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# Evaluation of Decentralized Website Performance Using Blockchain DNS

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***Abstract* – *Privacy violations and misuse of customer data are the failures of Web 2.0. Web 2.0 employs a centralized server that can be accessed by authorities. With the development of Web 3.0, which is built on blockchain and uses a decentralized application (dApp) to avoid privacy violations and data misuse. Decentralized systems can offer users privacy and autonomous control of the system, which is an important feature of consumer protection. Decentralized web development, also known as Web 3.0, was created using blockchain technology and the peer-to-peer network protocol (IPFS). In a decentralized website environment, data on the server can be linked to conventional domains (.com, .id, etc.) or to special domains provided by blockchain-based platform domains. Every transaction must be linked to the Ethereum wallet and cryptocurrency for the smart contract to function. This activity takes a long time and is a bad UX for decentralized web developers. To compare the performance of a decentralized web using blockchain DNS and a centralized web using conventional domains, a 15-minute usage scenario with a maximum of 50 users is used. The results show that the throughput and bandwidth of a decentralized web is higher than a centralized web.***

***Keywords*** *– Decentralized Web, IPFS, Ethereum, Smart Contract, Blockchain DNS, Performance.*

## I. Introduction

The internet acts as a digital information highway that is used by the wider community wherever and whenever. The website is an enabler for the internet to become an intermediary for exchanging information. Because information on the web can be linked to information stored elsewhere on the internet, in the first phase of web evolution (Web 1.0), content creators were few, and most of the users acted as content consumers. An open web platform is a collection of open technologies that make up Web 2.0. Every user on web 2.0 is possibly becoming a content creator due to the emergence of new technologies such as Mashup, AJAX, and REST API. With the presence of web 2.0, users can interact and collaborate. It is also possible to share information through the centralised social media platform provided by the big tech company. After a long focus on developing the front-end web, the evolution of web development has started to focus on developing the back-end web [1].

A semantic web, or Web 3.0, is a development from the previous version of the web. The presence of Web 3.0 is motivated by the implementation of Web 2.0, which causes a problem with data privacy. Web 2.0 uses a centralised server that can be accessed by the authorities. With the development of Web 3.0, which is built on blockchain and uses a decentralised application (dApp) to avoid privacy violations and data misuse [2], decentralisation is the most important feature of blockchain. Different from a centralised system that only has a single node (which is managed by a single entity), a decentralised system can be said to be a system that does not have a central node, so it requires a peer-to-peer consensus to determine the status of the system. The users can trust nobody, but they can trust the system, which is the definition of a belief system without trust. Decentralisation can be interpreted differently in terms of utilities. Decentralised systems can offer users privacy and autonomous control of the system, which is an important feature of consumer protection [3]. Decentralised web development, also known as Web 3.0, was created using blockchain technology and the peer-to-peer network protocol, or IPFS (Inter Planetary File System). In a decentralised website environment, data on the server can be linked to conventional domains (.com,.id, etc.) or special domains provided by blockchain-based platform domains [4]. To make sure a system is running properly and providing a better experience during high traffic, it is necessary to do performance testing. This research discusses the results of performance testing on the decentralised web compared with the centralised web. Blazemeter software is used to support this research. The problem discussed here is a performance comparison between decentralised and centralised web systems. Specifically, this research aims to determine how well decentralised web systems perform in high-traffic conditions compared to centralised systems. This is important to ensure that decentralised systems can provide a good user experience and maintain functionality during periods of high usage. This study uses Blazemeter software to conduct performance testing and evaluate the results, providing insight into the practical implications of implementing decentralised web technologies.

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## II. Literature Review

### A. Centralized Web and Decentralized Web

Web 1.0 was dominated by the read-only web because programming skills are needed to build a website. By the middle of 1990, the website had developed into an instant messaging service, allowing users to communicate with each other via the Internet. The Web 1.0 protocol is stateless, so it cannot store user data. Cookies technology was invented by Lou Montulli, a Netscape programmer. The technology allows a website to store data in the users' browsers locally.

