



**Redo Voting System White Paper: A Permanent End to
Election Irregularities and the Resulting Social Disruption**

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Executive Summary

INTRODUCTION

Election integrity remains an incendiary topic in America. Since the general election of 2000, every national election cycle has had races called into question or contested based on accusations of election irregularities, tampering, or outright fraud. As of the 2022 midterm elections, there are no electronic voting systems in use in the United States that can convincingly demonstrate or support their security, transparency, or reliability. Effectively addressing the credibility gap of this technology could significantly reduce the social disruption currently plaguing our electoral process.

PROBLEM STATEMENT

There are no election systems currently in use in the United States that are universally accessible, fully secure, 100% transparent, comprehensibly auditable both forensically and in real-time, possessing intrinsic, mathematically provable, indisputable accuracy.

SOLUTION

The solution is implementation of an election system that is universally accessible, fully secure, 100% transparent, comprehensibly auditable both forensically and in real-time, possessing intrinsic, mathematically provable, indisputable accuracy. There are secure, trustworthy technologies currently in use that can be combined and purposed to address the entire spectrum of election integrity concerns in America and remove even the potential for election irregularities.

Absolute integrity, as well as the incorruptible perception of integrity, must be the standard. The key is impregnable protection of access, security, and confidence for every voter and for the system itself.

- Access ensures that every registered voter has the uncomplicated ability to legally exercise their right to vote in local, state, and federal elections without unreasonable difficulty.
- Security combines protection and privacy, ensuring that voters are physically safe, protected from intimidation, harassment, or harm, and that their legitimate individual votes are delivered and tabulated as cast in a timely, accurate, and legally defined manner. Privacy of choice is protected for every voter without compromising the integrity of election outcomes.
- Confidence combines auditability, transparency, and reliability. Auditability ensures that there is a clearly observable, unobstructed path from the point where a vote is cast to where it is tabulated, resulting in a verified artifact from each voting transaction. Transparency ensures that the process for casting and tabulating votes is well understood and that the rules are clearly and observably followed. Reliability means that final vote tabulation is completely trustworthy, accurate, and repeatable. Any recount should generate the same result as the original tabulation, every single time regardless of who conducts the recount or when.

REDO VOTING

The good news is that the Redo Voting system addresses every major issue that plagues voting today and provides a path to the vision described above.

COST

In 2017, Massachusetts Institute of Technology and CalTech cooperated on a study through the MIT Election Data + Science Lab (MITEDSL) estimating the cost of elections over 26 states to average \$8.10 per voter, per election. In May of 2022, however, the National Institute for Civil Discourse (NICD) published an updated report on the cost of conducting elections, also in cooperation with the MITEDSL. Page 3 of “The Cost of Conducting Elections” quoted an Election Infrastructure Initiative study predicting annualized election expenses nationwide over the next 10 years to reach \$5.3 billion per year and includes a breakdown of election costs by all 50 states.

According to the U.S. Elections Project at University of Florida’s Department of Political Science, there were 239,470,150 people eligible to vote in the 2022 elections. Assuming an election year, \$5.3 billion divided by 239,470,150 voters is just over \$22 per voter. When you consider that the estimated voter turnout for this election was reported as 111,549,699, the number jumps to almost \$47.50 per voter, per election.

Redo Voting’s \$5.00 per ballot cost, paired with a dramatic reduction in required support services and no more machine repair and replacement costs, represents a massive budget win at every level of every jurisdiction. When taking into consideration the elimination of drawn-out ballot counts or recounts, accusations of irregularities, and the litigation and violence that accompanies them, the cost savings become exponential.

NEXT STEPS

The Redo Voting system is a fully developed product, ready for deployment as a full-service election system. Redo Voting is conducting a series of pilots at the state, county, and municipal level, the results of which will be incrementally added as updates to this paper as they are completed.

Additionally, Redo Voting will deploy an online beta for any end users interested in trying the system. The URL will appear here as an update when the site is established.

