



Blockchain by Cisco

Build trust-based business
networks for digital transformation



Executive summary

Blockchain, called the “tech breakthrough megatrend” by PWC¹, is rapidly gaining broad acceptance. According to IDC, global spending on this innovative technology is expected to reach \$2.1 billion in 2018.² Across the globe, industries are investigating ways to use blockchain to increase trust across their business value chains and address primary challenges around complexity, transparency, and security.

83%

of executives
believe trust is the
cornerstone of the
digital economy

10%

Global GDP that is
likely to be stored
on Blockchains
by 2027

\$9.7B

expected Blockchain
market by 2021

Although blockchain has the potential to transform the business landscape, important challenges to wider adoption remain. First, platform standards need to be established that meet the complex needs of the enterprise. Furthermore, customers are looking for industry-specific solutions to transform their business processes. Finally, interconnectivity of multiple independent blockchain networks is needed to unlock the true value of blockchain.

As we move from experimentation to widespread adoption in the enterprise, Cisco is leading several efforts to make blockchain technology enterprise ready. In this paper, we'll explore:

- What blockchain is and why it is important
- The role of blockchain in transforming the business
- How Cisco is developing blockchain technology for enterprises
- How Cisco is bringing together ecosystems, standards and alliances to drive industry adoption



Table of Contents

- 01 Executive summary
- 03 What is blockchain?
 - 03 Enabling a new level of trust
- 04 What is driving the blockchain revolution?
- 05 How big is the opportunity?
 - 06 Supply chain
 - 06 Internet of things
 - 06 Smart cities
- 07 Making blockchain enterprise ready
- 07 The Cisco framework
 - 08 Platform overview
 - 09 Interfaces
 - 10 Infrastructure and network
 - 11 Security and analytics
- 12 Building an ecosystem for industry solutions
- 13 Unlocking value through interoperability
 - 14 Trusted IoT Alliance
 - 14 Hyperledger Project
 - 14 Enterprise Ethereum Alliance
 - 14 Digital Chamber of Commerce
- 15 Conclusion

What is blockchain?

Blockchain technology enables multiple parties to reach an agreement on the authenticity of a transaction in a decentralized manner. These outcomes are then permanently recorded across a shared database known as a blockchain, which is cryptographically secured.

Because the blockchain ledger is shared among all participants involved, no one has sole ownership over the information that is recorded on the blockchain. This makes sure that the information cannot be tampered with. Multiple blockchain configurations are in use today that utilize different methods of reaching an agreement or consensus, depending on the type of blockchain network. For example, today's well-known bitcoin blockchain operates as a permissionless network in which anyone can participate. Alternatively, many enterprises are choosing to operate a permissioned blockchain in which only known entities may participate as this model provides more privacy, speed, and administrative tools to manage the network.

Enabling a new level of trust

The true innovation of blockchain is its ability to automate trust among the parties using it. Transactions are settled in a collective fashion and recorded on a distributed ledger, which removes the need for an established third party to create a trusted relationship. Participants can directly use the blockchain as the source of truth instead of one another.

This embedded trust allows consumers, enterprises, and governments to automate how they manage any transactional relationship. The Economist refers to this capability as the "trust machine" that will fundamentally transform the way we do business.⁶ Trust automation can dramatically simplify business processes by eliminating the need for intermediaries that were previously required to coordinate the exchange of business-critical information or assets.



What is driving the blockchain revolution?

The rise of the API economy has transformed how we use technology in the enterprise. However, although technology has advanced, methods of doing business over the Internet have not kept pace. Today's organizations must increasingly manage data and transactions among a large number of untrusted parties, creating business challenges around transparency, complexity, and security:



Transparency

Lack of visibility into a product's journey across global supply chains leads to challenges in identifying that product's provenance, with serious implications to counterfeiting, health, and safety.



Complexity

Global trade and commerce today involve multiple intermediaries such as financial institutions, brokers, and third parties, thus leading to increased costs of doing business.



Security

The centralized architecture of information across applications, users, and devices provides nonsanctioned hackers a single point to attack to gain access and control.

