**TON Network Research Report**

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# Problem Description

Lately the Technology Domain and especially the Software Development field of it was vastly invaded by new terms like Blockchain, Decentralization, Web3, etc. With the latest innovations that came along with the invention of cryptocurrency, it was determined that there is a more secure and progressive way of storing data than the classic ‘server’ option, which is a blockchain. A blockchain is similar to a database but instead of being run on a single machine it is split between all the nodes of the blockchain. The purpose of this research is to analyze the concept of the Blockchain, its principles, the pros and cons of using it as a an alternative to the ordinary data storing and the new iteration of the web, the Web3. I will take as my research phenomenon the innovative Proof of Stake blockchain TON(The Open Network).

# Research Question

Main Question:

How the proof of stake blockchain TON ensures a decentralized environment for developing web applications?

Sub Questions:

How is TON Blockchain architecture and what is innovative about it?

What is Ton Web and how it ensures decentralization?

# Research Framework and Methods

The purpose of this research is to immerse into the concept of decentralization and specifically the decentralization of World Wide Web. This research will help in better understanding the innovations that come with the Blockchain technology how it comes to replace the usual web-development principles and how it can be used in future implementations.

For the means of this research the DOT Framework strategies will be used with the following research Methods:

Library:

* Literature Study – analyze information, existing documentation and articles.
* SWOT analysis – determine the pros and cons of Web3 in comparison to Web2.

Field:

* + Document Analysis – analyze the documentation of the TON blockchain.
  + Domain modelling – determine the domain that is most suitable for a decentralized web-application.

Workshop:

* Prototyping – develop a concept using the JavaScript SDK that will function on the TON Blockchain

Deliverables:

Research Report

# How is TON Blockchain architecture and what is innovative about it?

* Literature study

The Open Network (TON) is a fast, secure and scalable blockchain and network project, capable of handling millions of transactions per second if necessary, and both user-friendly and service provider-friendly. It is aimed to be able to host all reasonable applications currently proposed and conceived. One might think about TON as a huge distributed supercomputer, or rather a huge "superserver", intended to host and provide a variety of services.

Brief Description of TON Components

The The Open Network (TON) is a combination of the following components:

* A flexible multi-blockchain platform, capable of processing millions of transactions per second, with Turing complete smart contracts, upgradable formal blockchain specifications, multi-cryptocurrency value transfer, support for micropayment channels and on-chain payment networks. TON Blockchain presents some new and unique features, such as the 'self-healing' vertical blockchain mechanism and Instant Hypercube Routing, which enable it to be fast, reliable, scalable and self-consistent at the same time.
* A peer-to-peer network, used for accessing the TON Blockchain, sending transaction candidates, and receiving updates about only those parts of the blockchain a client is interested in (e.g., those related to the client's accounts and smart contracts), but also able to support arbitrary distributed services, blockchain-related or not.
* A distributed file storage technology, accessible through TON Network, used by the TON Blockchain to store archive copies of blocks and status data (snapshots), but also available for storing arbitrary files for users or other services running on the platform, with torrent-like access technology.
* A network proxy/anonymizer layer, similar to the Invisible Internet Project, used to hide the identity and IP addresses of TON Network nodes if necessary (e.g., nodes committing transactions from accounts with large amounts of cryptocurrency, or high-stake blockchain validator nodes who wish to hide their exact IP address and geographical location as a measure against DDoS attacks).
* A Kademlia-like distributed hash table, used as a 'torrent tracker' for TON Storage, as an 'input tunnel locator' for TON Proxy, and as a service locator for TON Services.
* A platform for arbitrary services, residing in and available through TON Network and TON Proxy, with formalized interfaces enabling browser-like or smartphone application interaction. These formal interfaces and persistent service entry points can be published in the TON Blockchain; actual nodes providing service at any given moment can be looked up through the TON DHT starting from information published in the TON Blockchain. Services may create smart contracts in the TON Blockchain to over some guarantees to their clients.
* TON DNS, a service for assigning human-readable names to accounts, smart contracts, services and network nodes.
* TON Payments, a platform for micropayments, micropayment channels and a micropayment channel network. It can be used for fast off-chain value transfers, and for paying for services powered by TON Services.
* TON will allow easy integration with third-party messaging and social networking applications, thus making blockchain technologies and distributed services finally available and accessible to ordinary users, rather than just to a handful of early cryptocurrency adopters.

