THE FUTURE OF VOTING
End-To-End Verifiable Internet Voting

Usability Study

10 July 2015

INTRODUCTION

This chapter reports on a series of interviews conducted with overseas voters demonstrating three different voting systems: two front end simulations of the Star-Vote [1] voting system originally developed by a consortium of academics and Travis County, TX election administrators, and the Helios [2] voting system developed by Ben Adida. The key differences between the three systems were how end-to-end (E2E) verifiable concepts were presented. The Star-Vote variations contained two content related differences (see **Attachment 1**) concerning descriptions of E2E properties as well as two further display variations (see **Attachment 2**). The differences between systems are summarized in **Table 1**.

Table 1: Voting System Differences

System Differences	Helios	Star-Vote 1	Star-Vote 2
Verification of Ballot	*'Audit Your Ballot'*	*'Spoil Your Ballot'*	*'Practice Ballot'*
Display Variations		Solid Select (with picture)	Spartan
Content Variations		Jargon	Gentle

The aim of these interviews was to gain an understanding of the issues that overseas voters might have with the implementation of a remote End-to-End Verifiable Internet Voting (E2E VIV) system, their ability to use that system correctly, their understanding of the system and its security properties, and their attitude towards 'online voting'. What was particularly important was to identify issues at an early stage that could be addressed in future derivatives of E2E VIV systems developed for use by the overseas population. The nature of these issues follows similar usability studies and ranges from straightforward usability issues to security features that users are unwilling or unable to use [3].

METHODOLOGY

Interviewing focus groups has previously been successful in capturing voter attitudes concerning remote voting [4]. These interviews provide a good way of identifying a range of reactions and viewpoints at an early stage of development, while high level design decisions are still under discussion. The intention in our case was to use three very different E2E VIV prototypes to obtain reactions, concerns and aspects of voter understanding concerning the properties and capabilities of E2E systems. This data would then inform development of the next versions of E2E VIV systems that will be designed for remote use.

Interview participants were selected from the respondent pool to the Overseas Vote Foundation (OVF) 2014 Post Election Survey. The OVF 2014 Post Election survey was deployed on 4 November 2014 and sent to 112,477 OVF users. In that survey, respondents were given an opportunity to volunteer for future

research by providing their email address. Of the total survey cohort, 322 respondents indicated their willingness to volunteer and provided their email addresses.

On 15 April 2015, all 322 volunteers were contacted via their email address (see **Attachment 3**) and invited to participate in the E2E VIV usability interviews. They were given instructions concerning what information would be required in order to participate in the interviews, and when the interviews would be taking place. The first thirty respondents who contacted the research@overseasvotefoundation.org email address with the appropriate information and availability were included in the study. Of this thirty, one participant cancelled, one participant was ultimately unable to participate due to scheduling conflicts, and one participant cancelled due to a family emergency. As such, 27 participants were included in this usability interview process.

Demographic data for the usability participants was collated from the 2014 Post Election Survey and is presented in **Table 2** along with the corresponding data from the 2014 Post Election Survey as a means of comparison. Based on this information, the sample is broadly representative of the OVF survey results, however there are some exceptions. Prior survey demographics from OVF have shown a broadly equivalent gender distribution, however in the usability participant sample, males outnumber females. Additionally, while Non-Hispanic White and Euro-Americans dominate ethnicity distributions, in the usability participant sample, other ethnic classifications have greater representation. Importantly, the age, education and occupation classifications reflect the variety of overseas voters and provide a good opportunity to capture a diverse range of usability experiences from the appropriate target user group.

It is important to note that the usability interview scheme *did not* include any overseas military personnel or any individuals that identified themselves as being disabled. However, two participants did not speak English as their first language.