Counterfeiting is estimated to cost U.S.-based semiconductor companies more than

\$7.5B
per year⁷

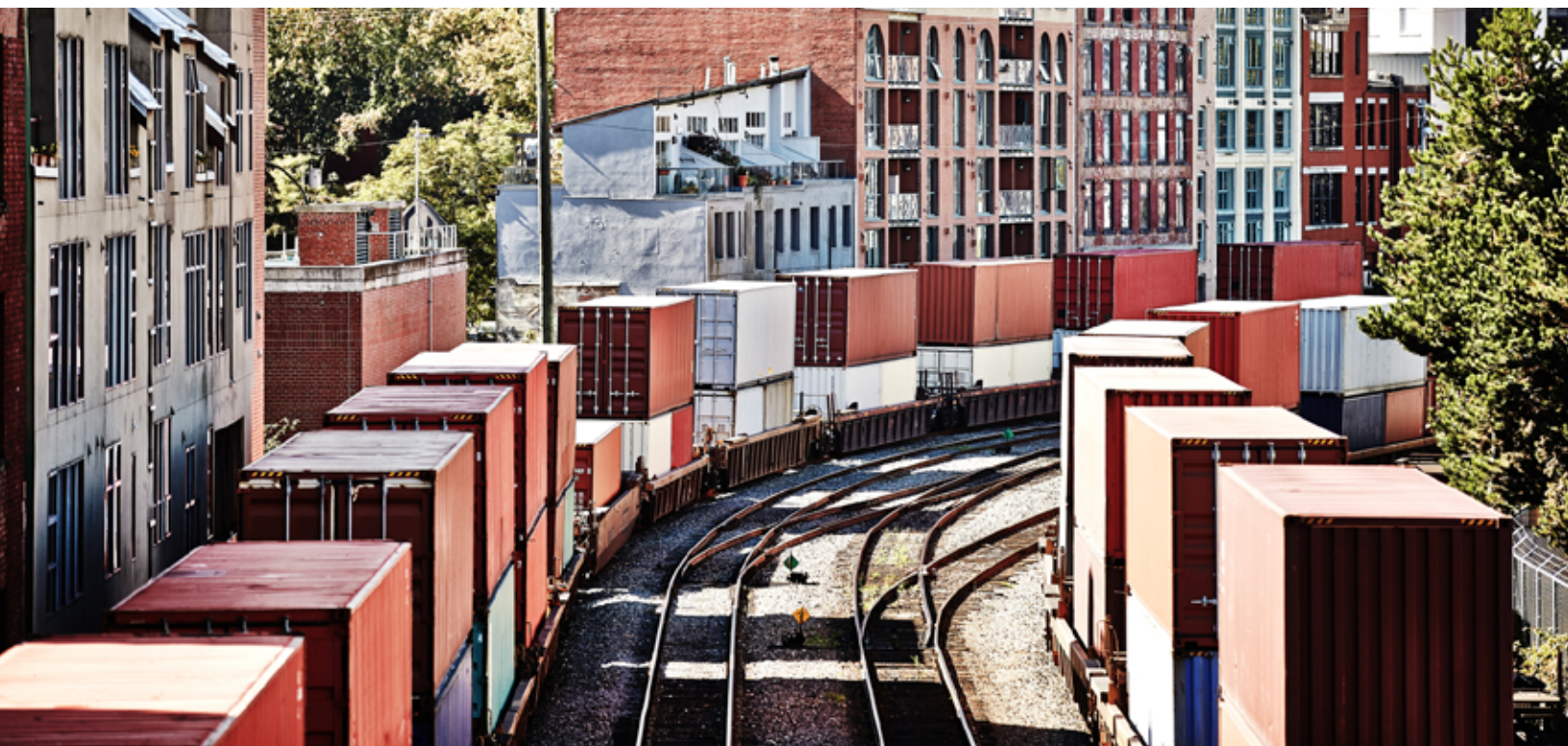
Suppliers in emerging markets today pay interest on receivable financing as high as

30%⁸

20B

IoT devices will be online by 2020, representing a significant number of attack surfaces⁹

Blockchain-based technologies can build a foundation for trust in the enterprise through the digitization of business processes, tokenization of assets, and codification of complex contracts. These technologies can enable business ecosystems, consisting of both internal and external partners, to securely interact and transact without human intervention and dramatically simplify operations for large enterprises.



How big is the opportunity?

Traditionally, institutions such as banks, governments, and corporations have played the role of managing risk to facilitate trade and commerce. Now, for the first time, organizations can use technology to manage this risk to lower uncertainty and reduce everyday transaction costs of doing business.⁹ This transformation promises to have a significant effect on our broader economy. The transformation toward an era of a programmable economy is expected to deliver efficiencies and new business value in excess of \$3 trillion by 2030.¹³ This will be driven primarily by improved cash flow, asset provenance, and native asset creation, as well as new trust-based business models.¹³

