The Paperless Chase: Electronic Voting and Democratic Values

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TABLE OF CONTENTS

INTRODUCTION........................................................................................................... 1712
I. THE STATE OF ELECTION SYSTEMS................................................................. 1717
   A. Paper or Plastic?: Types of Voting Equipment........................................ 1717
      1. Hand-Counted Paper Ballots............................................................... 1718
      2. Mechanical Lever Machines............................................................... 1719
      3. Punch-Card Ballots.............................................................................. 1719
      4. Optical-Scan Ballots.......................................................................... 1721
      5. Direct Record Electronic Machines.................................................. 1722
   B. Tracing the Chase: 2000-2004.................................................................. 1724
      1. Florida 2000...................................................................................... 1724
      2. Post-2000 Studies of Voting Technology.......................................... 1726
      3. Voting Equipment in the Courts....................................................... 1729
      4. State Legislative Responses............................................................. 1730
      5. The Help America Vote Act ("HAVA")............................................ 1732
      6. Controversy over Electronic Voting................................................ 1734
      7. Voting Technology in 2004............................................................... 1737
II. TECHNOLOGY AND EQUALITY.......................................................................... 1741
   A. Four Equality Norms.............................................................................. 1741
      1. Racial Equality.................................................................................... 1742
      2. Disability Access................................................................................ 1744
      3. Multi-Language Access...................................................................... 1747
      4. Inter-Jurisdictional Equality............................................................... 1748
   B. Empirical Research on Electronic Voting................................................ 1754
      1. Technology and Residual Votes........................................................ 1755
      2. Race and Voting Technology............................................................. 1760
         a. The Usage of Voting Technology.................................................... 1761
         b. The Impact of Voting Technology................................................... 1763
      3. Implications of the Empirical Research............................................. 1767
   C. Technology and Accessibility.................................................................. 1768
   D. Tallying the Results.................................................................................. 1772
III. SECURITY, TRANSPARENCY, AND ELECTRONIC VOTING..................... 1773
   A. The Risks of Electronic Voting.............................................................. 1774

1711
More than four years after the 2000 presidential election debacle, a fierce debate still rages over the machinery used for voting. The Help America Vote Act of 2002 ("HAVA") has promised major changes in
the infrastructure of American democracy, including funding for the replacement of outdated voting equipment. Spurred by both legislation and litigation, states from Florida to California have taken steps to replace the infamous “hanging chad” punch card with more modern—and supposedly more reliable—voting technology.2

Contrary to expectations, these changes have not ended the debate over the machinery used to cast and count votes, but have only intensified it. In 2004, some nineteen million registered voters—including approximately 70% in the swing state of Ohio—lived in jurisdictions that use the punch-card ballot made infamous in Florida’s 2000 election.3 Voters affected by the continuing deployment of this antiquated equipment have brought lawsuits to challenge its use,4 including an unsuccessful attempt to postpone the California recall.5 In addition, citizens with disabilities have brought lawsuits challenging paper-based equipment on the ground that it fails to allow secret and independent voting.6

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At the same time, the replacement of punch cards with touchscreens and other forms of electronic voting technology has generated enormous anxiety. Arguing that the present generation of electronic voting machines is insecure, some advocates have called for legislation mandating a “voter verified paper audit trail.” This legislation would require electronic voting machines to generate a contemporaneous paper record of the electronically cast ballot, something that has until now been attempted by only a few jurisdictions, with decidedly mixed reviews. In addition to pressing such “paper trail” legislation, electronic voting critics have mounted legal challenges to the present generation of paperless electronic voting.

The controversy over electronic voting pits traditional progressive allies against each other. It has resulted in a public and sometimes acrimonious conflict between civil rights organizations supportive of electronic voting (such as the Leadership Conference on Civil Rights and the American Association of People with Disabilities), and Democratic-leaning advocacy organizations suspicious of paperless voting (like Moveon.org and America Coming Together). Whatever the ultimate result of the voting technology wars, one thing is clear: It was not resolved in the 2004 election cycle and is unlikely to be resolved anytime soon.