The Web 2.0 protocol is a development from the Web 1.0 protocol to become more dynamic so that users can also create content on a website [5]. By using cookies, Web 2.0 can save, analyse, and know user needs. It is used by the tech company to increase income through an advertisement. These abilities fueled the rapid emergence of social media. With the presence of social media, the company can easily advertise to customers [4], [6]. The Web 2.0 protocol gives the tech company full control of the ecosystem that they built. Many content creators only earn a fraction of the content they create. Sometimes content creators are required to pay for their content to be published on the web. Not only that, but users are also sometimes required to pay to access the content [7]. A comparison between web 1.0, web 2.0, and web 3.0 can be seen in Figure 1.

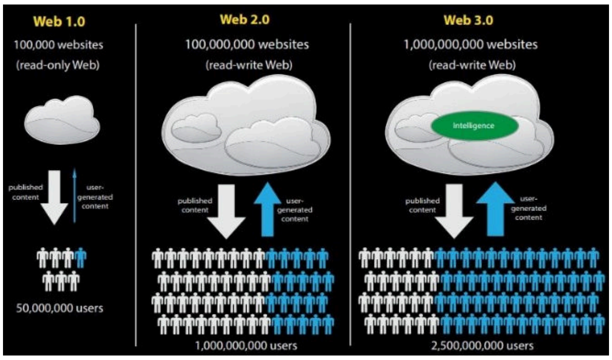


**Figure 1.** Comparison between web 1.0, web 2.0, and web 3.0 [7]

The Web 3.0 protocol allows users to manage data and information, monetize content, and collaborate with other people with common interests [8]. The protocol was built on blockchain technology, which is decentralised where public databases are stored safely on several computer networks. The data is no longer managed by centralised entities [9]. Data accuracy and integrity levels are managed through consensus. In essence, blockchain technology is a digital accounting system that records who owns any data and any changes over time. It made every change accountable [10].

The availability of decentralised concepts via blockchain technology is a big part of Web 3.0. With the concept of a decentralised internet, there is potential for a transfer of power from a large corporation to a small entity. They can create, communicate, and organise content more efficiently than ever. This allows them to have greater influence over business and society [11]. Table 1 shows the advantages and disadvantages of Web 1.0, Web 2.0, and Web 3.0.

**Table 1.** Advantages and Disadvantages of web 1.0, web 2.0 and web 3.0

| | Advantages | Disadvantages |
|---|---|---|
| **Web 1.0** | 1. Safe from malware, because only the developer has access. | 1. One way communication (from the content creator). |
| **Web 2.0** | 1. Easy to search information.<br>2. Dynamic content.<br>3. Possible to develop API (Application Programming Interface). | 1. High security risk (virus, fraud, spam).<br>2. Users' data stored by the tech company.<br>3. Economic benefits only for the tech company. |
| **Web 3.0** | 1. The users can control what data can be shared.<br>2. The website can recognize users' preferences much better.<br>3. Direct connection between user and the website (no intervention from central authorities). | 1. Not all devices support web 3.0.<br>2. Beginners may find it difficult to understand.<br>3. Other users can easily access personal data.<br>4. Need regulation about web 3.0. |

### B. Blockchain

The Blockchain is a distributed database that distributes data structures across all members of the network. The data structure consists of a list of records called blocks. Every block has a timestamp and hash code that is connected to the previous block. Using a hash code from every block, makes each block connected [12].

### C. Blockchain DNS

DNS (Domain Name System) is a hierarchy of organization domain names that is operated by ICANN (Internet Corporation for Assigned Names and Numbers) in the USA. the main role is organizing the determination of the domain name and IP address [13]. A centralized DNS system that is not encrypted or has weak encryption allows anyone in the route (government, spy, hacker, et al) to discover which websites were visited. Dependence on one company to watch root DNS and determine the Top-Level Domain can cause problems such as when the company is under pressure from the government and an organization so


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that they can be forced to delete such a name from the DNS or prohibit the use of certain names.

Blockchain DNS is a built-in domain on the public chain using a decentralized peer-to-peer network. Files and DNS resources are encrypted first using cryptography, then shared and distributed to all the blockchain networks, making blockchain DNS harder to hack, modify, delete, or break by the government or natural disasters affecting local areas [13].

