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

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**Abstract**

Web 2.0 marked a pivotal transition from viewing the web as a mere information source, akin to books, to recognizing it as a service platform. This evolution led to a "reverse pyramid" vertical web architecture, where contemporary internet behemoths form the narrow, unstable base. Such centralization has curtailed the web's innovative spirit. While there's been growth in terms of users and websites, the last decade has seen a dearth of transformative platforms or paradigm-shifting innovations, with the landscape dominated by familiar giants. This paper delves into the root causes of this stagnation, emphasizing the critical need for trust anchors to foster a richer web ecosystem. We introduce the "Smart Token" as an architectural choice for the next-generation web, harnessing the power of smart contracts to establish trust anchors. This approach envisions a multi-layered, modular next-generation web where sites leverage tokens to achieve integrations, elevate user experience, enhance privacy, and diminish reliance on the monolithic structures of today's internet giants. The paper further explores the potential for transformative shifts in various web facets and outlines the technical challenges, potential pitfalls, and barriers to adoption.

## 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 organizes 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. Mobile apps evolved to mirror the concept of sites, with Airbnb and Netflix being typical examples. Like a site, an 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.u

However, it's worth noting that Berners-Lee and other early web pioneers didn't choose sites as the web's building blocks for the evolutionary power of websites in a competitive, capitalist market. Rather, a prevailing metaphor of that era, likening the Internet to a vast library, influenced its design. The concept of a library—a collection of books—was transposed onto the digital realm, where the Internet became a collection of sites. The unit of reference in a book is a page; similarly, the web adopted the term "web page". This metaphor inspired the structuring of the Internet around origins (sites), akin to authors of books, rather than topics (as in usenet) or functionality. Hyperlinks worked similarly to library indexes, but with site owners controlling these links, creating a self-referential mega-book comprising the entire library.

The choice to structure the Web around the origin (sites) rather than topics (like USENET) or functionality (like FTP) had profound implications. It led to the single-origin design of websites, reminiscent of books having designated authors. Multi-domain sites, where a website sources information from multiple origin, remain rare. This design choice also shaped our trust paradigm: our interaction with a site is often dictated by the level of trust we place in its origin. In essence, a site isn't just a book of information; it's also a reflection of its origin's trustworthiness, for better or worse. As we'll explore in subsequent sections, this design choice inadvertently paved the way for centralization.

## 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 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.

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

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 potentially 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. The website, code named OpenBanking, however, 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: in terms of functionality, the website delivering a specific service 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.

## Centralization and its Implications

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 previous research attributes 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 decentralized entity, the web transitioned to a centralized model in the Web 2.0 era, characterized by its vertical, pyramid-like structure. Recognizing and conceptually separating these intertwined elements, as this paper argues, paves the way for future solutions.