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**Vivian: Decentralized Global Naming and  
Storage System on Tangle**

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# Vivian: Decentralized Global Naming and Storage System on Tangle

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**Abstract**—With the booming of distributed ledger technology (DLT) such as blockchain, many previous IT architectures can have alternative decentralized approaches for more secure, transparent, and immutable data storage. In this paper, we present the design and implementation of Vivian, a new decentralized global naming and storage system based on IOTA Tangle for re-decentralizing the current Internet service and building decentralized applications. Unlike the traditional Domain name System (DNS), trust points like DNS root servers are removed and critical data bindings are secured by the distributed ledger. All the nodes in the system form a peer-to-peer (P2P) network for data sharing. The P2P network is established through Kademlia DHT, mDNS peer discovery and eventually consistency of data is ensured by Gossip protocol. In this system, users can own their application data directly rather than relying on the central authorities. The system has no single point failure and the nodes in the network do not need to trust each other. By using IOTA Tangle, a directed-acyclic-graph (DAG) structure distributed ledger, the system inherits its scalable, lightweight, and feeless characteristics and enables the possibility of application in Internet-of-Thing (IoT) services.

and its history can date back to 1970s, when ARPANET<sup>2</sup> was developed. Hosts in the network were assigned names for more convenient use and memorization by humans. With the growth of the network, it became impossible to store all the hosts in a single table. And Domain Name System (DNS) invented by Paul Mockapetris of USC/ISI permitted a scalable distributed mechanism for resolving hierarchical host names into Internet addresses [5].

## I. INTRODUCTION

A distributed ledger is a type of distributed database which tolerates nodes with malicious intentions in the system. And distributed ledger technology (DLT) enables the realization and operation of distributed ledgers, which allows benign nodes, to agree on an almost immutable record of transactions with Byzantine failure tolerance (BFT) and eventual consistency via a predefined consensus mechanism [1]. Blockchain is one of the most well-known DLTs which was first implemented on Bitcoin. It proposed a simple but robust way for transaction data storage without relying on trust of third parties [2]. Blockchain also ensures improved security and anonymity of Bitcoin transactions compared with traditional electronic transactions. Since the introduction of Bitcoin in 2009, DLT based cryptocurrencies have made a great impact on financial sectors. Later on people also discovered that the usefulness of DLTs is beyond exchange of currencies and significant adoption of DLTs were made in many other industries for other different services. Namecoin is the first *altcoin*<sup>1</sup> for being the first to create its own blockchain separate from Bitcoin's [3]. And its functionalities are not limited to financial transactions. The creation of Namecoin was inspired by the idea of BitDNS [4] and for establishing a decentralized domain name looking up system.

The Internet today is a widespread information infrastructure

<sup>2</sup>ARPANET: Advanced Research Projects Agency Network. The first wide-area packet-switching network with distributed control originally established by United States Department of Defense

<sup>1</sup>Altcoin: any cryptocurrencies that are not Bitcoin

## REFERENCES

- [1] A. Sunyaev, *Distributed Ledger Technology*, pp. 265–299. Cham: Springer International Publishing, 2020.
- [2] S. Nakamoto and A. Bitcoin, “A peer-to-peer electronic cash system,” *Bitcoin*.—URL: <https://bitcoin.org/bitcoin.pdf>, vol. 4, 2008.
- [3] H. A. Kalodner, M. Carlsten, P. Ellenbogen, J. Bonneau, and A. Narayanan, “An empirical study of namecoin and lessons for decentralized namespace design,” in *WEIS*, Citeseer, 2015.
- [4] F2b, “BitDNS and Generalizing Bitcoin.” <https://bitcointalk.org/index.php?topic=1790.0/>, 2010. [Online; accessed 25-Feb-2021].
- [5] B. M. Leiner, V. G. Cerf, D. D. Clark, R. E. Kahn, L. Kleinrock, D. C. Lynch, J. Postel, L. G. Roberts, and S. Wolff, “A brief history of the internet,” *ACM SIGCOMM Computer Communication Review*, vol. 39, no. 5, pp. 22–31, 2009.