Blockchain DNS works by changing the address to a character that is easy to know and remember. For example, ENS (Ethereum Name Service) is built on Ethereum and offers Ethereum domain names that end with the extension .eth. Domain status can be found on the ENS website. Vitalik Buterin, for example, uses vitalik.eth rather than the 42-digits combination of real numbers and words from the wallet address. Aside from the uniqueness, ease of use, and traceability of a traditional domain name, blockchain DNS has several additional features, including:

- Blockchain DNS has the characteristic of not being modified or deleted.
- When combined with other dApps, Blockchain DNS can connect wallets and streamline operations.
- Based on public chain security, blockchain DNS can reduce server hacking problems or domain theft.
- Blockchain DNS replaces wallet addresses as an identity representation for on-chain users [14].

Several Blockchain DNS platform examples to get blockchain names among others: Unstoppable Domains, ENS, PeerName, Diode, Stacks, EmerCoin, RIF, Solana, ProtonChain, etc. [14].

### D. IPFS (Inter Planetary File System)

IPFS is distributed file system motivated by the success story of previous peer-to-peer systems, including DHT (Distributed-Hash Table), BitTorrent, Git, and SFS (Self-Certified File System). IPFS contributes by combining proven techniques into a cohesive system, greater than its parts. The IPFS system provides a new way to read, distribute, and make a big data version of data. Even IPFS may develop itself [15].

### E. Smart Contract Ethereum

Smart Contract is a straightforward program that runs on Ethereum Blockchain. It is a collection of code (function) and data (status) that correspond to specific Ethereum Blockchain addresses. A Smart contract is an account type in Ethereum, which means it has a balance and can be the target of transactions. Smart contracts are not controlled by users; otherwise, they are spread all over networks and executed as programmed. Smart Contracts cannot be deleted by default and trading interaction cannot be changed. Ethereum uses a consensus proof-of-stake mechanism [16]

### F. Previous Research

Research about the analysis and implementation of communication between IPFS nodes on Ethereum Smart Contract has been done by Achmad et al. In that research, they build a web-based dApps system that implements IPFS on Ethereum Smart Contract. They also test the data integrity and QoS (Quality of Service) between IPFS nodes on Ethereum Smart Contract. According to their study, IPFS data integrity meets the criteria of information security and the QoS metrics are 56.40 Kbps, 65.8 Kbps, and 66.31 Kbps on average. The packet loss average is 1.92%, 1.57%, and 0.85%, while the delay average is 24.78 ms, 25.87 ms, and 20.17 ms with the average index of Qos, which meets the satisfactory category based on THIPON [17].

Geun-Hyung Kim reviews centralized web architecture and decentralized storage platforms, and study about the potential of Blockchain for decentralized web architecture. Geun also discusses trusted decentralized web architecture that avoids Internet gatekeepers and takes control of data [1].

The research that has been done by Raman et al discusses the Internet that becomes more decentralized by a small number of giant technology companies that control many of the most popular technology enterprise applications and the content placed on their platforms. The availability of local ISP (Internet Service Providers) in every country causes the government from different jurisdictions Can pressure these technology companies and ISPs to impose restrictions on their citizens' use of the internet, such as blocking access to certain sites or content. Raman et al propose DWeb (Decentralized Website) to solve these issues. The proposed concept is simulated using NS3, Multichain, and Docker technology [18].

The research that Kumar et al did review the history of the web and how the web went through iterations of time to reach the version in use today. WWW evolved from a read-only web page where users just consume the information from the static web to an interactive web where first-time users can create, communicate, and consume because of the appearance of a giant social media platform. Web 3.0 brings a decentralized internet vision where the user has control of their data and uses the web without a central point that arranges the data, so dApps developed [19].

