Blockchain and the Credit Union: The Asset Transfer Revolution

Executive Summary

Blockchain technology has captured the imagination of the financial services industry, including credit union leadership. Fintech companies, traditional technology firms and scores of startups are evaluating the application of this new approach to a wide range of use cases, from person-to-person payments to financial institution-grade intra-bank settlement, and even programmable contractual relationships, also called smart contracts.

The blockchain design is essentially a form of database that is optimized for ledger-based use cases. The blockchain ledger database is distributed across multiple devices. Users of a blockchain-based database trust the ledger because the entire community validates the integrity of each transaction using common software and operating rules. As a result, ledger access can be granted to a wider range of stakeholders than is typical for traditional database systems. Further, the ability to initiate a transaction—to move value from one owner to another—is held by the owner of the asset, not by the owner of the entire database. This combination of wide distribution and granular transaction control is unique, giving rise to a flood of ideas on how best to employ it.

Encouraged by blockchain reliability, technologists are exploring its capabilities. Led by some of the largest financial institutions and technology service providers like IBM, consortia are exploring what is required to put the technology and the

About this White Paper

This white paper is the result of collaboration between PSCU and Glenbrook Partners. Because payments are a core service of credit unions, PSCU asked Glenbrook to examine blockchain technology and its potential for credit unions. To build a credit union roadmap, Glenbrook interviewed CU leaders from across the country. In our discussions, we found significant awareness and much discussion among credit unions regarding applicability of blockchain technology to the credit union industry.

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business and legal arrangements in place. For some participants, fear of being left out has been reason enough for participation.

Along with other financial institutions, credit unions are rightly examining the implications of blockchain technology for their members and their own operations. Credit union leaders have identified settlement, record keeping and identity management as potential use cases.

An important challenge for credit unions as a whole is to identify a handful of specific cases that would benefit the entire credit union community and, perhaps, other smaller institutions, working together to bring the new technologies into common use. Blockchains are built for broad, collaborative access to data. An industry-wide application could be the most effective approach, one that could also strengthen the credit union industry as a whole. It is reasonable to expect that blockchain technology will have long-range impact on all financial services players, but its short-term value for credit unions remains unclear.

Credit unions are actively evaluating the potential of this new technology. CULedger[1] is a collaborative effort among CUNA, Best Innovation Group, the Mountain West Credit Union Association, PSCU and other industry partners to examine blockchain operation and to pilot useful applications.

Blockchain evolution in financial services is at the beginning stage. It will take five years or more to develop cost-efficient, fully proven blockchain-based alternatives to traditional approaches.

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Blockchain Basics

Blockchain technology is a novel, yet proven, approach to storing, securing and sharing data. Blockchain databases are especially applicable to ledger-based uses—when it is necessary to record balances, debits and credits that transfer value. They are ideal for recording transaction histories, ownership records—almost anything associated with value. Blockchain-managed data is referred to as "distributed" because it is hosted on every computer in a network running the same version of software. That software uses familiar, strong cryptographic techniques to ensure that every network node agrees on data accuracy. Any counterfeit transactions are detected and rejected. Strong security contributes to a growing consensus among both technologists and business people that blockchains are trustworthy custodians of sensitive data and are capable of sharing data accurately across multiple stakeholders.

[1] *www.culedger.com*

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The blockchain database was invented to serve as the transaction ledger for a virtual currency called Bitcoin. Bitcoin needed a public ledger that could exclude counterfeit transactions in a manner that was transparent to the whole Bitcoin ecosystem. The blockchain data structure and software have proven resistant to compromise and resilient in the face of attacks. Those strengths have inspired confidence in this novel form of a distributed ledger. Because it has succeeded in its mission—despite some bad actors—the blockchain approach has generated interest for other uses beyond Bitcoin, especially in financial applications.

The blockchain approach is particularly useful for tracking balances and ownership of money and asset types. The blockchain data structure records every transaction, making that history available to a wide set of users.

