CIOs should expect APIs to become a key part of the next generation of blockchain technology. This development will be necessary as blockchain solutions grow more complex, connect to third-party data sources and require more interoperability with other blockchain platforms.

Key Findings

- Successful blockchain platforms need ecosystems of third parties, and digital platforms (of which blockchain platforms are a subset) are based on APIs.
- With the current generation of blockchain platforms (primarily Bitcoin but also Ethereum), APIs are present in some areas, but not widespread, because current foundation-level architecture is more monolithic than modular, at least from the perspective of third-party developers.
- As the scope of the next generation of blockchain platforms broadens and complexity increases, and as ecosystems start to play an important role in competitive differentiation, APIs will become essential to enable these platforms to evolve and serve a broader range of use cases. This trend has already begun with regard to some platforms, such as Bitcoin and Chain.
- We expect API management platforms targeted at the financial services sector to add blockchain-specific functionality, such as cross-chain interoperability, and support the integration of data sources for smart contracts.

Recommendations

CIOs modernizing application architecture and infrastructure with blockchain technology in pursuit of digital business should:

- Identify what blockchain APIs are available and publicly exposed for their industry or use case.
- Plan for the gradual emergence of API management platforms and marketplaces that include blockchain functionality.
- Favor blockchain implementations with well-designed API sets to ease business ecosystem collaboration, market adoption, integration and interoperability.
Use APIs and API management in blockchain experiments to learn how to use security and operation policies, and how developer portals can help build an ecosystem of third parties.

Plan for integration and interoperability work to comprise at least 40% of the effort of building an enterprise-oriented blockchain-based solution, and for the remaining 60% or so to be about creating applications and user portals that sit on top of that platform.

Analysis

Introduction to Blockchains, APIs and the API Economy

Blockchain experts are unfamiliar with APIs, and API experts are unfamiliar with blockchains. This document seeks to bridge that gap and to illustrate how the two worlds can benefit each other and create value.

Blockchain systems are distributed, decentralized solutions that use a distributed ledger as a permanent, immutable record of transactions and other significant events. Given the variety of blockchain use cases (see Figure 1), the even broader potential uses of blockchains, and the value APIs deliver (see below), it’s logical to conclude that combining the two technologies would deliver benefits.
Figure 1. Blockchain Use Cases Across Multiple Industries

Academia: Holberton School, the Leonardo da Vinci Engineering School

Internet of Things: IBM, Microsoft, Samsung, Filament

Music Industry: Up, Bittunes


Media and entertainment: Ilibrium, ascribe, Augur, Gnosis

Healthcare: Royal Philips, HealthNautica, Stanford University

Smart contracts: Empowered Law, Deloitte

Client auditing: Deloitte

E-commerce: Purse, Alipay

Remittances/payments and money transfer: Visa Europe

Fraud and antitcounterfeiting: Everledger, Blockverify, Edgelogic, Deutsche Bank

Prediction: Gnosis, Augur

Supply chain/logistics: Skuchain, Wave

Utilities: Bankymoon, EMS Invirotel Energy Management

Pharmaceuticals: Blockverify

Stock trading: Nasdaq, TeraExchange, Mirror, DXMarkets, MUNA, Symbiont

Securities settlement: UBS, Clearmatics

Trade finance: IDA, UBS, Clearmatics

Ride sharing: LaZooz

Source: Gartner (May 2017)
The use of APIs in a number of domains, such as cloud computing, integration, application rationalization and mobile development, is well-established. APIs enable modularity in large software systems. In turn, modularity enables complex systems to scale, evolve and interoperate. In the past, APIs were an afterthought in the process of building and delivering solutions. But as IT environments have grown more complex, API management has become a discipline in itself, supported by an ecosystem of tool vendors and professional services firms.

In recent years, increased business use of APIs has resulted in a phenomenon called the "API economy" (see "The API Economy: Turning Your Business Into a Platform (or Your Platform Into a Business)"). In the API economy, use of APIs largely by business partners and external ecosystems of developers has created fresh business channels. Most recently, APIs have been identified as a fundamental part of platforms for digital business (see "Building a Digital Business Technology Platform"). APIs enable the building of ecosystems of business partners and, ultimately, the execution of digital strategies (see "Building Platforms for a Digital Society: Key Insights From the 2016 Gartner Symposium/ITxpo Keynote"). Consequently, they demand the attention of CIOs (see "Top 10 Things CIOs Need to Know About APIs and the API Economy").

Successful blockchain platforms need an ecosystem of third parties, and digital platforms (of which blockchain platforms are a subset) are based on APIs — hence the publication of this document.

**Current Status of Blockchains and APIs**

Currently, blockchain systems offer APIs that cover only part of their functionality, but the situation is improving (see, for example, "Bitcoin Developer APIs" and BlockCypher’s API documentation).