## III. Research Methodology

### A. System Architecture

Most architecture is involved in the building of Web 2.0. First, they must have a database to store the essential data. Second, back-end code, which is usually written in Node.js, Java, or Python, must define the website business logic that will be developed. Third, front-end code, which is usually written in JavaScript, HTML, and CSS, was to specify user interface logic like how the website interface is, what happens when users interact with the back end, and how the back end


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communicates with the database. All the transactions and codes will be stored on a central server and sent by users through an internet browser. This is an overview of how most web 2.0 works. The centralised web system architecture is shown in Figure 2.

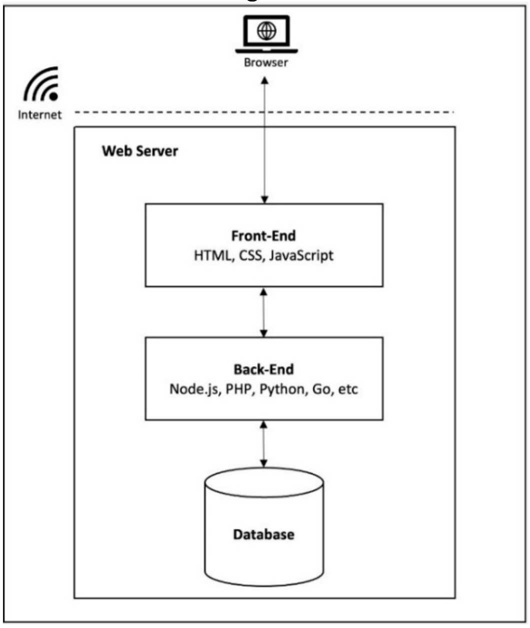


**Figure 2.** The centralized web system architecture

Unlike Web 2.0, Web 3.0 removes the middleman. There are no centralised databases that save the application status, and there is no centralised web where the back-end logic resides. Instead, use blockchain to create an application on a decentralised state machine managed by an anonymous node on the internet. A state machine is a machine that maintains some specific state of programme and future status that are allowed on that machine. A blockchain is a state machine that is used with several original states and has strict rules (consensus) that determine how these states can transition. Moreover, there is no single entity that controls the decentralised state machine because this state machine is maintained collectively by all users in the network. For back-end servers, instead of controlling the back end in Web 3.0, it can be written using a smart contract that defines the logic of the created application and deploys it to the decentralised state machine.

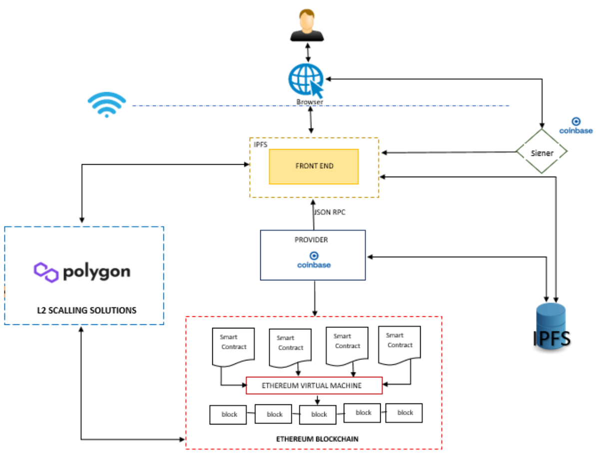


**Figure 3.** Decentralized web architecture system

Figure 3 shows a decentralised web architecture system. Front-end and smart contracts must be able to communicate and function. However, Ethereum is a decentralised network. Users can use the node provided by the third party to broadcast new transactions and maintain the node infrastructure. In this architecture, users can use Coinbase, which is called a provider. Every client of Ethereum (the provider) implements the JSON RPC specification. The JSON RPC is used to confirm that there is a set of similar methods when the front-end application wants to interact with the blockchain. Once connected to the blockchain through the provider (Coinbase), the saved status on the blockchain can be read. But if you want to write to state, there is something to do before submitting the transaction to the blockchain, which is to do a “sign” transaction using a private key [20].

