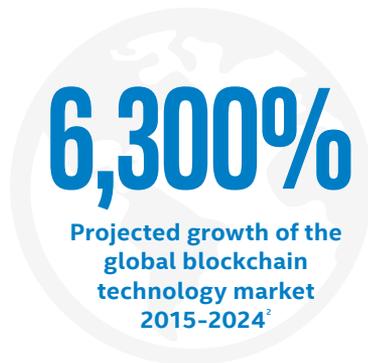




Blockchain Technology – Moving Beyond The Hype

Intel is engaged with industry thought leaders to deliver hardware-optimized platform options for enterprise blockchain solutions



- Transparency Market Research

So, what is blockchain and how is it impacting business?

Simply put, blockchain technology can change the way your business exchanges data. According to the Gartner* August 2017 report¹, blockchain will be “transformational” across a variety of industries in the next five – 10 years. Here’s what you need to know:

- The value of blockchain lies in its ability to provide a secure platform for exchange while reducing the cost and complexity of transactions by eliminating the need for intermediaries and third-party verification.
- Blockchain has the potential to not only transform asset and data exchange, but also change business processes, trade, economic and social systems.
- Blockchain is the technology behind Bitcoin*, but that’s a limited example of its potential to transform multiple industries and drive innovation throughout the global economy.
- Right now, organizations worldwide are exploring the many ways that blockchain solutions can streamline their business processes.
- According to Transparency Market Research*, the global blockchain technology market is expected to be worth US\$20 billion by the end of 2024, as compared to US\$315.9 million in 2015—**an increase of more than 6,300% in less than a decade**. During the same period, the overall market is expected to show a compound annual growth rate (CAGR) of 58.7 percent.²

How do blockchains work?

Blockchains decentralize and distribute data across a network of computers, functioning as distributed ledgers. These ledgers facilitate and simplify transactions and data or asset exchanges and currently there are three common types of distributed ledgers in use.

1. Public (or open) ledgers
2. Fully private (or permissioned) ledgers
3. Consortium ledgers (available only to a pre-selected group of entities)

Each type of distributed ledger functions essentially the same as every other. The differences lie in who has access to the database.

Blockchain technology eliminates the need for a centralized authority because each participant has a copy of the stored data in a secure, distributed and shared database. Changes to data are validated by members collectively and updated across the network. This provides an unchangeable record and ensures data quality and integrity.

THREE TYPES OF DISTRIBUTED LEDGERS

- 1 **Public** - open for anyone to view
- 2 **Fully private** - accessible only with permission
- 3 **Consortium** - available only to a pre-selected group of entities



Figure 1. Traditional systems rely on a clearing house to record all transactions and maintain a ledger on behalf of participants.

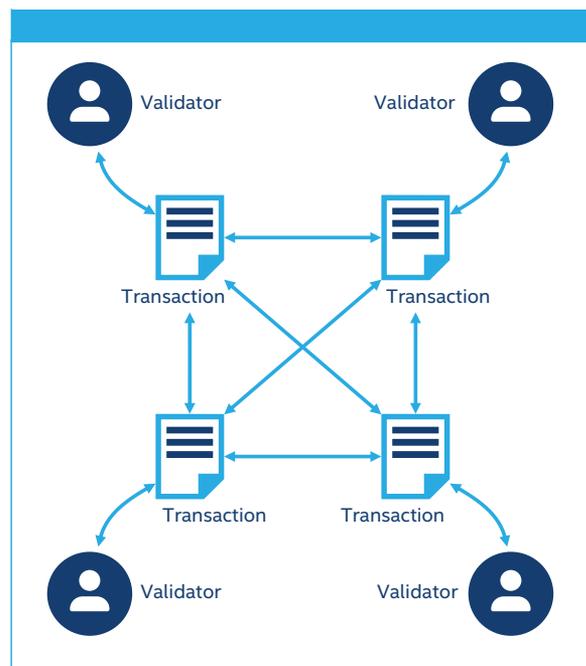


Figure 2. Blockchain systems operate with no central clearinghouse, but rather rely on distributed ledgers maintained by each participant, which are automatically updated with each transaction.

