Soul Searching

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An in-depth look at Soulbound Tokens
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Key Takeaways

◆ SBTs offer a publicly visible, non-transferable token that can help to foster a decentralized society by creating an “immutable” record

◆ Currently, most SBTs are built on ERC-721, with mintability and voting

◆ The design of an SBT should satisfy specific product requirements and the type of credential that the token encompasses. These requirements include but are not limited to Issuance, Acceptance, Control, Expiration, Discoverability, Queryability, and Trust

◆ The Binance Account Bound (BAB) token represents the credentials of Binance Know-Your-Client (KYC) users. BAB aims to tackle identity verification issues in Web3, serving as a digital verification tool for Binance users who have completed KYC

◆ The use cases for SBTs are wide-ranging, complementing the current NFT landscape. We see a majority of the benefits associated with projects rather than users

◆ Within the NFT space, one advantage comes with the provenance of NFTs. Another benefit introduced includes the ability to design minting in a way that only wallets with a specific SBT can mint an NFT collection

◆ With the proof of KYC credentials, a lot of new allies open up for DeFi protocols and the interaction between CeFi and DeFi
Introduction

After Vitalik Buterin, one of the co-founders of Ethereum, revealed that he too was probably a World of Warcraft fan, there has been some discussion about so-called “Soulbound Tokens” (SBTs) within the crypto space.

**SBTs build upon the concept of NFTs by removing the transferability element** that characterizes today’s ERC\textsuperscript{1}\textsuperscript{-721\textsuperscript{(1)}} smart contracts. The idea stems from the video game World of Warcraft, where some items can be “Soulbound” - e.g., players cannot sell or trade the items. Vitalik Buterin, Glen Weyl, and Puja Ohlhaver picked up that idea and brought it to the NFT space. Since their paper was first published in May, we saw how the concept has slowly gained attention and adoption. However, as of now, the space remains in its infancy.

The purpose of this report is to dive deeper into the current landscape of Soulbound tokens, get an understanding of how they work, the different use cases, and discuss how the space might develop going forward. As of now, we should cover the basics and get a shared understanding of what “Soulbound Tokens” actually are.

**Why Soulbound?**

The problem we’re trying to solve with SBTs is a dependency on Web2 infrastructure by introducing a native Web3 identity.

“SBTs offer an (initially) publicly visible, non-transferable (but possibly revocable-by-the-issuer) token that can help to foster a decentralized society by creating an “immutable” record.”\textsuperscript{(2)}

This can include (but is not limited to) employment, work experience, and academic credentials and is thus offering a way to create a reputation on Web3.

That’s not to say that non-fungible tokens (NFTs) have not already offered a significant improvement in the way we exercise ownership over digital assets. It’s more that their use cases are limited in aspects and don’t help to overcome the dependency on Web2 per se.

\textsuperscript{1} “Ethereum request for comment”
Let’s consider this:

- DAOs still depend on Web2 applications like Discord and Twitter to negate the possibility of a Sybil attack
- NFT collectors still depend on centralized platforms such as OpenSea to show the provenance of their collections
- DeFi platforms are limiting their offerings due to a missing trust element

As such, **SBTs could unlock benefits that can transform how we currently view social identities in real life, but also how crypto will evolve going forward.** A user’s identity should be portable across platforms, which helps to comprehensively build up their reputation in Web3.

In our latest report on [Tokenomics](https://www.binance.com/en/research), we discussed how trust plays an essential role in the utility of tokens. Trust is also a crucial element within Web3, and the lack of it is limiting the growth and adoption of the space. **Soulbound Tokens can help to overcome this and foster adoption, create clarity and promote transparency.**
Design

SBTs are designed to be permanent, non-transferable tokens that allow individuals to verify their personal credentials (such as education, work history, and certifications) on-chain. Users can port their SBTs across various dApps to exhibit their verified traits. As of now, both ERC-20 and ERC-721 are transferable. SBTs, in contrast, are static and cannot be moved. This allows for a wide range of new use cases because it adds a new layer of functionality.

“SBTs allow for a wide range of new use cases because they add a new layer of functionality”

Figure 1: Clear differentiation between SBTs and NFTs

<table>
<thead>
<tr>
<th>SBTs</th>
<th>NFTs</th>
</tr>
</thead>
<tbody>
<tr>
<td>non-transferable</td>
<td>Can be traded and transferred</td>
</tr>
<tr>
<td>Purpose of proof</td>
<td>Providing ownership</td>
</tr>
<tr>
<td>May allow for community recovery model</td>
<td>Almost impossible to recover</td>
</tr>
<tr>
<td>Can show provenance of an NFT, DeFi, etc.</td>
<td>Cannot show provenance themselves</td>
</tr>
</tbody>
</table>

While non-transferability is the primary differentiating factor between SBTs and NFTs, it is not the only one. SBTs and NFTs offer different use cases. While NFTs provide proof of ownership, SBTs offer proof of credentials.