In this case, the Coinbase wallet acts as the signer. Related facts: the use of Ethereum is very expensive because when users want to add new data to the blockchain, users must pay a high price. Because adding status to a decentralised state machine can improve the cost of nodes that maintain the state machine, One way to resolve this is by using an off-chain solution that is decentralised, like IPFS. IPFS has an incentive layer that is called Filecoin. This layer gives an incentive to all the nodes around the world to keep and get data. Can also use providers like Pinata that provide easy-to-use services when users can attach files to IPFS and get IPFS, then store them on the blockchain. There are some problems when building dApps. The problem when building dApps on Ethereum with high gas fees and full blocks leads to a bad user experience. There are several solutions developed; one of them is Polygon. Polygon is an L2 scaling solution. Instead of executing the transaction on the main blockchain, the polygon has a sidechain that processes and executes the transactions. Ethereum and Polygon need to be used together, as this combination addresses Ethereum's scalability and high fee issues while maintaining a high level of security and decentralization. Ethereum, although highly secure, often faces network congestion and high transaction fees, while Polygon offers a solution with faster transactions and lower fees through processing outside of the Ethereum main chain. By using both, developers can create efficient and economical decentralised applications, providing a better user experience without sacrificing security or interoperability with the broader Ethereum ecosystem.

## B. Decentralized web workflow with Blockchain DNS

Decentralised webs are created using unstoppable domains. Unstoppable Domains has a mission to decentralise the web. Offering a decentralised website and domain name using the blockchain’s user, which replaces a cryptocurrency address with a URL that can be read by humans. In this research, the generated URL is bdcptest.zil. Unstoppable domains prioritise digital


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identity ownership and simplify cryptocurrency payment [21]. The following is the Decentralized web workflow with Blockchain DNS.

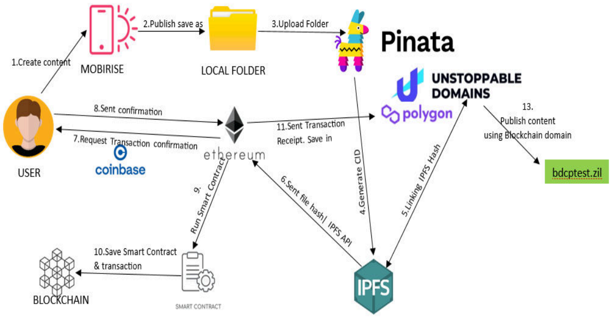


**Figure 4.** Decentralized web workflow with Blockchain DNS

Unstoppable Domains provides templates for users to create their own simple website with three options. The first option is to create a website using a template. Unstoppable Domains provides ready-to-use templates. Second option: upload the website file to IPFS. Here, users can upload website files with HTML, CSS, and other extensions. Third option: custom website linking, where users can create a simple website with a second party's help. The use of the second party is Mobirise. When the content is ready, users can publish the website by saving it as a local folder and uploading it to the Pinata cloud. Pinata Cloud will give a CID (content identifier) automatically. A CID is a hash that is generated by the IPFS protocol and represents the content. After the launch website button is clicked, users are directed to sign up for a wallet that relates to Unstoppable Domains. The wallets used are a Coinbase wallet and an Ethereum address. Users confirm the request from the wallet, then Ethereum runs a smart contract and hash code, and the transaction is saved on the blockchain. The transaction receipts are saved on the third-party Polygon, and the content can be accessed with the domain bdcptest.zil. The supported browsers for blockchain DNS are Opera, Brave, Firefox, and Google Chrome with an extension added, or you can use the Unstoppable Domains browser.

## IV. Result and Discussion

### A. Transaction details on Polygon

When the developer makes transaction updates, deletes, and creates the content on the website using blockchain DNS, then it will be saved on third-party Polygon. If the status is pending, that means the transaction is still waiting for confirmation from nodes that are linked on the Ethereum network. The time that is needed to confirm is 3-5 minutes. This is a bad UX because it takes longer than the centralised web, which does not need more time to confirm on the network.