Instead of a single ledger that all parties in a transaction network must use and copy information from, **blockchains give all members their own copies of the ledger**. These copies are continually updated and reconciled so they remain current and identical. Users submit transactions, which are collected as a block and the network then distributes and verifies the blocks and appends them to an irreversible chain.

Blockchains use cryptography, an immutable ledger, as well as distributed consensus to facilitate the exchange of assets between two untrusted parties and eliminate the need for intermediaries. **Cryptographic signatures ensure accuracy and guarantee non-repudiation**, meaning that once a transaction is committed to the blockchain, it cannot be un-committed or withdrawn, creating an immutable ledger. Distributed-consensus algorithms ensure all participants see the same series of transactions, even if bad actors try to compromise the system, **making blockchains virtually unhackable**.

By eliminating the need for intermediaries and third-party verification, blockchains:

- Increase efficiency
- Reduce the cost and complexity of transactions
- Providing transparency, autonomous management, and resistance to data tampering and modification.

As a result, blockchain technology offers a highly secure solution that helps mitigate risk in transactions, as each step is fully visible to all parties.

Blockchain challenges and opportunities

Because trust is rarely assumed in commercial relationships, we insist on verifying transactions with contracts, records, and receipts. And we rely on intermediaries to negotiate on our behalf and provide a middle layer of management in many of our transactions, which increases both cost and complexity and introduces the potential for security breaches.

Blockchains simplify and streamline many of these costly and complex business processes, and the distributed ledgers they enable provide an efficient and secure infrastructure for the issuance and exchange of information and assets.

By functioning as distributed ledgers, they enable multiple parties to exchange and store sensitive information in a space that is secure, permanent, anonymous and easily accessible. As a result, blockchain technology can simplify many expensive or logistically complicated processes like:

- Streamline cross-border payments
- Facilitate ride-sharing transactions
- Enable shared access to customer data with assured identity protection

Intel® and blockchain – enabling transformation

Intel® constantly explores the potential of new technologies such as blockchain, because we recognized quite early that Intel has an important role in providing the foundational technology that can enable and enhance blockchain solutions. Intel® processor technologies provide unique capabilities that can help improve the security, scalability, trust and privacy of distributed ledger networks.

Intel contributed its distributed ledger platform, Sawtooth Lake, to The Linux Foundation* Hyperledger* project in 2016. Hyperledger* incubates and promotes a range of business blockchain technologies, including distributed ledger frameworks, and smart contract engines. One of those frameworks, Hyperledger Sawtooth*, was designed to provide a common set of building blocks that developers can customize to meet a broad set of application requirements.

Intel® Software Guard Extensions (Intel® SGX) is an Intel® architecture extension designed to increase the security of select application code and data, protecting it from disclosure or modification. Intel SGX makes such protections possible through the use of enclaves, which are protected areas of execution in memory. Blockchain data is protected through encryption until required for a transaction and verification of correct computation can be performed in a Trusted Execution Environment (TEE).

Intel® Xeon® Scalable processors are an ideal foundation for building blockchain solutions. They include a broad set of hardware-based security features like Intel® Advanced Vector Extensions 512 (Intel® AVX-512) and Intel® Advanced Encryption Standard – New Instructions (Intel® AES-NI) which are valuable in optimizing the performance of cryptographic hashing and improve blockchain security.