CONCLUSION

There are currently no acceptable large-scale, electronic voting systems in use in the United States. Failure to address growing skepticism about the current state of our election systems and the potential for irregularities is likely to further undermine the legitimacy of our government and create discord.

Elections with no more accusations of fraud are within reach. Elections with no accusations of voter suppression and no more drawn-out ballot counts or recounts... just the will of the people completely, accurately, and immediately reflected when the polls close. No more riots or protesting over election results, no more property damage, no more carnage. Only transparent popular sovereignty and completely peaceful transition of power.

Redo Voting. For Elections that Unite.

REDO VOTING SYSTEM WHITE PAPER: A Permanent End to Election Irregularities and the Resulting Social Disruption

INTRODUCTION

Election integrity remains an incendiary topic in America. Since the general election of 2000, every national election cycle has had races called into question or contested based on accusations of election irregularities, tampering, or outright fraud. As of the 2022 midterm elections, there are no electronic voting systems in use in the United States that can convincingly demonstrate or support their security, transparency, or reliability. Effectively addressing the credibility gap of this technology could significantly reduce the social disruption currently plaguing our electoral process.

Our society is rapidly becoming both more electronically connected and physically isolated. With the rise of social networks and necessary societal prudence in the face of potential future pandemic events, it makes sense that the next major evolution in elections will be a dramatic shift to online voting. With a voting-eligible population of close to 240 million, the possibility of timely, accurate election outcomes using non-electronic means is not possible.¹ Statistics show that internet user penetration in the United States will reach over 93% by the 2024 election, so a system that operates on that infrastructure while optimizing access, preserving security, and generating confidence is critical.²

PROBLEM STATEMENT

As of this paper's publication, there are no election systems currently in use in the United States that are universally accessible, fully secure, 100% transparent, comprehensibly auditable both forensically and in real-time, possessing intrinsic, mathematically provable, indisputable accuracy.

The state of U.S. election processes has consistently generated concern, and the loudest accusations of lapses in integrity most often seem to come from whichever faction is losing the most elections. Because traditional balloting methods are largely opaque, abandoning the arena of ideas in favor of partisan fraud accusations is a low-risk, high-reward strategy. A disappointing result of these tactics is that inflamed factions are often inspired to violence, and in the eyes of the world America is no different than any other agitated realm calling itself a republic. This cycle perpetuates undeterred because counter to the American tradition of jurisprudence and Hitchen's razor, the burden of proof for such claims falls not on the accuser, but the accused.³ In other words, the accusers do not have to prove there were lapses in election integrity; the accused must prove there were not. Hence, the problem that must be comprehensively addressed is not election integrity itself, but the perception of active threats associated with election integrity and their potential to undermine universal faith in election results.

Perceived active threats to election integrity come in many forms, but currently the most popular among these is the potential for bad actors to manually inject fraudulent ballots into the process, or to remove or block legitimate ballots.⁴ There are also concerns about intimidation and undue influence at polling

¹ <https://worldpopulationreview.com/state-rankings/voter-turnout-by-state>

² <https://www.statista.com/statistics/590800/internet-usage-reach-usa/>

³ Epistemological razor that states "what can be asserted without evidence can also be dismissed without evidence."

⁴ <https://www.brennancenter.org/our-work/analysis-opinion/addressing-insider-threats-elections>

stations, suppression of certain demographics based on difficulty accessing the polls, and in some places the requirement to show identification is a perceived deterrent.⁵

SOLUTION

The solution is implementation of an election system that is universally accessible, fully secure, 100% transparent, comprehensibly auditable both forensically and in real-time, possessing intrinsic, mathematically provable, indisputable accuracy. There are secure, trustworthy technologies currently in use that can be combined and purposed to address the entire spectrum of election integrity concerns in America and remove even the potential for election irregularities.