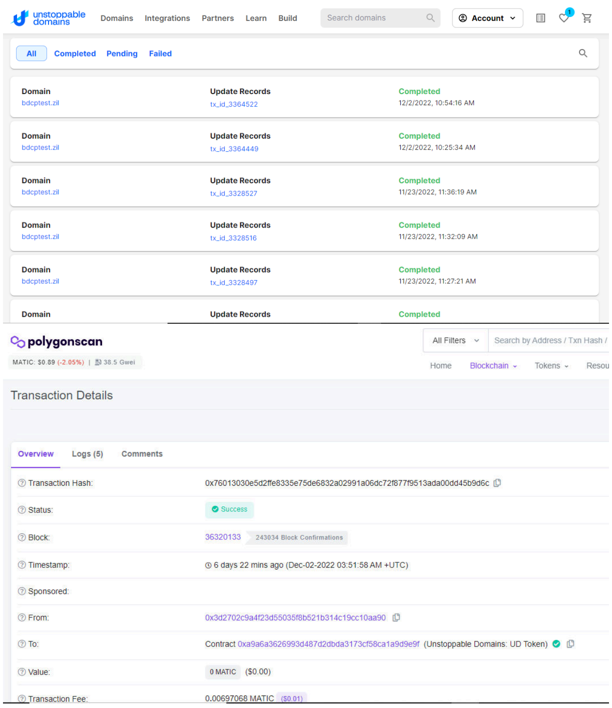

**Figure 5.** Transaction detail saved on Polygon

### B. Web performance testing: Throughput and Bandwidth

Performance testing of throughput and bandwidth on a decentralised web using blockchain DNS and a centralised web using conventional DNS. Test results were carried out with a test scenario lasting 15 minutes and a maximum number of users of 50 people. Testing is carried out for 15 minutes with a maximum number of users of 50 people to ensure that the system or network can handle peak workloads in a short period of time. This test realistically reflects high traffic conditions, which often occur suddenly and briefly. By testing over a short period of time, it can identify system limitations, such as maximum throughput capacity and bandwidth, before performance begins to degrade. The throughput test results are shown in Figure 6, and the bandwidth test results are shown in Figure 7.

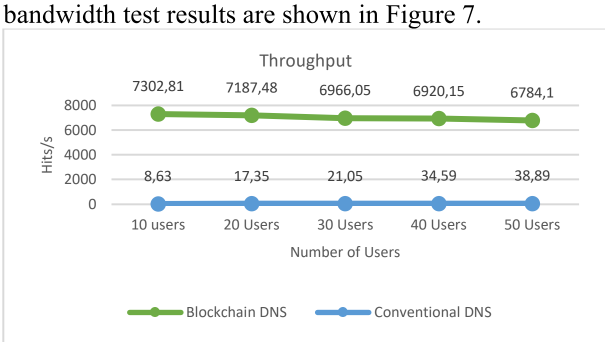


**Figure 6.** The result of comparison throughput decentralized web using blockchain DNS and centralized web using conventional DNS testing.

Throughput is the main metric that shows the total requests that can be handled by the software application in a certain time unit (seconds, minutes, or hours). In


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other words, throughput measures the level of success of the message until it arrives at the destination. As shown in Figure 6, the graphic shows that the that the throughput on the website that used blockchain DNS was higher than that on the web that used conventional DNS. The higher the throughput value, the better the web.

The following figure 7 shows bandwidth performance testing from the web. Bandwidth refers to the total amount of data that can be transferred or downloaded from the website. The higher the bandwidth, the faster data will be transferred, which means the faster the website will be loaded. If the website is not supported with adequate bandwidth, it will take a longer time to load and will damage the website's performance. The graphic in Figure 7 shows that a decentralised web using blockchain DNS has a higher bandwidth than a centralised web using conventional DNS. It means a decentralised web using blockchain has better performance in terms of throughput and bandwidth.

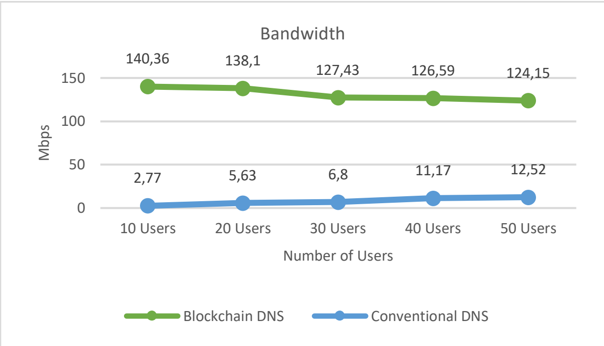


**Figure 7.** The result of comparison Bandwidth decentralized web using blockchain DNS and centralized web using conventional DNS testing.

