



POINT OF VIEW | APPLICATION SERVICES

# Functional Testing for Blockchain Applications

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# What is blockchain?

## Did you know?

Invented by Satoshi Nakamoto in 2008 to serve as the public transaction ledger of the cryptocurrency bitcoin, blockchain combines preexisting techniques, such as cryptographic hash, public key encryption and the Merkle tree data structure, in unique ways. This allows users to conduct transactions without a middleman, create new forms of digital assets (while resolving the problem of double-spending) and provide both immutability and traceability of data and assets.

Blockchain technology is everywhere — from healthcare to banking and retail. But what is it really? Blockchain is a decentralized, distributed and digital ledger used to document transactions (or blocks) across many computers (referred to as nodes) so the record can't be altered retroactively without also altering all subsequent blocks and having the consensus of the network.

The key characteristics that make blockchain unique include:

- **Decentralization driven.** This means that transactions across networks do not need to adhere to any specific central authority and that no specific entity can claim exclusive control over the data or the processes.
- **Consensus protocol based.** This means that every transaction requires all relevant parties to be in agreement for the transaction to be valid.
- **Immutable.** This means that once the transaction is agreed upon and recorded in a blockchain, it can never be changed or tampered with — creating trust in every transaction.
- **Transparent.** This means that the history of every transaction is recorded and accessible for any contributing party to audit. It creates a source through which asset lifetimes can be tracked.

Another aspect of blockchain technology is smart contracts. Either a computer program or a protocol, a smart contract typically runs on a blockchain and facilitates, verifies or executes business processes that could be triggered by events, on-chain transactions or interactions with other smart contracts. A smart contract adds dynamic, programmed behavior to transactions, and while potentially very disruptive, these contracts also remain immature — and risky.

Blockchain offers new mechanisms to establish and manage trust across entities. As such, it can impact transactions and interactions that involve consumers, businesses and governments.

The scope of blockchain's impact is far reaching and spans technology, business, industry and society. It has triggered a paradigm shift in the global economic system, with a deep impact on records management, identity management, know your customer, auditing, supply chain management, voting, taxes, land registration and medical records.

With this technology branching into all major industries, the retail, government, healthcare and life sciences, and commercial sectors are gearing up to take advantage of the blockchain phenomenon. In the financial industry, the potential of blockchain and cryptocurrencies — and the application of both — is nothing short of revolutionary.

Given blockchain's reach, characteristics and inherent risks, it's extremely important that any blockchain solution or application be thoroughly tested before it's deployed.

# Why it's critical to test a blockchain application

Blockchain applications do not exist exclusively in the domain of digital currency platforms. They need to integrate with other systems that provide access to real-world data and events, such as smart contracts. But the integration points require an application programming interface (API) design and layer of abstraction to live on beyond the initial blockchain application. APIs can also enable different kinds of foundational technology, not just blockchain technology, to be incorporated as part of an overall blockchain solution.

The immutability of a blockchain record and the distributed nature of a blockchain system make smart contracts an attractive option for enterprises.

It's the lack of best practices and standards that make blockchain security a challenge. Security vulnerabilities also exist in the technology that surrounds the blockchain ledger, meaning that all blockchain projects must be evaluated for technology, governance and compliance, human misunderstanding and value at risk. What would happen to all the transactions recorded on a blockchain if it deploys with a defective smart contract? Significant monetary loss, for example, could occur. In fact, according to CNBC and security firm Carbon Black, "\$1.1 billion in cryptocurrency has been stolen this year [2018], and it was apparently easy to do."<sup>1</sup>

Smart contracts within blockchain platforms may have a lot to offer, but the lack of regulation and testing make them a potential vulnerability. In 2016, for example, the Decentralized Autonomous Organization (DAO) announced that a hacker had exploited a vulnerability in Ethereum, a blockchain platform utilized by the group. The flaw was not in the blockchain platform itself, but rather in the smart contract. The hacker was able to trigger a recursive send vulnerability, where the act of sending funds triggered another "send funds" request. Ethereum did exactly what it was supposed to do, but a loophole in the smart contract code exposed the organization to a hack. The total loss to the DAO was reported at \$150 million, \$60 million of which was lost in the first 12 hours.<sup>2</sup>

The immutability of a blockchain record and the distributed nature of a blockchain system make smart contracts an attractive option for enterprises. In theory, they establish indisputable provenance. However, the immaturity of the technology means there's also potentially significant drawbacks. For example, smart contracts are independent, which means that they obey only their own code and, once deployed, cannot be controlled by either the originator or any legal system. Additionally, they are irrevocable and can only be replaced by a completely new contract. The DAO hack proves what can happen if that code is not exhaustively tested for every potential outcome.

# The best functional tests for a blockchain app

For the purposes of this point of view we'll focus on an Ethereum-based blockchain application — like the one used by the DAO. Similar to any project, a blockchain-based application requires functional, non-functional and specialized testing.

To better understand the functional testing needs, Figure 1 shows a sample reference architecture for a blockchain-based application.

Some of the key aspects for functional testing in the Figure 1 sample architecture include user interface testing, middleware testing and smart contracts testing.

