Blockchain in Banking: A Measured Approach

Blockchain is emerging as a potentially disruptive force capable of transforming the financial services industry by making transactions faster, cheaper, more secure and transparent. Here's our foundational view on how the market is taking shape and what banks should consider as they move from ideation and experimentation to pilot deployments.

Cognizant

Executive Summary

If market hype is any indication, blockchain – the underlying technology for cryptocurrencies such as Bitcoin – is poised to solve multiple challenges facing the banking industry by enabling faster, secure and more transparent transactions. Yet the story of blockchain is one of unintended consequences.

Blockchain, also known as a distributed ledger technology,[1] was originally created as a tracking database for Bitcoin transactions. It was developed in 2009 to enable individuals and organizations to process transactions without the need for a central bank or other intermediary, using complex algorithms and consensus to verify transactions. Fast-forward seven years, and an array of startups and established technology, banking and finance players today are betting on blockchain to provide a reliable alternative to systems that depend on intermediaries and third-party validation of transactions. Their goal is to leverage blockchain's distributed ledger approach to create a system that decentralizes trust – a radical departure from existing transaction processing methods – to significantly slash all types of transaction fees and reduce processing times.

The disruptive potential of blockchain is widely claimed to equal that of the early commercial Internet. A crucial difference, however, is that while the Internet enables the exchange of data, blockchain could enable the exchange of value; that is, it could enable users to carry out trade and commerce across the globe without the need for payment processors, custodians and settlement and reconciliation entities.

Although blockchain is posited as an open system for transaction processing across the financial system, banks are looking inward, experimenting with the distributed ledger approach to create efficiencies and a single version of digital truth. Their goal is to automate processes, reduce data storage costs, minimize data duplication and enhance data security.

Similar to the Internet and e-commerce, an open-to-all blockchain that disrupts the traditional financial market might only result from trial-and-error deployments within limited parameters, whether through internal trials or partnerships between incumbents and startups. However, to realize the full potential of blockchain across the financial system, the banking industry will need to come together and set standards that enable interoperability.

That said, banks planning to deploy blockchains need to answer a series of fundamental questions. For example, given that existing systems are built on reliable legacy solutions, how will they determine which process to move to a blockchain? Further, given blockchain's fast-changing landscape, it is critical to develop a thoughtful, long-term plan of action (e.g., experimenting, strategically deploying and then scaling in a logical progression) to ensure a successful transition from centralized legacy to fully distributed digital transaction processing.

We believe the key considerations for banks exploring blockchain include:

- Identifying opportunities for innovation.

- Determining feasibility and impact on existing systems.

- Testing proofs of concept.

- Understanding the regulatory and data security implications.

- Dissecting the blockchain implementation: open vs. permissioned.

- Planning for transaction scalability.

- Forming partnerships and cross-functional and cross-industry collaboration.
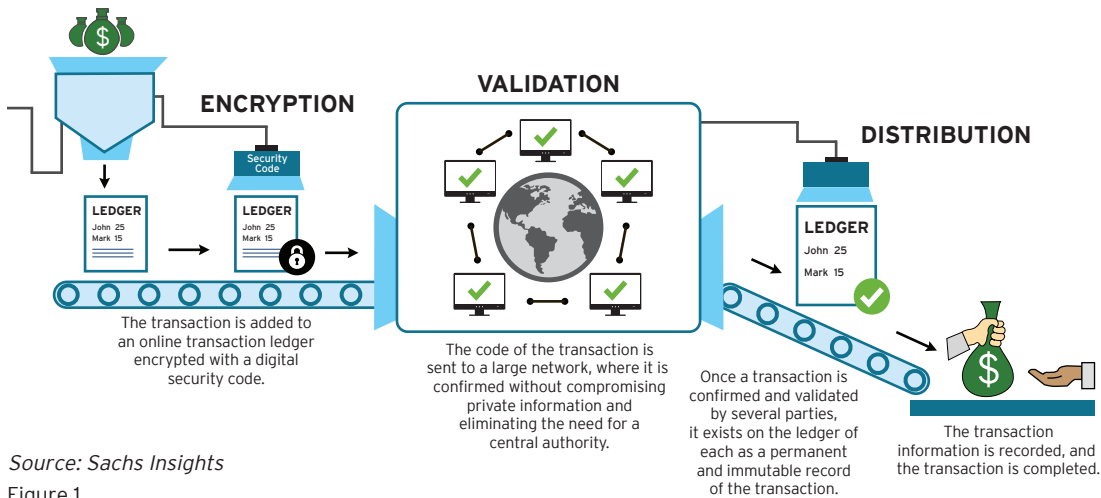
Blockchain's Promise: Banking and Beyond

Ever since the first Bitcoin transaction was carried out in January 2009, the digital cryptocurrency has been a topic of debate. While banks and regulators have largely remained wary of Bitcoin, the underlying technology of blockchain and distributed ledger began attracting the attention of banks and startups by the end of 2013.