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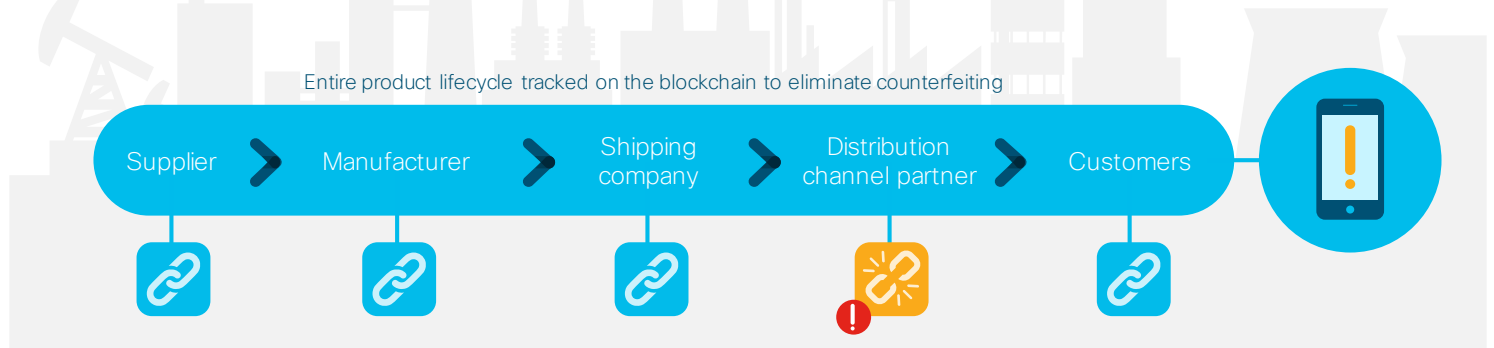
\$3T by 2030.



As the effects of blockchain permeates across our economy, it will transform industries that today rely on centralized infrastructure and business processes.

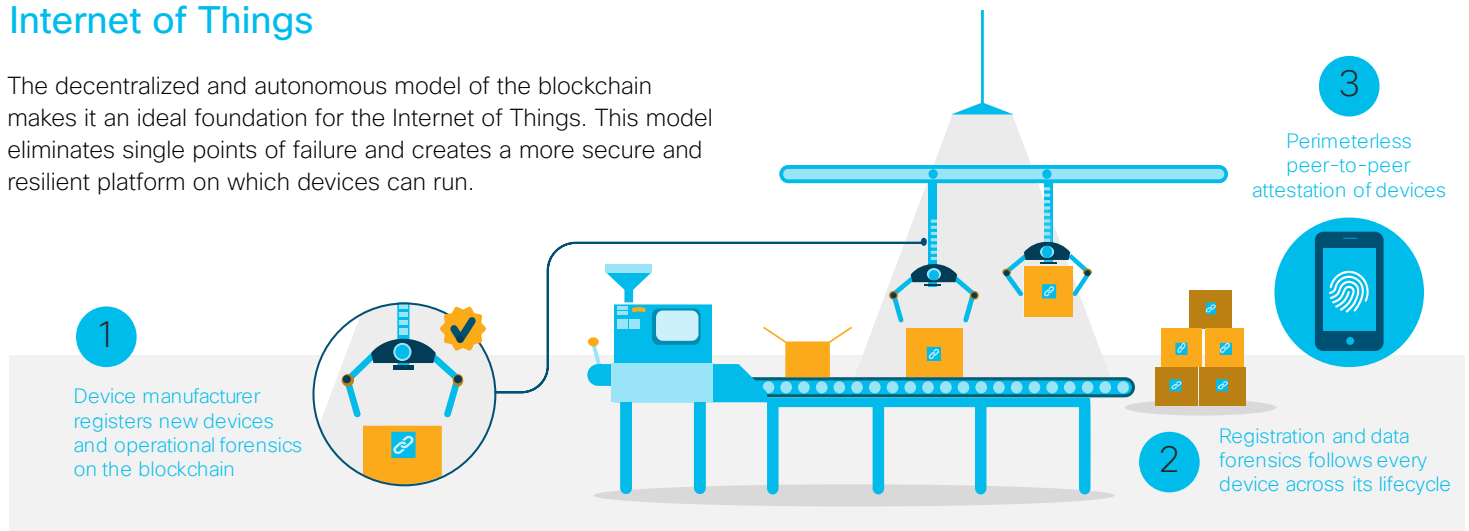
Supply chain

Blockchain can enable manufacturers to improve track and trace of components and finished goods across a supply chain and enable new applications around anticounterfeiting, supplier and purchaser financing, or management of supply chain disruptions and recalls.



