



What's next for WYVOTE2021 & beyond!

White Paper



WYVote 2021 & Beyond!

Implementation of a blockchain e-voting system for Wyoming & widespread digital voting adoption in the United States

White Paper

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“We are at the very point in time when a 400-year old age is dying and another is struggling to be born - a shifting of culture, science, society, and institutions enormously greater than the world has ever experienced. Ahead, the possibility of the regeneration of individuality, liberty, community and ethics such as the world has never known....”

— Dee Hock, Visa founder of the world’s largest payment network

Abstract

We present *WYVote2021 and Beyond!*, a design proposal for establishing the best solution for a blockchain voting dApp that incorporates **voter self-sovereign-identification** and **verifiable ballot tabulation**. Our proof-of-concept (POC) submission is scratching the surface of what is possible. We highlight extensible options tailored for use in Wyoming elections and easily modeled to any state's voting system based on their specific election rules, expressed in *Smart Contracts*. We provide special consideration for an agnostic design so that a funded project by the State of Wyoming offers a foundation to scale and augment the election systems and roadmap to embrace a 21st-century vision.

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Introduction

“We have it in our power to begin the world over again.” — Thomas Paine

As the U.S. gets ready for an election during a pandemic, we are reminded that the current election system suffers from inflexible services bound to “in-person” voting options and tied to physical infrastructure that also requires human capital to oversee and administer a safe and reliable experience. Moreover, the public discourse remains that our United States election process and voting systems suffer from severe security flaws and are vulnerable to adversarial manipulation. On the other extreme, many tout emerging technologies as the promise to solve all security ills and technical failings. Still, they fall short on a viable path to augment existing systems with a firm foundation to innovate and progress voters to mainstream adoption on a 21st-century platform. Given these extremes and the challenge to innovate or fall further behind, we have positioned our proposal on building a firm foundation based on the first principles of the voter’s journey and repairing public trust.

First Tenet

As a voter, “I am who I say I am,” and I rely on a digital representation of my self-sovereign-identity, which ***I am verified*** once, and I am in control of ‘HOW’ and ‘WHO’ I transact with.

Second Tenet

As a voter, I demand data providence. My vote must count; it must be irrefutable and verified by election officials charged with administering the election process for my State.

Third Tenet

As a voter, I am entitled to enduring privacy in my election choice, with no fear of reprisal, discrimination, or targeted and unwanted solicitation from those that seek to exploit or influence my free will and point-in-time decision, today, tomorrow, or ever.

Our proposal addresses these fundamental principles and demonstrates key capabilities and considerations for a fully-funded initiative and immediate benefits for Wyoming by risk reduction, improved voter turn-out, ongoing engagement, and significant cost savings by minimizing errors and manual data entry and system administration for legacy systems.

Objectives

“Our goals can only be reached through a vehicle of a plan, in which we must fervently believe, and upon which we must vigorously act. There is no other route to success.” —Pablo Picasso

Our Purpose

We believe that an electronic voting dApp should be purpose-driven, community-oriented, based on open standards for blockchain technologies, voter privacy and security as an imperative, and independent verification and transparency for ballot tabulation.

Our [project](#) aims to build the best solution for a blockchain voting dApp for the state of Wyoming that incorporates the following:

- Identity authentication through Voter Self-Sovereign-Identification.
- Intuitive and simplistic design that allows voters to check their registration status, cast a vote, verify a ballot, and stay informed.
- Privacy, vote immutability with verifiable ballot tabulation.
- Extensible options that can be tailored for use in Wyoming elections and voting system infrastructure.



Figure 1 - Blockchain Voting dAPP Features

Why Us?

And we say, “If not us who? Why not us?”. No one has more to lose in unfair elections than the citizens themselves. We believe extraordinary things can happen with ordinary citizens! Although we focus on modern technologies and the promise of blockchain, distributed ledger technologies, smart contracts, and consensus algorithms for the most secure, open, transparent, and reliable design, we acknowledge that voter experience and understanding is key to mass adoption.

We dare to believe we can make a difference with a citizen-focused design that helps the average voter understand the benefits and on-going use. It starts with us, our #blockchain-vote Wyoming Hackathon team, and people *like us, for us, with us*, this **is our community!**

The Challenges

“If I had one hour to save the world, I would spend fifty-five minutes defining the problem and only five minutes finding the solution.” – Albert Einstein

The general challenge every American is facing right now as we quote the US Department of State, “Since our first issue on voting rights, a new challenge has emerged: how to conduct elections amid a

public health emergency.”¹ There are national concerns over election security and potential US Postal Service delays.²

Voting System

Voting systems all suffer from being proprietary, centralized at a physical location, unreliable, and costly. These machines utilize proprietary, closed-source, and outdated software, often riddled with security vulnerabilities that are difficult to remediate or easily deploy software patches due to the nature of firmware and major software upgrades that require a hard reboot and physical interaction. If this article outlining the Windows 7 operating system is any indication of widespread systemic problems, an overhaul of Wyoming’s voting systems is a Secretary of State imperative!³

There are two voting machines⁴ widely used: Optical Scan and Direct Recording Electronic. Hundreds of errors in optical scan systems⁵ have been found, from feeding ballots upside down, multiple ballots pulled through at once in central counts, paper jams, broken, blocked, or overheated sensors which misinterpret some or many ballots, printing which does not align with the programming, programming errors, and loss of files.^[31] While Direct Recording Problems have included public web access to the software before it is loaded into machines for each election, and programming errors which increment different candidates than voters select.^[31] The Federal Constitutional Court of Germany⁶ found that existing machines could not be allowed because the public could not monitor them. There have been incidents that both machines are hackable.

Wyoming Voting System

The [Wyoming election process](#) consists of manual procedures and legacy technology options. The following are examples of current procedures that we propose to address with our electronic voting system based on blockchain verifiable and open standards.

- ❑ **Online voter registration** - Wyoming is the only state that requires a notarized signature for mailed-in voter registration forms. A cryptographically verifiable solution resolves this challenge.
- ❑ **Accessibility** - Polling locations and hours of operation are currently tied to brick-and-mortar buildings and hours of operation. Our online decentralized blockchain application (dApp) solves this.
- ❑ **Voter data** - Wyoming voters are entitled to voter data. However, the process is either manual or subject to security concerns. Many IT and security professionals would argue that both email and the file-transfer-protocol (FTP) service commonly used are antiquated forms of data exchange. Both email and FTP are non-secure data transmission protocols and considered insecure in light of more secure transport mechanisms. Transport mechanisms as sFTP and other data transfer methods that incorporate transport-layer-security (TLS) or strong cryptography and form the very foundation of blockchain technologies...