While the TON Blockchain is the core of the TON project, and the other components might be considered as playing a supportive role for the blockchain, they turn out to have useful and interesting functionality by themselves. Combined, they allow the platform to host more versatile applications than it would be possible by just using the TON Blockchain.

* Document Analysis

TON Comparison to Other Blockchain Projects

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Project | Year | G. | Cons. | Sm. | Ch. | R. | Sh. | Int. |
| Bitcoin | 2009 | 1 | PoW | no | 1 |  | | |
| Ethereum | 2013, 2015 | 2 | PoW | yes | 1 |
| NXT | 2014 | 2+ | PoS | no | 1 |
| Tezos | 2017, ? | 2+ | PoS | yes | 1 |
| Casper | 2015, (2017) | 3 | PoW/PoS | yes | 1 |
| BitShares | 2013, 2014 | 3j | DPoS | no | m | ht. | no | L |
| EOS | 2016, (2018) | 4 | DPoS | yes | m | ht. | no | L |
| PolkaDot | 2016, (2019) | 4 | PoS BFT | yes | m | ht. | no | L |
| Cosmos | 2017, ? | 4 | PoS BFT | yes | m | ht. | no | L |
| TON | 2017, (2018) | 5 | PoS BFT | yes | m | mix | dyn. | T |

Table 1: A summary of some notable blockchain projects. The columns are: Project - project name; Year - year announced and year deployed; G. – generation; Cons. - consensus algorithm; Sm. - support for arbitrary code; Ch. - single/multiple blockchain system; R. - heterogeneous/homogeneous multichain systems; Sh. - sharding support; Int. - interaction between blockchains, (L)oose or (T)ight.

To conclude the brief description of the TON Blockchain and its most important and unique features by trying to find a place for it on a map containing existing and proposed blockchain projects. It analyzes different blockchain projects in a uniform way and construct such a ‘map of blockchain projects’. It represents this map as Table 1, and then briefly discusses a few projects separately to point out their peculiarities that may not fit into the general scheme

**Bitcoin**: https://bitcoin.org/. Bitcoin (2009) is the first and the most famous blockchain project. It is a typical first-generation blockchain project: it is single-chain, it uses Proof-of-Work with a ‘longest-fork-wins’ fork selection algorithm, and it does not have a Turing-complete scripting language (however, simple scripts without loops are supported). The Bitcoin blockchain has no notion of an account; it uses the UTXO (Unspent Transaction Output) model instead.

**Ethereum**: https://ethereum.org/. Ethereum (2015) is the first blockchain with support for Turing-complete smart contracts. As such, it is a typical second-generation project, and the most popular among them. It uses Proof-of-Work on a single blockchain, but has smart contracts and accounts.

**The TON Blockchain**: The TON (The Open Network) Blockchain (planned 2018) is the project described in this document. It is designed to be the first fifth-generation blockchain project - that is, a BFT PoS - multichain project, mixed homogeneous /heterogeneous, with support for (shardable) custom workchains, with native sharding support, and tightly coupled (in particular, capable of forwarding messages between shards almost instantly while preserving a consistent state of all shardchains). As such, it will be a truly scalable general-purpose blockchain project, capable of accommodating essentially any applications that can be implemented in a blockchain at all. When augmented by the other components of the TON Project, its possibilities expand even further.

* Domain Modeling

**Is it possible to ‘upload Facebook into a blockchain’?**

Sometimes people claim that it will be possible to implement a social network on the scale of Facebook as a distributed application residing in a blockchain. Usually a favorite blockchain project is cited as a possible host for such an application.