## User interface testing

This wouldn't be any different from the user interface testing for any web-based application. It requires testing of the usability, accessibility, cross-device/browser and other functional aspects of the application. All these

## API/middleware testing

The sample architecture in Figure 1 shows how several middleware features can be leveraged in a real-world blockchain project. These include the following:

- Integration of different data sources in real time — for example, blockchain clients, various backends (like enterprise resource planning, customer relationship management and legacy systems), cloud services and partner APIs
- API gateways and management
- Blockchain access APIs and integration APIs
- Correlation of blockchain and non-blockchain events in real time, sometimes including machine learning and analytics models

All the APIs mentioned would require thorough testing for functionality to ensure that there are no functional issues and that the service integration works seamlessly. Several

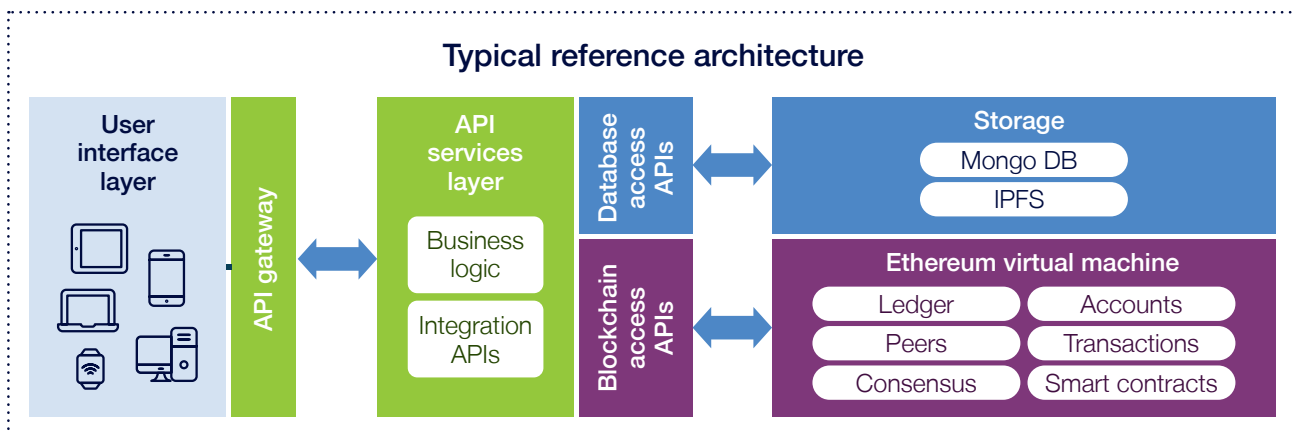


Figure 1: Sample reference architecture — blockchain-based application

aspects can be easily automated and tested by leveraging any open-source (such as Selenium) or commercial (such as UFT and Test Complete) tool.

NTT DATA Services has ready-to-deploy automation frameworks to automate these aspects of testing that can easily save an organization up to 30% of its script development efforts.

open-source (SoapUI, Katalon Studio and Postman) or commercial (Parasoft SOAtest and Tricentis Tosca) tools can be leveraged to automate API testing.

Our test automation framework (or an open-source framework like Robot Framework3) can be leveraged to jump-start API test automation.

## Smart contracts testing

Simply explained, a smart contract is a set of rules or conditions on which a transaction is executed on blockchain. Once deployed, the contract works on its own; no centralized person or body controls it. Thus, it is essential that the contract be thoroughly tested to make sure it does what it's supposed to do, perfectly. The following are some of the key things that need to be validated for smart contracts:

- Functional testing of business logic
- Node testing to ensure consistency of transactions
- Validating the consensus mechanism and data immutability

Test frameworks such as Truffle, Mocha and Chai are available to test smart contracts. To do so, these frameworks need to be deployed in an environment like an Ethereum live environment. There are a number of different ways to achieve this like Ganache local blockchain or Testnets like Rinkeby to deploy the smart contract.

Leveraging test-driven development is a good option when testing smart contracts, as this will ensure that there is no room for error. Our test automation framework, Open2Test, can be leveraged for this purpose, as well.



## Conclusion

Testing and quality assurance are clearly a very critical and important aspect for any blockchain implementation. The consequences of any incident in real time can be severe and cause significant financial loss, depending on the industry or application. This point of view focused on the functional aspects of testing a sample blockchain application and the key areas that need to be tested for such applications, including recommendations for test automation frameworks that can help perform these tests in an efficient manner.



# About the author



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Ashwini Sukhwani is a project management professional with close to 18 years of IT consulting experience helping Fortune 500 organizations across the North America, EMEA and APAC regions improve their maturity in the areas of quality engineering and testing processes. He has set up and delivered a variety of complex testing engagements and test centers of excellence, as well as implemented test frameworks and accelerators to improve the effectiveness and efficiency of testing organizations. Ashwini has been a speaker at various conferences held in North America and India on topics pertaining to test innovation and best practices associated with quality engineering.

## Sources

1. Kate Rooney. "\$1.1 billion in cryptocurrency has been stolen this year, and it was apparently easy to do." CNBC. June 7, 2018. <https://www.cnbc.com/2018/06/07/1-point-1b-in-cryptocurrency-was-stolen-this-year-and-it-was-easy-to-do.html>
2. Ronald David Smith and David E. Barrett. "The DAO's Wild Ride: Where Does Blockchain Go From Here?" Forbes. July 1, 2016. <https://www.forbes.com/sites/realspin/2016/07/01/the-daos-wild-ride-where-does-blockchain-go-from-here/#63772a843e5c>
3. Robot Framework. <https://robotframework.org/>



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