¹

https://www.americanbar.org/groups/crsj/publications/human_rights_magazine_home/voting-in-2020/current-issues-in-voting/

² <https://www.wyofile.com/voting-in-a-pandemic-what-wyoming-learned-from-the-primary/>

³

<https://www.theverge.com/2019/7/13/20692952/us-presidential-election-2020-voting-machines-windows-7-vulnerabilities-upgrades>

⁴ https://en.wikipedia.org/wiki/Voting_machine

⁵ https://en.wikipedia.org/wiki/Electronic_voting_in_the_United_States#Errors_in_optical_scans

⁶ https://en.wikipedia.org/wiki/Federal_Constitutional_Court

- ❑ transport-layer-security (TLS) or strong cryptography, the very foundation of blockchain technologies..⁷

Wyoming Elections (Socioeconomic & Cultural Context) Issues

The state of Wyoming is known to be the culmination of breakthrough policies i.e., women's suffrage in 1896⁸ and passing HB0070, a bill enabling the use of blockchain for commercial filing systems⁹. However, we need to address that voting is oftentimes also a socioeconomic¹⁰ privilege.

Registered voter turnouts in the Wyoming primary elections have increased to approximately. 140,000 as compared to elections in 2016, at approximately 114,437 registered voter turnouts.¹¹ However, there are problems that need to be addressed when it comes to the working class.¹² The convenience, reliability, and flexibility are required to address the working-class voter. For the underrepresented minorities in Wyoming, forming 5%¹³ of the total population, they need to be well-informed, empowered, and we need to earn their trust.

Wyoming voters will likely embrace the use of technology if they are informed and included in the process to adopt it through legislative means. Recent census data reveals that out of the total population of 578,759, most constituents have access to an online device and the Internet:¹⁴

- Households with a computer 2014-2018 - 90%
- Households with a broadband subscription 2014-2018 - 81.1%

Our blockchain solution will be complementary to current systems managed by the Secretary of State, election officials, and county clerks to earn the voter's trust for strong digital identity, accessibility, and voter usability.

The Process

"Democracy is based upon the conviction there are extraordinary possibilities in ordinary people."-**Harry Emerson Fosdick**

In approaching the challenges with Wyoming's election system, we present three fictional voters with different demographics and motivations for using an electronic voting system.

⁷ Wyoming Voter Data Order Form -

<https://sos.wyo.gov/Forms/Elections/General/VoterProductOrderForm.pdf>

⁸ Wyoming historical data - https://en.wikipedia.org/wiki/Women%27s_suffrage_in_Wyoming

⁹ Wyoming landmark legislation - <https://www.wyoleg.gov/Legislation/2019/HB0070>

¹⁰ General voting concerns

<https://www.npr.org/2018/09/10/645223716/on-the-sidelines-of-democracy-exploring-why-so-many-americans-dont-vote>

¹¹ Wyoming voter trends - <https://sos.wyo.gov/Elections/Docs/VoterProfile.pdf>

¹² Wyoming workforce - <https://wallethub.com/edu/hardest-working-states-in-america/52400/>

¹³ Wyoming minorities -

<https://www.wyofile.com/advocates-barriers-to-diverse-voter-turnout-persist-in-equality-state/>

¹⁴ Wyoming Census Data - <https://www.census.gov/quickfacts/WY>

The Voters

- ❑ **Voter one: Vivian Jackson** - A military member deployed overseas. She wants to stay informed on ballot issues for Wyoming along with information on the candidates for the general election. Vivian uses the app to get reliable information from non-profit organizations that she trusts and complies with the Wyoming Constitution, *Article 2 - Paid Advertising in Any Communication Medium or Printed Literature to Support, Oppose or Influence Legislation 22-24-201*.¹⁵
 - ❑ See her story [#WYVote2020-Vivian-Jackson-Story](#)
- ❑ **Voter Two: Cora Sublette** - A senior citizen. Cora is not too sure how to install mobile apps on her phone, so she makes an appointment for early voting at her nearby county office. She uses a voting kiosk with the app already installed. She watches a quick tutorial video and gets in-person support to help her get started with an account and guidance using the different features on the app.
 - ❑ See her story [#WYVote2020-Cora-Sublette-Story](#)
- ❑ **Voter Three: Cody Park** - A Computer Science student at the University of Wyoming. He learned about blockchain technology in his coursework. Cody is enthusiastic about the subject and is curious to learn more about the blockchain voting app. He finds a link about the technical details for the app and is confident his information is secure. He is excited that his state is the first to have a cross-chain Blockchain app that can be used for voting in elections. Cody sees the potential of the technology from managing his medical records to verifying his research papers.
 - ❑ See his story [#WYVote2020-Cody-Park-Story](#)

Wyoming Elections

The following Wyoming election process was obtained from the Wyoming Secretary of State office¹⁶. Our proposal seeks to integrate with the current process in the near-term and add immediate benefits by improving and augmenting current state processes and technology with our proposed design.

- ❑ **UI/UX requirements for Wyoming voting application and replacing manual legacy processes:** Home screen with navigation that includes current state process information and the new online blockchain dApp design.

Table 1

Current State	Proposed State
Check your voter registration status at least 30 days before the election by calling your county clerk's office .	[NEW - Online Registration] Wyoming is the only state that requires a notarized signature for mailed-in voter registration forms. ¹⁷ Wyoming legislature and governing bodies are incentivized to address many of the

¹⁵ Wyoming Constitution - <http://www.iandrinstitute.org/docs/Wyoming-Constitution.pdf>

¹⁶ <https://sos.wyo.gov/>

¹⁷ Wyoming notary laws - https://www.rocketminer.com/news/state/lawmakers-look-to-overhaul-notary-laws/article_d35d9bcc-a63f-5f0b-8fca-4be162ee1f7d.html