The lure of blockchain was its method of verifying and tracking transactions. Instead of a trusted third-party or a central bank, it relies on consensus among a peer-to-peer network of computers based on complex algorithms. Rather than being stored in a single database, blocks of time-stamped transactions are stored on all systems across a value chain (see Figure 1, next page). This elimination of middlemen and

Anatomy of a Typical Blockchain Transaction

Here's a step-by-step breakdown of how a transaction between two parties occurs algorithmically via distributed ledger technology.

ENCRYPTION
The transaction is added to an online transaction ledger encrypted with a digital security code.

VALIDATION
The code of the transaction is sent to a large network, where it is confirmed without compromising private information and eliminating the need for a central authority.

Once a transaction is confirmed and validated by several parties, it exists on the ledger of each as a permanent and immutable record of the transaction.

DISTRIBUTION
The transaction information is recorded, and the transaction is completed.

Source: Sachs Insights
Figure 1

decentralization of trust has introduced possibilities to make processes such as cross-border payments, trading and settlement faster, more reliable and less costly.

Blockchain's foundational elements include:

- **Decentralization:** Rather than one central authority controlling everything within an ecosystem, blockchain distributes control among all peers in the transaction chain, creating a shared infrastructure.

- **Digital signature:** Blockchain enables an exchange of transactional value using unique digital signatures that rely on public keys (decryption code known to everyone on the network) and private keys (codes known only to the owner) to create proof of ownership.

> ### Data stored on blockchain acts as a single version of truth for all parties involved, reducing the risk of fraud.

- **Mining:** A distributed consensus system rewards miners for confirmation and verification of transactions and stores them in blocks using strict cryptographic rules.

- **Data integrity:** The use of complex algorithms and consensus among users ensures that transaction data, once agreed upon, cannot be tampered with. Data stored on blockchain thus acts as a single version of truth for all parties involved, reducing the risk of fraud.

Efficiencies and Cost Reduction

In addition to enabling trade, blockchain's theft- and tamper-resistant model can also be applied to non-monetary transactions. Because it eliminates errors and duplication, blockchain is ideal for transforming a host of digital processes. Key benefits of blockchain include:

- Reduction of settlement time to mere seconds by removing intermediaries.

- Replacement of trusted third parties with access by all participants in the value chain to cloud-based assets that verify each party's identity.

- Significant security enhancement in areas such as payments and credit card fraud through a decentralized public transaction record that stores details of every transaction and undergoes continuous verification by miners.

- Material cost reduction through the elimination of expensive proprietary infrastructure.[2]

- Elimination of error handling through real-time tracking of transactions with no double spending.[3]

- Full automation of transactional processes, from payment through settlement.

- Removal of documentation bottlenecks caused by duplication.

- Risk reduction through data integrity ensured by chronological storing of data enforced with cryptography. This, in turn, reduces the compliance burden and cuts regulatory costs in areas such as know your customer (KYC) initiatives.

Increased Competition

Blockchain can also enable entry into markets that have traditionally been dominated by banks and other financial institutions. In the modern digital era, banks have seen an increase in competition from non-banking players in areas such as mobile payments and lending; blockchain is likely to intensify such competition, as it will reduce technological barriers for digitally savvy non-banking entrants. Some examples include:

- **Permissioned blockchains:** Companies could create blockchains restricted to select clients for a specific purpose. Such a service is offered by SetI,[4] which has created a permission-based ledger system that can move cash and assets in real-time to settle market transactions.

- **Liquidity creator:** A blockchain-based system can allow companies to become market makers and open up cash in exchange for completing a cross-border transaction at a lower rate. This could allow non-profit entities to compete with banks.

- **Equity funding:** A blockchain-based platform could provide crowdfunding of equity financing using smart contracts (see Quick Take, page 7).