Table 2: Demographic Characteristics of Usability Participants from 2014 OVF Post-Election Survey

		Usability Participants	OVF 2014
Gender	Female	29.6%	51.2%
	Male	70.4%	48.8%
Age	30-39	3.7%	12.6%
	40-49	18.5%	16.8%
	50-59	33.4%	22.4%
	60-69	29.6%	25.2%
	70-79	14.8%	14.0%
Education	High School Graduate	3.7%	5.9%
	Trade School	3.7%	2.1%
	College or Associates Degree	18.5%	9.2%
	Bachelors Degree	33.4%	32.1%
	Masters Degree	29.6%	34.5%
	Doctorate	11.1%	15.6%

Ethnicity	Non-Hispanic White or Euro-American	88.9%	80.4%
	Latino or Hispanic American	7.4%	3.3%
	Multiracial American	3.7%	2.9%
Occupation	Architecture and Related Occupations	7.4%	.9%
	Arts, Entertainment and Related Occupations	3.7%	5.5%
	Computers and Technology Related Occupations	7.4%	4.8%
	Education, Teaching, Academic Research and Related Occupations	22.2%	18.2%
	Finance and Financial Related Occupations	3.7%	2.5%
	Management, Professional and Related Occupations	14.8%	8.2%
	Medical Practitioner and Related Occupations	3.7%	4.2%
	Office and Administrative Support	3.7%	1.5%
	Other	11.1%	6.1%
	Retired	18.6%	20.8%
	Missing Value	3.7%	7.9%

UOCAVA STATUS

The Uniformed and Overseas Citizens Absentee Voting Act is commonly referred to as UOCAVA. UOCAVA voters are U.S. citizens who are active members of the Uniformed Services, the Merchant Marine, and the commissioned corps of the Public Health Service and the National Oceanic and Atmospheric Administration, their family members, and U.S. citizens residing outside the U.S. The Act, passed in 1986, provides the legal basis for absentee voting requirements for these citizens. Since 2004, OVF has been collecting particular data that is unique and significant to this group. This data is relevant to this usability interviewing process because it provides further insight into the characteristics of the cohort and their voting history. Further, the data provides the participant's current country of residence and state of legal voting residence, both important considerations when contemplating remote voting.

As developers understand, the election system in the U.S. is very decentralized with a wide array of voting rules and regulations that need to be taken into consideration when developing and deploying any voting system. Further, certain countries pose different levels of security concerns regarding U.S. elections, as well as varying levels of Internet access for U.S. citizens. The UOCAVA data concerning the usability participants is shown in **Table 3**.

Table 3: UOCAVA Data

		Usability Participants	OVF 2014
UOCAVA Status	U.S. citizen living outside the U.S. *temporarily*, and I intend to return	7.4%	13.8%
	U.S. citizen living outside the U.S. *indefinitely*, and my return is not certain	88.9%	64.8%
	Missing Value	3.7%	17.7%
Voting History	I have not voted, or attempted to vote, prior to the 2014 Midterm Election.	3.7%	2.1%
	I have only voted as an overseas or military absentee voter, but never in the U.S.	14.8%	11.0%

	I have voted both in the U.S. and as an overseas or military absentee voter.	77.8%	64.7%
	Missing Value	3.7%	17.7%
When did you last reside in the U.S.?	At least 1 year but less than 2 years ago	3.7%	1.8%
	At least 2 years but less than 5 years ago	18.5%	7.9%
	At least 5 years but less than 10 years ago	11.1%	16.7%
	10 or more years ago	63.0%	67.3%
	Don't know/Don't remember	3.7%	.6%
Country of Residence	Argentina	3.7%	.5%
	Australia	14.8%	5.9%
	Canada	7.4%	14.1%
	China, People's Republic of	3.7%	1.6%
	Costa Rica	7.4%	.6%
	France	3.7%	8.8%
	Germany	3.7%	8.8%
	Israel	37.1%	7.3%
	Mexico	3.7%	2.5%
	Netherlands	3.7%	1.9%
	Philippines	3.7%	1.1%
	Singapore	3.7%	.9%
	Turkey	3.7%	.5%
Legal Voting Residence in U.S.	California	7.4%	12.7%
	Colorado	7.4%	2.5%
	Florida	3.7%	4.6%
	Illinois	11.1%	2.9%
	Indiana	3.7%	.9%
	Maryland	3.7%	2.0%
	Massachusetts	3.7%	3.4%
	Michigan	3.7%	2.8%
	Minnesota	3.7%	4.9%
	Nevada	3.7%	.6%
	New Jersey	7.4%	2.7%
	New York	22.3%	19.5%
	Ohio	7.4%	4.1%
	Texas	7.4%	8.1%
	Washington	3.7%	2.7%

RESEARCH DESIGN

Due to the geographic distribution of the interview participants, the interviews were held via Skype. Participants were given a specific date and time for their interview. Once contacted, participants were notified that in addition to the moderator, an assistant from OVF would be on the call.