Guardians

We all know the risks of losing access to our wallets. While losing access makes NFTs almost impossible to recover, there can be design aspects of SBTs that could allow for a recovery model. For example, a social recovery method that takes advantage of so-called guardians (this could be individuals, wallets, or institutions) could help to reset a private key.
As of now, there are certain operational risks to overcome first, though. Social recovery wallets - while in theory a great way to secure a wallet long-term - force you to maintain a close relationship with your group of guardians.

As such, Vitalik’s current view is that this system is best implemented not by curating guardians but by determining a “maximally broad set of real-time relationships”\(^{(4)}\), such as participation in protocol governance, a DAO, or memberships to communities.

**Figure 2: A Community Recovery Model allows for a sustainable recovery model**

Furthermore, NFTs, while being on the blockchain, don’t show provenance per se. This, however, is different for SBTs, which can show provenance.

**Technical Aspects**

Currently, most SBTs are built on ERC-721, with mintability (in order to create new ones) and voting (to allow for DAO compatibility).

The key element we’re removing in an SBT is the ability to transfer the token. While you might want to define a “require” statement of “true == false” to stop transfers, this wouldn’t work in practice because it would stop minting from taking place. Instead, we should check to see that the sender is the zero address; that way, we can assure that we have mint transactions but no transfers. When the code runs, it will block the transfer with the error message “Err. token is SOUL BOUND”.

Source: Binance Research, Bankless
Figure 3: Removing NFT transferability in just a few steps to create an SBT

```solidity
function _beforeTokenTransfer(address from, address to, uint256 tokenId) internal override(ERC721, ERC721Votes) {
    require(from == address(0), "Err: token is SOUL BOUND");
    super._beforeTokenTransfer(from, to, tokenId);
}
```

Source: James Bachini

With these few steps, we can create a Soulbound NFT that can be minted but not transferred. Even better, because we’re using ERC-721, the SBT can also operate in DAOs.

Notably, there are other methodologies to achieve non-transferability. For instance, RabbitHole overrides the standard ERC-721 `approve` and `setApprovalForAll` functions, blocking users from selling, trading, or transferring their credentials post-mint. In addition, RabbitHole whitelists the burn address so that users who wish to remove their credentials may dispose of them. This example demonstrates the flexibility of ERC-721 and the potential for various technical variations based on a project’s proposed utility. RabbitHole Credentials are designed to be on-chain proof that the holder possesses a specific skill set, which in this context, is intuitive that the token should be disposable per the holder’s judgment.

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IT'S NOT A BUG

IT'S A HAPPY LITTLE FEATURE
As previously demonstrated, the design of an **SBT should satisfy specific product requirements and the type of credential that the token encompasses**. When building an SBT, there are multiple aspects to consider:

- **Issuance** - SBTs should be easy to set up and provide high performance and scalability.

- **Acceptance** - Since SBTs are public, users should have the ability to accept any SBT issued proactively. This prevents problems where an issuer could spam the user with an SBT they don’t want, or a bad actor could issue the user an SBT that could harm someone’s reputation.

- **Control** - There can be special use cases for non-rejectable issuance of SBTs where the issuer has more control over the particular SBT-based reputation system. In those cases, users cannot easily wipe out an undesirable record to forge their reputation. Furthermore, since SBTs are often attestations from the issuer about the user, an issuer needs the ability to remove their attestation at a later time if it’s no longer valid or true.

- **Expiration** - It’s quite common for assertions to have an expiration date that needs to be supported and should be considered in the design of an SBT.

- **Discoverability** - It should be possible for third parties to discover which accounts have particular SBTs.

- **Queryability** - It should be possible for third parties to easily query a given address to determine which Soulbound tokens are attached to that address.

- **Trust** - Anyone viewing a user’s SBTs should have trust about who issued the token, that it was issued to the user, and if it is still valid.
Competitive Landscape

Looking at the current landscape of SBTs makes it clear that we are in the early stages. While various projects are experimenting with different approaches, we do not yet see the space to be what Vitalik envisioned it to be. This, partly due to the lack of demand and uncertainty around regulation, will likely change in the future. For now, let us look at the current landscape. We will discuss how we envision the space to develop in the upcoming chapter and look closely at Binance Account Bound (BAB) - one of the most interesting SBT projects out there.

Outside of BAB, there are five projects that we will have a closer look at, which all (in one way or another) try to implement SBTs.