What is a Blockchain?

To paraphrase Adam Ludwin[2], CEO of fintech blockchain firm Chain, think of a blockchain as an enormous wall of mailboxes. A unique number is printed on the door of every box that is visible to anyone—its public address. Every door also has a slot in the front through which others can push items (a mail slot in a home's front door), but items cannot be backed out. No one can reach through the slot to remove the contents. It's secure because only the box owner has the key, so only the box owner can open the mailbox and move some or all of its contents to another mailbox.

In other words, the owner has a private key and the recipient has a public address. To make a transfer, the recipient tells the sender which public address to use. The sender shifts control of a specific value or a specific asset to the recipient, and that fact is recorded on the blockchain. The owner's key essentially allows the transfer of whatever's held in the owner's box to a new owner. This approach uses well-understood public and private key cryptography.

Just as with physical keys to a home or building, maintaining careful security over a private key is required, since possession of the key confers control of valuables inside. That is why multi-factor authentication like PINs, out-of-band text messages and biometrics are typically used by blockchain-based systems.

Another important attribute of the blockchain approach is that every such change in ownership is recorded permanently into the blockchain. As a result, blockchains provide superior auditability because software can inspect the blockchain—the record written on each and every door—to discover how money or ownership of an asset has changed from the moment the asset was first recorded in the blockchain.

[2]*https://medium.com/chain-inc/why-central-banks-will-issue-digital-currency 5fd9c1d3d8a2#.48jt57ofp*

Currency, Commodity, or Database

Blockchain-based systems can possess multiple, simultaneous roles. Consider Bitcoin. It functions as a currency. It also enables transactions, acting as a digital payments system. Bitcoin's price and cost of production also make it behave at times like a commodity. Its price fluctuations suggest it is a more volatile version of gold, another store of value.

But the most important quality, and the one under primary consideration here, is the role of the blockchain technology it pioneered as an immutable ledger, a permanent record of transaction history and asset transfer between sellers and buyers, available to multiple participants in either a permissioned or permissionless mode.

A Permanent Record

Another attribute of this database structure is its immutability. Relational databases and other record keeping techniques can be hacked without immediate detection if someone obtains the ability to change a ledger balance. It has happened before.[3] Blockchains make such a hack nearly impossible for two reasons. First, there is not just one copy of the blockchain. Copies exist on every computer that runs the blockchain management software, performing what is essentially the transaction-processing task. Second, the transaction-processing software includes algorithms that make it impossible to enter counterfeit transactions or change a transaction record without detection. Blockchains have removed the counterfeit risk. The strong mathematical basis of the software detects fraudulent changes and rejects them automatically. To stay in sync, the members of the blockchain community validate every new transaction against the blockchain and communicate with one another in order to propagate the latest transaction data and ledger status.

Permissioned vs. Permissionless Blockchains

A compelling characteristic of a blockchain-based system is how it expands the pool of users accessing its data. Because it is so difficult to hack, a database of this kind may be opened up to many more participants than the typical ledger-based systems managed and secured by a single entity. The users of today's databases are generally well-known and typically are members of a given enterprise. Administrative privileges of a core system, for example, are confined to the core system provider's personnel; its credit union customers may administer only a subset of accounts with a subset of privileges. As the sensitivity of the data increases, so does the level of access control. Opening up a sensitive database to tens or hundreds of companies, and thousands of employee users, has been impractical.

The promise of blockchains is placing the ability to alter individual ownership records into the hands of the asset owners themselves through the private

[3] *http://www.computerworld.com/article/2497272/government-it/payment-card-processors-hacked-in--45-million-fraud.html*

> Users have to trust that the software system, never mind the organization that built it, will continue to operate over decades.

key mechanism. Depending upon the blockchain mode, access to the database can be wide open or restricted. For inspection purposes such as an audit, access to the entire database is available.

Two blockchain modes exist, reflecting different approaches to system control and management.