Information concerning the interview was provided to each participant, followed by a request to audio record the interview. If permission was given, the interview was recorded using QuickTime Player. There were two instances where an audio recording was not possible due to a poor Internet connection. In these cases, the interview was conducted over the telephone. Each interview lasted around 30 minutes.

The interviews began with a preliminary set of questions concerning voting habits and Internet use. In this case, an understanding of where participants access the Internet and what devices they use was an important addition to the discussion concerning security concerns, which include coercion, as related to deployment of remote E2E VIV systems [5].

Additional questions were asked regarding general views of online voting and the participants' thoughts regarding the system requirements or desired properties for any online voting system. A visual representation of the participants' responses is presented using data visualizations. The use of data visualizations is an effective tool for preliminary textual analysis, and quickly highlights points of interest while giving direction to future analysis [6]. These visualizations were created using Tagul and reflect the top 50 pieces of text data from the combined text of all 27 interviews. The intent is to present the most salient points and themes captured in the interviews.

Figure 1: What do you think about online voting?

As seen in **Table 4**, all participants would favor an online voting system over the current paper based system used by overseas voters. Given this, it was not surprising that the majority of participants viewed online voting favorably, noting that it seems 'inevitable'. However, many noted the importance of security, most notably concerning the authentication and identity verification process.

Security issues including coercion and ballot secrecy were not seen to be as important as ensuring that only those who are legally allowed to vote can vote. This same sentiment followed through to the expected functions of an online voting system. Participants expressed the necessity to have a robust

Figure 2: What would you expect of an online voting system?

authentication system, as well as the desire to have the process be as close to the in-person voting experience as possible. This included ballot design and user language.

Table 4: Preliminary Questions

How often do you vote in US Elections?	Always	33.3%
	Almost Always	59.3%
	Occasionally	3.7%
	Try but unable to complete the process	3.7%
How comfortable do you feel using the internet?	Very comfortable	92.6%
	Somewhat comfortable	7.4%
Where do you most often access the internet? (Multiple responses)	At home	92.6%
	From my office	59.3%
	Off site at client offices	3.7%
	Due to travel at airports and hotels	3.7%
What type of devices do you use to access the internet? (Multiple responses)	Home computer or laptop	96.3%
	Mobile device i.e. smartphone or IPhone	55.6%
	Tablet i.e., IPad or Kindle	48.1%
If given an option, would you choose to vote online or continue to use paper?	Online	100%
	Paper	0%

Following this series of questions, participants were asked to screen share via Skype in order to allow the moderator and assistant to follow the participant's interactions with each voting system. Once this function was enabled, participants were first sent the link to the Star-Vote voting system via Skype Chat, along with an access code. They were then sent the link to the Helios voting system.

Once the Star-Vote voting system was accessed, one of the four possible variations of Star-Vote was to be presented to the participant via an automatic randomization function. After the interviews commenced on day one, Galois provided a new link to the Star-Vote system with a new list of access codes. However, this change disabled all the links to the Star-Vote system. As such, for two interviews, participants could only access the Helios systems. These participants were subsequently sent working links to the Star-Vote system and provided feedback via email. Additionally, the moderator and assistant observed that the automatic randomization of the derivatives of the Star-Vote system did not seem to be functioning properly as it was not until the afternoon of day three of interviewing that the solid select display variant appeared. The moderator enquired if data was available indicating the access frequency of each variant but was told logs of this data were not available. Given these issues, there are some problems with the data concerning the Star-Vote system in that it is not possible to provide the level of specificity that was originally envisioned.

There were no significant problems accessing Helios, however as noted in the results section of this chapter, despite creating a designated log in for this testing, participants were very reluctant to log in to Yahoo, Facebook or Google in order to cast their ballot. It was decided to bypass this step because in doing

so, the material functioning of Helios was not altered and participants were more comfortable testing that system. Of importance to participants was the inability to edit your ballot selections in 'Step 2 Review' of the Helios flow. This was reported to the individual who set up the OVF election on the Helios system who subsequently reported the error to Helios operators.

TECHNICAL DESCRIPTIONS

The voting systems forming the basis of this usability testing are Star-Vote and Helios. For screen shots of STAR-Vote, see **Attachment 4** and for Helios, see **Attachment 5**.