POAPs

Proof of Attendance Protocol (POAP), launched in August 2021, is an Ethereum-based digital collectible that enables keeping records of online and offline experiences. Those badges come as ERC-721 tokens. More than 2 million POAPs have been minted to date. Each POAP badge has a unique serial number; they are immutable and can be collected via the POAP dApp as a digital representation of the holders’ life experiences. Despite the project’s popularity, its dApp has been overwhelmed by airdrop farmers and speculators, revealing a key paradox in its minting and distribution mechanism: POAP is costless. This not only incentivizes distributors to mint more POAPs than needed to connect with and reward participants but also allows airdrop speculators to easily game the system.

Project Galaxy

As of now, Project Galaxy is one of the largest Web3 credential data networks in the world and was responsible for events such as the “Arbitrum Odyssey”. Participants who bridged to Arbitrum during the first week of the Odyssey received an NFT to represent their completion of bridging into Arbitrum. Built on open and collaborative infrastructure, Project Galaxy helps Web3 developers and projects leverage credential data to build better products and communities. At the same time, data curators are rewarded when credentials are used in Galaxy’s Application Modules, Credential Oracle Engine, and Credential API. An example of on-chain credentials would be the record that you borrowed money from AAVE and Compound but never got liquidated. Your contribution to a protocol’s liquidity pool when it first launched or your on-chain voting history are all credentials. As a comparison, all of your behavioral data
in Web2 count towards your credentials, and companies like Google and Meta run algorithms on your credentials so that they can send you targeted advertisements. (10)

**RabbitHole**

*RabbitHole sees itself as a “proof of skill” application.* Essentially, they are trying to educate users about crypto and allowing for this newly learned skill to be displayed. By guiding users through a series of on-chain actions in a specific area in Web3, such as staking ETH on Lido, providing stETH as collateral on Aave, or providing liquidity on Uniswap, a user earns eligibility to mint RabbitHole credentials. (11)

**Noox World**

Noox World is taking a direct approach to SBTs. Like RabbitHole, Noox World allows users to earn SBTs by performing on-chain actions. After doing so, a user will receive a badge for their skill. **Noox World introduces the Noox Badge Standard, which includes a string of metadata for the on-chain actions, eligibility requirements, and validation logic for each issued badge.** Users can use blockchain data, including event logs and transaction data, to program rules like the number of interactions, the value, volume, and time of interactions, etc. (12)

**DeQuest**

DeQuest has taken a more niche approach in the SBT space by focusing on gaming. Similar to RabbitHole, **DeQuest features “Quests,” which guide users to learn and explore various games.** As such DeQuest can be seen as the GameFi extension of an SBT that is created based on the meta-data of someone’s wallet. (13)
BAB - Deep Dive

The Binance Account Bound token represents the credentials of Binance Know-Your-Client (KYC) users. The BAB token is non-transferable, has no monetary value, and is the first-ever SBT issued on the BNB Chain. BAB aims to tackle identity verification issues in Web3, serving as a digital verification tool for Binance users who have completed KYC.

Three key properties:

❖ **Non-transferable** - Cannot be transferred from one address to another
❖ **Revocable** - It can be revoked by issuers.
❖ **Uniqueness** - One UID only has one BAB token at one time on one chain

When thinking about the benefits of BAB, it becomes clear that a lot of them lie with other projects. For example, one possibility is that a new protocol only airdrops addresses with BAB tokens. There are a lot of benefits within the NFT space too. Imagine being able to avoid bots when creating a new NFT project. This is another aspect tackled by the BAB token, with NFT projects being able to only allow minting from addresses with BAB tokens. The same holds for DAO voting, where only addresses with BAB tokens could be allowed to vote - potentially even capping voting power to ensure governance fairness.

These use cases make it clear how powerful BAB can be and that it brings many benefits to the BNB Chain. As a matter of fact, there was no previous method to identify Binance users or Binance KYC users on the BNB Chain. Since Binance and BNB Chain are different platforms, an NFT protocol, for example, cannot determine which BNB Chain user is also a Binance KYC user.
Use Cases

Outside of the BAB Tokens KYC, we have other use cases of SBTs that we should discuss in more detail. While looking at the Landscape of SBTs showed us that the current use cases are quite limited, let us have a look at the potential that SBTs could offer. The use cases for SBTs are wide-ranging, complementing the current NFT landscape. To understand the benefits of SBTs, let us explore some of the use cases.

Figure 4: SBTs offer numerous new Use Cases

While Soulbound tokens hold appeal for their ease of quickly conveying facets of a person’s identity, the concept of on-chain tokens representing personal identifiable information (PII) raised some early concerns due to the immutable public nature of distributed ledgers. However, many of these early concerns were considered, and with users being able to remove SBTs from their profile, they’re given a chance to decide which credentials they want to show.

