Blockchain technology: Contribution to improved transaction management

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Abstract

Blockchain holds great promise, and experimentation with it continues to grow. Transactions are the operations of reading and writing to add or read information within this technology. With the advent of smart contracts, the possibility of accessing blockchain technology via any client application has become a reality. However, blockchain is notoriously slow to respond, depending on the number of transactions, checks and workload required. Added to this are the problems associated with the operation of the existing system. In this paper, we propose a Transaction Management Framework for a blockchain solution, as well as a decision-making aid to help you make the most of this technology.

Keywords

Blockchain, Framework, Decision aid

1. Introduction

In our hyper-connected world, data reigns supreme. Indeed, sources of information have multiplied. This information varies according to environment, context and type of process. It is produced in large quantities on a daily basis through processes, and is in part a key to success. From another angle, thanks to the advent of new technologies over the last few years, we are contributing enormously to the increase in the amount of information, or in this case data. This situation is prompting large organizations to take a close interest in the data they produce, and in securing the processes adopted during operations. As an innovative technology, blockchain is attracting the attention of researchers and large organizations alike. Despite its potential, blockchain faces a number of challenges: long response times leading to excessive energy consumption, an immaturity that limits many blockchain projects to the experimental phase [1,2,3], and problems linked to the functioning of the existing system. Since its appearance in 2008 to support bitcoin-related transactions, even though the blockchain is experiencing growing success and attracting investors who seek to experiment with it in various domains (such as in the case of the supply chain) in order to achieve better performance, experiences have shown that implementing a blockchain project is far from being a simple traditional project. Research has shown that 85% of blockchain projects in the Netherlands stagnate in their testing phase. In their article, [4] state that "project management in blockchain technology will be different from managing other projects, as these types of projects will require a greater capacity to adapt and a lot of preparation to handle the unexpected."

This contribution focuses on a Transaction Management Framework for a blockchain solution to improve the user experience. In the same perspective, some decision support points will be proposed

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to facilitate decision-making during a blockchain project. First, we will address the state of the art to identify the different works done at this level. The second part will focus on our contribution with the modeling of our Framework and the proposal of decision support.

2. State of art

Initially, the main aim of blockchain was to ensure exchange between parties without the intervention of a third party to ensure that the established rules were followed. In addition, the decentralization of information is also an important factor in the design of blockchain. Based on research, most authors focus on the contributions of blockchain in different fields, but fewer on the costs of implementing it, let alone on areas for improvement [3,5,6,7]. The survey carried out in [3] revealed that 45% of the risk of failure was linked to a lack of expertise. The waiting time for an operation has fallen considerably as a result of demands and technological developments. This waiting time has increased again with blockchain, due to the numerous controls and consensus algorithms [8]. The POW (proof of work) consensus algorithm used by certain types of blockchain (public blockchains) is the main factor behind the very high latency times with its following cryptographic function [8].

$$\mathbf{f(B, IM, hash(n)^{-1}, random) < C} \quad (1)$$

B= Block to be mined
IM= Miner identification
$\mathrm{hash(n)^{-1}}$ = hash of previous block
C = Fixed complexity

This calculation is repeated as many times as necessary until the function is verified [9,10,11]. We can observe that, through this control mechanism, blockchain technology uses a lot of energy to ensure security controls [12]. Finally, blockchain is used to ensure the security and transparency of transactions between different stakeholders. To achieve this, a control mechanism is used to collect, verify and validate transactions. However, several studies have shown that this mechanism requires significant energy consumption [13,14,15,16], which is a key challenge. As a solution to this problem, [17] has carried out a comparison that illustrates the difference in latency between the continuous execution of transactions and their grouping into data blocks prior to processing. According to the authors, dispensing with the need to group transactions into data blocks would significantly reduce latency during operations. Table 1 summarizes a number of challenges identified by authors.

Table 1: Blockchain challenges

Actor(s)	Challenges
Hackius and al.[8]	Lack of maturity
Floréa [12]	Excessive energy consumption
E. Wall and al.[13]	Excessive energy consumption
M. Marchesi and al.[16]	Lack of maturity
D.Mao and al.[18]	Low latency: long waiting times
J.Li and al.[19]	Lack of skills

The information in the table shows that there are many challenges ahead. With this in mind, we've decided to focus on one case: transaction management. This management will ensure good ergonomics and reduce latency during operations. In the following sections, we will focus on this aspect and make our contribution by proposing a Framework.