Helios

Helios [7], proposed by Ben Adida, is an open-source online voting system specifically meant for remote environments where the risk of voter coercion is thought to be low, while secrecy and trust are important. The key contribution of Helios is that it brings together innovations from different systems to build an efficient and usable E2E VIV voting system that has proved fairly influential in the academic research community.

One of the key properties of Helios, the notion of voter initiated auditing, was introduced by Josh Benaloh [8] and is now referred to as the 'Benaloh Challenge'. Voter initiated auditing allows the voter to audit their ballot on the spot before casting it to develop confidence that the voting machine was correctly encrypting their vote. Helios uses the concept of Benaloh's challenge to convince the voter their vote is cast as intended.

When the voter has made their candidate choice on the voting terminal, the machine performs the vote encryption and their receipt is printed but not released. The voter is then asked whether they wish to cast the vote or challenge it. If the voter chooses to cast it, the machine affixes a digital signature on the receipt and discharges it. If the voter wishes to challenge it, the machine prints on the receipt the contents of the ballot and the randomizing element used in the encryption. Using this information, any observer can check the correctness of the encryption for themselves. The voter can then repeat the vote casting process.

STAR-Vote

Like Helios, STAR-Vote follows the standard template of voter-initiated auditing systems. The system is designed to be both paper based and electronic in order to support audit trails. However, the derivative used in these interviews was only electronic.

On Election Day, the voter identifies themselves to polling staff as an eligible voter and is issued voting credentials, which include information regarding the appropriate ballot style and precinct. The voter then walks to a voting terminal, enters their credentials, and is presented with the correct ballot. The voter then

makes their choices on the screen. The machine then encrypts their vote and prints out two items: a physical copy of the ballot, which is human-readable information pertaining to their choices; and a receipt to take home which includes voting information such as time of voting, and the machine used.

The voter is also given a short character string, which is the cryptographic association to their vote, but does not reveal what the vote was. The voter can then:

1) Confirm that their choice has been correctly marked on the ballot copy;
2) Cast their ballot into a physical ballot box in the precinct;
3) Or, alternatively, opt to challenge the machine to see if it has correctly encrypted the vote.

RESULTS

HELIOS
The results of the interviews concerning Helios did not significantly deviate from prior Helios usability testing [9][10]. Participants found Helios very unfriendly, with many of the concepts presented regarding Helios lacking meaning and context.

Vote Verification
Participants specifically suggested that words like 'audit', 'verifiability', or 'ballot fingerprint' do not equate with their voting experience. They did not understand what these concepts meant in the election context because they were not actions they had ever taken before in a prior election. Concerning vote verification, the majority of participants indicated they would *not* be likely to verify their vote by taking note of their ballot's cryptographic string and verifying on a public bulletin board, and preferred to receive some verification or confirmation 'Your vote has been cast' notice via email. Only two participants said they would actively track their ballot, but expressed a lack of clarity at what that process would entail.

'It doesn't really tell me what I should do with the tracker'

Challenges
Two potential challenges likely obstruct the verifiability aspect of E2E systems: the first being that the voter finds the verification process too difficult, and the second that the voter does not perceive the need to verify their vote [11]. One possible explanation concerning this perception is the absence of trust transference from election authorities to the voter. For example, Olembo et al. found that while voters may initially verify their vote out of curiosity, after continued use of an E2E voting system requiring verification, trust would be established in the voting system and verification would be deemed unnecessary [12].

'The language of Helios is convincingly obtuse'

In respect to the need to verify their vote, participants using both Helios and STAR-Vote noted they had a tacit level of trust in *any* voting system provided it was officially branded i.e. Jurisdiction x Official Election Website. If the voting system met this very basic criterion, the participants considered vote verification unnecessary, as trust was implicit in the voting system.

'I don't like using social media. I would rather have a system that has a robust authentication ' verification system/ID.

Participants also expressed concern over the security of the Helios authentication process, which involves logging into Google, Yahoo or Facebook in order to receive a voter receipt at the associated email address for the various accounts. This sentiment occurred despite having a designated participant log-in account with Google for use during the interviews. Participants did not find this reassuring and felt it compromised their privacy.

'When I see the cryptography on the screen it makes me feel some assurance'

Nevertheless, there were features of Helios that were favorable, including the status bar which indicated the workflow and the ballot-like features including a tick box to select candidates. Further, several participants liked seeing their ballot being encrypted on screen.