NFT Ownership

One advantage of SBTs is facilitating the current NFT landscape. SBTs’ advantage comes with their provenance of NFTs. Currently, the Web3 space still relies on centralized businesses such as OpenSea, which introduces several risks. Furthermore, benefits introduced also include designing the prerequisites for minting in a way that only wallets with a specific SBT can mint an NFT collection. We could also think of a “lifelong” DAO or Community membership, where membership is granted through holding an SBT, proving specific qualifications or actions performed on-chain.
DeFi Lending

Benefits on the Decentralized Finance (DeFi) side are far-ranging. Currently, the majority of DeFi lending platforms, such as Aave Protocol, do not always offer new services due to the hostility of highly private decentralized environments. This is where SBTs come in. By leveraging a user’s interactions with different communities, DeFi protocols could move closer to offering new financial products to retail users. SBTs already allow proving interaction with a project, proving some “user sophistication”. Together with the proof of KYC credentials, a lot of new allies open up for DeFi protocols and the interaction between CeFi and DeFi.

Sybil Resistance Attacks

Sybil Attacks are a key concern for DAOs, limiting their growth and adoption. As such, Sybil attacks are the most notable system risks in coin voting within a DAO. To understand Sybil attacks consider the following scenario: If an individual accesses more than 51% of DAO tokens, the individual could gain control over the protocol. SBTs could help in solving the challenge through a representation of voting rights in DAOs. The non-transferable nature of SBT ensures that no particular individual can buy the tokens required for a Sybil attack. In addition, SBT can also ensure the transfer of voting rights to only those members that have an SBT credential proving some skill, academic credentials, and endorsement from other members.

Souldrops

It is one of the common practices for crypto projects to launch airdrops alongside general token sales. However, the process is generally associated with Sybil attacks, with whales consuming most of the drops. SBTs can potentially solve the problem by facilitating airdrops based on designed prerequisites and prior analyses of SBTs.

Academic Credentials

Universities, colleges, and schools can use SBT as digital proof of attendance or academic credentials for students. As an important set of non-transferable NFTs, they can help in verifying the credentials and proof of attendance of candidates.
GameFi Credentials

SBTs can help automate onboarding and expertise checks in GameFi apps by creating and recording a history of on-chain work and experience. From a game design perspective, you could limit access to specific levels and items to only those that have been airdropped an SBT proving the completion of a quest or similar.

Digital CV

Furthermore, SBTs can also offer the opportunity to create a unique digital CV. SBTs can act as verifiable endorsements to help prove that an individual has the necessary skills for the job. The non-transferable NFTs would ensure that professionals in different fields would have a publicly-verifiable digital CV. As a result, it would be easier for employers to make hiring decisions based on the SBT a candidate has from their previous employers or academic institutions.

DAO Governance

One promising use case for SBTs is DAO governance. For example, Soulbound tokens can be used to implement one-person, one-vote rules or to enforce on-chain voting requirements for specific proposals. Furthermore, they can help DAOs, and other token-gated communities track applicants’ experiences, skills, achievements, loot, and earnings across the whole metaverse.
Outlook

SBTs are still in their early stages of adoption but show a lot of promise already. **Not only do SBTs enable the creation of better trust relationships in decentralized environments, but they also offer significant improvements to protocols.** These improvements are far-reaching, from improving the voting mechanisms within DAOs to offering improvements to the DeFi and NFT space.

Going forward, we forecast two major developments for Soulbound tokens.

1. Increased Adoption

While SBTs have played a minor role as of now, we expect this to change. **Initiatives like the BAB Soulbound token introduce new ways for DAOs to fight Sybil attacks and for projects to Airdrop.** As such, **we expect adoption to be driven from a protocol level rather than a user level.** Once enough projects have started using SBTs, we will likely see a shift towards retail users driving growth to qualify for airdrops, NFT minting, and other incentives.

Originating from World of Warcraft, we see SBTs also returning to Games, with GameFi platforms so far not fully utilizing the potential of SBTs. Further growth of the Metaverse and GameFi space could drive fully crypto-native games that utilize SBTs to a greater extent. Within both these segments, the growth of SBTs will likely follow the overall growth of the space.

2. Regulatory clarity

**Regulatory certainty is a great way to drive further adoption,** and we believe that it will become important for regulators to address privacy concerns once the space gains enough substance. We believe that General Data Protection Regulation will be at the forefront of the debate but are confident that already existing design aspects help to ensure that SBTs exist within this regulation.
Conclusion

The benefits of SBTs are wide-ranging, complementing areas such as NFTs, DeFi, GameFi, and the Metaverse. Projects like the BAB token, which is tackling identity-verification issues within Web3, are great initiatives that help on a project level and will likely drive further adoption of the space by introducing more trust to the system.
Soul Searching - Soulbound Tokens

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