- **Hybrid lending:** Companies can look for funding from blockchain-based peer-to-peer lenders. Since such lenders would have lower operational costs than traditional banks, they could charge lower interest rates. The Lending DApp network by LoanCoin[5] is an example of hybrid lending.

For banks, this should be a signal to up their game in these areas, perhaps by creating their own versions of these platforms on a blockchain, as non-traditional players, equipped with technology and free of regulatory compliance requirements, could make quick inroads into their traditional strongholds.

New Banking Vistas

Blockchain is also expected to create a new set of opportunities for banks to partner with startups exploring niche business areas (see Figure 2, next page). These include:

- **Internet of Things (IoT) plus blockchain:** Smart devices can be enabled to carry out autonomous transactions through smart contracts.

- **Tracking healthcare allowances:** A blockchain-based system could ensure that care allowance is spent exclusively on healthcare activities. The system can save time spent on reconciliation after every transaction, helping with straight-through processing.

- **Trading anything:** A platform could enable tradable exchange for any under-utilized asset (e.g., Wi-Fi routers, computer storage, coupons, etc.) in return for a service or product already agreed upon.
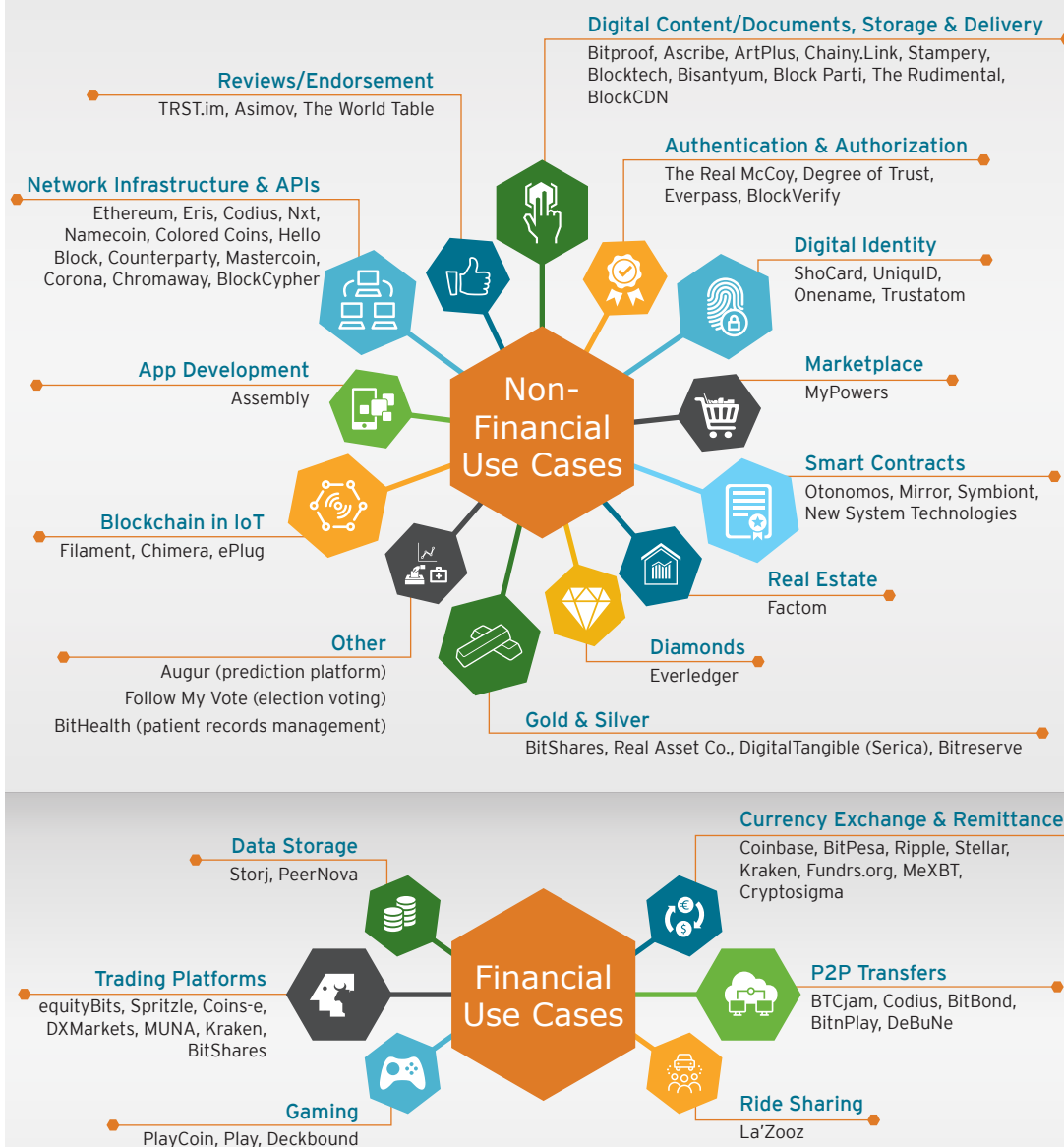
A Rush of Startups and Incumbents