3. Contribution

3.1. Framework

Our contribution is based on the use of middleware to control and manage transactions (see figure 1). Initially, the client calls a service according to its needs via a client application. This REST call will be retrieved by the middleware, which will control the user's permissions in relation to the accesses defined for him. This method enables access and authorization controls to be performed directly in the middleware. This will allow only transactions authorized to be executed to be sorted. All validated transactions will be stored in a database and will be executed on the blockchain according to the policies defined and the availability of Smart Contracts. The use of middleware is of crucial importance as it allows:

- From a technical standpoint, ease of extension (code reuse).

- Improved performance of the blockchain with a first level of control, which allows for the elimination of operations that do not comply with predefined rules.

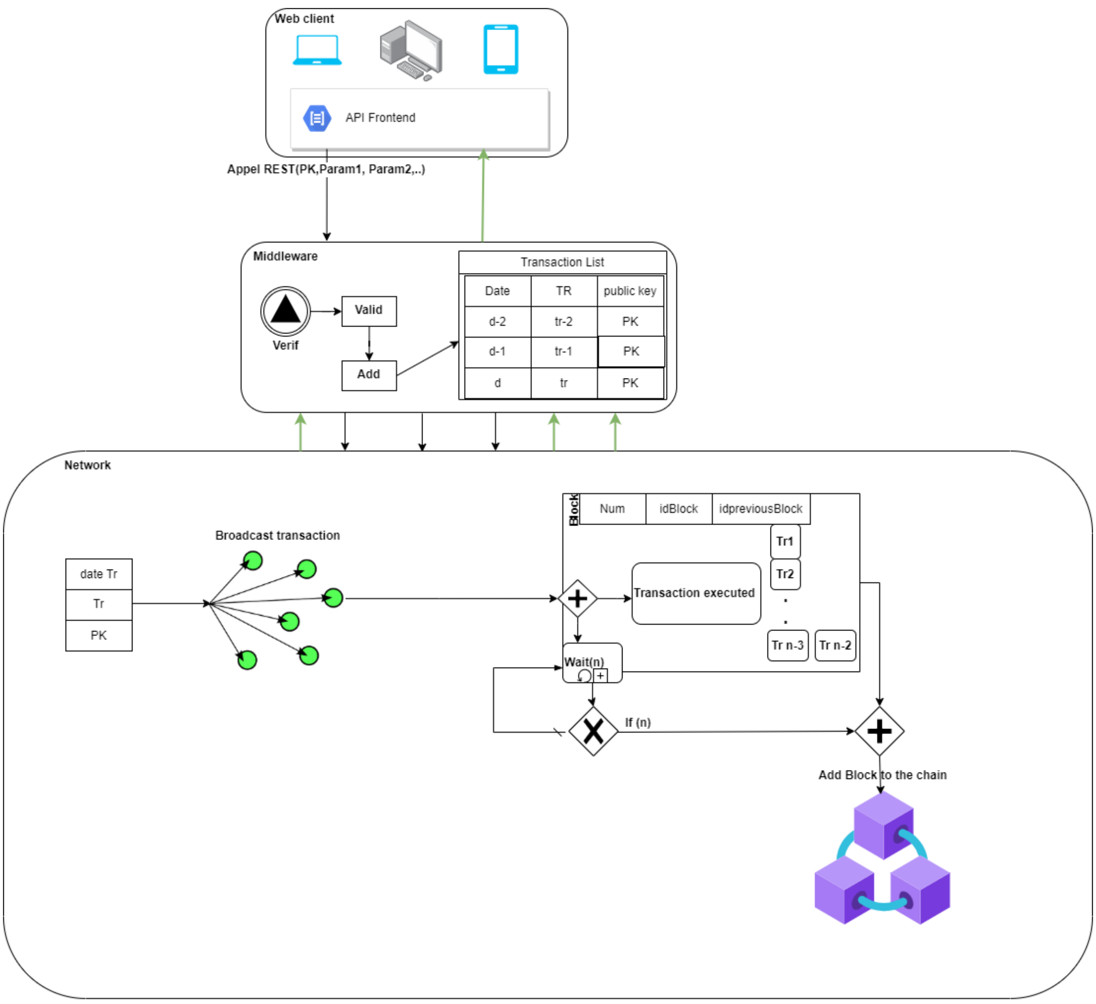

Figure 1: Transaction management framework

This framework enables the separation of client and blockchain technology, with middleware in between. The latter retrieves all user requests before passing them on to the blockchain. Firstly, this saves time by performing a number of checks and blocking certain operations if the rules are not respected. Secondly, thanks to the database used to collect transactions, users no longer have to wait for a transaction to be validated. As soon as the transaction is launched, a "Transaction taken into account" notification will be sent to the user. It's important to note that this middleware will store all user-initiated transactions, even when the blockchain is down. All these transactions will be checked, and those that do not meet the set conditions will be automatically rejected (in which case a notification will be sent directly to the user). The remaining transactions will be scheduled and sent directly to the Blockchain once its services have been restored. With this method, we can dispense with control methods and reduce energy consumption. In summary, this contribution allows:

- To reduce latency within the blockchain network through pre-check functions defined in the middleware to perform initial verifications. These long waiting times are part of the bottlenecks that cause blockchain projects[3,12].

- To backup operations (using a database) launched if the blockchain network is down and execute them when the services are restored. In this case, MongoDB database proves to be more efficient as it allows perfect adaptation to a large volume of data. Additionally, replication is automatically ensured in case of server failure.

3.2. Decision aid

In this section, we make a number of proposals for decision aids to help us meet these challenges. These decisions are part of the control process for managing a blockchain project.