	<p>election reform challenges that currently prohibit the use of modern applications.¹⁸</p> <p>Our dApp, using Blockchain and distributed ledger technologies (DLT), demonstrates how these concerns can be satisfied.</p>
<p>Locate your polling place and note the hours of operation.</p>	<p>[NEW - Online app available 24x7]</p> <p>Our dAPP integrates with the current process and online access. Voters who have difficulty getting to the polls will have the option to either use the same technology on their online device or make an appointment to vote at a registered polling place. Polling places will use our voting dApp at a provided kiosk computer designed to inform the voter on how to use the system, register to vote, and securely authenticate with their trusted Identity. Voters are ensured that their voting data is immutable and recorded on the blockchain service. They can access a record of their historical voter data at any time.</p> <p>#WYVote2020-Cora-Sublette-Story</p>
<p>Consider voting early or request an absentee ballot, if possible.</p> <p>You can request an absentee ballot from your county clerk's office.</p> <p>If you plan to vote at the polls, go early in the day to avoid the last-minute rush.</p>	<p>[NEW - Standard online process for absentee registration and voting]</p> <p>Wyoming counties have their own websites and links to pdf documents that describe the process for early or absentee voting. Our dApp design accounts for a standard, end-to-end process.¹⁹</p> <p>See #WYVote2020-Vivian-Jackson-Story</p>
<p>Make sure your ID is valid and up to date.</p>	<p>[New - VoterID Verification]</p> <p>Wyoming does not offer so-called “motor-voter” registration whereby eligible voters are either automatically registered or allowed to voluntarily register while obtaining or renewing a driver’s license or while otherwise conducting business with state agencies.”²⁰ Recent Wyoming laws and proposed ballot measures for digital notary and blockchain technologies will enable this feature, which is key for voter identity verification. Our dApp will integrate with an approved SSI service, such as <i>I am verified.</i></p>
<p>Contacts</p>	<p>[New - Chat and Online support ticket system]</p>

¹⁸ Wyoming voter turn-out and election reform -

<https://www.wyofile.com/wyoming-voter-turnout-lags-averages-could-access-reforms-help/>

¹⁹ Example of Hot Springs County: <https://www.hscounty.com/2020-election>

²⁰ Wyoming election reform -

<https://www.wyofile.com/wyoming-voter-turnout-lags-averages-could-access-reforms-help/>

<ul style="list-style-type: none"> ❑ Wyoming Secretary of State – Elections Division <ul style="list-style-type: none"> ❑ 307-777-5860 ❑ Sos.wyo.gov ❑ U.S. Department of Justice <ul style="list-style-type: none"> ❑ 800-253-3931 	<p>Given COVID19, many businesses and organizations have had to adapt to new ways of providing customer service quickly. With many employers having to manage services with a remote workforce, legacy procedures for in-person transactions have failed to scale during this pandemic. Organizations that incorporate online communication and support are better positioned to recover services during the pandemic and post-economic recovery.</p>
<p>Resources</p>	<p>[New - Subscribe and Follow]</p> <p>Wyoming Secretary of State election and county websites have good resources for voters, but no standard way for voters to subscribe to trusted resources, follow ballot measures and candidates they are interested in.</p> <p>Wyoming Constitution - Article 2 - Paid Advertising in Any Communication Medium or Printed Literature to Support,, Oppose or Influence Legislation 22-24-201</p>
<p>Post Election - Voter Data Request Process</p>	<p>[New - Accessible Voter Data Post Election]</p> <p>Wyoming Voter data can be obtained via email or FTP. ²¹ Email and FTP are not considered to be secure means for important online data transfer. Our dApp would replace these current methods, reduce risk, and save money for the ongoing manual process and currently used systems. In addition, distributed ledger technologies (DLT) allow for smart data providence by security storing and recording only what is essential for evidence of the overall transaction (a.ka. a confirmation of a received voter ballot from a past election) versus the entire paper ballot or scanned version itself.</p> <p>#WYVote2020-Cody-Park-Story</p>

²¹ Wyoming Voter Data Order Form - <https://sos.wyo.gov/Forms/Elections/General/VoterProductOrderForm.pdf>

The Design

"Substance is enduring, form is ephemeral. Preserve substance; modify form; know the difference."
- Dee Hock

Proof-of-Concept (POC)

We chose the [SIMBA Chain platform](#) to build our demo for this Hackathon because of its robust feature set, allowing our team to easily design, build, and deploy blockchain systems across multiple blockchains and data stores. Some of the key features include:

- A WYSIWYG design interface to graphically map out assets and transactions
- Auto-generated smart contract code
- Built-in testnet/mainnet features
- REST APIs for interacting with an application client
- Various wallet support
- Notifications with SMS, email, or webhooks
- Multi-team collaboration support

Our **election2020** dApp includes the following methods:

- ☐ **Step one:** Election officials create a contract for an election ballot.
- ☐ **Step two:** Election Official owner adds candidates on the election ballot
- ☐ **Step three:** Voters can vote on the candidates
- ☐ **Step four:** Votes get tallied and displayed