- Permissionless blockchains allow any computer to run the blockchain protocol and join the network of computers running that software. Bitcoin is the first and best example. There is no central authority, no Bitcoin Inc., no company licensing the software or selling services. Permissionless approaches take considerable computing power to run the transaction processing protocol that eliminates counterfeit risk and maintain the blockchain's accuracy. Bitcoin transaction processing times can be lengthy (over 10 minutes) and volume limited because the mathematics required to maintain security are intensive. Yet, as a result, trust in the system is well-established and maintained. It also makes changes to the protocol difficult because so many systems run the same software.
- Permissioned blockchains require membership. Closed groups of known participants cooperate to maintain a common blockchain. They may work with one or more technology providers to develop and maintain it. Most of the pilot programs currently under way among financial institutions and fintech providers operate in this mode. Such limited membership simplifies the trust problem—it's easy to manage access and find bad actors—making it comparatively straightforward to update transaction processing rules and parameters to suit member requirements. Limited membership also simplifies system governance, although consortia have also proven difficult to manage over the long term.

Blockchain Governance

There is agreement that blockchain software, running as it does on multiple systems, is resilient to faults and reliable, provided it has been tested under commercial conditions. However, an important question remains: Who manages the blockchain for the long term? Blockchains are being considered for the custodianship of long-term ownership relationships such as loan agreements, stock ownership and even land titles. The management of blockchains has to address time horizons that span multiple decades, if not centuries.

The Bitcoin experience is a case in point. While the software does its transaction

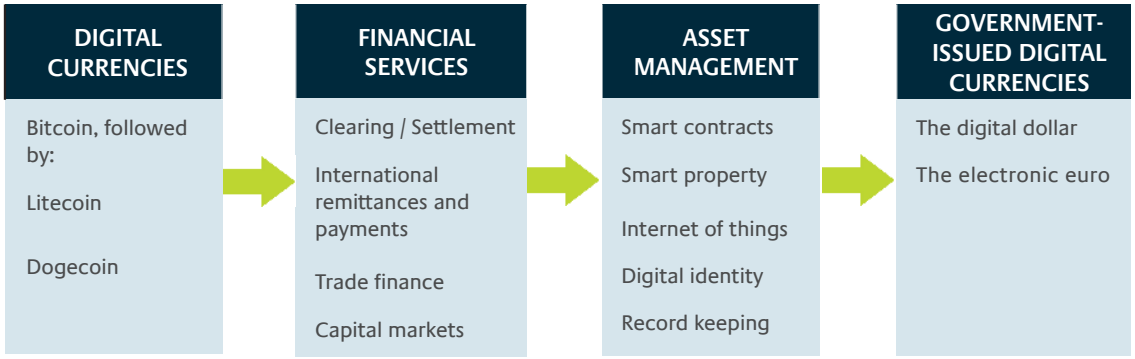
processing tasks reliably, the decision-making process around upgrades to that software and the overall evolution of the Bitcoin system is nearly broken. Decision-making is shared by a handful of software engineers who are unable to agree. This has led to a planning stalemate that remains unresolved.

Obviously, that is untenable for commercial systems. Users have to trust that the software system, never mind the organization that built it, will continue to operate over decades. The governance of such a system—how its rules change, how the system is maintained and upgraded, how its management evolves—has to be established and maintained in a transparent manner. These tasks require human action and intervention. Change is an inevitability that platform designers must address. Expecting any system to run autonomously for decades without human intervention runs contrary to both human and technological history.

Blockchain Use Cases

The following section discusses a range of blockchain use cases, from simple person-to-person transfers of value to more complex, large-scale possibilities. Figure 1 illustrates the possible evolution of blockchain-based use cases.