This Article examines the ongoing transformation of election technology from both a legal and policy perspective. It defines core democratic values that should guide the assessment of different technologies, placing special emphasis on equal political

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8. Although proponents of this requirement generally refer to this security measure as the “voter-verifi ed paper trail” (“VVPT”) or “voter-verified paper audit trail” (“VVPAT”), this Article mainly uses the term “contemporaneous paper record.” This is the term that the Department of Justice has used in its guidance on the subject. See Sheldon Bradshaw, U.S. Dep’t of Justice, Whether Certain Direct Recording Electronic Voting Systems Comply with the Help America Vote Act and the Americans with Disabilities Act (Oct. 10, 2003), available at http://www.usdoj.gov/olc/drevotingsystems.htm.


participation—a value that I have previously argued is embedded in the First Amendment as well as the Fourteenth Amendment.\(^1\) After describing the equality norms germane to the voting technology debate, this Article considers the sometimes competing values of security and transparency.

As I explain, the public discourse over electronic voting has focused mainly upon the potential for fraud, with little attention to voting rights protected by federal law.\(^2\) This debate has also paid relatively little attention to the different roles that the multiple institutional players in the area of administration—including courts, legislatures, administrative agencies, and state and local election officials—should play in the transformation of voting technology.\(^3\) This Article seeks to add a different perspective, by putting the value of equal political participation at the center of its analysis rather than the periphery. Informed by the legal protections for the franchise that exist under federal law, I identify four equality norms that are encompassed within the value of equal political participation: (1) racial equality, (2) multilingual access, (3) disability access, and (4) inter-jurisdictional equality. These four norms, I contend, should guide the assessment of different voting technologies.\(^4\)

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3. In his recent *Harvard Law Review* Foreword, Professor Pildes urges that judicial review of the democratic process be conceived as a “functional problem in institutional design,” which “requires [an] understanding [of] the interlocking relationships of the institutions and structures that organize the democratic system.” Richard H. Pildes, *Foreword: The Constitutionalization of Democratic Politics*, 118 Harv. L. Rev. 29, 41 (2004). When it comes to the technology used for voting, those institutions include Congress, state legislatures, administrative bodies, state election officials, and the many local election officials responsible for administering elections. In keeping with this suggestion, this Article attempts to understand the proper role of the courts in the area of voting technology alongside that of the other institutional players that have responsibilities in this area.
4. This is not meant to be an exclusive list of the equality principles that should govern election law generally, but is instead meant to define the ones most pertinent to the debate over voting technology. For a discussion of core equality principles that should guide judicial decision making, see generally Richard L. Hasen, *The Supreme Court and Election Law: Judging Equality from Baker v. Carr to Bush v. Gore* (2003).
Organizing the debate around these equality norms yields a very different picture of the electronic voting controversy from that which has commonly been painted. Empirical research conducted since 2000 shows that electronic voting can significantly advance racial equality, compared to at least some paper-based systems.\textsuperscript{15} It may also have considerable advantages from the perspective of disability and multilingual access.\textsuperscript{16}

Equality is, of course, not the only democratic value that must be taken into consideration when it comes to the machinery of elections. Security and transparency are also important values implicated by the transformation of voting technology. But there is still great uncertainty over the best means by which to promote these values. While courts have an important role to play in eliminating technologies that harm certain groups of voters, I conclude that they should not require uniform technology statewide. Likewise, legislative bodies should avoid mandating any particular technological fix, such as the contemporaneous paper record or "voter verified paper audit trail."\textsuperscript{17} A likely effect of that sort of mandate is to disadvantage minority, disabled, and non-English speaking voters. It can also be expected to stifle innovation by locking in a particular type of security enhancement, while discouraging other possibilities that may be more effective and easier to implement.