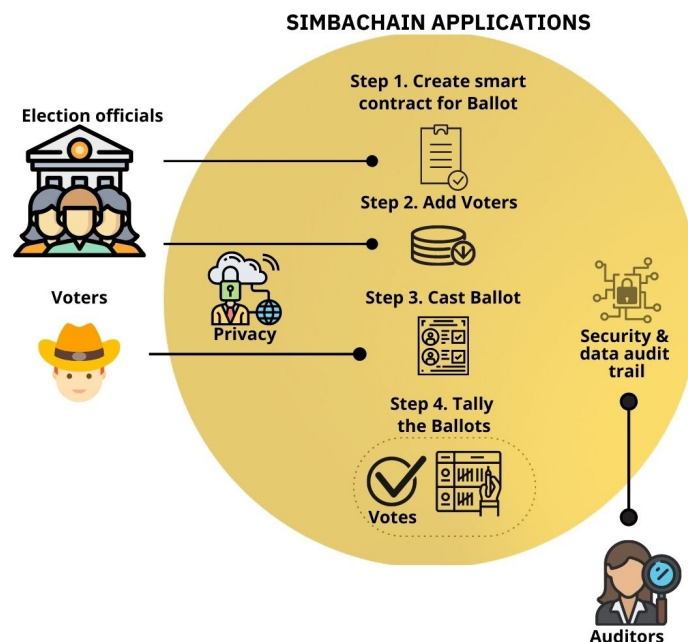


Figure 2 - Election2020 Blockchain Voting dAPP

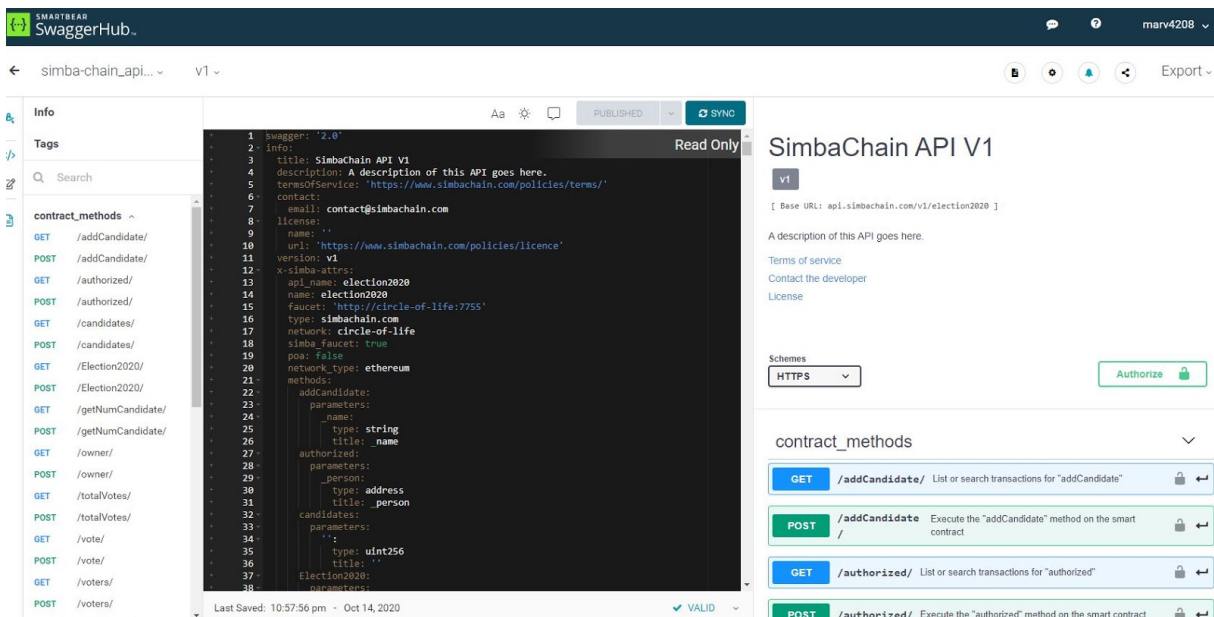


Figure 3 - Simba API Methods Shown in Swagger

POC Apps, Tools & Collaboration

- ❑ Devpost Project: <https://devpost.com/software/wyvote2020-cjaqm2>
- ❑ Team Discord: [#FairVoteApp](#)
- ❑ 5min pitch: <https://my.visme.co/view/y4jv66nz-fairvotewy>
- ❑ Agile Board: [Trello Project Board for Fair Vote Project WyoHackathon 2020](#)
- ❑ SIMBA Chain Project: <https://app.simbachain.com/app>
- ❑ Smart Contract Development and Testing with Remix Solidity IDE: <http://remix.ethereum.org>
- ❑ Truffle Suite Ganache for localhost Blockchain testing: <https://github.com/trufflesuite/ganache>
- ❑ Visual Studio Community Edition: <https://visualstudio.microsoft.com/downloads/>
- ❑ Swagger for APIs: https://app.swaggerhub.com/apis/wyvote2021/simba-chain_api_v_1/v1
- ❑ Collab Folder and Research: [Google Project Drive](#)
- ❑ Lean Stack Startup Plan: https://github.com/bchainify/wyvote2020/blob/main/mktg/LeanCanvas_Oct-2020.pdf
- ❑ Github project wiki - <https://github.com/bchainify/wyvote2020/wiki>
- ❑ Check out our source code on Github - <https://github.com/bchainify>
 - ❑ Election Official Admin App - <https://github.com/bchainify/wyvote2020>
 - ❑ Voter App - <https://github.com/bchainify/wyvote2020-voter>

Smart Contract

The smart contract “Election2020” provides the following functions:

- Election officials create a smart contract for a tokenized election ballot.
- The Election Official (smart contract owner) adds candidates to the election ballot
- The Election Official (smart contract owner) adds authorized voters so they can vote on the election ballot

- Voters register with a wallet so that they can cast a secure and private vote
- Voters then cast their vote for a selected candidate
- Voters get a confirmed transaction ID that is a unique hash on the blockchain, confirming their vote was cast
- Voters can also sign up for SMS or email notification to confirm their vote
- Election officials can view vote tally by a candidate or by overall ballot
- Election officials can end the election ballot, locking it from further transactions

```

1  pragma solidity ^0.4.24;
2
3  contract Election {
4
5      struct Candidate {
6          string name;
7          uint voteCount;
8      }
9      struct Voter {
10         bool authorized;
11         bool voted;
12         uint vote;
13     }
14     address public owner;
15     string public WYElection;
16
17     mapping(address => Voter) public voters;
18     Candidate[] public candidates;
19     uint public totalVotes;
20
21     modifier ownerOnly() {
22         require(msg.sender == owner);
23         _;
24     }
25
26     function Election2020(string _name) public {
27         owner = msg.sender;
28         WYElection = _name;
29     }
30
31     function addCandidate(string _name) ownerOnly public {
32         candidates.push(Candidate(_name, 0));
33     }
34
35     function getNumCandidate() public view returns(uint) {
36         return candidates.length;
37     }
38
39     function authorized(address _person) ownerOnly public {
40         voters[_person].authorized = true;
41     }
42     function vote(uint _voteIndex) public {
43         require(voters[msg.sender].voted);
44         require(voters[msg.sender].authorized);
45
46         voters[msg.sender].vote = _voteIndex;
47         voters[msg.sender].voted = true;
48
49         candidates[_voteIndex].voteCount += 1;
50         totalVotes += 1;
51     }
52
53     function() ownerOnly public {
54         selfdestruct(owner);
55     }
56 }

```

Figure 4 - Smart Contract "Election2020.sol"

2021 & Beyond Development

Our project team was able to test our election smart contracts on both public and private blockchain services, demonstrating the versatility of our design. According to James Kitkat, Open Rights Group, “A free and fair election has to have three things; it needs to be secure so that your vote can’t be changed; It has to be anonymous so that people can’t know how you voted, and it also has to be accurate.”²² Our dApp meets these requirements by tokenizing the election ballot and the voter’s identity via their wallet address²³ so that the vote is secure and anonymous, thus creating an immutable ledger and audit record for each transaction. In addition, voters are able to get an immediate notification that their vote was received and confirmed on the blockchain.