STAR-Vote

During the testing, it became quite evident that STAR-Vote was the preferred system, with voters noting that the language and interface was easier to use. However, there were many comments concerning font size, as well as the use of candidate pictures and instructions.

The prototype seemed to lack some of the key functions required in an E2E system and this was not lost on the participants. For example, many participants indicated they were unable to perform some of the tasks outlined in the description, for example checking and verifying their ballot. The concept of "spoiling" a ballot (Benaloh challenge) did not make sense to most participants primarily because it was not clear that this was the process to challenge the accuracy of the system. For those participants that did spoil their ballot, the result did not provide enough information to inform the participant what happened to their spoiled ballot.

'I was completely unsure and not feeling too good about the concept of "spoiling" the ballot.

Several participants noted the need for more detailed instructions. For example, confirmations after each candidate selection, replacing 'next step' with 'next race', replacing 'done with this ballot' with 'review your

'Needs some type of preamble "This is an election for..."'

ballot' and using the full candidate party affiliation descriptor rather than an abbreviated version. Additionally, many participants felt the pictures of the candidates were too small, and wanted a 'tick box' to select their choices rather than a highlighted 'bar'. This supports many assertions that participants want the interface to look as close as possible to an actual paper ballot as possible.

There were several universal themes that emerged concerning both systems. Firstly, voters liked having candidate pictures on the ballot because most admitted they were not familiar with the candidates due to their remote location. Secondly, participants wanted embedded links in the candidate lists that would provide additional information concerning the candidates. Thirdly, participants wanted the ability to vote a straight party ticket. Additionally, as noted previously in this chapter, English was not the primary language for two participants. Both noted the need to 'make the system bilingual'.

'I would like a link to a candidate statement for information'

'I would much rather see a replication of the actual paper ballot'

Finally, the issue of vote verification was a persistent problem in both systems. Individual vote verification is a new concept for voters. They must participate in the vote verification process in order to take advantage of the security guarantees E2E systems offer. The goal of verifiability is to provide some evidence to voters that the election outcome is correct. The participants in this study did not understand the vote verification concept, regardless of the system they used.

'I don't understand this - and because I don't understand it does not give me confidence'

Voter verification protocols as they exist now simply may not be enough to convince voters to verify their vote. Indeed, as Schneider et al. found in their study concerning Pret-a-Voter, simply confirming that a voter's encrypted vote on a bulletin board corresponds to a receipt does not provide sufficient security guarantees for voters [13]. From this interview process, it is clear that a novel approach to vote verification is needed.

CONCLUSION

These interviews have provided some initial information concerning overseas voters feelings about remote online voting, their expectations of any E2E voting system that could potentially be deployed, and given insight into several design issues that need to be taken into consideration in future E2E system developments.

Broadly speaking, participants are very positive concerning implementing 'online voting', but expressed concerns regarding the need for strict voter

authentication protocols. In the U.S. context, the requirements for voter authentication will be largely determined by the individual states. However, this does not preclude developers from considering a variety of ways in which remote voters could authenticate themselves safely and securely, for example one-time passwords or the use of digital certificates.

The importance of accessible language and terminology cannot be understated. Words like 'receipt' have pre-existing meanings to users that may not apply to the properties of E2E voting systems. Using incorrect terminology raises expectations of users by inadvertently connecting to a more familiar experience. For example, participants reported that receipts usually contain full and complete information, not a series of numbers and letters. Ensuring the use of accurate and simple terminology will be essential in future development.

Most participants were able to work through the flow of the voting systems presented to them, but were less clear concerning the vote verification process. As other usability studies have found, relying on a voter's understanding of a voting system as motivation for carrying out ballot audit and receipt checking is not sufficient [14]. Further, as these interviews revealed, participants were unlikely to verify their vote for a variety of reasons not related to understanding of the voting system. Given this, the approach to vote verification needs to be considered carefully form the perspective of the end user. This means approaching vote verification in a new and novel way if the development of E2E systems is to move forward.

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ATTACHMENTS

Attachment 1: Jargon v. Gentle

About the prototype

This voting system prototype has a special feature called PRACTICE BALLOTS. With practice ballots, you can:

- See the list of races and candidates and how they appear on the ballot, letting you pause to do some research on who you want to vote for.
- Try out the candidate selection process to make sure you can do it without making mistakes.
- Reveal your ballot to make sure it was created properly and was not tampered with by some part of a potentially hacked voting system.