Figure 1: Potential Evolution of Blockchain Use Cases



Person-to-Person Payments (P2P)

Person-to-person (P2P) payments are viewed by many as the original use case for blockchain-based transactions—Bitcoin for example. But connecting Bitcoin currency to a dollar-denominated account (or any other flat currency denominated account in other geographies) has been a challenge because simply buying Bitcoin is an awkward and complicated process. In the United States, P2P uses of blockchain have gained little traction because there are plenty of functionally equivalent alternatives, such as PayPal, its Venmo subsidiary, Early Warning's Zelle (formerly clearXchange) and others.

More recently, however, an emerging class of person-to-person service providers has chosen to use the Bitcoin blockchain as payment rails used behind the scenes. Rather than requiring the customer to touch Bitcoin at all, these providers handle the currency exchange step and simply use the Bitcoin blockchain as a way of moving money among their own operations. Circle Internet Finance (circle.com), for example, has focused on strong national regulatory compliance, including Anti-Money Laundering (AML) and Know Your Customer (KYC). As a result, the company offers its users accounts denominated in USD, pound sterling, euros or Bitcoin. Circle operates in the United States, the United Kingdom, the European Union and is expected to begin service in China in 2017. Circle uses Bitcoin when useful for transfer purposes but has little need to expose that fact to its users.

International Remittances and Payments

While Bitcoin proponents have held up international remittances as a strong Bitcoin use case, services provided by Western Union, MoneyGram, Xoom and others address those needs very well. The cost of converting to and from Bitcoin at either end of the remittance process makes Bitcoin less useful for this application today, especially when agents are needed at the recipient's end to dispense cash. For the time being, most remittance recipients still prefer to receive funds in cash.

As with Circle, however, some providers are using the Bitcoin blockchain to make international payments fast and predictable, both in terms of price and timing. Consider Align Commerce, a firm specializing in small business cross-border payments. Targeting globally oriented manufacturers, importers, wholesalers, service providers and other users of cross-border payments, Align's service lets a small business in the United States, for example, pay a German supplier in a matter of hours. First, the small business sends U.S. dollars to Align. Align converts those dollars to Bitcoin and, within an hour or less, has its German operation pull that value off of the blockchain for conversion into euros and deposit into the supplier's demand deposit account. This can't be done today using standard correspondent banking arrangements and the SWIFT messaging system.

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Financial Institution Settlement

If small value transactions can be facilitated via blockchain, why not large-scale transactions between financial institutions? Both central banks and leading commercial institutions are, in fact, already exploring that potential. The R3 CEV consortium, for example, offers its more than 50 global members the chance to evaluate the collaborative use of a distributed ledger mechanism for interbank settlement and the trading of various assets such as stocks and bonds. The consortium is piloting other use cases, too. The consortium expects to expand membership as it develops its distributed ledger platform and pilot use cases over the next three-plus years—it will take that long to bring blockchain-based technology to operational readiness. The blockchain approach must offer clear advantages in terms of cost and reliability. Those advantages may not be a given, however.

Another player is Ripple Labs, a provider of a distributed ledger whose focus is entirely on cross-border, interbank settlement and settlement between the national units of global financial institutions. Processing transactions within eight seconds, Ripple has successfully demonstrated cross-border payments via a blockchain ledger between two financial institutions: Canada's ATB Financial and Reise Bank in Germany. Ripple claims to be in negotiations to bring 10 more banks into commercial production. Ripple has also attracted personnel experienced in international payments, including veterans of SWIFT.

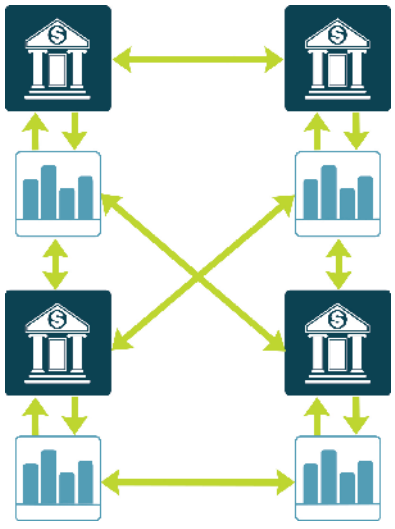
Asset Exchange

So far we have considered the transfer of money between parties, whether consumers, businesses or financial institutions. The concept of a trusted record of asset ownership, however, has application far beyond the transfer of currency. Other asset classes being considered, or in active pilot, include stocks, bonds, derivatives, land titles, mortgages, commercial and retail loan documents.

