrowers make payments through their bank accounts, funds are received, the blockchain is searched for applicable loan holders, then funds are sent directly to the loan investor(s). Investors may receive a traditional payment via ACH or could be issued a U.S. dollar-backed digital asset on the blockchain. This USD-backed digital asset could be used throughout the ecosystem for purchases, fees, or other transactions.

In addition to borrower payments, funds may be held in escrow on the blockchain for taxes and insurance and to distribute servicing and other fees directly to the appropriate parties. All USD-backed digital asset-based payments on the blockchain are distributed within seconds. Real-time payments would allow all parties to have near-perfect information on loan performance while providing loan investors with immediate cash to reinvest in other assets. Furthermore, real-time payments are the core infrastructure for all additional future use cases.

Real-Time Trading and Settlement

One of the key benefits of digital assets is the speed, cost, and security at which transactions occur. To use a simple example, assume two counterparties would like to trade the loan-backed digital asset mentioned earlier, "M01". Both parties have simple multi-signature validation internally stating two people must sign off on every transaction. The seller captures the two requisite signatures internally and sends the M01 asset into an escrow account on the blockchain. Likewise, the buyer captures two signatures stating the intent to buy and the release of funding. The seller funds the blockchain escrow account with a USD-backed digital asset equivalent to the purchase price of the transaction.

Once the funds and M01 digital asset are deposited into the blockchain escrow account, all counterparties sign off on a final transaction to release funds to the seller and digital asset to the buyer. This entire process, assuming approvals and signatures are obtained promptly, would only take a few minutes as opposed to days in the current environment. Additionally, all documentation, due diligence, and loan data are instantly verifiable from the original hashed records on-chain. The ability to transact at this type of speed creates other unique opportunities and potential for new types of products.

Fractionalization

Given the blockchain-based payment infrastructure and ability to trade and settle in near real-time, digital assets further open the mortgage ecosystem to fractionalization. Investors could more readily now choose to hold whole loan-backed digital assets or fractions of these assets.

The first use case is a mortgage-backed asset manager seeking to structure several types of securities and risk profiles. Let us assume this asset manager has many portfolios and would like to divide loans by a few key attributes: FICO, LTV, Geography, and Loan Size. When a single loan is originated (or purchased), a loan-backed digital asset is created with the corresponding current principal balance outstanding. The digital asset is then assigned pro-rata to these attribute portfolios with 25% of the asset deposited into each portfolio. Once enough loan-backed digital assets are acquired, the asset manager may choose to securitize and sell the attribute-based risk portfolio. Now instead of having a California-only pool of 1,000 loans, the pool may now have 4,000 slices, or even 20,000 slices of loan-backed digital assets with the same allocated capital.

Similarly, assume a small local bank has a limited balance sheet of \$250 million. This bank prefers to maintain its relationship with the borrower but given the size of its portfolio, it has a limit of how many loans it may originate to hold. In the case of fractionalization, this bank could create a loan-backed digital asset, hold 10% of the asset, then sell 90% of the digital asset to the market. Theoretically, this bank could now hold 10,000 slices of loans instead of 1,000 whole loans on its balance sheet.

The diversification impacts and risk profile creation in both scenarios provides great opportunity for the mortgage ecosystem to enhance risk pricing and offer borrowers more competitive risk-adjusted rates. These benefits are possible because the underlying blockchain-backed infrastructure supports fractionalization and one-to-many payments within seconds.

New Products

Creating the infrastructure for real-time trading, settlement, payment management, and fractionalization of loan-backed digital assets, provides an opportunity for new product innovation across the mortgage ecosystem. Some of these products could include:

- Attribute-based loan-backed securitizations
- Closed-end funds backed by fractionalized loan-backed digital assets
- ETFs comprised of loan-backed digital assets
- Distributed warehouse lines across several providers (each holding fractions)
- Senior-Subordinate warehouse lines with fractionalized assets

These are some of the potential opportunities using a new blockchain-backed infrastructure. There are additional products which may be offered directly to different participants in the ecosystem including borrowers, servicers, due diligence firms, and other partners

Recent Accomplishments

This white paper is the culmination of significant research, development, and engagement by the team at Redwood Trust. The following are some accomplishments achieved over the past several months in conjunction with the Liquid Mortgage team.

Extensive Review of Technology and Processes

A substantial amount of time was spent reviewing and thoroughly vetting blockchain technology and the impact, if any, the technology could have on the mortgage ecosystem. During this process, a review of the technology, different blockchains, mechanics, and service providers led to significant internal documentation on the viability of such technology. The following areas were key sources of focus:

- General Blockchain Knowledge and Technology
- Blockchain-Specific Review
- Data-Related Methods and Processes
- Blockchain Reporting and Interaction
- Liquid Mortgage Process and Integration
- Digital Assets and Fractionalization
- Blockchain-Based Payment Systems
- Ecosystem Involvement

After review of these topics, Redwood Trust chose to move forward with a pilot implementation in conjunction with Liquid Mortgage.

SEMT 2020-4 Securitization

As an initial pilot, Redwood Trust and Liquid Mortgage placed all loans in the SEMT 2020-4 securitization on a blockchain test environment. The pool consists of 338 loans and an approximate current principal value of \$294 million as of December 2020. Each loan was assigned its own unique digital asset identifier with an outstanding balance equal to its principal balance at the close of the previous remittance cycle.

Over the next several months, payments will be tracked using publicly available reports² and posted to the test blockchain when received. Digital asset balances will be adjusted according to principal

² Performance information on SEMT 2020-4 is available at: <https://sf.citidirect.com/stfin/index.html>

It is important to note that, for purposes of this simulation, a population of loans collateralizing an actual Sequoia transaction was used, and the results will be used for internal purposes only; no digital assets have been created in a 'live' blockchain environment and the trustee of SEMT 2020-4 remains owner of the related loans for the benefit of the certificate holders. No non-public information relating to the loans and/or their performance will be shared with third parties in connection with this simulation. Our hope is that this test will enable us to incorporate blockchain technology into the live Sequoia platform at some date in the future.

payments and prepayments. Any loans paid off during this period will see the corresponding digital asset retired within the test environment.

Ecosystem Development

Redwood Trust is in discussions with several industry partners to build an ecosystem around blockchain technology. It is imperative to partner with forward-looking organizations to effectively integrate current processes while building infrastructure for the future. With full realization the industry will not change overnight, adding innovative partners over time will begin to capitalize on the opportunity to enact change.

Final Comment

There exists an opportunity for industry constituents to come together to reimagine post-close processes using technology to make the ecosystem more robust and better for all. This white paper has outlined the key pain points in the industry and has proposed solutions to resolve these issues and build infrastructure for the future of the mortgage industry. By implementing certain facets of blockchain technology today, the industry can streamline document validation, data memorialization, payment systems, and performance reporting. Building on this base infrastructure, the industry can look to a future of real-time payments, real-time trading, fractionalization, and the advent of new financial products.

Redwood Trust is excited to be involved in the development of a new ecosystem which focuses on data accuracy, validation, and transparency. Implementing blockchain technology will increase efficiencies throughout the system, lead to overall cost reductions and, ultimately, benefit mortgage borrowers. If you or your firm would like to be involved in the next generation ecosystem, please contact Redwood Trust or Liquid Mortgage for more information.

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