It can’t be stated that this is a technical impossibility. Of course, one needs a tightly-coupled blockchain project with true sharding (i.e., TON) in order for such a large application not to work too slowly (e.g., deliver messages and updates from users residing in one shardchain to their friends residing in another shardchain with reasonable delays). However, this is not needed and will never be done, because the price would be prohibitive.

Let us consider ‘uploading Facebook into a blockchain’ as a thought experiment; any other project of similar scale might serve as an example as well. Once Facebook is uploaded into a blockchain, all operations currently done by Facebook's servers will be serialized as transactions in certain blockchains (e.g., TON's shardchains), and will be performed by all validators of these blockchains. Each operation will have to be performed, say, at least twenty times, if we expect every block to collect at least twenty validator signatures (immediately or eventually, as in DPOS systems). Similarly, all data kept by Facebook's servers on their disks will be kept on the disks of all validators for the corresponding shardchain (i.e., in at least twenty copies).

Because the validators are essentially the same servers (or perhaps clusters of servers, but this does not affect the validity of this argument) as those currently used by Facebook, we see that the total hardware expenses associated with running Facebook in a blockchain are at least twenty times higher than if it were implemented in the conventional way.

In fact, the expenses would be much higher still, because the blockchain's virtual machine is slower than the bare CPU running optimized compiled code, and its storage is not optimized for Facebook-specific problems. One might partially mitigate this problem by crafting a specific workchain with some special transactions adapted for Facebook; this is the approach of BitShares and EOS to achieving high performance, available in the TON Blockchain as well. However, the general blockchain design would still impose some additional restrictions by itself, such as the necessity to register all operations as transactions in a block, to organize these transactions in a Merkle tree, to compute and check their Merkle hashes, to propagate this block further, and so on.

Therefore, a conservative estimate is that one would need 100 times more servers of the same performance as those used by Facebook now in order to validate a blockchain project hosting a social network of that scale. Somebody will have to pay for these servers, either the company owning the distributed application (imagine seeing 700 ads on each Facebook page instead of 7) or its users. Either way, this does not seem economically viable.

This states that it is not true that everything should be uploaded into the blockchain. For example, it is not necessary to keep user photographs in the blockchain; registering the hashes of these photographs in the blockchain and keeping the photographs in a distributed o-chain storage (such as FileCoin or TON Storage) would be a better idea. This is the reason why TON is not just a blockchain project, but a collection of several components (TON P2P Network, TON Storage, TON Services) centered around the TON Blockchain.

# What is TON Web and how it ensures decentralization?

Currently, the world is going crazy for Web3 and the capabilities it’s bringing to the world. However, current Web3 applications deployed on Ethereum and other popular networks can still be considered as semi-centralized entities due to the high concentration of intermediary service providers. The industry needs to choose another standard, and TON Sites services are a perfect example of true Web3 service applications.

* SWOT Analysis

What is Web3 and why hasn’t it still reached its perfect state?

Web3 is actually a pretty ambiguous term that refers to the internet of the third generation. Web3 will create a Web 2.0 environment with services comparable to Facebook and Google — but decentralized.

A perfect example of a Web3 service is nonfungible tokens (NFT). Most people think of NFTs as images and digital art that store their data on-chain. However, this is only partially true. Most NFTs that function on-chain store a link instead of an image. This link leads you to a centralized data point. Contrary to what many believe, the art displayed on popular NFT marketplace OpenSea is not located on the Ethereum blockchain — it’s kept on centralized servers. Thus, most of the art that is currently circulating on-chain is in fact a combination of URLs that don’t store images on-chain — contrary to the tenets of Web3. As a result, such an architectural approach creates a strong dependence on centralized data providers, such as Amazon. These data providers could potentially go offline at any moment, meaning that the data and the NFT art would be lost forever.