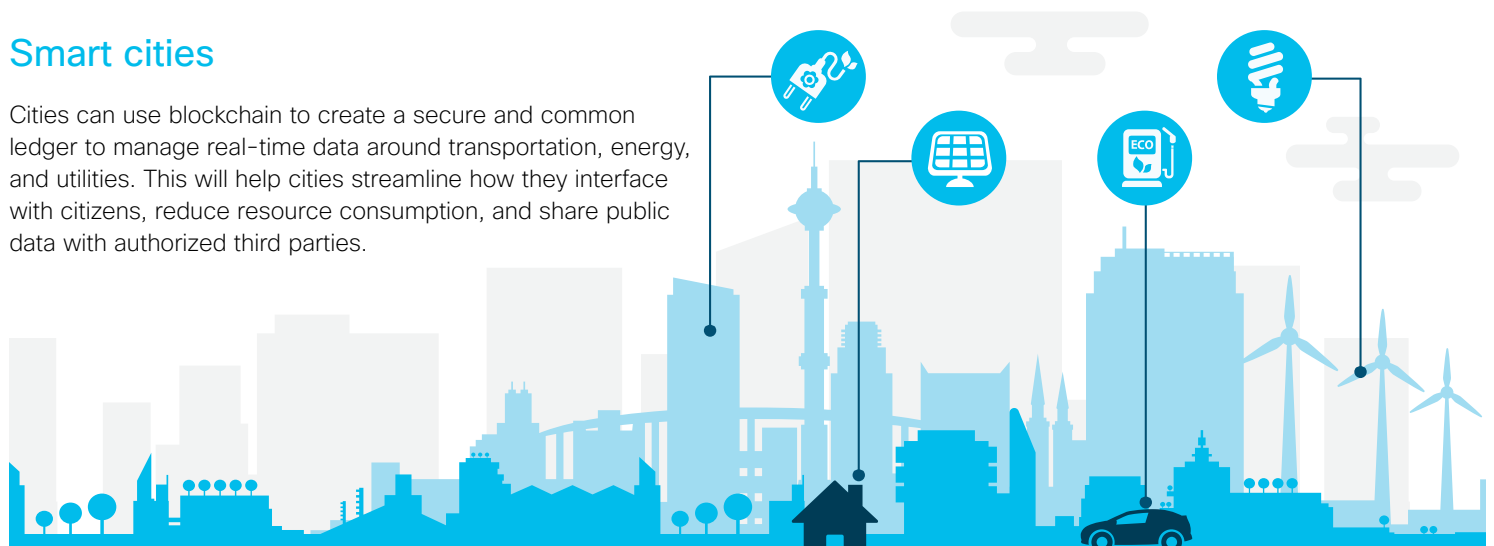
Internet of Things

The decentralized and autonomous model of the blockchain makes it an ideal foundation for the Internet of Things. This model eliminates single points of failure and creates a more secure and resilient platform on which devices can run.



Smart cities

Cities can use blockchain to create a secure and common ledger to manage real-time data around transportation, energy, and utilities. This will help cities streamline how they interface with citizens, reduce resource consumption, and share public data with authorized third parties.



Making blockchain enterprise ready

Most of today's blockchain efforts are still in the experimental stage, and many proofs of concept have yet to gain widespread adoption. As permissioned blockchains continue to evolve, industries and governments are still working through a set of primary challenges:

- As organizations evaluate platforms, they are looking for an established set of standards that meets the complex needs of the enterprise.
- Although blockchain is a transformational technology, organizations are ultimately looking for industry-specific solutions to transform their business processes.

- As large enterprises with complex business relationships look to build blockchain networks at scale, true value will be unlocked by the interconnectivity of many independent blockchain networks.

As companies move from proofs of concept to large-scale enterprise deployments, they are looking for the right partner to help them succeed. Cisco is developing a comprehensive foundation for enterprises to build trust-based business networks on the blockchain.

The Cisco framework

The Cisco® blockchain framework details the necessary elements for a simple, secure, scalable enterprise-grade blockchain that is based on Cisco's propriety technology. Our blockchain framework is composed of the following reference groups:

1

Platform

2

Interfaces

3

Infrastructure
and network

4

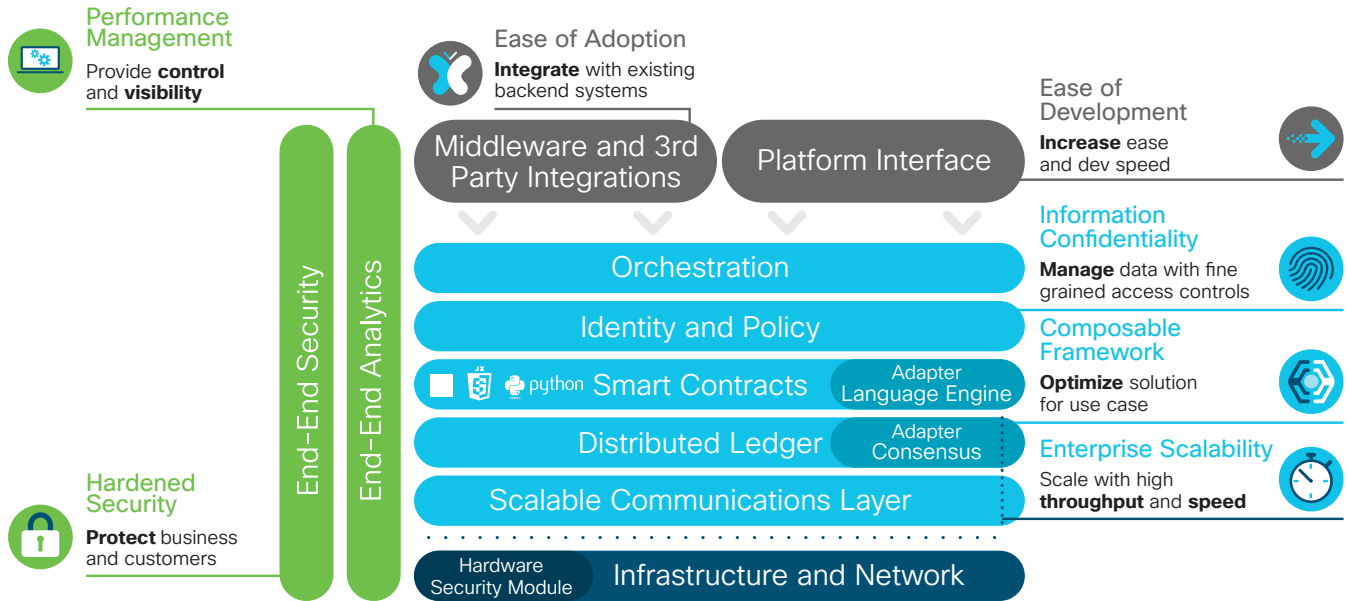
Security
and analytics



1. Platform overview

Cisco is building a blockchain platform (Figure 1), defined by a composable platform architecture that enables specific implementations to meet desired use-case requirements across different industries. Composability enables services to be upgraded over time, with new features introduced as blockchain technologies advance. Taking advantage of modern microservice design patterns, the platform architecture helps future-proof an enterprise's investment in blockchain. The platform core consists of multiple layers, each including multiple subservices, with many customizable using pluggable interfaces.

Figure 1. Cisco blockchain framework: platform



Communications layer and distributed ledger

A set of services that enable blockchain nodes to communicate with each other and maintain consensus with respect to the ledger state.



Smart contracts

A pluggable smart contract engine, executed in a secure environment that supports familiar developer languages such as JavaScript, GoLang, and Python.



Identity and policy

An identity and policy layer that is responsible for tasks such as authentication, authorization, and identity management.