The attractiveness of blockchain (and the resulting applications) can best be gauged by the kind of attention it garners from startups and incumbents alike, especially in banking and finance. One estimate puts the number of blockchain startups at more than 200,[6] with an average valuation of $4.4 million. Venture capital funding for Bitcoin and blockchain startups reached $1 billion in 2015,[7] and some expect blockchain funding to hit $2.5 billion in 2016.[8]

Meanwhile, many top U.S. and European banks are exploring blockchain applications by either partnering with startups or creating innovation labs to test their proofs of concept. A prominent example is the consortium formed by blockchain startup R3, which has so far attracted 42 international banks and financial institutions. R3 has created a shared laboratory setting to bring blockchain technology to the financial system. It recently connected 11 partner banks to a peer-to-peer distributed ledger[9] and has put in place industry standards and protocols for blockchain in banking; it will also develop commercial applications for banks and financial institutions.[10] R3's efforts to create industry standards is a small but significant step toward creating interoperability of blockchain solutions across the financial system.

Areas of focus for banks and startups include cross-border payments, trading activities, custody services and customer behavior analysis.

A Plethora of Use Cases

Digital Content/Documents, Storage & Delivery
Bitproof, Ascribe, ArtPlus, Chainy.Link, Stampery, Blocktech, Bisantyum, Block Parti, The Rudimental, BlockCDN

Reviews/Endorsement
TRST.im, Asimov, The World Table

Authentication & Authorization
The Real McCoy, Degree of Trust, Everpass, BlockVerify

Network Infrastructure & APIs
Ethereum, Eris, Codius, Nxt, Namecoin, Colored Coins, Hello Block, Counterparty, Mastercoin, Corona, Chromaway, BlockCypher

Digital Identity
ShoCard, UniquID, Onename, Trustatom

App Development
Assembly

Marketplace
MyPowers

Non-Financial Use Cases

Smart Contracts
Otonomos, Mirror, Symbiont, New System Technologies

Blockchain in IoT
Filament, Chimera, ePlug

Real Estate
Factom

Other
Augur (prediction platform)
Follow My Vote (election voting)
BitHealth (patient records management)

Diamonds
Everledger

Gold & Silver
BitShares, Real Asset Co., DigitalTangible (Serica), Bitreserve

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Data Storage
Storj, PeerNova

Currency Exchange & Remittance
Coinbase, BitPesa, Ripple, Stellar, Kraken, Fundrs.org, MeXBT, Cryptosigma

Trading Platforms
equityBits, Spritzle, Coins-e, DXMarkets, MUNA, Kraken, BitShares

Financial Use Cases

P2P Transfers
BTCjam, Codius, BitBond, BitnPlay, DeBuNe

Gaming
PlayCoin, Play, Deckbound

Ride Sharing
La'Zooz

Source: Lets Talk Payments
Figure 2

Santander, for example, claims to have identified 20 to 25 use cases, with a focus on international payments and smart contracts. Barclays is reportedly focusing on 45 internal use case experiments, while Citibank has created its own version of Bitcoin, called Citicoin.[11]

Startups focusing on non-financial use cases have seen a jump in numbers, with several new entities reportedly entering the space in 2015.[12] The emerging picture suggests that non-financial use cases outnumber financial ones,[13] indicating that real-world assets could increasingly be linked to blockchain and traded.

How Blockchain Will Transform Business

Blockchain's disruptive nature is derived from its ability to transform almost any process, from basic documentation, to settling complex contracts across geographies. This inherent capability is alluring to finance and banking decision-makers, who believe its disruptive power is good for their industry. Their confidence is reflected

in a survey by The International Securities Association for Institutional Trade Communication (ISITC), which found that 55% of companies polled are monitoring, researching or already developing solutions on blockchain technology.[16] Blockchain's transformative effect will extend from banks' back offices to the global financial system itself.