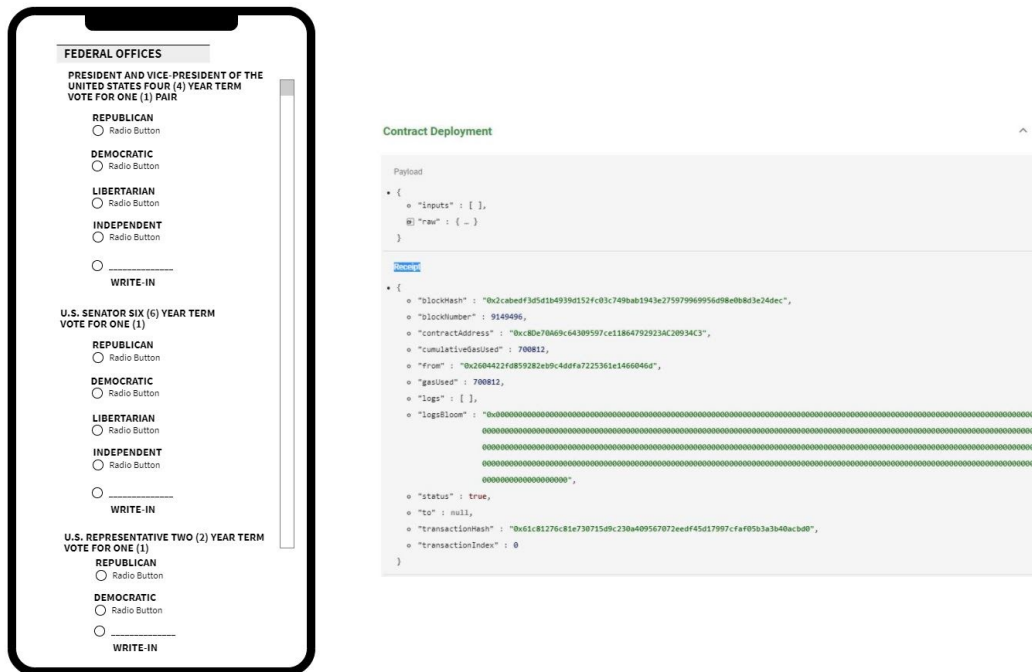


Figure 5 - Wireframe Design - Tokenized Ballot on the Blockchain

²² Security Analysis of the Estonian E-Voting System - https://www.youtube.com/watch?v=iit5WdLYwns&feature=emb_logo

²³ SIMBA libsimba-js initialise wallet function - <https://simbachain.github.io/libsimba-js/example.html>

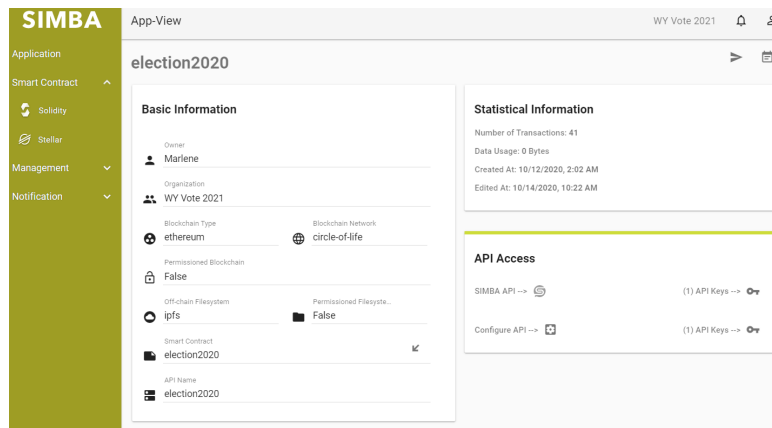


Figure 6 -Simba Chain Blockchain Services and App Configuration

More Demonstrations of the Blockchain Voting App

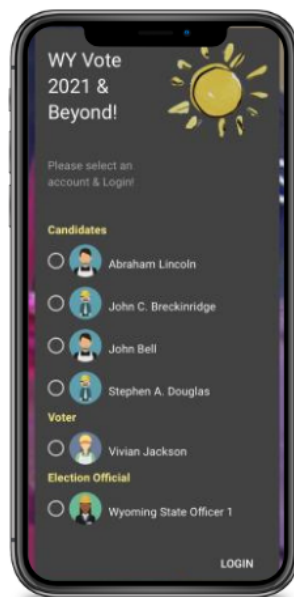


Figure 7 - Election Official's Admin Portal App



Figure 8 - Voter Admin Portal App

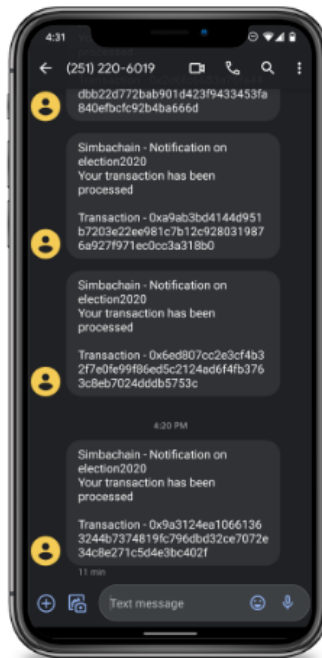


Figure 9 - Voter SMS Notifications

Future Work

The following areas are requirements that we believe are important aspects for eventual production design and deployment, so we want to mention them here.

Reporting Trends and Metrics

The graphs below show the potential to add meaningful election trends and business analytics. According to the Simba Chain dev team, GraphQL will be available in their upcoming Smart Contract as a Service V2 platform available in the coming months.