Blockchain-based stock trades, for example, could clear and settle within 10 minutes—much faster than the typical two to three days using current technology and processes. That tight timeline substantially reduces settlement risk and improves liquidity.

Figure 2 depicts settlement flow in a blockchain environment. Elimination of centralized settlement is faster and more secure.

Figure 2: Decentralized Settlement



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One of Chain's founding investors and partners is the NASDAQ stock exchange. It has created a blockchain-based stock exchange to record the sale and ownership transfer of pre-IPO private stock. Called Linq, it speeds the heavily manual process of documenting the trade. Not surprising, the first stock to be transferred on the blockchain was issued by Chain.

Significantly, some of these benefits may accrue even without blockchain-based payments as part of the transaction flow. Faster Payments, Same Day ACH, wires or another payment system may conduct the actual transfer of value, while a blockchain records the change in asset ownership. The blockchain could even record that the payment for that asset transfer had taken place. While clearing and settlement may also be part of the transaction flow, they may not be required functions for a blockchain solution. In other words, the payment function could remain a function of financial transfer systems as ownership transfer processes move to blockchain technology.

Figure 3 demonstrates the breadth of assets that blockchain proponents view as candidates for recording on a blockchain. This is just a partial list of the scores of ideas considered for blockchain use.

Figure 3: Potential Asset and Data Transfer Use Cases

FINANCIAL SERVICES	PUBLIC RECORDS	PRIVATE RECORDS
Currency	Land titles	Contracts
Private equities	Vehicle registration	Signatures
Public equities	Business license	Wills
Bonds	Incorporation / Dissolution records	Trusts
Derivatives / Futures	Passports	Escrows
Commodities	Birth / Death certificates	GPS trails
Mortgages / Loans	Health / Safety inspections	
Crowd funding	Court records	

Record Keeping

In our discussions with credit union leadership, we heard about the potential benefits of a blockchain-based asset tracking and transfer mechanism for record keeping, a time-consuming, labor intensive activity all too familiar to credit unions. Indeed, this challenging process may turn out to be among the most-compelling application for blockchain-based databases. With straightforward access to a trusted record of each asset transfer, transaction counterparties will gain efficiencies.

Consider the notion of a blockchain dedicated to auto loans. Open to financial institutions, automobile manufacturers, leasing companies, state and local governments, and, perhaps, to consumers, this blockchain tracks vehicle ownership and loan ownership. It may use another blockchain-based mechanism to assure the identity of those transacting on the system. Based on access rights and controls, this database would allow each stakeholder to inspect the status of individual loans and to support ownership transfer.

A system like this would speed and condense what is currently a multi-step process, reduce paperwork and have the potential to lower costs, especially once a majority of stakeholders use the system. Such a system lays the groundwork for other automation opportunities that operate over the "Internet of Things." Should a loan delinquency get too far, for example, a signal could be sent to disable the vehicle and provide its GPS location to a recovery company.

Identity Management

Another potential opportunity identified by credit union leaders is security, in particular, the application of blockchain technology to manage identity. The idea is to use a blockchain to hold proof of a user's identity through the storage of a digital representation of a driver's license or birth certificate, a passport, a biometric such as a fingerprint, a photograph or other data. This consolidated identity management concept contrasts with the status quo. Today, our digital identities are scattered across diverse online services and in the databases of credit bureaus, marketing companies and, most deeply, in the hands of platform companies such as Google, Facebook, Amazon, Apple and Microsoft.