The first blockchain platform, the Bitcoin technology stack, was effectively a monolith that did not use APIs in any significant manner to provide extensibility and adaptability. Of course, every complex piece of software has an internal structure of files, classes and interfaces, so current blockchain platforms do have internal APIs to generate and send transactions across peer-to-peer networks, for example. But these platforms are essentially monolithic from the perspective of external third-party developers, in that there is one part of the system that simply calls on another, rather than there being an interface to multiple clients that are decoupled from the core and that can be replaced or revised.

The Bitcoin stack is the most proven and mature blockchain platform, having been deployed on the internet since January 2009. Although its foundation is solid, the Bitcoin stack has some significant built-in problems and limitations with regard to scalability, data confidentiality, flexibility, transaction latency, manageability, tooling and governance. Some of these are easier to address than others.

To succeed more widely, the Bitcoin stack must evolve into a next-generation version that addresses these problems in the short term. Due to limitations in the governance process, it has proved difficult to make even simple changes to the Bitcoin stack’s codebase, such as changing the block size parameter from 1 megabyte to 2 megabytes, which is theoretically just a one-line code change (albeit one with significant technical, economic and political implications). If the system had been designed in a modular fashion and for a modern, API-based architecture, changes in the codebase would have been easier to make, and some of the problems indicated above would have been mitigated.
In response to the well-known limitations of the Bitcoin stack, over 70 competing blockchain platforms are emerging. Many of these seek to displace the dominant player and become the foundation of the era of the "Internet of Money" or what Gartner calls the "programmable economy." Most of these offer some APIs, generally limited to specific functional areas, such as the digital wallet (see below). To differentiate themselves, these emerging blockchain platforms are offering improved capabilities in terms of scalability, confidentiality and flexibility, for example. These systems are larger and more complex, and benefit from APIs internally. Their APIs also allow modular replacement of subsystems, such as replacing one consensus algorithm (proof of work) with another (proof of stake).

Much of this modularity and API enablement in blockchains is in its early stages, in that current prerelease versions of some systems have only one instance of a module, not multiple instances of different types. However, this is changing (see, for example, "What Is Blockchain, the Bitcoin Ecosystem Based on APIs?"). Also, APIs are already a popular way of packaging algorithms, with marketplace sites such as algorithmia.com gaining usage and credibility.

At present, the primary use of blockchains is inherently transactional, so it’s natural to think that APIs layered onto blockchain platforms would be of immediate use for building decentralized business models as part of the API economy or a digital strategy. However, the API economy’s systems of value are mostly not based on transactions, and the most common business models are indirect. And whenever there are transactions, they are generally based on conventional payment systems, which blockchains are unlikely to impact significantly in the short term.

**Recommendations**

CIOs should:

- Identify what blockchain APIs are available and publicly exposed for their industry or use case.
- Plan for the gradual emergence of API management platforms and marketplaces that include blockchain functionality.

**The Future of Blockchains and APIs**

The following are areas in which APIs are currently used to a limited extent for blockchains, and in which this use will grow over time:

- **Digital wallets**, which form the front-end of a blockchain solution that is combined with an operational infrastructure like that of Blockchain.info, BitGo, blockr.io or BlockCypher. Blockchain platforms such as Bitcoin and Ethereum come bundled with basic wallets, but are designed to allow third-party wallets to provide a different user experience, something they accomplish through APIs. External usage of digital wallets by ecosystems of partners and fintech companies is rising quickly, prompted by API economy use cases and regulations like the Second Payment Services Directive (PSD2) in the EU (see below).

- **Data persistence mechanisms.** Currently, the data persistence mechanism (the subsystem that records transactions or other significant events) is tightly coupled and embedded in the
monolithic system: for example, Bitcoin basically has a flat file data store (albeit one that is massively replicated). However, this situation is also changing. Platform architects are realizing that this is an area where different kinds of subsystem can be used. Also, third-party mechanisms are emerging to provide high-performance, scalable storage that will work with different blockchain platforms; these storage mechanisms will be accessed through APIs. The value proposition is not just better scalability but also easier governance, policy-based security (as in API management platforms) and broader storage of data, because current blockchain data storage is very limited (a flat file of transaction records). Data storage subsystems include BigchainDB, IPDB, the InterPlanetary File System (IPFS), Filecoin, Monax (formerly Eris), StorJ and Swarm. (Note that, due to the emerging nature of this category, the systems are not all directly comparable, and that some overlap and some complement each other.)

- **Smart contracts**, which add dynamic adjustment and policy management when value is exchanged in a blockchain. The precursor to smart contracts is Bitcoin script, a simple stack-based language with opcodes similar to the Forth programming language. It offers only limited programmability, not full-strength ("Turing complete") programmability. It does not rely on APIs, but instead uses opcodes in the interpreted script. The next step up in smart-contract power is the Ethereum platform, which does have a Turing-complete language. Again, this system is (at the virtual-machine level) opcode-centric, rather than API-centric (although at higher levels of the stack, there are APIs to connect browser-based front ends with the blockchain platform). We are starting to see blockchain providers decouple the smart-contract subsystem from the rest of the platform, and APIs will increasingly provide the means of connecting the two.