Decentralized Trade Settlement

Trade settlement processes currently require two to three days for payments and securities to change hands.[17] Moving this process to a decentralized ledger can have a transformative effect on the capital markets. This need not be limited to equities and debt instruments, but can also be extended to complex instruments, such as derivatives. Key incentives for banks and financial institutions to deploy blockchain in capital markets include:

- **Lower operational cost:** A decentralized trade settlement platform could eliminate or change the role of intermediaries, resulting in reduced commissions and other costs. Ideally, trades could be settled instantaneously (T+0 timeframe).

- **Global trade:** Such a model will allow seamless trade globally by keeping securities positions on a decentralized ledger, allowing trades beyond existing regional systems, such as Target 2 Securities (T2S) for the Eurozone.

- **Clearing:** Decentralizing the clearing process will eliminate the considerable amount of risk in trading of over-the-counter (OTC) products such as swaps, which has been mandated by regulators.

- **Increased trust:** With all transactions recorded transparently on a distributed ledger, trust levels throughout the capital markets would increase.

- **Reduced risk:** By executing transactions in real-time, a decentralized platform would eliminate counterparty risk and improve the regulation of "naked short-selling" and other speculative trading methods.

By storing data in blocks and using a tamper-proof hash format, banks can improve the security of the stored identity, improve portability of data and reduce the time taken for KYC efforts.

- **Regulatory reporting:** Easier access to transaction information for regulators would reduce the cost of regulatory reporting for market participants.

Decentralized Trade Finance

Trade finance is an important focus area for banks when it comes to applying blockchain technology. Global leaders including UBS, Deutsche Banks, JP Morgan and Bank of America Merrill Lynch are testing blockchain applications to improve workflows and reduce costs.[18] JP Morgan is already testing its blockchain systems with 2,200 clients.[19]

A trade finance solution with letter of credit, bill of lading and multi-signature solutions based on blockchain would include the following features:

- Carriers issue bill of lading on the blockchain as a digital asset.

- Banks issue letter of credit as a digital asset on the blockchain.

- Multi-signature contracts.

- Smart-contract-enabled, event-based fund release to ensure speed and transparency (see Quick Take, next page).

Document Signing and Records Management

Decentralizing document verification would allow companies to execute the latest documents and verify their authenticity. Such a solution would enable:

- Easy sharing of verified documents with third-party requestors.

- Reduced time for on-boarding users.

- Guaranteed processing of the latest version of the documents.

- Speedier multi-party verification.

Distributed Identity

A decentralized identity management platform would reduce the stress on the current centralized approach to storing customer information. By storing data in blocks and using a tamper-proof hash format, banks can improve the security of the stored identity, improve portability of data and reduce the time taken for KYC efforts.

Implementing Blockchain

Despite the heightened activity over the past year or so, it is still very early days for blockchain. Banks' blockchain initiatives are at various stages of internal trials. Changes incurred by blockchain, such as storing data in multiple locations rather than one central location, represent a radical shift in the way banks operate. This in itself could be a major hurdle to overcome in terms of organizational culture. Nevertheless, given its disruptive potential, banks would be ill-advised not to begin taking steps toward incorporating blockchain into their existing systems.

What follows are a subset of the key initial steps banks should consider when implementing a blockchain platform alongside existing systems.

- **Identify opportunities for innovation.** The key question to ask before starting a trial is which processes to move to blockchain. This can be tricky. Blockchain is essentially a shared database, and banks have commonly relied on database management technologies to store and control access to data. Creating a working group that explores the pros and cons of moving a process to blockchain would be an ideal place to start. Such a group would operate like a startup and explore areas where blockchain can add value, while staying in sync with the bank's strategic goals.

- **Assess feasibility and impact on existing systems.** This involves weighing the benefits and costs of moving a process to blockchain. Taking the perspective of key stakeholders and partners impacted by the move is critical.

- **Test proofs of concept.** Not all ideas will have the potential to reach this stage, but once a proof-of-concept (PoC) application is ready, it needs to be tested against real-world simulations to identify areas of improvement. By measuring the results against expectations, banks will be able to refine the application and use this knowledge for future application development.