### C. Relation testing between bandwidth to throughput

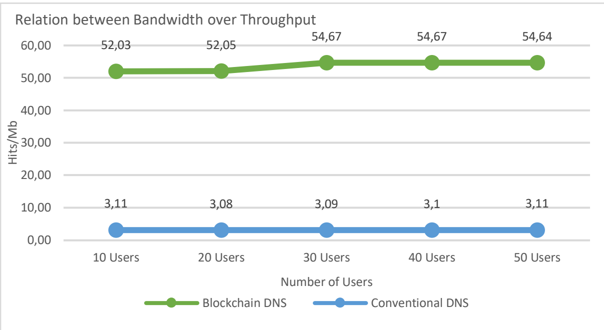


**Figure 8.** The result of relation bandwidth to throughput testing.

Figure 8 shows the result of the relationship between bandwidth and throughput testing. The meaning of this test is to see how much data hits 1 MB. The graph shows a big difference between a decentralised web using blockchain DNS and a centralised web using conventional DNS. It claims that the decentralised web can send more data per second for every 1 MB.

## V. Conclusion

Based on the tests that have been done to see throughput and bandwidth performance on the decentralised web with blockchain DNS, the decentralised web with DNS has superiority over the centralised web with conventional DNS. The higher the throughput and the bandwidth values, the better the web. Performance comparisons between centralised and decentralised systems provide important insights into the strengths and weaknesses of each approach, especially in terms of throughput and bandwidth. However, to ensure overall system reliability, it is necessary to perform other types of testing and monitor relevant metrics. These methods and metrics help ensure that the system not only performs well under ideal conditions but is also reliable and safe in a variety of real-world usage scenarios. The advantage of a decentralised web using blockchain and IPFS is that data files on a website cannot be changed or deleted and are always available because they are not dependent on a single server but are distributed over peer-to-peer servers in IPFS. The disadvantage of the decentralised web when built is that this process involves Ethereum blockchain transactions, so it will depend on transaction traffic conditions in the blockchain, including gas fees. When it has peaked, the processing time will take longer. It is bad UX for developers. There is also an influence on the use of the domain that was purchased at the beginning. If the developer wants to make the process faster, they can pay more using the crypto asset ZIL. Also, the platform for the current decentralised web is only used to create a simple website like a blog containing content, and it is still in the development stage and not all browsers can execute the blockchain DNS URL. There are still many pros and cons related to the development of the decentralised web. However, this research is to see what potential can be provided by the decentralised system using blockchain DNS for technological development.

## References

[1] G.-H. Kim, "Blockchain for the Trustworthy Decentralized Web Architecture," International Journal of Internet, Broadcasting and Communication, vol. 13, no. 1, pp. 26–36, 2021.

[2] M. Sharma, "Comparison Between Web 1.0, Web 2.0 and Web 3.0," Nov. 04, 2022. Comparison Between Web 1.0, Web 2.0 and Web 3.0 (accessed Dec. 12, 2022).

[3] J. Lee, B. Lee, J. Jung, H. Shim, and H. Kim, "DQ: Two approaches to measure the degree of decentralization of blockchain," ICT Express, vol. 7, no. 3, pp. 278–282, Sep. 2021, doi: 10.1016/j.icte.2021.08.008.

[4] P. Saujana, "Membuat Website Desentralistik di Blockchain+IPFS [BAGIAN PERTAMA]," Mar. 26, 2020. https://blockchainmedia.id/membuat-website-desentralistik-di-blockchainipfs-bagian-pertama/ (accessed Dec. 12, 2022).


*Submitted: 14 December 2022; Revised: 7 January 2023; Accepted: 22 January 2023; Published: 31 January 2023*

[5] A. M. Kaplan and M. Haenlein, "Users of the world, unite! The challenges and opportunities of Social Media," Bus Horiz, vol. 53, no. 1, pp. 59–68, Jan. 2010, doi: 10.1016/j.bushor.2009.09.003.