Instead of mandating a particular solution, courts and legislative bodies should recognize that the decentralization of our election systems—whatever its costs—provides an opportunity for innovation. With respect to the implementation of new voting technology, this Article thus recommends that HAVA be given a chance to work. This means affording state and local jurisdictions some room to experiment with different technologies, while giving the newly created Election Assistance Commission ("EAC")\textsuperscript{18} the time and resources needed to develop guidelines that will promote the democratic values of equality, security, and transparency.

Most important, it is imperative that election reform no longer be thought of as a once-in-a-generation occurrence. Instead, we should consider the improvement of voting systems an ongoing process, one


\textsuperscript{18} 42 U.S.C.S. § 15321 (LexisNexis 2004) (establishing the EAC).
in which the judicial, legislative, executive, and administrative components of government all have important responsibilities. This process was not completed in 2004 nor will it likely be completed in 2006 or 2008. It will instead continue for as long as voting technology continues to improve.

This Article proceeds in four parts. Part I examines the infrastructure of American democracy, providing an overview of the types of voting systems currently in use and summarizing developments between 2000 and 2004. Part II describes four core equality norms that should guide assessment of different voting technologies, taking into account the considerable social science literature since the 2000 election. Part III considers the values of security and transparency, which have figured prominently in the debate over electronic voting. Part IV suggests how the multiple institutions with responsibilities in the area of voting technology should reconcile these values, protecting equality while also promoting security and transparency.

I. THE STATE OF ELECTION SYSTEMS

A. Paper or Plastic?: Types of Voting Equipment

While it is common to speak of the United States' election system as a unitary entity, authority over elections actually lies in the hands of thousands of state, county, and municipal officials scattered throughout the country. Nationwide, there are approximately 13,000 local jurisdictions with responsibility for administering elections. The United States thus does not have a single election system, but many election systems. The technology used to cast votes is, moreover, only one component of those systems. But it is an important component, one that can dramatically affect the right to have one's vote counted.

Making sense of the present debate over voting technology requires an understanding of the multiplicity of equipment used in different parts of the country, often varying from county to county within a state and sometimes within counties. Part I.A describes the five basic types of voting equipment presently used in the United States. From the oldest to the most recently developed, they are: (1) hand-counted paper ballots, (2) mechanical lever machines, (3) punch-card ballots, (4) optical scan ballots, and (5) direct-entry systems.

19. See Robert A. Pastor, Improving the U.S. Electoral System: Lessons from Canada and Mexico, 3 Election L.J. 584, 585 (2004) (stating that the U.S. election system is "dysfunctionally decentralized, fragmented into 13,000 sovereign counties and municipalities, each one designing its own ballots, organizing its own electoral register, and counting its votes in its own way").

(4) optical-scan or "Marksense" ballots, and (5) direct record electronic or "DRE" machines. While there is significant variation within these general categories, all the voting equipment currently used in the United States can be placed within one of these five major headings.

As set forth below, the five basic types of equipment vary considerably in their operation and their susceptibility to error. They also differ in their capacity to prevent inadvertent "overvotes" (voting for more than the allowed number of candidates) and "undervotes" (voting for fewer than the allowed number of candidates). Perhaps most important, there are significant differences in the capacity of different technologies to provide feedback to voters, by notifying them of mistakes and providing an opportunity to correct such mistakes. These differences exist not only among these five general categories but within some of them.

