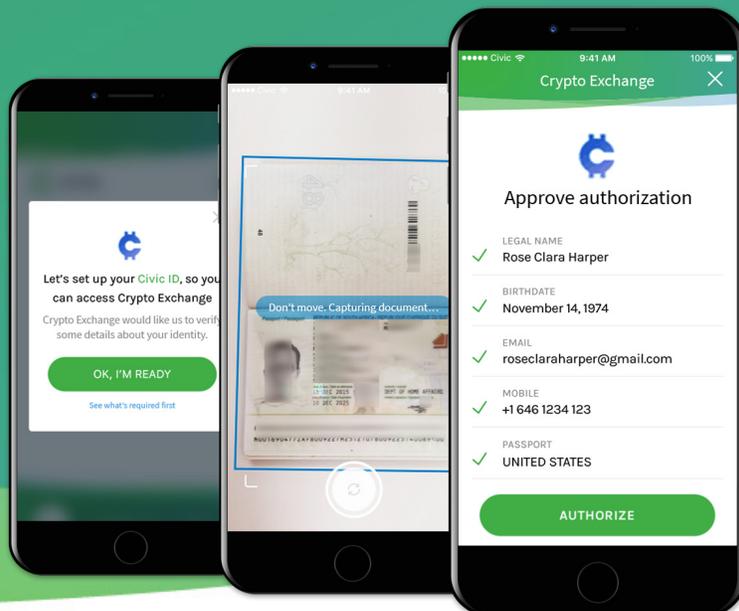# Token Behavior Model

Summary

Civic Token Behavior Model Summary

Background

Civic is creating a decentralized identity management market-place which is designed to incentivize participation by trust-worthy Identity Verification Providers known as "Validators", who may include financial institutions, government entities, and utility companies, among others. Validators will be able to verify the identity of an individual or business, known as a "User", and record this approval on the blockchain in the form of an attestation.

Parties known as "Requesters" who are seeking to verify the same information about a given User, and who may include other Validators, would no longer need to independently verify that information and could instead leverage the work already performed by trusted Validators.

The Civic token (CVC) is the native token of the Civic platform. When the token was first described in the whitepaper associated with its issuance, its use as a medium of exchange and incentivization was explored. Here we summarize the behavioral aspects of the Civic marketplace that control and incentivize the correct behavior within the ecosystem.

Before we define the correct behavior within the network, the different network participants within the ecosystem and how they interact are discussed. The network participant could be any one of three types in the network that interact with each other as shown in *Figure 1*.

VALIDATOR: An institution that has the capability to attest to Personal Identifiable Information (PII).
REQUESTER: An institution that requires proof of validated PII.
USER: A member of the public who wants to use a Requester service.

The structure and purpose of the Civic network illustrated in *Figure 1* is described more fully as:

1. The User approaches a Requester to use a service (or purchase goods). The Requester sends the User a list of all Validators it accepts and which PII proof they require. If the User has the required information attested by an acceptable Validator, then they actively agree to the transmission of the required proof and send those to the Requester.
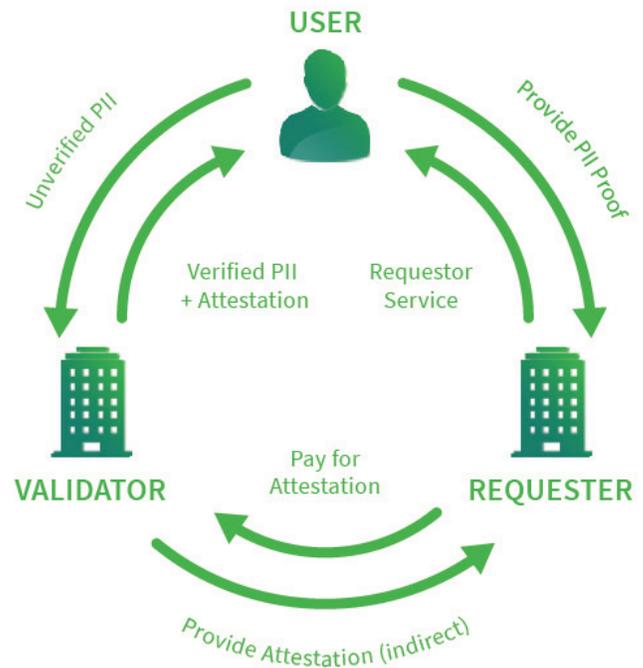
Figure 1: High-level system architecture. This diagram indicates how the three network participants interact. The Interaction between Validator and Requester is simplified and always abstracted via Blockchain technology.