Intel also collaborates with industry organizations, such as Enterprise Ethereum Alliance*, and works with leading companies and the Initiative for Cryptocurrencies & Contracts* (IC3) to accelerate the deployment of blockchain technologies across industries. Innovative blockchain solutions powered by Intel processor technologies are beginning to transform a cross-section of industries, including retail, financial services, healthcare, entertainment and many others, like:

- **The Open Music Initiative*** is using distributed ledger technology to ensure music rights owners are accurately identified and fairly compensated each time their music is played.⁴
- **Pokitdok***, a healthcare consortium, uses Hyperledger Sawtooth to protect the privacy of medical records. The solution leverages the hardware-based security technologies to provide the security and HIPAA compliance essential for processing healthcare data.⁵
- **Ledger*** has collaborated with Intel to deliver enhanced security for a cryptocurrency wallet that supports both Bitcoin and Ethereum*.⁶



- **SAP* Co-Innovation Initiative** is gathering participants across multiple industries to identify blockchain uses within supply-chain applications.⁷
- **Oracle*** has announced a blockchain cloud service that will help customers increase business velocity, create new revenue streams and reduce cost and risk by securely extending business applications on a trusted network.⁸
- **The Enterprise Ethereum Alliance** is working with enterprises, startups, academics and technology vendors to address enterprise requirements for Ethereum blockchain.⁹
- **Hyperledger** is an open source collaborative effort created to advance cross-industry blockchain technologies.⁵ It is a global collaboration, that includes leaders in finance, banking, IoT, supply chain, manufacturing and technology.¹⁰
- **R3*** and their member financial institutions, regulators and associations developed Corda*, a blockchain-inspired platform that removes costly friction in business transactions by enabling institutions to transact directly using smart contracts, while ensuring the highest levels of privacy and security.¹¹
- **Microsoft Azure*** introduced the Coco Framework*, an enterprise-grade open-source system designed specifically for confidential consortiums, where nodes and actors are explicitly declared and controlled. Coco's alternative approach to ledger construction facilitates scalability, distributed governance and enhanced confidentiality.¹²

Get started with blockchain

It's clear that blockchain technology is going to change the global marketplace and it can help you completely transform your business. Next steps? Here are three:

1. **Reflect:** Think about how your business can be transformed by utilizing blockchain technology? What business challenges can you solve through blockchain?
2. **Learn:** Which blockchain approach best fits your opportunity and addresses your needs? Can your organization benefit from work a consortium or association has developed?
3. **Engage:** Talk to Intel and/or our ecosystem partners. We're here to help bring value to your business transformation through blockchain. Look for blockchain expertise and knowledge, a partner for your organization who has experience in development and deployment solutions.

¹ Gartner Report Top Trends in the Gartner Hype Cycle for Emerging Technologies, 2017* (Reference: <https://www.gartner.com/>)

² Blockchain Technology Market—Global Industry Analysis, Size, Share, Growth, Trends, and Forecast, 2016-2024, Transparency Market Research, January 18, 2017 (Reference: www.transparencymarketresearch.com/blockchain-technology-market.html)

³ Ibid.

⁴ Open Music Initiative (Reference: <http://open-music.org/#principles>)

⁵ PokitDok teams with Intel on healthcare blockchain solution, TechCrunch, May 10, 2017 (Reference: businesswire.com/news/home/20170510006122/en/PokitDok-Advances-Healthcare-Smart-Contracts-Intel%C2%AE-Blockchain)

⁶ Ledger (Reference: www.ledger.fr/2017/10/23/ledger-enhances-blockchain-applications-security-using-intel-technology/)

⁷ SAP (Reference: www.sap.com/corporate/en/company/innovation/sap-coil.html)

⁸ Oracle (Reference: www.oracle.com/corporate/pressrelease/ooow17-oracle-launches-blockchain-cloud-service-100217.html)

⁹ Enterprise Ethereum Alliance (Reference: <https://entethalliance.org/>)

¹⁰ Hyperledger Sawtooth (Reference: <https://01.org/sawtooth/>) Hyperledger Sawtooth and the Linux Foundation (Reference: <https://www.hyperledger.org/projects/sawtooth>)

¹¹ R3 consortium web site (Reference: <http://www.r3cev.com>)

¹² Microsoft Azure (Reference: news.microsoft.com/2017/08/10/microsoft-announces-the-coco-framework/)

Intel technologies' features and benefits depend on system configuration and may require enabled hardware, software, or service activation. Performance varies depending on system configuration. No computer system can be absolutely secure. Check with your manufacturer or retailer or learn more at intel.com.

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