Identity management is a complex concern, however. A database holding unalterable representations of identification credentials may be useful but, as every credit union knows, it is insufficient because the source of those credentials has to be validated. That's the KYC step. Credit unions have performed much of this KYC work and, as an industry known for its member focus, could enhance member services by developing such an identity management platform. That said, it is a major task. While credit union interests and competencies overlap with the identity management problem, identity requires an ecosystem-wide evolution across multiple functions. Blockchain technology may contribute to the overall solution.

Smart Contracts

As software, blockchain systems can be modified to achieve different goals. Some, like Bitcoin, also have a measure of programmability. A Bitcoin address can be programmed to require, for example, multiple approvals for a single transaction. But Bitcoin's scripting language is not a full programming language (it is not capable of doing loops and other basic program execution functions) so its utility is limited.

Enter Ethereum, a permission-less blockchain-based digital currency that comes with a full programming language. It is through that programming language, and the growing value of its corresponding currency "ether" (now around $1 billion in market cap), that the Ethereum platform is able to support the execution of smart contracts. Ethereum can be thought of as a service layer that sits on top of an asset management blockchain. It is the service layer that executes the contracts.

From a technical point of view, smart contracts are software programs that execute when certain conditions are met. Consider these examples:

- A smart contract runs when a member pays off her auto loan, automatically transferring the title to her and recording the ownership change with the relevant state, the loan provider and a credit bureau.
- A simple bequest to a young relative could be expressed as a smart contract to execute when two conditions are met: the donor has passed away and the recipient is over 25 years of age. Once those two conditions are met—both conditions testable using publicly available data—the value stored in the donor's blockchain-based account is transferred to the beneficiary. Optionally, ownership alone changes and the value is transferred by traditional means.

The programmability of the Ethereum platform means it could be applied to far more sophisticated applications, including the creation of businesses entirely defined and operated in software.[4] But smart contracts are not restricted to Ethereum. In the permissioned blockchain world, R3 is using its Corda platform as a test bed for smart contract templates with the UK bank Barclays to standardize and strengthen the connection between software and legal contract language.

Indeed, almost every major technology provider is examining its role in the development of blockchain-based capabilities, including Microsoft and IBM. IBM, for example, has contributed software and financial support to the Hyperledger Project, an industry collaboration targeting large financial institutions.[5]

Government-Issued Digital Currency

Taking the concept another step further, proponents of blockchain-based distributed ledgers suggest central banks should evaluate issuance of digital national currency. And central banks are listening. The U.S. Federal Reserve has held meetings

[4] *https://en.wikipedia.org/wiki/Decentralized_autonomous_organization*
[5] *https://www.hyperledger.org/*

with domestic and international bankers to discuss government-issued digital currency. The Bank of England has considered how it may use a government-based version of pound sterling.[6] Canada has conducted an early-stage pilot using the R3 CEV technology to examine blockchain potential for financial institution settlement applications.

Despite the excitement, caution is in order. As Carolyn Wilkins, Senior Deputy Governor of the Bank of Canada puts it, "Other frameworks need to be investigated, and there are many hurdles that need to be cleared before such a system would ever be ready for prime time."[7]

Conclusions

Beginning of the Beginning

Blockchain evolution has entered an active testing and early piloting phase. Outside of the Bitcoin network—the most established blockchain in production today—the technology's potential is being closely evaluated. Bear in mind, however, that even the strongest advocates of the technology's versatility recognize that determining appropriate use cases and building production-ready systems will take five years or more.

Further complicating this evolution is the fact that many of the use cases involve financial transactions and custodial functions, all subject to multiple layers of regulation across many geographies and jurisdictions. None of our existing regulations anticipated blockchain-based approaches such as the automation of compliance oversight or contract execution. This is not the only contemporary example of technology capabilities threatening to outpace regulations. Look at Uber and Airbnb. While those firms forced regulators to catch up with their innovation after they had entered the market, the financial nature of many blockchain implementations strongly suggests that any necessary regulatory changes will need to be well underway prior to production.