2. If the User is not able to present a suitable PII proof to the Requester, then the User approaches a Validator with un-verified PII. Once satisfied with the authenticity of the PII, the Validator attests to this information. This attestation is recorded as a hash onto a blockchain and also stored in an encrypted format on the User's mobile device.
3. Once there is a match between a Requester and a suitable Validator attestation, the Requester locks in the Validator's published price for providing the PII attestation. The Requester places CVC tokens equal to the attestation fee into an escrow smart contract and the User sends the PII to the Requester[1].

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[1] A description of the full flow of the token appears on pages 15-16 of the whitepaper, available here: https://tokensale.civic.com/CivicTokenSaleWhitePaper.pdf.

Behavioral Model

Requesters must be confident that Validators will maintain a level of accuracy required for their use cases. In a decentralized system, the enforcement of accuracy cannot be achieved through a central authority and must instead rely on the creation of incentives[2]. The accuracy of the network is critical. If the system becomes unreliable or unpredictable, then Requesters may avoid using it and negative feedback loops would occur.

Behavioral Model Goal

To create a decentralized identity management network that exhibits a high level of accuracy by making use of embedded incentives that reward good behavior (accuracy) and penalties that discourage bad behavior in the Identity Marketplace.

Achieving this goal required designing a new incentive structure using a technique called backward induction[3], which is a branch of game theory. In backward induction, the end goal is decided and then a game is designed to attempt to reach this goal. In order to simplify the analysis of the game present in the CVC marketplace mechanisms, the User was removed from the design of the system.

Behavioral Model Assumption

All Users are trying to cheat both the Requester and the Validator.

Is this a valid assumption? Yes, because Validators treat all Users' PII submissions with this assumption today by having to verify and cross-reference a User's details, instead of just trusting their submissions.

This design decision reduces the system to a two-player game comprising a Validator and a Requester. The full detail of this game, along with the mathematical substantiation, are included in an upcoming Civic whitepaper update.

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[2] Data protection laws further prohibit non-consensual sharing of PII and make an oracle solution cumbersome.

[3] http://web.mit.edu/14.12/www/02F_lecture7-9.pdf

System Goals

On a high level, the system aims to ensure that:

1. The contested PII is not shared with any other entity, but rather that the two actors are incentivized through a combination of decisions, flags, penalties and rewards in a repeated interaction.
2. The Validator is incentivized to maintain their self-defined accuracy (e.g. for a 99% accurate Validator, only 1 in 100 attestations are incorrect). This is achieved by requiring that the Validator pays a penalty to the network if they attest PII erroneously. The Validator will pay this penalty out of a stake of CVC tokens and must maintain a minimum stake of CVC to use the network.
3. The Requester is rewarded when they report erroneous attestations but is not incentivized to falsely report correct attestations.
4. A Nash Equilibrium, whereby no participant in the game can gain an advantage by unilaterally changing its strategy if the strategy of the other participants maintain their strategies, exists in the system when the Validator attests a correct attestation and the Requester accepts the correct attestation.

	VALIDATOR	
	Correct Validation	Incorrect Validation
Accept PII Proof	R + V +	R - V -
Reject PII Proof	R - V -	R + V -

(REQUESTER spans the left side of the Accept/Reject rows)

*Figure 2: System Goals Visualization. **R**, **V** Requestor, Validator on the Civic Marketplace, **+**, **-** reward or penalty for marketplace behavior. The purpose of the Behavioral Model to achieve equilibrium states, where Correct Validations that are accepted by Requesters lead to rewards to both parties, while Incorrectly validated PII correctly rejected yields Requester rewards, increasing the overall system reliability.*

New Marketplace Features

The expanded use of CVC within the identity marketplace enables two new features
not presented in the original whitepaper to promote network accuracy.

High economic incentives for network accuracy

With these changes, the Civic marketplace provides additional incentives for Validators to increase or maintain identity accuracy at a particular confidence level, other than solely in order to maintain their reputation. In a young network characterized by limited participants, individual reputation level is a poor motivator for overall network success and the updated design addresses this issue.

Improved network effects

A token that enables network participants to share in the value captured by the network encourages new network participants to join. This positive feedback loop amplifies and accelerates traditional network effects and is effective at bootstrapping a network. A high-velocity medium of exchange token does not create high-value network effects, as network participants necessarily exit the network after they participate in an exchange.

Conclusion

As can be seen in this summary, the updated behavioral model in the Civic identity network uses staking and the threat of punishment to ensure that a Validator provides accurate attestations. The Requester is similarly incentivized to maintain accuracy through substantial rewards for detecting incorrect attestations and flagging them in the network. Both network participants are now incentivized to create and ensure overall system accuracy.

A comprehensive token behavior model which fully describes the relationships between network participants in the Civic Marketplace and their associated behaviors and incentives will be released shortly. The document is currently undergoing legal and internal peer-review prior to being released to Civic users, holders and the public more broadly.

Created in collaboration with

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