Web 3.0, Blockchain and Smart Contracts

Since its inception in the 1990s, the internet has seen considerable transformations. The original decentralised Web1.0 transitioned to the current centralised Web2.0 and now we are witnessing yet another transition. Web3.0 is built on the concept of re-decentralisation and semantic web, employing the use of blockchain and smart contracts technologies to fully realise this. (Corbyn, 2018)

What is decentralisation?

Web2 is built around the use of web hosting services, meaning most of the control is held by a handful of huge platforms, like Google and Microsoft, with their central systems allowing them to make all the decisions around data collection, and how users interact with their services. The nature of this architecture is detrimental for users particularly in the areas of security, with no power over how their data is protected, and data privacy, with public awareness of invasive tailored ad campaigns, and online government surveillance ever-growing (Corbyn, 2018).

The move towards decentralisation addresses these issues, specifically through better-disconnecting users' real-world and online identities, whilst also providing better network reliability through removing the need for an integral central hub. Decentralised web has also been described as prioritising online democracy and freedom, with no single authority and reduced censorship (Vojíř 2020).

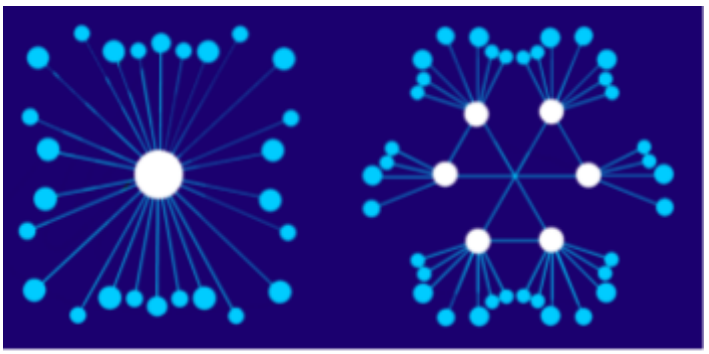


Fig1. In a decentralized network, no single authority server controls the nodes, they all have individual entity (Blockchain Engineer, 2019).

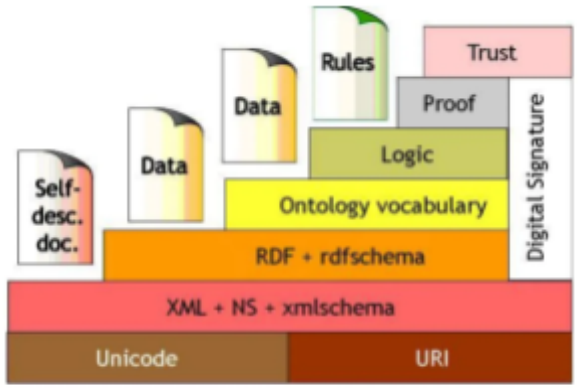
The decentralised ecosystem implementation follows a peer-to-peer infrastructure instead of using centralised platforms, spreading ownership and control out over nodes in the network rather than a central hub model. At the level of a specific application, this system generally relies on open-source software available for anyone to launch independent servers called instances. General users can then connect with whichever instance they choose, and these instances are then meshed to generate a global integrated platform. This implementation relies heavily on these decentralised applications (dApps) such as Mastodon, PeerTube and Hubzilla (Raman, 2019) , and blockchain technologies.

Semantic Web

The Semantic Web is a public, global semantic network that has standardised the presentation of information in a form suitable for machine processing and based on the World Wide Web. In an ordinary working World Wide Web, information is embedded in the text of the pages and is intended for human reading. The Semantic Web consists of machine-readable nodes of the semantic network and is based on ontologies which provides the basis for machines to understand the meaning and context of the content on the internet (Belozerov & Klimov, 2022). The Semantic Web's focus on data interoperability and reuse has influenced the development of decentralised data marketplaces and knowledge graphs, which can be used to share and monetize data in a more decentralised and transparent manner. Uniform Resource Identifier is an integral part of the Semantic Web as it is the address used to refer to an object. Each object of the global semantic network has a unique URI that uniquely names a certain object in the system (Belozerov & Klimov, 2022).

World-Wide Consortium W3C promotes the concept of the Semantic Web being adopted to enhance performance and build upon the foundations of Web 1.0 and 2.0 (Worldwide Consortium, 2023). The W3C proposes that the Resource Description Framework (RDF) can be used as the machine-readable format (Resource Description Framework, 2004). RDF allows you to describe the

structure of the semantic network as a graph, each node, and each arc of which is assigned an own URI.