You can do as many practice ballots as you want. In fact, we encourage you to do several practice ballots. Eventually, we want you to cast your final ballot for this study. You do not need to tell us ahead of time when you are practicing and when you are doing your "real" ballot.

About the prototype

This voting system has a special feature called VERIFIABLE VOTING. With verifiable voting, you can:

- "Spoil" your ballot to challenge the voting terminal to prove that it is behaving correctly.
- Verify with a voting receipt that your ballot is included in the electronic ballot box.
- Check that the election tally was computed from all the ballots in the electronic ballot box.

You do not have to verify your ballot if you do not want to.

Attachment 2: Spartan v. Solid Select (with pictures)

Oregon Governor

Select a candidate and press "next step".

- Aaron Auer (Con)
  Minister of the Gospel
- Tovia E Fornah (Non)
  Service
- Paul Grad (L)
  Investor
- Chris Henry (P)
- John Kitzhaber (Dem)

Oregon Governor
Select a candidate and pre

Aaron Auer C
Minister of the Gospel

Tovia E Forna

Attachment 3: Research Participation Invitation

Invitation to Participate in Overseas Voter Research

Dear Friend of Overseas Vote Foundation,

In your response to the recent 2014 Post-Election Survey, you indicated that you would be interested in participating in further research to improve the voting process for overseas voters like you.

We would like to invite you to participate in our Future of Voting Project concerning the use of online voting.

As a participant in this project, you will test an online voting system and, simultaneously, via Skype, participate in a one-to-one interview concerning your thoughts about this system and Internet Voting in general.

The testing will take place during the week of May 4 - 8, 2015. We anticipate the testing and interview to require just one hour or less of your time. To participate, you will need a Skype account and access to the Internet.

You and all of your responses in this study will remain anonymous. You, as a participant, will not be named in this study.

As a thank you for your participation in this project, you will be given a prepaid €75 Mastercard or the equivalent.

To participate in this study, please reply by April 24th or earlier to this email and provide:

1. Your name
2. Your time zone
3. Your telephone number/s
4. Your Skype name
5. At least 3 open time blocks when you could be interviewed during the week of May 4 - 8, 2015

You will then receive a reply from us as to whether you have been accepted into the study and exactly what date and time the call will take place.

If you have any questions concerning this project and your potential involvement, please contact Dr. Judith Murray at research@overseasvotefoundation.org or call +1 (202) 470-2480.

We appreciate your consideration and look forward to working with you on this important study.

With warm regards,

Dr. Judith Murray
Research Consultant
Overseas Vote Foundation

Attachment 4: Star-Vote

1.

Welcome to the study

Thank you for agreeing to participate in a study of a prototype voting system. This is an early prototype, so some parts are still rough. But your participation will help us make it better.

The study will include having you try voting using our prototype. Then we will ask you some questions afterwards. The study will take about fifteen minutes in total.

Before we begin, make sure you that have the "voter access code" that was included in the email.

You are free to stop your participation at any time.

| ❮ No thanks, I do not want to participate | I am ready to begin the study ❯ |

2.

About the prototype

This voting system prototype has a special feature called PRACTICE BALLOTS. With practice ballots, you can:

- See the list of races and candidates and how they appear on the ballot, letting you pause to do some research on who you want to vote for.
- Try out the candidate selection process to make sure you can do it without making mistakes.
- Reveal your ballot to make sure it was created properly and was not tampered with by some part of a potentially hacked voting system.

You can do as many practice ballots as you want. In fact, we encourage you to do several practice ballots. Eventually, we want you to cast your final ballot for this study. You do not need to tell us ahead of time when you are practicing and when you are doing your "real" ballot.

| ❮ Stop | Proceed ❯ |

3.

Sign in

Enter in the voter access code that was given to you in email.

[   ] Sign in

❮ Stop

4.

Filling out your ballot

For this study, we have a mock election with three races and several candidates for each race.

Remember, you can do as many practice ballots as you wish.

❮ Stop   Proceed ❯

5.

Oregon Governor

Select a candidate and press "next step".

○ Aaron Auer (Con)
　Minister of the Gospel
○ Tovia E Fornah (Non)
　Service
○ Paul Grad (L)
　Investor
○ Chris Henry (P)

○ John Kitzhaber (Dem)
　Governor of Oregon
○ Jason Levin (Grn)
　Cannabis Industry Professional
○ Dennis Richardson (Rep)
　Businessman; State Representative

next step ❯

6.

