Blockchain | What's Under The Hood

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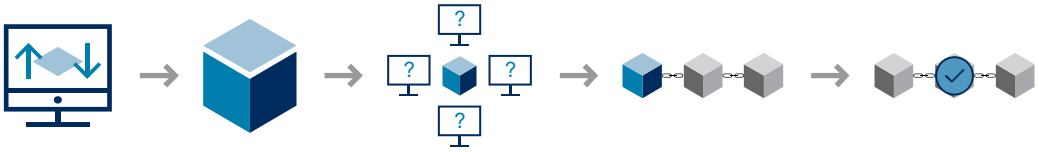
Blockchain technology removes the need for a trusted central party for settlement and clearing, and has the potential to revolutionize how digital value is recorded and transferred.

What is a blockchain?

Blockchain is a new way to record data. It is a subset of distributed ledger technology (DLT), a database that stores information on a ledger that is distributed among a network of participants, as opposed to databases that store and manage information in a centralized location. Blockchains are a type of DLT that groups data into "blocks," which, when verified by members of the network, are linked together to form the "blockchain." Unlike regular databases, there is generally no single authority controlling this ledger. Instead, identical copies of the ledger are held by all participants across different locations in the network (nodes).

Decentralization and immutability are key advantages. Blocks of data are sequentially linked, and new ones are added using a consensus mechanism. Members of the network verify and cross-check updates to ensure data validity. All entries are permanent and traceable.

Simplified Blockchain Process



An exchange is requested (e.g., general data, digital assets etc.)

The requested exchange is added to a "block", grouping it with other recent requested exchanges

Network nodes validate the block of requested exchanges for a reward

Validated blocks are added to the blockchain

The exchange is complete, with an immutable digital record on the blockchain

Source: S&P Global Ratings.

The technology provides an edge in transaction record keeping. Blockchain can provide a viable alternative to processes that require a trusted intermediary to handle transactions (such as trade finance), a digital store of value (such as digital assets or cryptocurrencies), or for processes that are notoriously complex in the real world by legacy and may be overhauled (such as securities settlement).

Smart contracts can irreversibly encode processes. These are programs that are stored on a blockchain and are executed by any party willing to pay the fees necessary to execute the contract. Permissioned use on the public blockchain is typically handled by a smart contract providing services to wallet addresses that own some asset or attribute, typically a token. For example, a smart contract could automatically initiate a payment once an order has been shipped by automatically issuing payment to one or more token holders who hold a token associated with the order. This could be triggered by any party contingent upon logic specified in the smart contract and data stored on the blockchain. This provides transparency and certainty for all involved parties, although the irreversible nature of blockchain entries also brings its own set of risks, in case of bugs in the code or unexpected inputs.

The current landscape

Adoption across many industries is accelerating. The first implementation of a blockchain was the Bitcoin network, but the spectrum of blockchain implementations is much broader today and includes tasks such as supply chain and logistics solutions, health care, or royalty tracking. Most of these projects are still in the conceptional or testing phase, and we see little adoption of large public use cases. One area of rapid growth is decentralized finance (DeFi), which drives the adoption of blockchain and crypto assets. DeFi aims to replicate

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The adoption of blockchain is accelerating across many industries

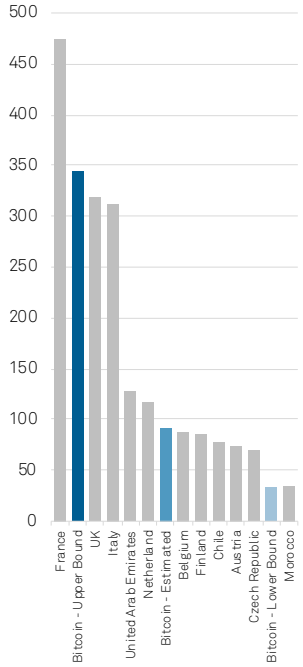
traditional financial products and bring them on-chain to benefit from the advantages of blockchain technology.

Blockchain technology still has many hurdles to clear. The main challenges relate to lack of blockchain scalability and standardization, as well as a lack of interoperability between different blockchains and with traditional systems. For example, the dominant platform for smart contracts--Ethereum--can process only around 30 transactions per second, compared with thousands for traditional credit card networks. While blockchain projects are making progress in addressing these issues, we consider the technology to be still in its early stages.

Blockchains' steep energy consumption raises environmental concerns. The largest public blockchains, Bitcoin and Ethereum, utilize a proof-of-work algorithm to validate transactions, which is based on an energy-intensive process. For example, bitcoin mining's energy consumption is in line with that of the Netherlands (Cambridge Bitcoin Electricity Consumption Index). Additionally, the reportedly short lifespan of the mining machines adds to environmental concerns. But Ethereum's ongoing transition to a proof-of-stake algorithm is expected to considerably reduce its energy consumption by around 99% by 2022.

There are different types of blockchains. Private (permissioned) blockchains differ from public (permissionless) ones in that they are open only to selected participants. Typically, they are also more centralized, which helps to avoid time-consuming consensus mechanisms and improve throughput. This makes them particularly relevant for many enterprise solutions, which seek to retain a level of control (for example, Hyperledger Fabric and R3 Corda). However, critics point out that private blockchains are typically more prone to hacks and data breaches owing to a lower level of decentralization when compared with their public counterparts. This is because the lower number of nodes makes it easier for malicious actors to gain control over the consensus network.

Bitcoin Energy Consumption Versus Selected Countries (TWh)



Note: Bitcoin estimate for Sept.1, 2021. Country data as of 2019 (or most recent available year). Sources: S&P Global Ratings, International Energy Agency, University of Cambridge. U.S. Energy Information Administration.

The credit implications

Blockchain's scalability and efficiency improvements will determine its long-term applicable use cases. Most large blockchains work actively to solve the limitations listed above (for example, Ethereum 2.0 or the Bitcoin lightning project), while other blockchains are already more advanced. We expect entrepreneurial focus and rising investments will help to address these limitations and refine the technology.

Blockchain can be a solution for multiple problems, but it is not appropriate for every situation. Blockchains are best suited to processes that involve multiple parties that need to interact but wish to do so in a trustless manner, and where a central authority is either not available or not desired. Users must weigh the additional complexity and network efficiency of blockchains against the vulnerabilities and control conferred by centralized databases when implementing a solution.

Blockchain capabilities can both complement and disrupt business workflows and market functions. Blockchain-based solutions can help to improve cumbersome legacy processes and raise operational efficiencies, particularly for those use cases that so far involve multiple participants and slow transaction times, such as securities settlement or trade finance. However, other use cases could disrupt the established role of financial intermediaries. For example, decentralized exchanges, such as Uniswap, facilitate peer-to-peer cryptocurrency transactions without the need for a traditional intermediary. It remains highly uncertain which of these scenarios will prevail, but we believe it is more plausible that existing players will disrupt themselves first and use the technology to their advantage.

We expect that specific use cases will increasingly become regulated, but not the technology itself. This includes those activities whose traditional counterparts are regulated, such as digital assets, cryptocurrencies, or decentralized finance. So far, regulation is still at an early stage and authorities' responses vary considerably. It remains unclear how most jurisdictions are going to balance innovation and regulation, but we expect more clarity in the coming years.

Bitcoin mining's average energy consumption is approximately in line with that of the Netherlands