(Fig2. Semantic Web Technology, 2020)

As well as the Semantic Web improving the machine learning understanding of the context of internet content, it also enables search engines to interact efficiently with client-side search queries. Semantic search is an information retrieval method and technology based on the use of contextual (semantic) meaning of the required phrase instead of the dictionary meanings of the phrases' individual parts (Belozerov & Klimov, 2022). With the growing popularity of semantic networks, the number of metadata for search engines has also increased. Some of the most popular search engines, such as Google or Bing, use some elements of semantic search but are not pure semantic search engines.

Blockchain

Blockchain technology is a new and innovative way to implement decentralisation. Blockchain technology is a system for keeping records by everybody without any need for a central authority like a bank, a decentralised way of maintaining a ledger which is practically impossible to falsify. (Swan, 2015)

Blockchain stores information in batches called blocks that are linked together in a chronological fashion to form a continuous line, metaphorically a chain of blocks. If you make a change to the information recorded in one block, you don't rewrite it, instead, the change is stored in a new block showing that the data changed at a particular data at a particular time. Unlike data storage systems or database files, blockchain was designed to be decentralised and distributed across a large network of computers. This is what enables decentralisation. (Michael Crosby, 2016)

Blockchain technology can be used in several ways to support the development of Web 3.0. For instance blockchain technology provides a secure and transparent way to store data in a decentralised way so not one single database holds all the information. An example of a distributed storage system in web 3.0 is the InterPlanetary File System (IPFS), Instead of addressing files by their location, as is the case with traditional internet protocols, IPFS uses a peer-to-peer network to store and distribute files, which allows users to access content without having to rely on a centralised server or hosting provider. (Mckay, 2022)

One of the main benefits of the block chain is decentralisation, blockchain enables a decentralised and trustless peer-to-peer network where peers do not need a trusted intermediary for interacting with each other, and all transactions are verified and validated by consensus. Furthermore, the transparent nature of a public ledger maintained by a blockchain network makes it secure and auditable as everyone on the network knows about all the transactions and the transactions cannot be disputed. However a blockchain can struggle to handle large volumes of transactions, since all nodes on the network perform the same computation for every transaction, it can lead to slow transaction times and high energy consumption, which is inefficient and expensive to run. Blockchain technology can be complex and difficult to understand, requiring specialised knowledge and expertise.

Smart Contracts

First created by Nick Szabo in 1994 (Petersson, 2018), smart contracts are programs stored on a blockchain that will only execute when a set of predetermined conditions are met (IBM). Most smart contracts are currently written on the Ethereum network using a coding language called solidity. As evidenced by Ethereum's current market cap of 223 billion (YCharts, 2023), many people believe in the power and use cases of smart contracts.

Smart contracts have two very important features, they are immutable and distributed. Immutable means they cannot change. Once they are created neither a third party or somebody involved with the smart contract can alter the predetermined conditions. A potential downside to this is that if there is an error, bug, or inefficiency in the code these also cannot be changed. A common solution to this is to make a new smart contract.

Smart contracts are also distributed, meaning that practically anyone, if they wished, could look at a smart contract and how users have interacted with it. Since conditions are agreed upon before a smart contract is created, and anyone can see these conditions, there can be no discrepancies or disagreements about a smart contract being executed.

Smart contracts have a wide range of use cases. As an example, they could be used for insurance. An insurance company could create a contract with a customer, agreeing that if certain conditions are met, like somebody meeting their insurance payments and then getting injured, the insurance company would instantly have to pay out an insurance amount to the customer. Since the smart contract is just a piece of code it needs to be fed information by a third party on whether the customer was injured. Oracle's are trusted third parties that feed information from the real world into smart contracts.

Smart contracts could also be used for selling goods from one person. If somebody wanted to sell a house, they could put the deed for the house into a smart contract on the blockchain. They could set conditions such as price and time. If somebody in the allocated time paid enough money, they would instantly get the deed and the person selling the house would instantly get the money. If the time allocated passes without payment the deed would return to the current owner.

Regarding Web3.0, smart contracts contribute to decentralisation by eliminating the need for third party intermediaries when managing transactions, and allow parties to come into trustless agreements which supports the creation of the semantic web.

Conclusion

Blockchain and smart contracts are the integral technologies driving the transition from Web2.0 towards the decentralisation and semantic web properties of Web3.0. By separating users' offline and online identities and dispersing ownership and control over network nodes, decentralisation enables a safer and more private internet. Decentralised data markets and knowledge graphs, which may be used to exchange and commercialise data in a more decentralised and transparent manner, have been developed as a result of the Semantic Web's emphasis on data interoperability and reuse. A decentralised, secure method of maintaining a ledger that is virtually hard to forge is made feasible by blockchain technology. Smart contracts remove the need for intermediaries and facilitate trustless data exchange. With no single authority and less restriction, Web3.0 can advance toward a more democratic and open internet thanks to all of these technologies.

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