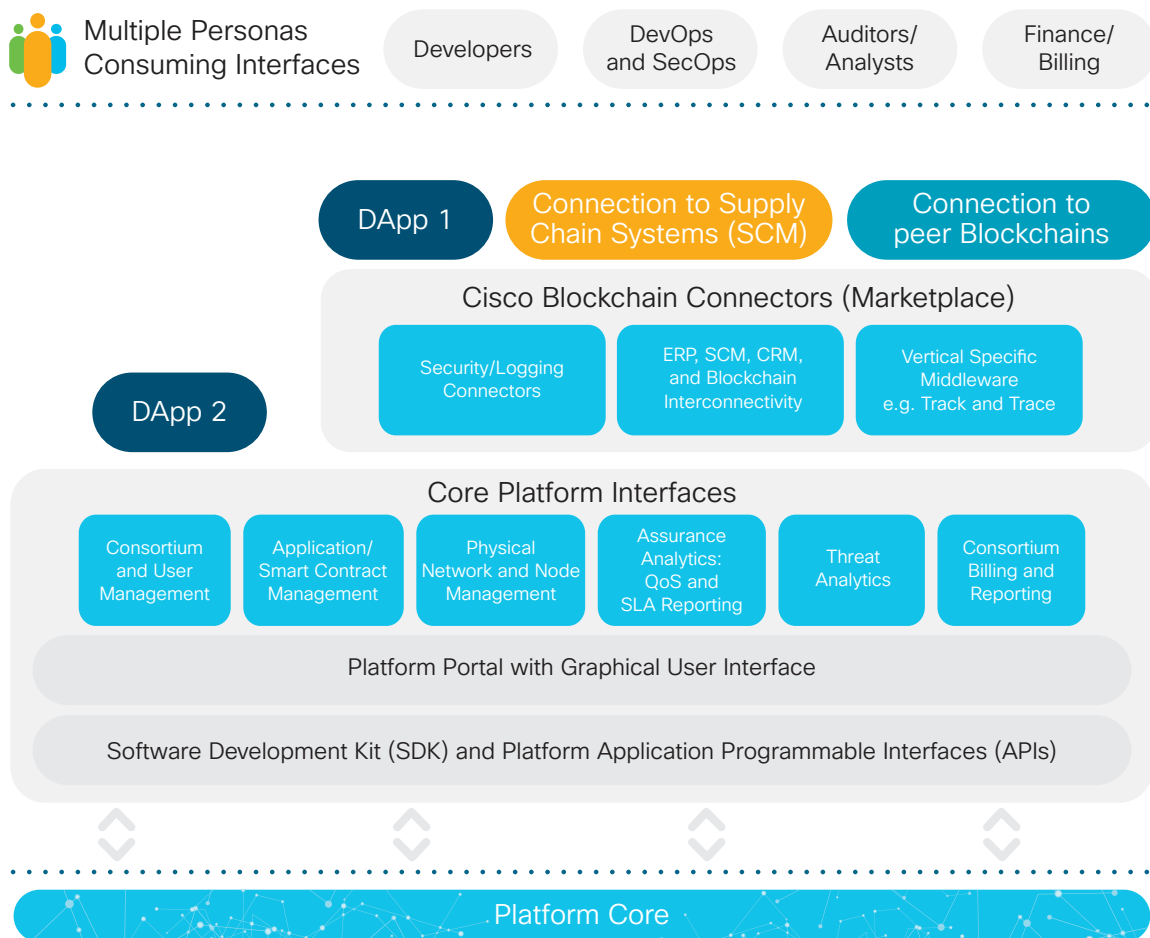
Orchestration

An orchestration layer that ties all the other service levels together as part of a "service mesh." Enterprises can use their tool of choice, such as Kubernetes, Rancher, and Docker swarm. The orchestration layer facilitates tasks such as adding and removing nodes, made simple via the administrator portal.

2. Interfaces

When evaluating any new enterprise blockchain technology, it is important to consider the ease of deploying and managing the network, developing applications with best-in-class tools, and integration with existing enterprise systems. Our blockchain framework includes interfaces that expose the necessary functionality to perform these objectives, enhancing overall ease of use. Figure 2 offers a closer look at these interfaces.

Figure 2. Cisco blockchain framework: interfaces



Platform interface

The native platform interface is composed of a software developer kit (SDK) with flexible APIs, as well as an administrator portal that exposes important SDK functionality via an intuitive graphical user interface.



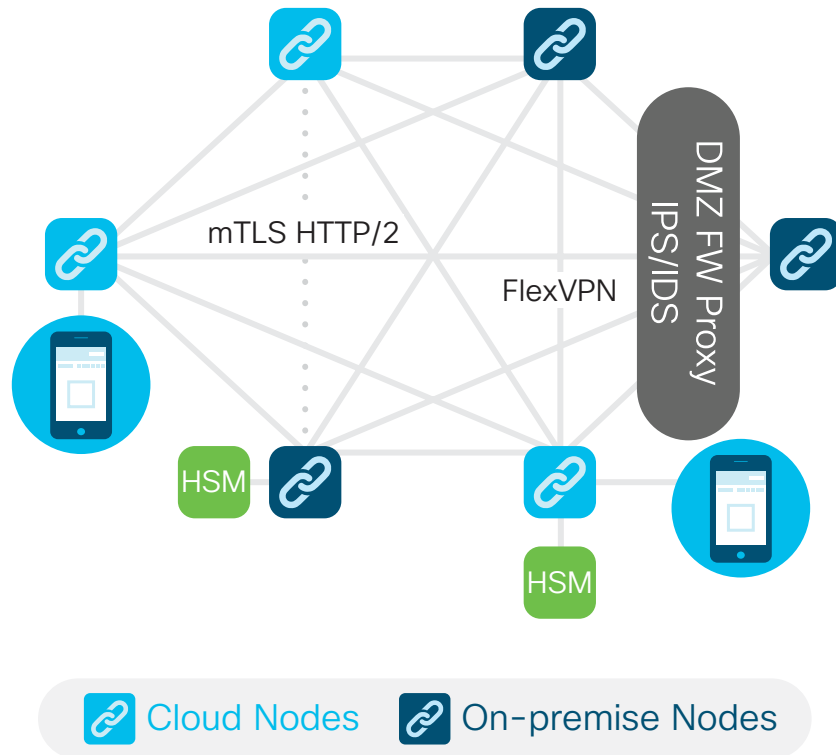
Middleware and connectors

To further simplify ease of use and accelerate enterprise adoption, the blockchain platform architecture defines a middleware and connector interface that integrates with existing centralized enterprise systems as well as other blockchain networks. This is achieved via a library of native and third-party application connectors and middleware, made available via a developer marketplace.