Leading organizations in blockchain development such as R3 and Digital Asset Holdings are focusing their efforts on international payments, securities markets, and trade settlement. Important areas, yes, but of little relevance to credit unions.

Blockchains Will Manage Assets—Payments Systems Will Move Money

Blockchain usage may well be focused, not on payments, but on the immutable, distributed, shared recording of asset transfers between owners. The payment for those assets themselves could well be conducted using payment systems under the control of financial institutions and central banks, especially those with the attributes of real-time clearing and settlement.

In other words, credit union payment revenues will not be eroded by blockchain approaches in the foreseeable future. This outcome is very different from what was envisioned by Bitcoin visionaries who imagined a world of payment and asset

[6] *http://www.bankofengland.co.uk/publications/Documents/speeches/2016/speech914.pdf*
[7] *http://www.ft.com/cms/s/0/1117c780-3397-11e6-bda0-04585c31b153.html#axzz4EDxCod00*

transactions without need of a central authority. Reality indicates otherwise. Individual transactions and day-to-day operations may be entirely automated and autonomous via a blockchain; even audit functions may be largely automated and self-reporting. But the payment function will be under traditional controls.

Recommendations for Credit Unions

Credit unions have good reason to be excited about the potential of blockchain technology. It may function as an asset custodian, improve record keeping and automate contracts. Still, it's important not to get caught up in the hype. We recommend the following steps:

- **Act as an Industry.** One of the singular aspects of a blockchain is its ability to securely and reliably share critical data across a broad base of stakeholders. This characteristic, coupled with the sheer complexity of blockchain technology, precludes an isolationist approach to developing services that will ultimately need to benefit the entire credit union industry. Whether the answer is an auto loan application, an identify management opportunity or some other systemic service, acting as a unified industry could be an effective strategy. Credit unions' interests are better served through a coalition of credit unions, trusted industry partners and advocates working collaboratively and with a commitment to take advantage of blockchain power. Given the pressure from technology-driven competitors, the benefit of acting in concert as demonstrated by the CULedger initiative could be potentially transformational.
- **Monitor Blockchain Activity.** Monitoring ever-increasing blockchain activity will be important during the next several years. Assign that task to a team or identify an individual responsible for tracking the intersection of blockchain technology and credit union mission. Have them report on a quarterly basis on the state-of-industry consortia, regulatory discussions, experimentations and pilot testing, looking in particular at innovations in loan management, identity management and smart contracts.
- **Scrutinize Blockchain Management.** To serve the long-term interests of members, credit unions must cautiously assess blockchain-based initiatives that must run for years. Asset tracking and smart contract services must offer high reliability and availability for decades, so a critical consideration is the long-term operation and management of these services.

Disclaimer

These are "early days" for blockchain use in financial services. Mention of specific companies is only made to illustrate the trends and pilot programs that we view as important. Inclusion in this white paper is not an endorsement of any business or particular approach nor is lack of mention meant to imply criticism. This is a dynamic area, and we will see many firms enter and leave as the technology and its use evolve.

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About Glenbrook Partners

Founded in 2001, Glenbrook is a payments industry strategy consulting and research firm. The firm brings its clients a unique combination of our specialized skills in payments, many years of hands-on experience in the field, and our network of professional relationships.

Glenbrook serves payments professionals in many different kinds of companies, including payments services providers, card networks, technology and risk management companies, financial institutions, merchants, and corporate treasury managers. Glenbrook enjoys meeting and working with start-ups in the industry as well as managers from leading companies that are looking to innovate.

Glenbrook's team is composed of executives with broad exposure to many facets of the payments industry, including business management, marketing, technology, operations, and risk management.

Glenbrook offers our clients strategy consulting, research, competitive intellegence, and industry education programs. Glenbrook also facilitates industry collaborations and provides landscape overviews of emerging payments.

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