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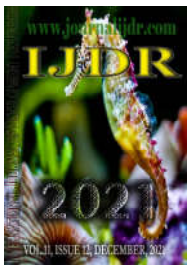

RESEARCH ARTICLE OPEN ACCESS

BLOCKCHAIN AND TCP: A COMPARATIVE APPROACH

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ABSTRACT

In this article we will show that the characteristics and functionalities of a blockchain data structure, although developed in the application layer, are similar to those of the Transmission Control Protocol (TCP) in the Transport Layer. The TCP protocol is characterised by a point-to-point connection, reliable delivery, through validation mechanisms with confirmation and sequencing and retransmission. These characteristics are present in a blockchain, either in the form of software components or software and hardware arrangements. The proposed approach allows us to identify possibilities of replacing, in classic data applications, the TCPl protocol, which is reliable and secure, but slow, with the User Datagram Protocol (UDP), less reliable but fast, leaving reliability and security to the blockchains, in the application layer.

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INTRODUCTION

Blockchain is often related to a technology, due to its association with bitcoins (NAKAMOTO, 2008), (D. BYER *et al*, 1993), being part of a complex set of software and hardware whose main objective is to guarantee security, confidentiality, and reliability in digital currency transactions. In this article we look at a blockchain isolated from the technology context and what we see is an Application layer message structure, with similar characteristics to those of the Transport layer, more specifically in the TCP protocol (FOROUZAN, 2002), (KUROSE *et al,* 2013). Table I shows some of these characteristics.

Table 1. Comparative table of BLOCKCHAIN and TCP characteristics

Characteristic	Tcp	Blockchain
Connection Oriented	Yes	Yes
Fragmentation	Yes	Yes
Reassembly	Yes	Yes
Sequencing	Yes	Yes
Confirmation	Yes	Yes

For contextualisation purposes, Figure 1 shows the Internet layer model (KUROSE *et al*, 2013), (MELO, *et al*, 2019) where the Application, Transport, Network, and Network Interface layers are defined. In the Application layer are applications such as Database, File Transfer, Web Pages, Domain Name System (DNS), among others. At the Transport layer are TCP and UDP. TCP is often selected for data applications that require a reliable delivery service, which is provided by TCP through functionalities that implement the features described in Table 1. TCP also implements two mechanisms that make it a slow protocol, as we will see in the Materials and Methods Section, namely, Flow and Congestion Control.

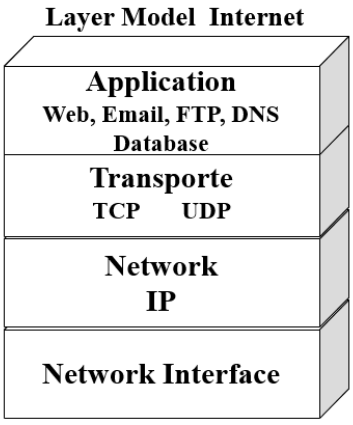

Figure 1. Internet Layer Model, emphasizing Application and Transport layers

For TCP, the characteristics shown in Table I are well known and explicit, however, for BLOCKCHAIN, some are implicit, such as confirmation, which in the case of BLOCKCHAIN is equivalent to block validation. Another aspect refers to the manipulated data structure, in the case of TCP it is called a segment (KUROSE *et al*, 2013) and in the case of BLOCKCHAIN they are called blocks (Drescher, 2017). The characteristics are detailed and compared in the Materials and Methods section. In the Results section, although there are no experiments, we summarize the details of the characteristics. In the Discussion section we critically analyse the implications of this comparative study. In the acknowledgments section, we briefly thank the project sponsor who motivated the writing of this article.

MATERIAL AND METHODS

In this section, we detail the characteristics that approximate TCP to BLOCKCHAIN, listed in Table I. We start with a description of the structure of a TCP segment, Figure 2.

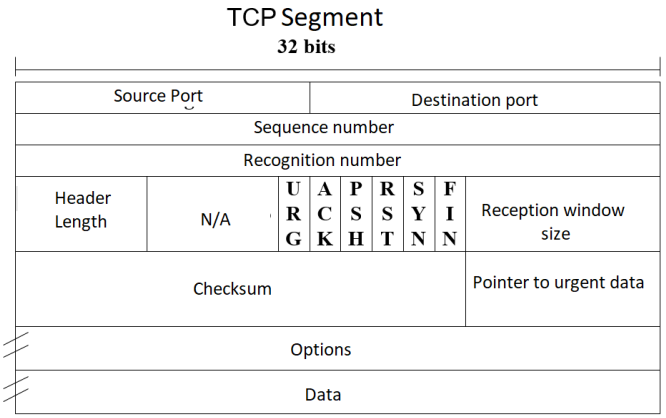

Figure 2. Structure of a TCP segment

Below is a brief description of the well-known features of TCP and their comparison with blockchain.

Connection Orientation: Before exchanging messages, TCP establishes a connection between the nodes that wish to communicate, which is done by a sequence of SYN and ACK, shown in Figure 2. A blockchain uses the P2P protocol to make this connection.