3. Infrastructure and network

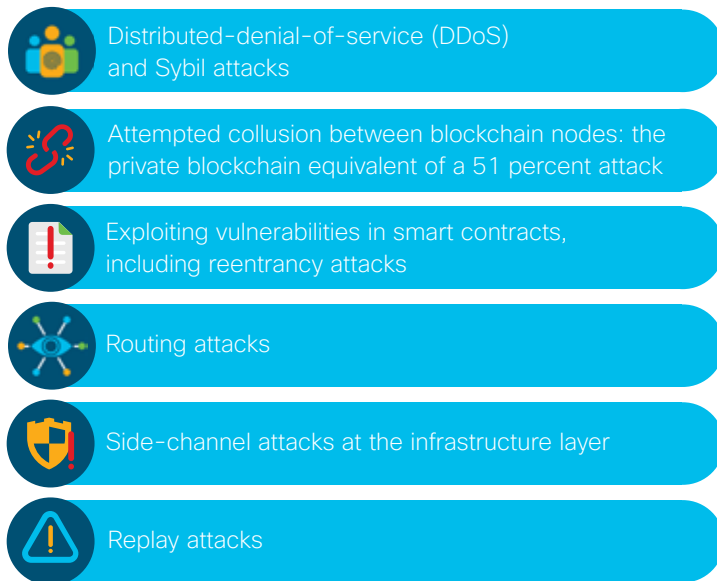
Our hardware-independent blockchain framework defines a set of standards to address infrastructure-level security risks, including reference architectures to deploy on the premises: in an enterprise's demilitarized zone (DMZ), in the cloud, or via a hybrid deployment. Furthermore, the platform provides flexible support for a choice of infrastructure technologies, including hardware security modules (HSMs) and WAN optimization tools such as software-defined WAN.

Figure 3. Cisco blockchain framework: infrastructure and network



4. Security and analytics

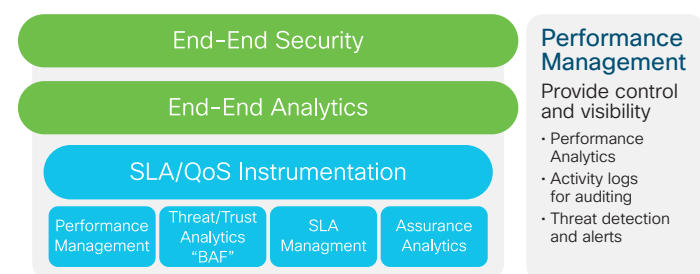
A common misconception is that the distributed nature of blockchains makes them inherently secure. However, without the correct design measures, they can be prone to multiple threats, including:



Our blockchain framework is completed with end-to-end security and analytics, spanning the infrastructure layer through to the interface layer. Additional protection is also provided by a blockchain application firewall, or BAF. The BAF is analogous to a web application firewall (WAF), which detects and protects against various attack vectors by inspecting for unusual patterns using analytics. For example, a BAF might detect unusual traffic from an agent that could represent an attempted DDoS attack.

Analytics also measure the performance of the blockchain network to provide enterprise SLAs and service assurance. Cisco's leadership in network security and application analytics is helping redefine security and analytics for enterprise blockchain.

Figure 4. Cisco blockchain framework: security and analytics



Building an ecosystem for industry solutions

In addition to robust platform standards, organizations are looking to partners to build industry-specific solutions for large-scale adoption. As companies explore enterprise solutions and industry use cases, they will need experienced partners, including:



Cloud service providers

Hybrid deployments will dominate the enterprise blockchain space. Major cloud providers are already offering or about to announce blockchain tools and templates. We expect more blockchain offerings as cloud providers rush to capture the momentum.



System integrators

Integrating with an organization's legacy systems requires professional expertise. Systems integrators will be essential partners for building enterprise blockchain solutions and will work closely with app developers as they create new tools.



Industry specialists

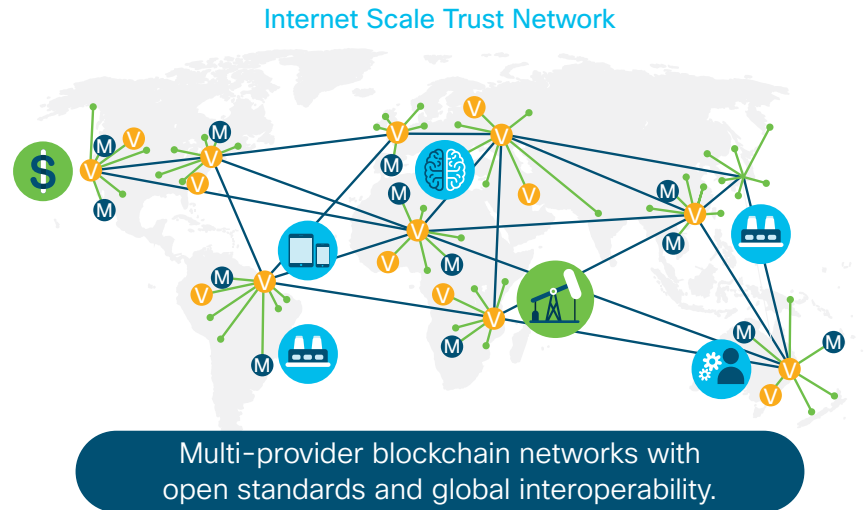
SMEs and industry consultants can focus deeply on specific industry requirements, assist with business case and ROI calculations, and make sure of compliance to industry regulations for each specific deployment.