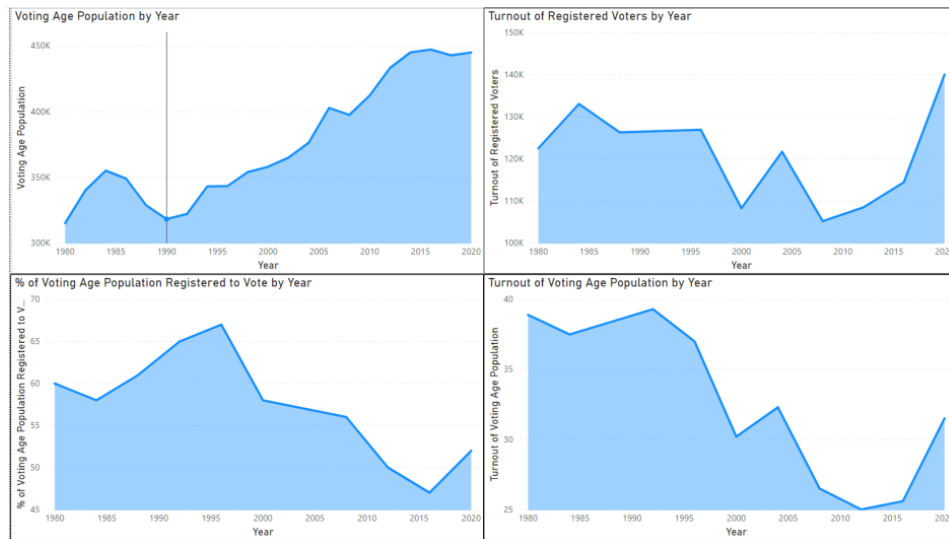


Figure 10 - Voter Demographics Analysis

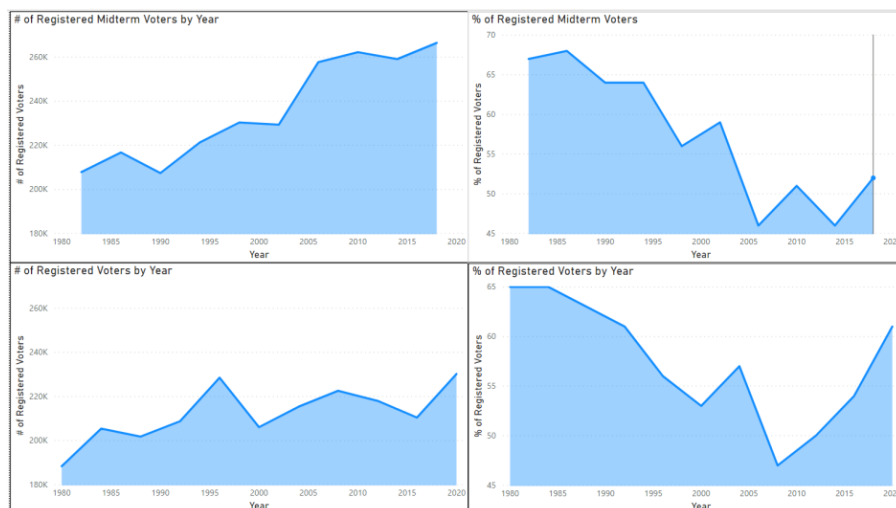


Figure 11 - Election Mid-Term Reporting

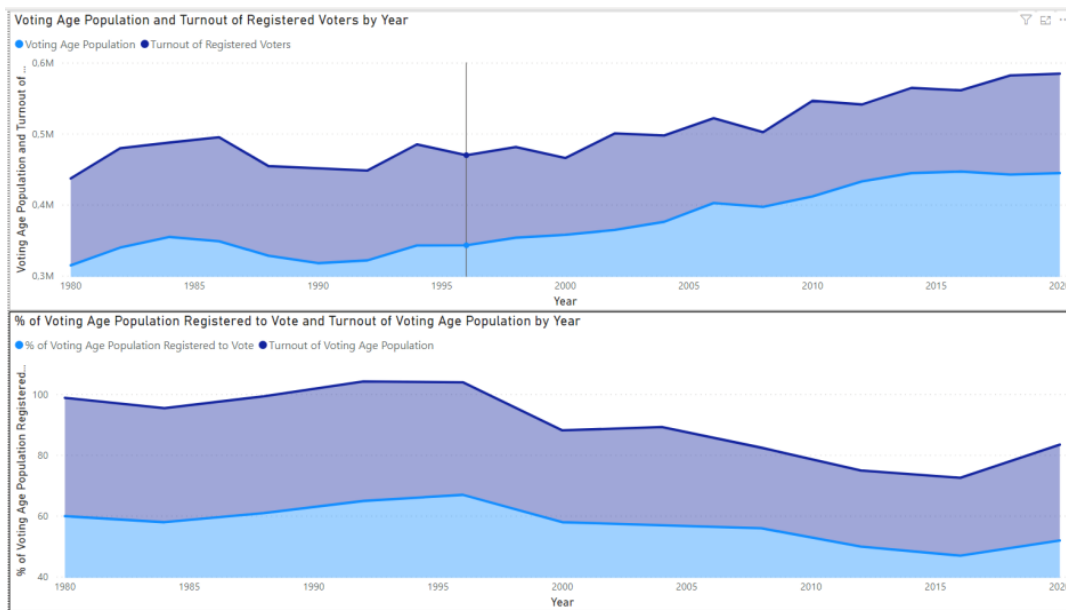


Figure 12 - Year-over-Year Trend Analysis

Cross-chaining

A funded project would entail a cross-chain architecture such that the administration features of the election process would be on a permissioned blockchain such as Hyperledger Fabric or Quorum. The voting could be conducted on a public blockchain due to the privacy features we've incorporated into the design with a tokenized election ballot and voter identity and represented with their wallet public address depicted in the diagram below.

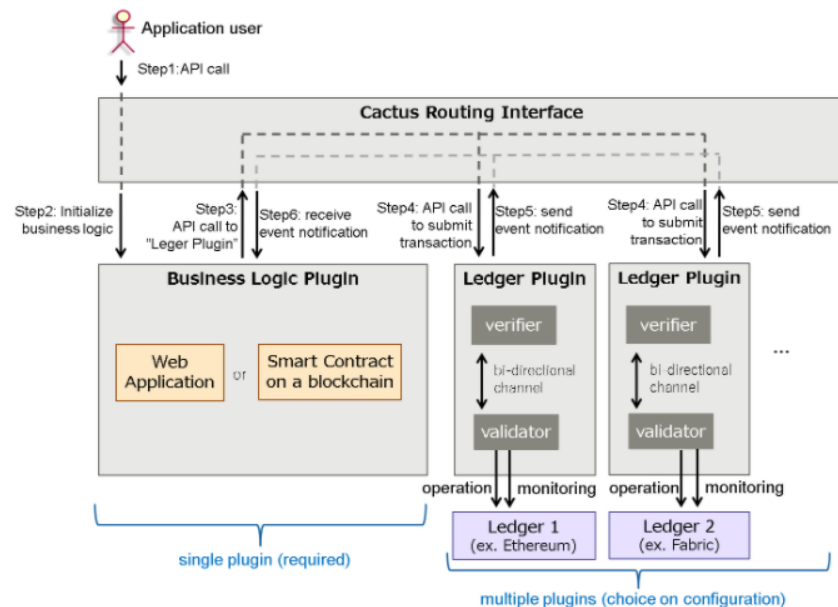


Figure 13- Cross-Chain Architecture Diagram²⁴

²⁴ Cactus Cross-Chain Architecture - <https://github.com/hyperledger/cactus>

The Opportunities

"The ballot is stronger than the bullet." - Abraham Lincoln

On September 26, 2020, six random individuals came together in response to the Wyohackathon 2020 #blockchain-voting challenge. We hail from three Countries, three States, and varying demographics. Yet our collective spirit to instill trust in the election process inspired us to action and to transcend physical limitations, party affiliations, and senseless debate on whether we can **demand and deserve** trustworthy elections and the responsible use of online technologies to address challenges for a diverse and inclusive democracy.