Fragmentation, Sequencing, and Reassembly: TCP breaks the message into fragments, numbers and then reassembles at the destination, through the segment sequence numbering and acknowledgment number. These characteristics are strongly associated with the essence of a Blockchain, that is, blocks are chained from the last sent/received block. Figure 3 illustrates this chain.

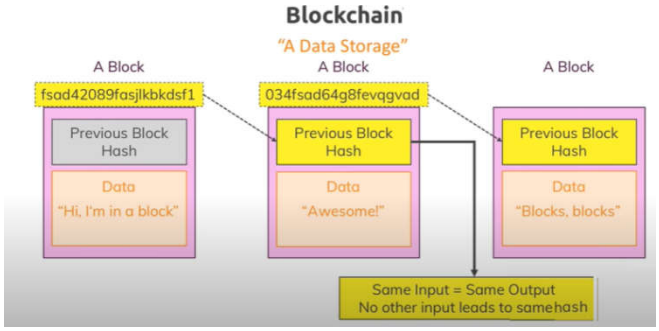

Figure 3. Fragmentation structure, sequencing, and reassembly of block chaining in a blockchain

Acknowledgment: TCP confirms the set of sent segments, through the ACK flag. While a Blockchain, working in the Application layer, confirms transactions through a validation process, which can be the insertion of the block into the chain, that is, if the block was inserted into the Blockchain it is because it was validated, this is confirmed (D. BYER *et al*, 1993), (FURNEAUX, 2018). TCP is a protocol from the decade and 1970, designed to guarantee reliability in the exchange of messages over an unreliable network, at a time when the means of communication were precarious and the speed of channels were in the order of Kbps. Reliable delivery is guaranteed by the confirmation and retransmission mechanisms, which slows down the communication process. Furthermore, the Flow Control and Congestion Control mechanisms (KUROSE *et al*, 2013), (MELO, *et al*, 2019) significantly contribute to this slowness. On the other hand, the UDP Transport Protocol (KUROSE *et al*, 2013), whose segment structure is shown in Figure 4, is lighter, does not make connection, does not confirm, does not perform Flow Control or Congestion Control, being frequently used for audio and video applications and shorter transactions such as Domain Name System (DNS).

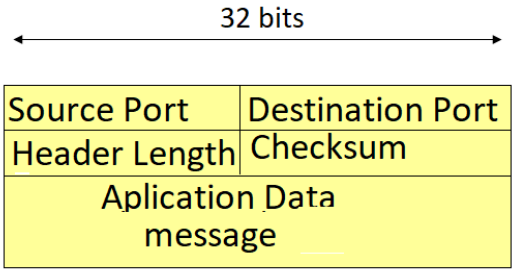

Figure 4. Structure of a UDP segment

To complete the scenario, some transport layer functions are performed at the Network layer as well. Namely, fragmentation and reassembly at the IP Network layer and Network Interface, such as confirmation and retransmission, error detection.

RESULTS

With this scenario described, and although we need to conduct experiments and measure parameters that validate our arguments, the results point to an adaptation of the Blockchains so that data applications use Blockchain as a protocol in the Application layer and UDP in the Transport layer as shown in Figure 5.

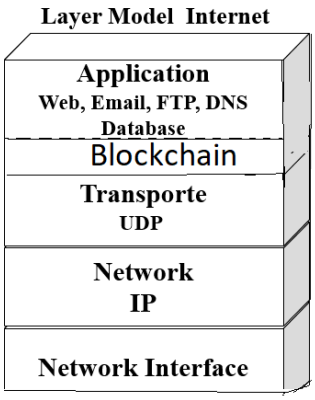

Figure 5. Proposed Layers Model. The TCP functions are partly implemented by the Blockchain in the Application layer and others already exist in the lower layers

DISCUSSION

Many applications use TCP as a transport protocol, which has proven its quality and robustness in the last five decades, mainly in internet applications. However, the changes in communication technologies and the demands of new applications, mainly in terms of security and speed requirements, require new approaches, such as Blockchain technology. This article does not intend or argue for the replacement

of TCP and the insertion of Blockchain in conventional applications in the data area, but rather to open the discussion on the subject.

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REFERENCES

D. Bayer, S. Haber, W.S. Stornetta, 1993 "Improving the efficiency and reliability of digital time-stamping," In Sequences II: Methods in Communication, Security and Computer Science, pages 329-334.

Drescher, Daniel 2017. Blockchain Basics: A Non-Technical Introduction in 25 Steps, Copyright © by Daniel Drescher

Forouzan, BA. 2002. TCP/IP protocol suite. dl.acm.org.

Furneaux, Nick, 2018. Investigating Cryptocurrencies: Understanding, Extracting, and Analyzing Blockchain Evidence. Published by John Wiley & Sons, Inc.

Kurose, Jim, Ross, Keith. 2013. Computer Networks and the Internet: A Top-Down Approach. Pearson Publishing. 6th Ed.

Melo, Ernande. Oliveira, HM 2019. Layer Model Applied to Physics https://www.researchgate.net/publication/336832192_Layer

Nakamoto, Satoshi 2008. Bitcoin: A Peer-to-Peer Electronic Cash System. https://bitcoin.org/bitcoin.pdf.2008

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