A carefully conceived and executed shift to online voting could conceivably eliminate all the observable issues discussed in the Problem Statement of this paper, but the potential for more sophisticated bad actors hacking into the process or the results being electronically altered could create an even greater legitimacy crisis than the one America faces right now.⁶ For an online election system to be acceptable, the access, security, and confidence would have to be unassailable and mathematically provable. Ballots would have to be universally accessible. There would have to be a way to ensure that each legitimately registered voter could submit only one ballot, and that no one who was not a legitimately registered voter could submit a ballot at all. Transparency must be absolute; no secret or inaccessible code and no part of the process the voter cannot personally see and verify. Results must be consistent and recounts must show exactly the same totals as the original tabulations every time, no matter who conducts the recount.

Absolute integrity, as well as the incorruptible perception of integrity, must be the standard. The key is impregnable protection of access, security, and confidence for every voter and for the system itself.

- Access ensures that every registered voter has the uncomplicated ability to legally exercise their right to vote in local, state, and federal elections without unreasonable difficulty.
- Security combines protection and privacy, ensuring that voters are physically safe, protected from intimidation, harassment, or harm, and that their legitimate individual votes are delivered and tabulated as cast in a timely, accurate, and legally defined manner. Privacy of choice is protected for every voter without compromising the integrity of election outcomes.
- Confidence combines auditability, transparency, and reliability. Auditability ensures that there is a clearly observable, unobstructed path from the point where a vote is cast to where it is tabulated, resulting in a verified artifact from each voting transaction. Transparency ensures that the process for casting and tabulating votes is well understood and that the rules are clearly and observably followed. Reliability means that final vote tabulation is completely trustworthy, accurate, and repeatable. Any recount should generate the same result as the original tabulation, every single time regardless of who conducts the recount or when.

This clear and all-encompassing end state is supported with existing technology. The most current access control technology is arguably imperfect, but effective enough that we entrust our most precious national secrets to carefully constructed and monitored access protocols. The most current encryption technology is also arguably imperfect, but effective enough that we regularly entrust it with our banking

⁵ <https://www.brennancenter.org/our-work/research-reports/voter-intimidation-and-election-worker-intimidation-resource-guide>

⁶ <https://www.pbs.org/newshour/science/heres-how-hackers-could-mess-with-electronic-voting>

transactions and the electronic filing of our individual income taxes. We can now combine universal and completely secure individual access with irreversible anonymity, complete transactional security, and the speed and accuracy of a calculator to our elections. Any system that does not clearly, directly, and provably address every facet described in this paper should be dismissed out of hand or discontinued if in use.

Imagine a world where campaign ads stop when the polls close; a world where election results are reliable, concessions or recounts unnecessary, and where the day after election day is not the first day of a series of protracted court battles, but of new beginnings and new opportunities for our elected officials to focus on the interests of their constituents over their own. The American people deserve a peaceful and uncontested transfer of power where both sides seek to serve them instead of looking for ways to undermine each other.

REDO VOTING

The good news is that the Redo Voting system addresses every major issue that plagues voting today and provides a path to the vision described above.

Accessibility: Accessibility means that every registered voter has the uncomplicated ability to legally exercise their right to vote in local, state, and federal elections without unreasonable difficulty, but this presents a dilemma. How can something be universally accessible to those allowed access, while at the same time utterly and completely impenetrable to those who are not? Redo Voting applies a secure document approach mirroring the one used to keep scratch-off lottery tickets secure and trusted for the past 30 years.

OFFICIAL BALLOT FOR YOUR GREAT STATE

★ STEP 1 ★

Voter Registration.

Scratch off to register or update your voter registration for this election.

Scratch the square above to expose the QR code.

Scan this QR code with your mobile device or camera-equipped computer, then click on the link that appears.

Follow the directions on the state's .gov Voter Registration Page to enter your voter identification information.

★ STEP 2 ★

Election Day Ballot.

Do not scratch off until polls are open and you are ready to vote.

Scratch the square above to expose the QR code.

Scan this QR code with your mobile device or camera-equipped computer, then click on the link that appears.

Choose your candidates and proposition choices on your secure, individualized ballot slate and securely submit your encrypted ballot.

★ REVIEW ★

Privately confirm your vote.

Scan this QR code with your mobile device or camera-equipped computer, then click on the link that appears.