1. Hand-Counted Paper Ballots

The least commonly used type of voting equipment is the old-fashioned hand-marked and hand-counted paper ballot. During the first century of American democracy, this was the only type of voting equipment used. Until the late 1800s, voters typically obtained pre-printed ballots with the names of the candidates for which they wished to vote. Vote-buying scandals led to the adoption of the Australian secret ballot, which was developed in 1856. Under this system, the

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21. According to an August 2001 survey, the percentage of voters using these systems in 2000 was:
   - Punch card 34.4%
   - Optical scan 27.5%
   - Lever 17.8%
   - Electronic 10.7%
   - Paper 1.3%
   - Mixed (different equipment used within counties) 8.1%


23. Henry E. Brady et al., Survey Research Ctr. and Inst. of Governmental Studies, Univ. of Cal., Berkeley, Counting All the Votes: The Performance of Voting Technology in the United States 10-11 (2001). Although optical-scan and punch-card systems are also paper-based, I use the term "paper ballot" to refer to systems in which voters mark their choices on pieces of paper that are then counted by hand.


25. Id.

26. Id. at 3.
names of all the candidates are listed on ballots, which voters mark in privacy.\textsuperscript{27}

Voters using this system make marks next to the names of their preferred candidates on pieces of paper, which are then counted by hand.\textsuperscript{28} Although used in 12.5\% of jurisdictions in 2000, only 1.3\% of people voted with hand-counted paper ballots in 2000.\textsuperscript{29} They are used primarily in rural jurisdictions.\textsuperscript{30} Errors can occur due to paper ballots that are not clearly marked, or mistakes made by those who decipher and count them.\textsuperscript{31}

2. Mechanical Lever Machines

Subsequent to the development of the Australian ballot, the first major alteration in voting technology came with the advent of the lever voting machine.\textsuperscript{32} Invented in 1892, this system was designed to address the possibility of tampering with paper ballots, since there is no document to tamper with.\textsuperscript{33} The machines have levers next to each ballot choice.\textsuperscript{34} Though less common than paper-based voting equipment, lever machines were still used by 17.8\% of voters nationwide in 2000.\textsuperscript{35}

To cast a vote, the voter enters the voting booth and turns levers next to his or her choices. After doing so, the voter may visually confirm those choices and then pull a large lever, which counts the votes. Problems with mechanical lever machines can occur if the machines are improperly configured, or if the counters fail to register voters’ choices.\textsuperscript{36} The age of these machines, and the difficulty in obtaining replacement parts, can also lead to problems with this system. Thus, over the past two decades, many jurisdictions have abandoned them.\textsuperscript{37}

3. Punch-Card Ballots

The most common type of voting equipment in 2000 was the punch-card ballot, used by one out of every three voters nationwide.\textsuperscript{38} Introduced in 1964, the punch card was the first technology to use

\textsuperscript{28} Brady et al., supra note 23, at 10; see also Alvarez et al., supra note 21, at 36.
\textsuperscript{29} Alvarez et al., supra note 21, at 39.
\textsuperscript{31} Brady et al., supra note 23, at 10.
\textsuperscript{32} Fischer, supra note 24, at 3.
\textsuperscript{33} Fischer, supra note 27, at 3; Fischer, supra note 24, at 3.
\textsuperscript{34} Brady et al., supra note 23, at 10.
\textsuperscript{35} Nat’l Comm’n on Fed. Election Reform, supra note 21, at 51.
\textsuperscript{36} Brady et al., supra note 23, at 10.
\textsuperscript{37} Caltech/MIT, supra note 30, at 20.
\textsuperscript{38} Id.
computers to count votes. There are two basic variants of the punch-card system: pre-scored or “Votomatic” style punch-card ballots (used by 30.9% of voters in 2000), and non-pre-scored or “Datavote” punch-card ballots (used by about 3.5% of voters).

Votomatic-style punch cards are the ones that became infamous during the Florida 2000 election controversy. This system relies on cards with pre-scored perforations, or “chads,” and small numbers imprinted on the card associated with each chad. At the time of voting, the voter places the punch card in a slot at the top of the punching device. When properly placed in the device, the pre-scored perforations on the card line up with the names of candidates or ballot measures, which are printed on pages attached to the device. A stylus is used to punch through the perforations in the card, corresponding to the candidates and other choices selected by the voter. If the ballot is not placed in the correct place on the machine, then the candidates’ names or ballot choices will not line up properly, resulting in an errant or invalid vote.