US Senator

Select a candidate and press "next step".

○ James E. Leuenberger (Con)

○ Christina Jean Lugo (Grn)
　Artist, Peace Activist
○ Jeff Merkley (Dem)
　United States Senator
○ Mike Montchalin (L)
　Candidate/Retired
○ Monica Wehby (Rep)
　Pediatric Neurosurgeon

❮ previous step　　　　　　　　　　next step ❯

7.

US Representative, 3rd District

Select a candidate and press "next step".

○ Earl Blumenauer (Dem)
　U.S. Congressman
○ James Buchal (Rep)
　Attorney
○ Jeffrey J Langan (L)

○ Michael Meo (Grn)
　retired schoolteacher
○ David Walker (Non)
　Family Nurse Practitioner

◄ previous step   next step ►

8.

Review your selections

Click any race title to change your selection for that race.

Oregon Governor
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　—

US Senator
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　—

US Representative, 3rd District
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　—

◄ previous step   done with this ballot

9.

Ballot complete

Congratulations, you have completed this ballot.

Next, you can either cast this ballot, or treat it like a practice ballot. Practice ballots let you check that the election system is working properly.

Cast

Practice

❮ Stop

10.

Ballot cast. You voted!

Thank you for casting your ballot.

We hope you will take a few minutes to discuss your experience with our moderator.

Attachment 5: Helios

1.

2. (questions)

3. (ballots & voters)

OVF Test Election #1 — Voters and Ballot Tracking Center [back to election]

Who can vote?

- any google user
- any facebook user
- any yahoo user

5 cast votes

Voters 1 - 5 (of 5)

Alias	Smart Ballot Tracker
V1	LID+1F5KKyOfZHFH2HDfnLyZrnSeT5cMQz/senLGtSE [view]
V2	uShB+X2tn+1rpnGJxIpCE2tLTmpPnD+MNtj+8Vj00ck [view]
V3	04rAzI2kf613o0JqzDTFT1VdjLoWaIgarILcEI0HTss [view]
V4	VeuA0OahzbyiHVrRSPUYfUrcN7x98NCrfbWs7Ht+54c [view]
V5	+YR7Fv8ZaNpzR43B2R7RIHd5YvXtEuIDOiqob3mebG8 [view]

not logged in. log in

4. (trustees)

OVF Test Election #1 — Trustees [back to election]

Trustees are responsible for decrypting the election result.
Each trustee generates a keypair and submits the public portion to Helios.
When it's time to decrypt, each trustee needs to provide his secret key.

Trustee #1: Helios Voting Administrator

Public Key Fingerprint: j3UyAHHmi0jT+ZZrm8lXnIsGMq0A9inRdgqBhgRB4i8

not logged in. log in

5. (audit info)

OVF Test Election #1

Share   Tweet

public election created by ▪️ **Keith Instone**

For this study, we have a mock election with three races and several candidates for each race.

questions (3) | voters & ballots | trustees (1)

Vote in this election

This election ends at the administrator's discretion.

This election is open to:
- any google user
- any facebook user
- any yahoo user

Log in to check your eligibility.

Audit Info

Election URL:
https://vote.heliosvoting.org/helios/e/ovftest1

Election Fingerprint:
J5lnyX80Lyh4dl0ykkNAqzgpk/D4uwb74d5t4rQoGXw

Ballot Tracking Center | Audited Ballots

not logged in. log in

6. (start)

Helios Voting Booth   [exit]

OVF Test Election #1

To cast a vote, you will be led through the following steps.
If you have not yet logged in, you will be asked to do so at the very end of the process.

1. **Select** your preferred options.
   You can easily navigate forwards and backwards.

2. **Review & Confirm** your choices.
   Your choices are encrypted safely inside your browser, and you get a smart ballot tracker.

3. **Submit** your encrypted ballot.
   You will be asked to log in to submit your encrypted ballot for tallying.

Start

Election Fingerprint: J5lnyX80Lyh4dl0ykkNAqzgpk/D4uwb74d5t4rQoGXw   help!