From a technical perspective, TON Sites are similar to usual websites, but they’re accessed through the TON blockchain, which is an overlay network atop the internet. Traffic in the new decentralized TON internet will pass through The Open Network’s nodes, which have a new ADNL protocol, meaning that data will never be stored by a single entity. This creates a long-lasting relationship with various NFT services by enabling creators and artists to be completely sure that all of their data (if needed) could be further stored securely within the decentralized TON network once NFTs are minted on the blockchain. This system will be completely decentralized and censorship-resistant, which was Web3’s initial intention.

* Literature study

At the moment of the research TON Web is still in development. According to TON’s roadmap the whole complex of TON Web features are going to be implemented till the end of 2022.

Supported by the blockchain network, TON has used its ecosystem as a playground for advanced innovative features. These features are user-oriented, with their eventual goal of giving rise to “A genuine Web3.0 Internet“.

There are four main elements that TON is focusing on building. Some are further in development than others, but the entire system will aim to provide users with:-

* TON Storage
* TON DNS
* TON Proxy
* TON Payments



TON Storage

Pushing user-interface simplicity as a core concept that TON storage thrives on, this system allows TON users to store and exchange data with ease. TON Storage relies on smart contracts to continually keep this service available as a more extensive, straightforward version of Dropbox.

It’s accessible through the TON P2P Network, democratizing digital storage as every user has access to a potentially boundless digital storage solution.

TON DNS

To achieve Web 3.0, blockchain must become mainstream and accessible to everyone. TON DNS is a huge step towards this dream, with the ability to assign human-readable names to assets, services, network nodes, accounts making the system highly accessible.

Considering that 96% of Americans don’t understand decentralized network systems, TON has emphasized making their systems as user-friendly as possible. TON recovers an element of familiarity by assigning human-readable names, their service becoming comparable to using the internet to browse. With everything being assigned a human-readable name, everyone can access the system and quickly gain a level of familiarity.

TON Proxy

A central feature of decentralized networks is online privacy and anonymity. The TON Proxy is the solution to this, with the network proxy providing a layer of anonymity to browsing. By accessing these features, users will be able to route through VPN services and blockchain-based TOR alternatives. Not only does this grant personal anonymity when browsing online, but it also allows decentralized applications that are created on the TON ecosystem to remain free of censorship.

TON Payments

TON also offers a payment system as an all-in-one platform, allowing users to make off-chain and on-chain transfers. These transfers can be between any two desired parties, including services, humans, and bots.

TON Payment has safeguards in place that allow even off-chain transfers to become secure, ensuring the complete safety of its users when within the ecosystem.

TON Services

As a platform that places innovation and community first, TON has also released TON Services, which allows anyone to use the TON ecosystem to develop decentralized apps.

These services allow users to create smartphone-like interfaces for other community members, further extending the ecosystem’s possibilities as new applications and features are developed daily.

# Conclusion

Potentially representing the beginning of Web 3.0, TON’s immense ecosystem has essential every single feature that a user would need when one thinks of what Web 3.0 would entail. From payment systems and data storage to WWW sites and DNS registries, TON’s symbiotic approach between revolutionary blockchain-driven technology and innovative human-led community features demonstrates the power of modern blockchain. Far surpassing what any other company has currently achieved in the decentralized ecosystem space, TON is an incredibly exciting company to follow.

TON is undoubtedly a great project with unique capabilities that place it at the level of large projects such as Ethereum, Polkadot or Cardano. Its development at the beginning was meteoric, but the problems that Telegram had with the SEC certainly turned everything upside down. Despite this, the community has been recovering this project little by little until putting it back in a relevant position.

The development of this project continues its path and has shown that it is a living project, which plans to complete the development of its main tools by the end of 2022. Thanks to the willingness of its developers and its growing community, it is very likely that they will be able to complete this goal. If they do, this will become the first blockchain project to actually fully provide all the key features of Web3.

Overall I can state that The Open Network is a conceptually revolutionary blockchain project that comes to offer the community all the key ideas that stand behind Web3 and other blockchain are still to integrate, so hopefully by the end of 2022 TON will be able to provide the community a fully functioning Web3 development environment.

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