After the voter makes his or her choices, the Votomatic punch card is placed in a box, and counted with a vote-counting machine that reads the ballot based on the passage of light through the spaces. Errors can occur if the chad is not fully removed, or is punched in the wrong place due to misalignment. Running the ballot through the counter or handling of the ballot can cause the chad to be dislodged. Also, because the candidate names and ballot choices do not appear on the punch card itself, voters cannot easily tell from looking at the ballot whether their votes were cast as intended. Votomatic style punch-card systems do not allow voters to be notified of “undervotes” or “overvotes.” Both undervotes and overvotes result in a ballot not being counted.

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39. Fischer, supra note 27, at 3; Fischer, supra note 24, at 3.
41. Alvarez et al., supra note 21, at 39.
42. Brady et al., supra note 23, at 12.
43. Id.
44. Id.
46. The exception is a system deployed in Cook County, Illinois, which was utilized with card readers at the precinct, similar to the precinct-count optical-scan
The other type of punch-card equipment is the Datavote. In contrast to the Votomatic punch card, the Datavote card does not have chads. Instead, the voter receives cards without pre-scored perforations. In contrast to the Votomatic system, the names of the candidates or ballot choices appear on the cards themselves. The voter inserts the card in the machine and makes his or her choice by punching a hole in the ballot, using a special mechanism that functions like a one-hole punch. The tool is mounted on a slide, so that it can move up and down and be positioned over the row to be punched.

The voter using a Datavote makes a mark directly adjacent to the candidate name, making it easier for voters to “check their work” than is the case with Votomatic-style systems. Because candidate names appear next to the punched holes, it is less difficult to determine whether a hole has been made in the correct place. The downside of Datavotes is that, because the names of candidates appear on the ballots, multiple cards are often necessary in a single election. This can lead to confused voters and inadvertent undervotes, making the Datavote a less attractive option for jurisdictions with lengthy ballots. In addition, there is no mechanism for automatic checking of overvotes or undervotes, as is possible with the precinct-count optical scan and electronic systems discussed below.

4. Optical-Scan Ballots

Optical-scan or “Marksense” technology has been used for decades for standardized tests such as the SAT. It first became available for use in voting in the 1980s. Optical-scan ballots were used by 27.5% of United States’ voters in 2000, the second most commonly used type of equipment after punch cards.

Like the punch-card ballot, the optical-scan ballot is a paper-based technology that relies on computers in the counting process. Voters
make their choices by using a pencil or pen to mark the ballot, typically by filling in an oval or drawing a straight line to connect two parts of an arrow.60 The ballots are counted by scanners, which may be located either at the precinct (in “precinct-count” systems) or at some central location (“central-count” systems).61 Voters using optical-scan ballots may inadvertently undervote or overvote, through stray marks or the failure to use the proper type of marking device.

The significant dividing line within the category of optical-scan equipment is between those that allow voters to check for errors at the precinct and those that do not.62 With precinct-count systems, the ballots may be scanned by a machine before being placed in a ballot box, and the scanner may be programmed to notify the voter if he or she has overvoted or undervoted.63 Such error notification, or “second chance” voting as it is sometimes called,64 may prevent voters from inadvertently marking more choices than allowed.