Our project team was transformed by this experience, as a team and as individual contributors. We **united** in our work to collaborate on solutions to solve this global concern. We researched the issues and became **informed** on past and current initiatives for online voting and fair elections. We reaffirmed our **resolve** to be part of the solution as concerned citizens. Finally, we are inspired by the Blockchain and all the potential harnessing this new technology may bring into creating a more fair and safer voting environment in the United States. Share in our personal journey and experiences below.

We are United

"Prior to this Hackathon challenge, I did another Hackathon project with my employer, a well-known Financial Services technology company. Our team decided to do a blockchain project to address fraud in prepaid and reloadable credit cards. Like in this experience, the project united us as a team, as colleagues, and as blockchain enthusiasts. We joined the ranks of community advocates for smart and ethical use of blockchain technologies. In learning more about smart contracts and using blockchain to eliminate fraud and co-exist with existing systems, not only were we united in objectives, but the technology itself is unifying on many levels. We believe Wyoming has a unified mindset and vision to embrace blockchain solutions for election reform, and we aim to be part of that!"

- Marlene Veum, Chief Security Architect, CISSP and Certified Blockchain Professional

We are Informed

"Our team is well informed and well aware of the possible threats and opportunities for election security. We value the in-depth knowledge of academics. Dan Boneh, a Stanford professor from a panel "Election Security,"²⁵ shared what he believes to be the security goals in an election system:

- 1) Authenticity*
- 2) Availability*
- 3) Secrecy*
- 4) The ballot should be cast as intended*
- 5) The ballot should be counted as cast*
- 6) Legitimacy of the election system*

He further mentions that innovations in the technology of end-to-end verifiable voting works (i.e., Helios²⁶) but concludes that the paper ballot is more effective as a fail-safe method in voting because of the paper trail audits. Until the end-user product, our smartphones, enhance their security, we will use mobile apps.

²⁵ <https://www.youtube.com/watch?v=j3wwKefXBCs>, "Stanford School of Engineering", 10/7/2020

²⁶ <https://heliosvoting.org/>

With regard to Wyoming, it has a small population with 23 counties. In these counties and small towns, there is a trust established between county clerks and the voters. There is also growing enthusiasm for new technology, specifically blockchain.

Trust matters most, and we have to create a product that will be authentically intuitive for the voter to understand.”

- Kristine Mallari, Communications Officer for BlockchainBTM

We are Resolved

“We have an economy where we create the same functionalities over and over again because we do not share or trust the technology that is being created. I believe we are about to cross to a new age, where most of the data will flow between computer programs in a decentralized environment. Because the code is immutable, transparent, and automated, we can trust the technology to execute transactions based on our agreements. I have chosen to participate in the WyoHackathon voting challenge to be part of that technological movement and help along to the best of my abilities.”

- Tevo Saks, IT Administrator in a Sales and Distribution Company

We are Inspired

“Coming into this project, I knew I wanted to work on a blockchain application that had feasible deployment potential. My personal goal was to create a project that could inspire future applications of these new technologies in a meaningful way. Based on the feedback we received from our mentors and peers along this journey, an answer for electronic voting in the United States was one of the more widely embraced usages of the burgeoning blockchain technology. The Blockchain's decentralized nature and its foundation as a secure digital ledger made it an excellent fit for us to develop a secure SIMBA chain application as a solution for voting and government elections. I am incredibly excited to see what the future holds for our project: WYVote2021 & Beyond!”

- Cedric Gin, Computer Science student at Michigan State University

Conclusion

“If “we” have the belief that “we” can do it, “we” shall surely acquire the capacity to do it even if “we” may not have it at the beginning..”- Mahatma Gandhi

Creating trust during these uncertain times is a challenge that we have to face. A growing concern enhanced by misinformation leads to a divided community. In addition, many efforts to address on-line voting systems are heavy in technical jargon and advanced implementations and digital solutions but fall short of instilling trust with the target audience (a.k.a. The Voter). We have taken a common-sense approach to this in establishing first principles²⁷ thinking, codified by three tenants:

Trusting the Voter - I am Verified

“The best way to find out if you can trust somebody is to trust them.”

— Ernest Hemingway

²⁷ https://en.wikipedia.org/wiki/First_principle

First Tenet: As a voter, “I am whom I say I am,” and I rely on a digital representation of my self-sovereign-identity, which **I am verified** once, and I am in control of ‘HOW’ and ‘WHO’ I transact with.

In the Information Age of the 21st century, more-and-more value is being placed on intangible assets. It is hard to imagine a world in which we don’t transact in the virtual world where our online presence is represented in our digital identity. The Constitution and Bill of Rights have provisions for fundamental freedoms and protection of property, yet there is no precept for an individual’s right to privacy. This has led to wide-scale abuse and harm as privacy violation continue to occur with no recourse for the affected individuals. Our design takes this fundamental right as a ‘first-principle’ prescript. Our vision for Wyoming’s election process is to allow online voter registration with a digital wallet that proves a decentralized digital identity (DiD). A person’s credentials would be held in an encrypted digital wallet for documenting trusted relationships with the government, banks, employers, and many other institutions. This system enables self-sovereign identity (SSI) and inherent privacy. In our design, a voter maintains a digital wallet that provides a public wallet address (a unique hash) in the place of their name (PII) when transacting their vote in the public blockchain. We acknowledge that the key to SSI is a secure implementation. Therefore a funded project would allow us further to develop this design for a real-world e-voting service.