[6] R. Hanna, A. Rohm, and V. L. Crittenden, "We're all connected: The power of the social media ecosystem," Bus Horiz, vol. 54, no. 3, pp. 265–273, May 2011, doi: 10.1016/j.bushor.2011.01.007.

[7] S. R. Sahoo and B. B. Gupta, "Fake profile detection in multimedia big data on online social networks," International Journal of Information and Computer Security, vol. 12, no. 2/3, p. 303, 2020, doi: 10.1504/IJICS.2020.105181.

[8] C. Hack, D. Lueth, and T. di Bartolo, Navigating the Metaverse: A Guide to Limitless Possibilities in a Web 3.0 World. John Willey & Sons, 2022.

[9] A. Malhotra, H. O'Neill, and P. Stowell, "Thinking strategically about blockchain adoption and risk mitigation," Bus Horiz, vol. 65, no. 2, pp. 159–171, Mar. 2022, doi: 10.1016/j.bushor.2021.02.033.

[10] J. Y. Lee, "A decentralized token economy: How blockchain and cryptocurrency can revolutionize business," Bus Horiz, vol. 62, no. 6, pp. 773–784, Nov. 2019, doi: 10.1016/j.bushor.2019.08.003.

[11] A. Murray, D. Kim, and J. Combs, "The promise of a decentralized Internet: What is web 3.0 and HOW can firms prepare?," Bus Horiz, Jun. 2022, doi: 10.1016/j.bushor.2022.06.002.

[12] A. M. Mabruroh, F. Dewanta, and A. A. Wardana, "Implementasi Ethereum Blockchain dan Smart Contract Pada Jaringan Smart Energy Meter," MULTINETICS, vol. 7, no. 1, pp. 82–91, Oct. 2021, doi: 10.32722/multinetics.v7i1.4122.

[13] "Top 13 BEST Blockchain DNS Software," Dec. 05, 2022. https://www.softwaretestinghelp.com/best-Blockchain-dns-software/ (accessed Dec. 12, 2022).

[14] D. P. Acharya, "10 Blockchain Naming Service (BNS) Platforms to Get Your Blockchain Domain Name," Dec. 08, 2022. https://geekflare.com/finance/Blockchain-naming-service-bns-platforms/ (accessed Dec. 12, 2022).

[15] J. Benet, "IPFS - Content Addressed, Versioned, P2P File System (DRAFT 3)."

[16] Ethereum Foundation, "Welcome to Ethereum," Dec. 09, 2022. https://ethereum.org/ (accessed Dec. 12, 2022).

[17] A. M. Aziz, A. Budiono, and A. Widjajarto, "Analisis dan Implementasi Komunikasi Antar Node IPFS (Interplanetary File System) pada Smart Contract Ethereum," in e-Proceeding of Engineering, 2019, pp. 7670–7678.

[18] R. Singh, A. Donegan, and H. Tewari, "Framework for a Decentralized Web," in 2020 30th International Telecommunication Networks and Applications Conference (ITNAC), Nov. 2020, pp. 1–7. doi: 10.1109/ITNAC50341.2020.9315032.

[19] A. K. Goel, R. Bakshi, and K. K. Agrawal, "Web 3.0 and Decentralized Applications," in The 2nd International Conference on Innovative Research in Renewable Energy Technologies (IRRET 2022), Jul. 2022, p. 8. doi: 10.3390/materproc2022010008.

[20] P. Kasireddy, "The Architecture of a Web 3.0 application," Sep. 22, 2021. https://www.preethikasireddy.com/post/the-architecture-of-a-web-3-0-application (accessed Dec. 12, 2022).

[21] M. Gould, "Unstoppable Domains: A Web Address for Your Crypto Wallet," Jun. 21, 2021. https://www.gemini.com/cryptopedia/unstoppable-domains-zil-domain-crypto-domain (accessed Dec. 12, 2022.




*Submitted: 14 December 2022; Revised: 7 January 2023; Accepted: 22 January 2023; Published: 31 January 2023*