Cisco is building an ecosystem to support blockchain adoption that brings together service providers, ISVs, and startups, as well as key consulting partners to create end-to-end industry solutions for the enterprise. This comprehensive approach to innovation is one that will future-proof our customers and partners while fully harnessing the possibilities of this radical new technology.



Unlocking value through interoperability

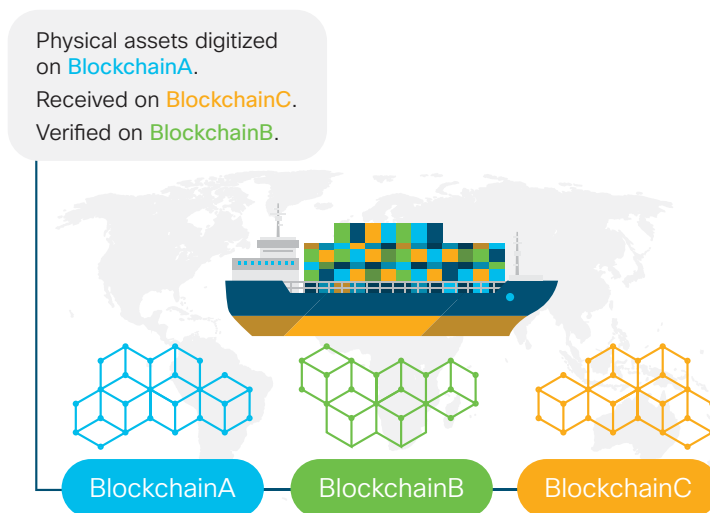
Each blockchain network represents a unique value chain, such as a manufacturing supply chain, a consortium of companies with interconnected IoT devices, or even a smart city. As blockchain networks grow and expand, these discrete networks will increasingly need to interact with one another. This close interaction will require new interoperability standards and protocols, as well as security toolkits to help secure these discrete blockchain bridges.



A primary focus of Cisco's blockchain effort is around creating a common data model for digitized physical assets that can be deployed on any existing blockchain network, including well-known platforms in the Hyperledger project and Enterprise Ethereum.

For example, Cisco envisions the ability for an asset to be digitized on one blockchain network type and transferred to others, while maintaining a cryptographically secure record of ownership or custody. Figure 10 shows how this capability could be used to track the import and export of goods.

Figure 5. Vision to track and provide continuity of chain of custody in heterogeneous blockchain operating environment



To deliver a true Internet-scale trust network that is interoperable, Cisco is working with a number of industry and ecosystem partners to develop standards and tools for blockchain technology to reach its full potential in the enterprise.



Trusted IoT alliance

Cisco is leading industry adoption efforts through the Trusted IoT Alliance, which is platform independent and focuses specifically on developing an interoperability framework for digitized physical assets and their smart contract libraries that live on blockchain networks. The Alliance is also focused on addressing challenges around scale and performance, through the launch of the first-of-its-kind test net for blockchain, enabling engineers to access a global open-source test environment for the development of blockchain solutions.



Hyperledger project

Hyperledger is an open-source umbrella project for multiple enterprise blockchain platforms and associated technology. Cisco is a founding member of the Hyperledger project; chairs the architecture working group; and participates in the organization's identity, marketing, and use-case working groups.



Enterprise Ethereum Alliance

Cisco officially joined the Enterprise Ethereum Alliance (EEA) in July 2017 to partner with industry leaders in developing open industry standards for enterprises looking to address issues around scalability, privacy, and confidentiality on the Ethereum blockchain.



Digital Chamber of Commerce

Cisco is an Executive Committee member of the Chamber of Digital Commerce, the world's leading trade association representing the digital asset and blockchain industry. Cisco and the Chamber are spearheading efforts to promote the acceptance of digital assets and blockchain-based technologies through education, advocacy, and collaboration with policymakers and regulatory agencies.



Conclusion

Blockchain has the potential to change the rules by automating trust, increasing transparency, and simplifying business processes. However, to unleash its full potential, it needs to be based on an established set of standards that meets the complex needs of the enterprise. In addition, today's organizations are seeking industry-specific solutions to transform their business processes and need the ability to build blockchain networks that are interoperable.

Cisco is building a comprehensive foundation for enterprise blockchain technology that brings together our strengths in high-availability distributed systems architecture as well as best-in-class capabilities around security, identity, and cryptography. To accelerate enterprise adoption, we're also bringing together a world-class ecosystem of partners and alliances to deliver a true Internet-scale trust network. As businesses look to realize the promise of this transformative technology, Cisco is focused on making blockchain enterprise ready, and we encourage you to contact your Cisco representative to learn more.



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