- **Understand the regulatory environment and data security.** External factors such as regulations play an important role in the blockchain era. The current regulatory framework has no provisions for accommodating a technology that could eliminate intermediaries. Storing customer data on computers in different countries will also require banks compliance with data privacy laws that may vary from one country to another.

Similarly, there is no framework of regulations to make smart contracts work in the capital markets as they exist today. While regulators

> **Changes incurred by blockchain, such as storing data in multiple locations rather than one central location, represent a radical shift in the way banks operate.**

⫸Quick Take

The Age of Smart Contracts

Although the term "smart contracts" preceded Bitcoin, they are at the heart of the blockchain revolution. In a smart (or self-executing) contract, transactions and a set of specified terms and conditions must be validated by a peer-to-peer network of computers in order for the terms of the contract to be executed.

Smart contracts eliminate the need for a third party or counterparty, thereby reducing costs and time, as well as the risk of fraud and forgery. For example, if a borrower misses a loan payment, the smart contract would cancel access to the digital keys as collateral. Similarly, in the case of an escrow transaction, the smart contract would monitor the transfer of ownership from buyer to seller and release funds to the seller upon completion of the transfer.

This opens up several possible use cases for smart contracts, from purchasing goods and services online, to creating peer-to-peer versions of securities exchanges. Not surprisingly, startups[14] and consortiums such as R3[15] are vying to create smart-contract platforms for any business need.

will eventually evolve, it will be important for early movers to embed this factor into their long-term plans.

- **Determine the nature of blockchain implementation: open vs. permissioned.** Most banks are known to be working on closed/permissioned blockchain platforms. Given the technology's embryonic state, it makes sense for them to retain control, which means assigning a central administrator to authorize blockchain participation. However, the full benefits of decentralization, such as lower transaction costs, cannot be achieved without giving up control. This permissioned blockchain approach makes sense in the near term, but as platforms emerge independently, industry players will be pressured to realize the true benefits of a blockchain platform.

- **Calculate scalability.** The Bitcoin community continues to debate[20] the best way to increase the transaction processing capacity of blockchain from the current seven transactions per second, as real-world scenarios would require banks to process thousands of transactions per second. Proposed solutions[21] include increasing the block size limit from the current 1MB per-block, direct payment channels between two users, and centralized servers that handle off-chain transactions.

Looking Forward: Partnerships and Collaboration

Amid all the activity surrounding blockchain, we believe a "wait and watch" approach would be suboptimal. Banks need to get started by creating plans to enable blockchain technology to co-exist with their legacy run-the-bank systems. Blockchain must mature and become robust enough to replace existing banking systems. The key to unlocking blockchain's potential in the long run is a common protocol that enables interoperability. While visibility is hazy on this front, banks planning to move their processes to blockchain should start by assessing how interoperability can advance their blockchain objectives.

The time to start experimenting is now, and to this end, banks are leaning toward an approach that combines internal trials with involvement in consortia that include fellow banks and technology providers to explore blockchain use cases. These experiments will lay the foundation – in the form of protocols and standards – upon which the future of blockchain will be built. Leaders[22] such as R3, the Hyperledger Project, Post Trade Distributed Ledger (PTDL) and Digital Asset Holding are creating a safe space to carry out pilot tests for blockchain prototypes.

Importantly, financial institutions and technology providers can feed off each others' ideas and experiments, while identifying areas of focus and avoidance. This will allow banks to identify and build key skill sets and use the collective knowledge to create a blueprint that will ease the seemingly inevitable transition to a blockchain-driven future.

Footnotes

[1] Bitcoin.org defines a blockchain as "a shared public ledger on which the entire Bitcoin network relies. All confirmed transactions are included in the blockchain. This way, Bitcoin wallets can calculate their spendable balance, and new transactions can be verified to be spending Bitcoins that are actually owned by the spender. The integrity and the chronological order of the blockchain are enforced with cryptography."

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[3] Double-spending is the result of spending money more than once. Bitcoin protects against double spending by verifying each transaction added to the blockchain to ensure the inputs for the transaction had not previously already been spent. Other electronic systems prevent double-spending by having a master authoritative source that follows business rules for authorizing each transaction. Bitcoin uses a decentralized system, where a consensus among nodes following the same protocol is substituted for a central authority. Source: *https://en.bitcoin.it/wiki/Double-spending*.

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