With central-count systems, the ballots are placed in a ballot box and sent to a central location for scanning. Central-count systems allow mistaken overvotes to occur, and cannot be programmed to notify the voter if he or she has undervoted.65 Second-chance voting is therefore impossible with a central-count system.66

5. Direct Record Electronic Machines

Electronic systems are the newest type of voting system, first introduced in the 1970s.67 Some type of Direct Record Electronic (or “DRE”) machine was used by 10.7% of American voters in 2000.68 Although sometimes referred to as “e-voting,” these machines are not hooked up to the internet.69 DREs are instead stand-alone machines that record votes in their internal memories.70 The risks inherent in DRE voting must therefore be distinguished from those arising from internet voting.71

60. Id.
61. Caltech/MIT, supra note 30, at 19.
64. See Kimball, supra note 22, at 2.
65. In addition, some counties that count optical-scan ballots at the precinct do not activate the error correction feature. Id. at 8 n.4. For simplicity, these will be treated as central-count optical-scan counties in this Article.
66. See id.
67. Fischer, supra note 24, at 4.
69. Fischer, supra note 24, at 4-5 (distinguishing DRE technology from internet voting).
70. Id. at 5.
71. Roy G. Saltman,Auditability of Non-Ballot, Poll-Site Voting Systems 3 (2003) (“The risks of Internet voting should not be used to taint the use of DREs by combining the latter with the former as ‘electronic voting’ and by giving the
There are two basic types of DRE systems. The first generation of DRE systems, some of which are still in use, are known as “full-face” systems because they present the entire ballot to the voter at once.\textsuperscript{72} These machines, some of which were modeled on lever machines, typically use push buttons.\textsuperscript{73} As of 2000, approximately two-thirds of the DRE counties used machines of the “full face” variety.\textsuperscript{74} The more recent models of DRE equipment, which I shall here refer to as “second generation,” include ATM-style touchscreens—so labeled because the voter touches the screen to cast his or her vote.\textsuperscript{75} In other second-generation models, the voter turns a wheel in order to cast his or her vote.\textsuperscript{76}

Instead of receiving a paper ballot, voters using these DRE machines typically receive a plastic card—sometimes known as a “smart card”—at the polling place.\textsuperscript{77} The voter inserts the smart card, which looks like a thick credit card, into the voting terminal, causing the ballot to be displayed and activated.\textsuperscript{78} The voter then makes his or her choices manually, either by touching a screen, using a dial, or pressing buttons, depending on the type of DRE machine being used.\textsuperscript{79} With second-generation systems, the voter is typically shown a verification screen at the end of the voting process, which may be checked to confirm that the choices made are correct. At the conclusion of the voting process, the voter touches the screen or depresses a button to cast the vote.\textsuperscript{80}

As with lever machines, it is not generally possible to overvote with DRE voting machines, either first- or second-generation. With second-generation DREs, the names of the candidates or ballot choices appear on the screen and, at the end of the voting session, the voter may check the choices made to confirm that they are correct.\textsuperscript{81}
Second-generation DREs do not generate a paper record of the ballot at the time of voting. Instead, they save the votes in electronic form, typically in multiple places within the unit.

Some of the second-generation DRE systems now available feature components that make it possible for voters with disabilities to vote independently. These include an audio component for people with visual impairments or illiterate voters, and “sip and puff” devices for voters with manual dexterity limitations. The more flexible interface of second-generation DRE screens also allows multiple languages to be displayed, thereby facilitating independent voting by non-English speaking voters.

B. Tracing the Chase: 2000-2004

The 2000 election laid bare the problems with the equipment currently used to cast votes. Yet despite an initial outpouring of interest on the part of citizens and public officials throughout the United States, and numerous studies documenting the serious problems with some of the equipment used, reform has not proceeded as expeditiously as many anticipated. Litigation and legislation have resulted in some significant changes, including the replacement of Votomatic-style punch-card equipment in several states. Yet the introduction of paperless electronic voting has generated escalating controversy, leading some advocates to label it a threat to democracy. The consequence is that many jurisdictions, including those in some swing states, decided to stand pat with their existing voting equipment in 2004.

1. Florida 2000

The logical starting point for discussion of the changes in voting technology over the past four years is Florida’s 2000 election. The story of this election is familiar and need only be briefly summarized.