GO/NOGO: Studying a project is an important step in any sector, and requires serious work to avoid any problems linked to its feasibility (even if zero risk does not exist). Like any new technology, blockchain has been the subject of many experiments through theories, POC (proof of concept) and standardizations. However, establishing the technical feasibility of a project is one thing, but ensuring that it runs successfully is quite another, and blockchain is no exception to the rule. Indeed, the notion of the high cost of this technology has caused several projects to fail, if the existing literature is anything to go by [3]. Faced with this situation, a decision aid becomes a necessity to enable self-assessment in order to measure one's ability to hold a blockchain project. To decide whether or not to launch a BC project, a great deal of information needs to be collected and analyzed before the decision is made.

Choice of technology: Blockchain solutions differ in terms of how they work. It is very important to take the time to examine the type of technology (public or private blockchain) to choose for a successful project. In [20], the authors propose a method based on Fuzzy Number to determine the type of blockchain to choose according to the defined needs criteria. This method is generic and highly efficient, and can determine the most suitable blockchain based on the input data.

Profitability study: To determine the profitability of a project, we must start by checking its feasibility. Through a POC (proof of concept), we can determine whether the project is achievable or not, depending on requirements:

- Economic relevance, to list the project's economic benefits.

- Ecological issues are currently essential elements to be considered in all projects. This study is carried out upstream of any project and is based on the results of analyses that are available, hence the need to be rigorous in all phases of study and analysis.

4. Conclusion

Since its emergence, blockchain technology has attracted a large number of sectors with its ability to meet a wide range of challenges. Alongside this enthusiasm, reality has shown that much remains to be done to make the most of this technology's potential. However, while some projects have succeeded with great satisfaction, many others have failed, as mentioned in [3,5]. Based on our optimism and successful projects, we can defend the idea that this technology could, like any new technology, contribute to current challenges as its maturity improves. Our contribution in this paper was the proposal of a Framework to ensure transaction management to enable users to save time on their requests. This proposal makes it possible to store all user-initiated operations in a database, and to prioritize transactions according to defined rules. This ensures that operations are not lost even if the blockchain services are not operational. In addition, this method considerably reduces the energy consumption associated with the technology (consensus mechanism). The second part of our contribution was a proposal for a decision-making aid to help anticipate the risks and long-term decisions involved in a blockchain project.

Declaration on Generative AI

The author(s) have not employed any Generative AI tools.

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