This link gives you secure, unique access to your vote in perpetuity, which can be downloaded as a PDF. This QR code is the only access to your vote. If you lose or destroy this QR code, no one can ever see your vote in the repository again.

★ STEP 3 ★

In-person validation.

ONLY A POLL WORKER MAY SCRATCH OFF THIS SQUARE.

If required, take this ballot to any active polling station in your state.

The poll worker will scratch off the square above to reveal a QR code.

The poll worker scans the QR code, confirming that your vote was legally cast and accepted into the repository.

SECRETARY OF STATE

STORE ONLY - DO NOT SCRATCH

REDO VOTING

Figure 1

Figure 1 shows an example of the Redo Voting ballot. These ballots are printed in one of three secure printing facilities in the United States authorized to print lottery scratch-off tickets, passports, visas, and other secure government documents. Note the gray rectangular square at the bottom left of the ballot and the four gray squares across top of the ballot. The gray on the rectangle in the lower left corner of the ballot represents 17 layers of latex covering a standard bar code. For the four squares across the top of the ballot, the gray represents 17 layers of latex applied over four computer generated QR codes, each of which is linked to the other three QR codes on the ballot by secure hash. No human eye will have ever seen either this bar code or these QR codes before the latex is scratched off.

Because the ballots are printed by the same secure facilities as lottery tickets, the same serial accountability control and distribution channels applied to scratch-off lottery tickets can be applied to the ballots. This results in universal access for voters because anyone who can get to a polling place can get to a gas station, and anyone who can get to a gas station can easily acquire a ballot. Just as scratch-off lottery tickets must be scanned into the lottery system upon purchase to have any value, so must the ballot be scanned and linked to the voter's registration to access the election system itself. This creates the unique circumstance of every registered voter having the uncomplicated ability to legally exercise their right to vote in local, state, and federal elections without unreasonable difficulty, while at the same time restricting election system access to only legally registered and eligible voters.

Security: Security is a combination of protection and privacy, ensuring that voters are physically safe, protected from intimidation, harassment, or harm, and that their legitimate individual votes are delivered and tabulated as cast in a timely, accurate, and legally defined manner. Privacy of choice is protected for every voter without compromising the integrity of election outcomes.

Although Redo Voting can conduct elections completely in person, online, or any combination of the two, it is primarily designed to be an online system protected by user-controlled protocols. The Redo Voting system works with existing voter identification requirements in every state, but driver's licenses and/or state issued IDs are the most cost and manpower effective method for linking the ballot with the voter's registration because all that is required is to scan the bar code on the back of the ID.

In an anonymous online environment where the voter has exclusive control over their interaction with the system, physical safety and freedom from intimidation, harassment, or harm are inherent. All the voter needs is private access to a camera-enabled, internet-capable device, which can take the form of any smart phone (does not even have to be their own), a home desktop or laptop computer, a tablet, a public use computer at the library, or even their cubicle computer at work. Once the ballot is registered to a particular voter, that voter and only that voter can use it for access. If the voter loses the ballot, no problem. Go back to the distribution point and ask for a new ballot. At the moment the new ballot is digitally paired to the voter's registration, the old one is automatically deactivated and will no longer work. Once the active ballot is used, the voter's registration cannot be used to vote again until the next election for which they are eligible to vote.

After the voter secures their ballot, at any point between registering the ballot and actually voting, the voter will access a camera-enabled, internet-capable device as described above. The voter scratches off the first latex square in the top left corner of the ballot in accordance with the instructions printed below the square. This reveals a QR code which, when scanned, takes the voter directly to their personal voter registration data on the state's dot gov website. It can do this because the scan of the rectangular bar code links this particular ballot to this particular voter, and the QR codes, while unique, are cryptographically linked within the ballot. The voter confirms their voter information or corrects it in the browser and submits. That information is then encrypted via one-way secure hash and completely wiped

from the browser. A one-way secure hash, unlike standard transactional cryptography, does not use passwords. This makes the hash irreversible so that the voter's registration and identity are completely and permanently anonymous. There is no decryption key for this step. All that can ever be determined from the hash is that it represents one unique, properly registered and eligible voter in the current election.