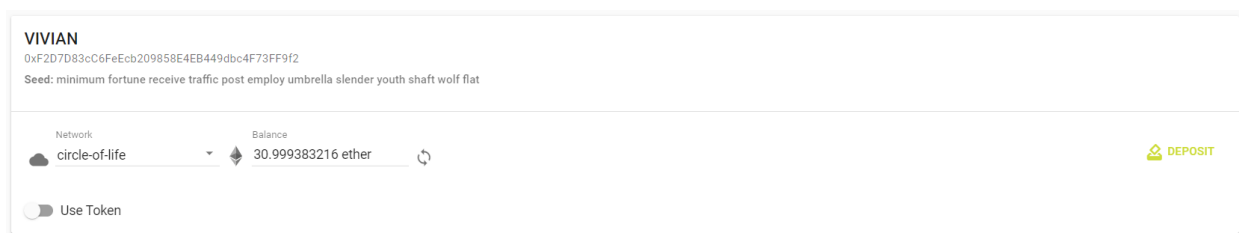


Figure 14 - Vivian Jackson - Voter’s Tokenized Identity Wallet Address

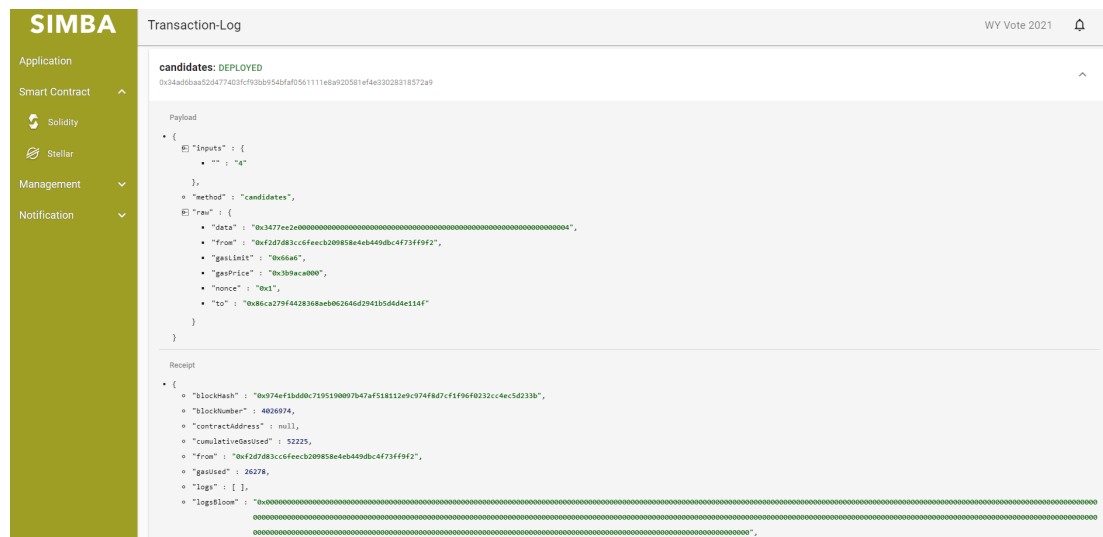


Figure 15 - Vivian Jackson’s Vote Transaction with Wallet Address (No-PII)

Trusting the Technology

Second Tenet: *As a voter, I demand data providence. My vote must count; it must be irrefutable and verified by election officials charged with administering the election process for my State.*

Our POC allowed us to envision a design for a solution to create trust. We used three fictional actors to represent a typical Wyoming voter, similar to us or people we know, that want to believe that their vote matters. It must count, it must be verified, and election officials must be held accountable to carry out their civic and legal obligations. We understand that open source standards provide voter transparency such that a voter can verify their ballot was received while also providing anonymity for the general public. Election officials charged with ballot tabulation should no longer struggle with mechanical failures and issues with accurate voter tabulation. Similar to how we can trust that our debit or credit card transactions were a result of our spending, our blockchain solution proposal provides an undeniable transaction, with our a voter's identity and their ballot elections. A "zero-knowledge proof" is a fancy term to describe an immutable record or agreement that I own a transaction (a.k.a. My vote) and that the receiving and responsible party can trust my submission. Both parties can independently verify and establish trust and have an immutable record that the transaction occurred and is not disputed.

We acknowledge that there are other factors outside of our control, such as security and reliability of end-user devices, subject to security flaws, and are exogenous to what we want to accomplish. However, blockchain technologies per se (especially the solution that we can provide) will enforce user verification and trust in a reliable framework. Informing the user and transparent design philosophy is the foundation for our proposed solution. Any sensible feature requirements that establish safe and secure use, independent third-party verification, and a foundation to iterate upon as these emerging technologies continue to advance and settle into mainstream adoption.

Trust Democracy

Third Tenet: *As a voter, I am entitled to enduring privacy in my election choice, with no fear of reprisal, discrimination, or targeted and unwanted solicitation from those that seek to exploit or influence my free will and point-in-time decision, today, tomorrow, or ever.*

Technology and systems fail, but it is generally understood that organizations, businesses, government agencies, and users still use digital systems to save time and money, reduce manual overhead, and extend their reach to end-users. Convenience is a major factor as to why we tolerate imperfection. These digital systems are too often overly complex in ways that no one person or group of owners, administrators, or users can fully understand or guarantee with an absolute level of trust, security, and stability.

Blind trust in technology is dangerous and leads to unrealistic expectations, misinformation, and lack of accountability. Our proposal focuses on how we can improve the current Wyoming election systems and processes. We define requirements for a funded project based on today's technology, first principle design, and three tenants that champion human rights to protect and enforce a private, secure, and trustworthy election system fitting 21st-century citizens in a democratic society.

Our design seeks to educate, inform, and unify regular citizens in the responsible use of technology for critical digital transactions. Consider a well-known example of social-media apps that have been fraught with privacy violations and security breaches. The user base continues to grow, and new variations of social-media and online interaction and technologies are on the rise, despite these shortcomings. What

can we learn from these systems? Ease of use, benefits for staying informed with reliable sources, and access to the content of personal interest are major incentives for on-going use of social-media despite their flaws.

We can do better by delivering transparency and accountability with a well-constructed design and responsible use of blockchain technologies. We can tap into similar benefits for long-term use. Despite challenges, we cannot stay stuck with yesterday's technology. We propose a phased plan that integrates and improves flaws and shortcomings with the current systems and positions Wyoming's Secretary of State election committee to progress and embrace new technology adoption and responsible use.

We highlight three actors, *Vivian Jackson*, *Cora Sublette*, and *Cody Park*, potential snapshots of realistic Wyoming voters, who can use a new digital voting system, for the people, and by the people! Fund our project and find out what's next and how these voters will benefit, [#wyvote2021-and-beyond!](#)