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82. Fischer, supra note 24, at 4.
83. Id.
86. Caltech/MIT, supra note 30, at 25.
87. See infra notes 129-54 and accompanying text.
89. In Ohio, approximately 72% of voters used punch cards in 2004. Rowland, supra note 3.
90. For an account of the recount battle that followed the 2000 presidential election, see generally Jeffrey Toobin, Too Close to Call (2001). For a description of the litigation surrounding the 2000 presidential election, see generally Abner S.
here. With the outcome of the presidential election hanging on the Florida recount, and George W. Bush leading narrowly after the machine count, then-Vice President Al Gore sought manual recounts of ballots in four counties. The Florida Secretary of State set a deadline of November 14 for the completion of manual recounts, later moved back to November 26 by an order of the Florida Supreme Court. The United States Supreme Court vacated that order in Bush v. Palm Beach County Canvassing Board, and the Florida Elections Canvassing Commission certified the election on November 26, with Bush prevailing by a narrow margin. Gore responded by filing a contest action pursuant to Florida law. A state circuit court denied Gore relief, but the Florida Supreme Court reversed in part, ordering a manual recount in all counties that had not yet conducted one.

That led to the opinion in Bush v. Gore, in which the U.S. Supreme Court held the manual recount procedure ordered by the Florida Supreme Court unconstitutional under the Equal Protection Clause. What is significant about the opinion, for purposes of understanding the subsequent changes in voting technology, is its recognition that the election exposed a serious but previously overlooked problem in need of attention. As the Court explained:

The closeness of this election, and the multitude of legal challenges which have followed in its wake, have brought into sharp focus a common, if heretofore unnoticed, phenomenon. Nationwide statistics reveal that an estimated 2% of ballots cast do not register a vote for President for whatever reason, including deliberately choosing no candidate at all or some voter error, such as voting for two candidates or insufficiently marking a ballot... This case has shown that punch card balloting machines can produce an unfortunate number of ballots which are not punched in a clean, complete way by the voter. After the current counting, it is likely legislative bodies nationwide will examine ways to improve the mechanisms and machinery for voting.

The Supreme Court did not expressly rule on whether the use of inaccurate voting equipment, in some but not all counties within a state, violated equal protection. Nor could the Court have ruled on this issue because this argument was not made by either side. Instead,

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93. 531 U.S. at 70.
94. Id. at 101.
95. Id. at 101-03.
96. Id. at 110.
97. Id. at 103-04.
the Court anticipated that legislative bodies would examine the problem in the months to come. 98

2. Post-2000 Studies of Voting Technology

Although previously understood by only a small cadre of experts, problems with punch-card voting machines were in fact nothing new. As early as 1988, Roy Saltman of the National Bureau of Standards described at considerable length the accuracy and integrity problems with punch-card voting systems. 99 In that report, Saltman found that the inaccuracies resulting from the continuing use of Votomatic-style punch-card machines threatened voter confidence, and recommended that the use of this equipment be ended. 100

The reports that followed the 2000 presidential election provided substantial empirical support for Saltman’s findings. 101 If better technology had been used in Florida during the 2000 election, it is quite possible that the result would have been different. As Judge Richard Posner has observed: “[I]f the question is what percentage of the people who voted in the Florida election thought they were voting for Gore, the probable answer is more than 50 percent.” 102

Shortly after the 2000 election, the United States Commission on Civil Rights undertook a thorough analysis of voting irregularities (combined overvotes and undervotes) in Florida. 103 As part of their final report, the commission released an empirical study by Allan J.