Beginning on election day, or at any point between when the state polls open and when they close, the voter will access a camera-enabled, internet-capable device as previously described and scratch off the second latex square. This reveals a second QR code which, when scanned, takes the voter directly to their personalized ballot slate based on the approved address in their hashed registration. It can do this because, as mentioned before, the unique QR codes within each ballot are cryptographically linked. While the hashes cannot be decrypted, they can recognize and interact with each other.

The voter makes their selections for each race and submits. As with the registration previously, all browser information is deleted and the ballot slate itself encrypted via one-way secure hash. This hash is transmitted immediately and directly to the designated digital repository for the election, housed on the state's dot gov server. The act of voting has now been accomplished safely, securely, and in private, with chain-of-custody fully visible to the voter at all times.

Confidence: Confidence combines auditability, transparency, and reliability. Auditability ensures that there is a clearly observable, unobstructed path from the point where a vote is cast to where it is tabulated, resulting in a verified artifact from each voting transaction. Transparency ensures that the process for casting and tabulating votes is well understood and that the rules are clearly and observably followed. Reliability means that final vote tabulation is completely trustworthy, accurate, and repeatable. Any recount should generate the same result as the original tabulation, every single time regardless of who conducts the recount, when, or where.

- **Auditability.** Because the Redo Voting system operates online, there is a digital record of every administrative and voter transaction that takes place within the system. Privacy and voter anonymity are preserved because each voting transaction begins with a verified, but irreversible hashed voter registration accessing the voter's ballot slate. When the encrypted ballot slate is submitted, it creates a digital record of that transaction within the system that can be both monitored in real-time and tracked forensically. In other words, for each individual vote there is a digital signature proving that the vote went directly into the state's digital repository as submitted and remained there to be counted. If there is any attempt to hamper or tamper, that is digitally captured as well.
- **Transparency.** All code used for the Redo Voting system is open source or publicly available. There is no secret or masked proprietary coding. The state's digital repository can be viewed by anyone to whom the state wishes to give access - media, law enforcement agencies, party officials, and even the entire voting public. Because all the transactions are encrypted, the important thing to observe in the repository is that the vote count only goes up and that files are unmolested. Legitimate votes come in, but they do not go out. When the polls close, the Secretary of State's office runs certification tests to confirm system integrity and the absence of anomalies and publishes the decryption key. Remember, this key ONLY decrypts the ballots themselves and sorts the choices into their respective elections. Individual voter identification is completely and permanently disassociated from the ballots, even when they are decrypted. In addition to the Secretary of State's official count, anyone with repository access who wishes to do so can download the decrypted files

and run their own tabulations. The tabulations, regardless of who runs them, will be identical and mathematically provable for every race.

- **Reliability.** The combination of unique, paper-based access protocols, state-of-the-art, one-way encryption, absolute transparency, and precisely repeatable, mathematically provable results makes Redo Voting the most reliable large scale election system ever conceived. There is, however, one more important feature addressing voter confidence in the system's reliability. The third latex square on the ballot is marked "REVIEW". Once the election results are announced, if they so desire, the voter can access a camera-enabled, internet-capable device as previously described and scratch off the third latex square. This reveals a third QR code which, when scanned, takes the voter directly to a downloadable, printable PDF of their personal ballot. Remember that the one-way secure hash applied to the voter's registration in the first step of the process permanently and irreversibly disassociates their identity from their ballot, but the linkage of the secure hashes within the ballot allows the voter unique, individual access to their own ballot. There are no personally identifying marks on the ballot itself or the file, but the QR code – only ever seen by the voter – provides permanent online access for as long as the voter keeps the QR code. This document provides undeniable confirmation for the voter that their vote was received and tabulated as cast. Although the mathematical provability of this system renders recounts superfluous, recounts can still be part of the election process. All the PDFs reside on the state's .gov server and are under state control, so they can all be printed out to a centralized cluster of printers guarded by the state police and recounted to confirm that the system precisely and correctly reflected the election results on the first count.