7. (race #1)

OVF Test Election #1

| (1) Select | (2) Review | (3) Submit |

Oregon Governor

#1 of 3 — vote for 1

- ☐ Aaron Auer (Con), Minister of the Gospel
- ☐ Tovia E Fornah (Non), Service
- ☐ Paul Grad (L), Investor
- ☐ Chris Henry (P)
- ☐ John Kitzhaber (Dem), Governor of Oregon
- ☐ Jason Levin (Grn), Cannabis Industry Professional
- ☐ Dennis Richardson (Rep), Businessman; State Representative

Next

Election Fingerprint: **J51nyX80Lyh4dl0ykkNAqzgpk/D4uwb74d5t4rQoGXw** help!

8. (race #2)

OVF Test Election #1

| (1) Select | (2) Review | (3) Submit |

US Senator

#2 of 3 — vote for 1

- ☐ James E. Leuenberger (Con)
- ☐ Christina Jean Lugo (Grn), Artist, Peace Activist
- ☐ Jeff Merkley (Dem), United States Senator
- ☐ Mike Montchalin (L), Candidate/Retired
- ☐ Monica Wehby (Rep), Pediatric Neurosurgeon

Previous   Next

Election Fingerprint: **J51nyX80Lyh4dl0ykkNAqzgpk/D4uwb74d5t4rQoGXw** help!

9. (race 3)

Helios Voting Booth   [exit]

OVF Test Election #1

(1) Select   (2) Review   (3) Submit

US Representative, 3rd District
#3 of 3 — vote for 1

☐ Earl Blumenauer (Dem), U.S. Congressman
☐ James Buchal (Rep), Attorney
☐ Jeffrey J Langan (L)
☐ Michael Meo (Grn), retired schoolteacher
☐ David Walker (Non), Family Nurse Practitioner

Previous   Proceed

Election Fingerprint: **J5lnyX80Lyh4dl0ykkNAqzgpk/D4uwb74d5t4rQoGXw**   help!

10. (encryption)

Helios Voting Booth   [exit]

OVF Test Election #1

(1) Select   **(2) Review**   (3) Submit

Helios is now encrypting your ballot
▮▮▮▮▮▮▮▮▮▯▯▯ (0%)

This may take up to two minutes.

Election Fingerprint: **J5lnyX80Lyh4dl0ykkNAqzgpk/D4uwb74d5t4rQoGXw**   help!

11. (review ballot)

12. (review ballot/ audit)

13. (audit ballot)

Helios Voting Booth [exit]

OVF Test Election #1

| (1) Select | **(2) Review** | (3) Submit |

Your audited ballot

IMPORTANT: this ballot, now that it has been audited, *will not be tallied*.
To cast a ballot, you must click the "Back to Voting" button below, re-encrypt it, and choose "cast" instead of "audit."

Why? Helios prevents you from auditing and casting the same ballot to provide you with some protection against coercion.

Now what? Select your ballot audit info, copy it to your clipboard, then use the ballot verifier to verify it.
Once you're satisfied, click the "back to voting" button to re-encrypt and cast your ballot.

{"answers": [{"choices": [{"alpha":
"4199480631695140653921832557419306168963675786506286171310357551093191862600
11982924741475385501638332666927454942266979162406081578145124551538872121372
2760515351095404658122693226164957023973100569728739920764778991696885442979
5875444900515266747306675179723291679748911855854407586952096481017528050664
1842613902856036409018784367849925856406237951509753620689924674822471488791
3664517009431111635804458212656615928606650725239823864159202180745858627852
5702445715000382335514959385215573334481281451480197965377182262123762162109
3329786408307414651665245077440964626587496312475301123903155468459722213197
144433", "beta":

Before going back to voting,
you can post this audited ballot to the Helios tracking center so that others might double-check the verification of this ballot.

Even if you post your audited ballot, you must go back to voting and choose "cast" if you want your vote to count.

[back to voting] [post audited ballot to tracking center]

Election Fingerprint: **J5lnyX8OLyh4dlOykkNAqzgpk/D4uwb74d5t4rQoGXw** help!

14. (final page)

Helios Voting | About | Code | Docs | FAQ | Privacy | Help!

Submitting your vote for **OVF Test Election #1**...

Wait! You need to log in.

Y! yahoo

f facebook

G google

Don't worry, we'll remember your ballot while you log in.
Your smart ballot tracker is:

kx9QAJ5v31qrJsHbMrylBdAsIy/sgM6hkZtbMJ3zeRO

not logged in. [log in]