Outside the blockchain sector, there are API management platforms that offer developer portals, which are used as a basis for API marketplaces. Developer portals list all available APIs, depending on the profile of the developer, and the visibility rules that the API provider assigns to target specific developers and enable specific business opportunities. API management platforms also enforce proper authentication, identity and, in general, security policies for the use of APIs, from development to operation. Most current open-banking endeavors use API management platforms heavily, as API-based security threats and risks are fairly obvious and well-known.

Offerings and breadth of functionality vary widely from one API management provider to another, but the most advanced platforms’ procedures for onboarding developers can be reasonably sophisticated. Furthermore, as the blockchain phenomenon gathers momentum, support for at least a minimum set of blockchain smart contracts is likely to be added, as this would be a natural extension of current developer portal and API marketplace capabilities, especially for providers that already have established offerings in the financial-services sector. Open-banking industry regulations like PSD2 in Europe, which are intrinsically API-based, will accelerate the usage of APIs in blockchains and the corresponding availability of dedicated functionality in API management platforms.

One key area for the future is the connection between the digital domain of the smart contract and the external data sources that may provide triggering events for the business logic within a smart contract. This is a classic API use case. For example, a derivative financial instrument based on the price of a commodity or stock could be implemented as a smart contract. The system implementing the derivative financial instrument is no longer self-contained and needs a connection to the real world of events. There are emerging, third-party, generally API-based external data sources of
different types that feed smart contract logic — for example, to provide the closing price of a stock or information about weather events (such as floods). The current industry term for a system that provides smart contract logic is "oracle" (which refers, not to the well-known enterprise technology vendor but to the concept of an authoritative data source, as in the Oracle of Delphi of ancient Greek tradition).

This connection between a smart contract and one or more data sources is accomplished through APIs. In addition, an API gateway (part of an API management platform) can apply security and operational policies and data transformation, and provide support for external events. API gateways will need to evolve to encompass specific ways of supporting data oracles, such as aggregating multiple data sources (weather data, for example) into an aggregate source that is more trusted.

Recommendations

CIOs should:

- Favor blockchain implementations with well-designed API sets to ease business ecosystem collaboration, market adoption, integration and interoperability.
- Use APIs and API management in blockchain experiments to learn how to use security and operation policies, and how developer portals can help build an ecosystem of third parties.

Integration and Interoperability

Outside the blockchain domain, APIs are useful for enabling integration and interoperability between systems that were designed separately but that now need to connect to each other. They act as enablers by helping to build a fundamental part of a digital platform on which an ecosystem of third parties can develop (see "Building a Digital Business Technology Platform").

The need for interoperability between blockchains is not yet prevalent, but it will become so, especially now that multiple blockchain platforms exist. We expect that financial processes will start hopping from one blockchain to another as digital strategies introduce new partners and collaborative processes.

There are various mechanisms for cross-blockchain interoperability, but at present these are more protocol-centric than API-centric. Systems that enable interoperability of various kinds include Blockstream Elements (through sidechains), Lisk, Monax, MultiChain, Ripple, the Interledger Protocol and Tendermint Cosmos.

As sidechains and blockchains proliferate, the interoperability problem will become more complex. APIs and ancillary tools for API management will play a big role in managing this complexity and enabling interoperability. This has already happened in other areas, such as B2B integration in supply chains.

APIs for blockchains will be published on developer portals, either by blockchain providers or by technology firms and system integrators developing on blockchains. Programmers given visibility into a specific blockchain implementation will be able to see how open the implementation is, what
functions of the blockchain can be called from outside it, what data one can get in and out of it, and what format the APIs will expect. They will be able to test the APIs with dummy data, and embed the APIs into the applications they are implementing. This will make blockchain integration and interoperability easier, and slowly turn blockchains into digital platforms.

**Recommendation**

CIOs should:

- Plan for integration and interoperability work to comprise at least 40% of the effort of building an enterprise-oriented blockchain-based solution, and for the remaining 60% or so to be about creating applications and user portals that sit on top of that platform.

**Gartner Recommended Reading**

*Some documents may not be available as part of your current Gartner subscription.*

"Top 10 Mistakes in Enterprise Blockchain Projects"

"Top 10 Things CIOs Need to Know About APIs and the API Economy"

"Toolkit: Overview of Blockchain Use Cases"

"The API Economy: Turning Your Business Into a Platform (or Your Platform Into a Business)"

"Building a Digital Business Technology Platform"

"Building Platforms for a Digital Society: Key Insights From the 2016 Gartner Symposium/ITxpo Keynote"