Smart Token: The Building Block for the Next-Generation Web

1st October, 2023

Abstract

Web 2.0 marked a significant shift from Web 1.0's flat architecture, where the Web was primarily seen as an information repository akin to books. With Web 2.0, the Web transformed into a service platform, leading to a "reverse pyramid" structure. In this new architecture, contemporary internet behemoths form the narrow, foundational base, reminiscent of a structure precariously balanced on its tip. Such centralisation has stifled the Web's innovative potential. While the number of users and websites has surged, the past decade has witnessed a plateau in transformative platforms or groundbreaking innovations, with the digital terrain largely commandeered by a few familiar giants. This paper delves into the root causes of this innovation drought, emphasising the indispensable role of trust anchors in nurturing a vibrant web ecosystem. We propose the "Smart Token" as a pivotal architectural choice for the next-generation Web, leveraging smart contracts to instantiate trust anchors. This vision entails a layered, modular next-generation web where sites employ tokens to facilitate integrations, amplify user experience, bolster privacy, and reduce dependence on today's monolithic internet titans. The paper further probes the potential for transformative shifts across various web dimensions and delineates the technical challenges, potential pitfalls, and adoption hurdles.

Introduction

The Web's Foundational Concepts

When Tim Berners-Lee and his team developed the foundational concepts of the Web, they selected "sites" as its primary building blocks. This seemingly intuitive approach was not a given, especially when other Internet protocols, like emails and USENET, did not revolve around the concept of sites. Consider USENET: it organises and manages information by topic, making it irrelevant which site or even which planet the information originates from under that topic. Several factors contributed to the Web's dominance as an Internet application,

notably the hyperlink, its nature as a development platform rather than a finished product, and its inherent competitiveness.

Today, even with the advent of mobile internet where sites are often supplanted by apps, the foundational model persists. Although early mobile system designers initially envisioned the mobile apps to be function-centric, akin to the word processors and movie players found on desktop computers, the reality ended up being much different. Prevailing smartphone apps evolved to mirror the concept of sites, with Airbnb and Netflix being typical examples. Like a site, a mainstream mobile app has a single origin, can be developed further, can activate other apps, and exists in competition with others. This evolution is a testament to the enduring influence of the site-based model, even in a landscape that has shifted significantly from Berners-Lee's original vision of the Web.

However, it's worth noting that Berners-Lee and other early web pioneers didn't choose "sites" as the Web's primary building blocks merely because of the potential evolutionary power of websites in a competitive, capitalist market. Instead, in pursue of the best way to access and share information on the Internet, the design of the Web was heavily influenced by a prevailing metaphor of that era — the library model, which likened the Internet to a vast library. This metaphor transposed the concept of a library—a collection of books—onto the digital realm, making the Internet a collection of sites. In a book, the primary unit of reference is a page; similarly, the Web adopted the term "web page". This metaphorical framework led to the Internet being structured around origins (sites), akin to how books have authors, rather than around topics (as in USENET) or functionality (as in FTP). While hyperlinks functioned similarly to library indexes, site owners controlled these links, creating a self-referential mega-book that encompassed the entire library.

This decision to structure the Web around origins (sites) rather than topics or functionality had significant ramifications. It gave rise to the single-origin design of websites, mirroring the way books have specific authors. Even today, multi-domain sites are a rarity. This design choice profoundly influenced our trust paradigm: our interactions with a site are often guided by the trust we place in its origin. A site, therefore, isn't merely a repository of information; it also stands for its origin's credibility. This design choice, as we'll delve into in later sections, inadvertently set the stage for the centralisation of the Web.

The Shift from Information to Action

This design influenced by the metaphor of an universal library leads to the understanding that the Web was initially envisioned as an information system[1]. Today, that description no longer fits. It's more accurate to describe the Internet as an action network. Only occasionally do people speak of themselves "browsing" the Internet for information; instead, they chat with friends, shop, book hotels, work remotely, network with peers, or kill time. Similarly, few people compare

---

[1]Its USENET topic name comp.infosystems.www accurately captured it.

Internet to a Universal Library anymore. The initial question of how a global computer network could serve as a valuable information source, transcending the limitations of a single database or physical library, no longer describes our contemporary Internet usage.

The transition from an information network to an action network marked the significant transformation of Web 2.0. This was achieved by expanding the site model into an application model through web services. Key technologies of Web 2.0 include AJAX, RESTful API, and SaaS. Notably, these are action-oriented technologies built atop the traditional site-based information model. Concurrently, HTML evolved from a document format to an application development User Interface description language. The rise of single-page applications dispelled the notion that the Web is like a book consisting of information pages, suggesting instead a singular page: the application.

This evolution was crucial. To support the application model, trust anchors were necessary. These anchors represent foundational points of trust, essential for the application model's operation.

It's imperative to distinguish between a website's functionality and the trust it either derives from or depends upon when providing such services. A real-world example elucidates this distinction. In 2008, one of this paper's authors, while affiliated with the German Chamber of Commerce in China, posited that a website integrating the then-popular Home Banking Computer Interface could outperform the bank's own website in terms of user experience. Users could input their credentials, select a German bank, and allow the website to interface with the bank, offering functionalities not provided by the banks, such as expenditure pie charts. When launched, user feedback highlighted a reluctance to input credentials into the website, even though it was open-source. Paradoxically, these same users had no reservations about entering their credentials into an open-source desktop software offering similar functionalities.

This experiment underscores a pivotal insight: *technically*, the website delivering a specific service's functionalities doesn't inherently need to be the same entity that engenders trust. However, in the prevailing web paradigm, a website serves a dual role: it is both the medium through which functionality is presented and a beacon of trust for its users. Even if an entity can develop a superior banking application, it either needs to be as trusted as a bank or possess a comparable level of trust. This shed light into the true causes of centralisation.

The conflation of functionality with trust and its role in the centralisation of the web

This dichotomy between functionality and trust is evident in Web 2.0's approach to user authentication. How can a website ascertain genuine user authentication while ensuring users' trust in safeguarding their credentials? This conundrum, inherent in Web 1.0, found a solution in Web 2.0 through internet giants who eliminated the need for websites to store or validate user credentials. While

3

previous researchs attribute centralisation to factors like data ownership, network effects, and IP laws, these factors don't fully account for the rise of user authentication services. Entities like Facebook and Google did offer identity services, but so could other platforms, such as OpenID. The distinction lay in the inherent trust users placed in giants like Facebook and Google, stemming from their regular engagement with the functionalities these platforms provided. In this context, the entities providing functions, like Facebook's social media platform or Google's Gmail, simultaneously established themselves as trust anchors. These trust anchors became foundational in the vertical architecture of Web 2.0, suggesting that factors beyond network effects, data ownership, and IP laws contributed to the Web's centralisation.

The conflation of functionality with trust and the oversight of the trust element elucidate the trajectory of the Internet's evolution. Starting as a decentralised entity, the Web transitioned to a centralised model in the Web 2.0 era, characterised by its vertical, pyramid-like structure. Recognising and conceptually separating these intertwined elements, as this paper argues, paves the way for future solutions.