Cost:

In 2017, Massachusetts Institute of Technology and CalTech cooperated on a study through the MIT Election Data + Science Lab (MITEDSL) estimating the cost of elections over 26 states to average \$8.10 per voter, per election.⁷ In May of 2022, however, the National Institute for Civil Discourse (NICD) published an updated report on the cost of conducting elections, also in cooperation with the MITEDSL.^{8,9} Page 3 of "The Cost of Conducting Elections" quoted an Election Infrastructure Initiative study predicting annualized election expenses nationwide over the next 10 years to reach \$5.3 billion per year and includes a breakdown of election costs by all 50 states.^{10,11}

⁷ https://electionlab.mit.edu/sites/default/files/2019-01/mohr_et_al_2017summary.pdf

⁸ Costs include election administration and operations, antiquated voting machine replacement, statewide voter registration systems modernization, confirming the accuracy of results, and cybersecurity improvements and maintenance.

⁹ <https://electionlab.mit.edu/sites/default/files/2022-05/TheCostofConductingElections-2022.pdf>

¹⁰ Election Infrastructure Initiative, 50 States of Need: How We Can Fully Fund Our State and Local Election Infrastructure, <https://static1.squarespace.com/static/6083502fc0f6531f14d6e929/t/61f836e405feca3722d63b9d/1643656990641/50-States-Of-Need.pdf>

¹¹ Pages 9-10

According to the U.S. Elections Project at University of Florida' Department of Political Science, there were 239,470,150 people eligible to vote in the 2022 elections.¹² Assuming an election year, \$5.3 billion divided by 239,470,150 eligible voters nationwide is just over \$22 per voter. When you consider that the estimated actual voter turnout for this election was reported as 111,549,699, the number jumps to almost \$47.50 per voter, per election.

Redo Voting's \$5.00 per ballot cost, paired with a dramatic reduction in required support services, is further amplified with the removal of machine repair and replacement costs from the equation. This represents a massive budget win at every level of every jurisdiction. When taking into consideration the elimination of drawn-out ballot counts and recounts, along with accusations of irregularities and the litigation and violence that can accompany them, the cost savings become exponential.

NEXT STEPS

The Redo Voting system is a fully developed product, ready for deployment as a full-service election system. Redo Voting is conducting a series of pilots at the state, county, and municipal level, the results of which will be incrementally added as updates to this paper as they are completed.

Additionally, Redo Voting will deploy an online beta for any end users interested in trying the system. The URL will appear here as an update when the site is established.

CONCLUSION

Questions about the integrity of our current election processes continue to generate concern across the country and, as a result, public confidence in election integrity has continued to fall.¹³ Traditional balloting methods are consistently questioned, and the arena of ideas abandoned in favor of partisan accusations of irregularities and fraud. Public officials are vilified, inflamed factions inspired to violence, and in the eyes of the world America is no different than any other agitated realm calling itself a republic.

There are currently no acceptable large-scale, electronic voting systems in use in the United States. Failure to address growing skepticism about the current state of our election systems and the potential for irregularities is likely to further undermine the legitimacy of our government and create discord. The Redo Voting system combines un-fakeable, user-unique access with unbreakable transaction encryption, resulting in universally accessible, completely secure elections featuring a 100% guaranteed chain-of-custody for every vote from registration through election results and mathematically provable accuracy. Any system that does not clearly, directly, transparently, and provably address every concern described in this paper should be dismissed out of hand or discontinued if in use.

Elections with no more accusations of fraud are within reach. Elections with no accusations of voter suppression and no more drawn-out ballot counts or recounts... just the will of the people completely, accurately, and immediately reflected when the polls close. No more riots or protesting over election results, no more property damage, no more carnage... only transparent popular sovereignty and completely peaceful transition of power.

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¹² <https://www.electproject.org/2022g>

¹³ <https://abcnews.go.com/Politics/americans-faith-election-integrity-drops-poll/story?id=82069876>