98. Id. at 104.
99. Saltman, supra note 45, § 3.4.
100. Id. § 6.9.2. For an even earlier study of punch-card voting equipment, see Herb Asher et al., The Effect of Voting Systems on Voter Participation, Address at the Annual Meeting of the Midwest Political Science Association, Milwaukee, Wisconsin (Apr. 28-May 1, 1982) (on file with author). Professor Asher and his colleagues found that in top-of-the-ticket races, “the punch-card system depresses the number of valid votes cast,” although the system actually did better in some down-ballot races. Id. at 11. They also found some evidence that “the errors made in punch-card voting do not occur uniformly among all population segments, but instead impact most heavily on voters in lower socioeconomic strata.” Id. at 12.
101. See, e.g., Brady et al., supra note 23, at 29 (finding a significantly higher residual vote rate for punch cards than other types of equipment in 2000 presidential election); Caltech/MIT, supra note 30, at 21 (finding a higher residual vote rate for punch cards than other types of voting equipment in presidential elections from 1980-2000); Richard A. Posner, Breaking the Deadlock: The 2000 Election, the Constitution, and the Courts 67-82 (2001) (analyzing Florida 2000 overvotes and undervotes with different types of technology).
102. Richard A. Posner, The 2000 Presidential Election: A Statistical and Legal Analysis, 12 Sup. Ct. Econ. Rev. 1, 20 (2004). Posner stops short of saying that Gore would have won if better technology had been used, speculating that the parties might have devoted more resources to Democratic-leaning counties if those counties had been using better equipment. Id. at 21.
Professor Lichtman concluded that approximately 2.9% of all ballots cast in Florida (approximately 180,000 of six million) did not contain a valid vote for President. The substantial majority of these were overvotes. Lichtman found that blacks were "far more likely than non-blacks to have their ballots rejected." The racial gap was especially severe in counties using punch cards, and was reduced (but not eliminated) in counties with optical-scan equipment that allows for errors to be corrected at the precinct level.

Media organizations likewise probed the incidence of uncounted votes in Florida's election, examining ballots for which no presidential vote had been registered. In November 18, 2001, the New York Times, Washington Post, and Sun-Sentinel all released the results of their inquiry into the Florida election. Looking at precinct-level data, these studies found that race, education, and income were all positively correlated with rejected ballots.

The Florida election sparked national studies, examining the performance of different types of voting machines throughout the country. Former presidents Gerald Ford and Jimmy Carter chaired a bipartisan commission, established to look into the functioning of the nation's election systems. The commission agreed that the performance of voting equipment throughout the country was one area where there was cause for concern. As for electronic voting, the commission noted that early DRE systems had high rates of voter errors, which were "significantly reduced by more modern hardware and more sophisticated software designs that improve the user interface." The Carter-Ford Commission did not, however, suggest the conversion to any single system. Instead, it urged setting

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105. Id. at 3.
106. Id. at 17.
108. See Kestin et al., supra note 107; Keating & Mintz, supra, note 107; Fessenden, supra note 107.
110. Id. at 55 (listing counties whose performance was deemed "worrying" or "unacceptable").
111. Id. at 52.
benchmarks for reliable performance, and allowing state and local
election officials to determine how best to meet those benchmarks.112

The first nationwide examination of the racial impact of voting
technology was conducted by the minority staff of the U.S. House
Committee on Government Reform.113 It examined forty
congressional districts in twenty states, half of which had high poverty
rates and large minority populations and half of which had low
poverty and small minority populations.114 The report found that
voters in the low-income, high-minority districts were more likely not
to have their votes counted, and that better technology significantly
reduced the gap.115 In particular, it found that some low-income, high-
minority districts achieved low rates of uncounted votes, using either
electronic or precinct-count optical-scan technology.116

A handful of legal academics also turned their attention on the
"nuts and bolts" of elections,117 including the machinery used to cast
and count votes.118 The most thorough consideration of the voting
technology divide in the wake of the 2000 election appears in an
article by Paul Schwartz, principally focused on the voting technology
used in Florida's 2000 election.119 Professor Schwartz described the
empirical research showing that election equipment providing
"feedback" to the voters resulted in fewer residual votes than central-
count punch card and optical-scan systems that lack such feedback.120
He found that precinct-count optical scans and lever machines, both
of which provide some feedback to the voter, did best.121 Professor
Schwartz concluded that the use of inferior technology "exacerbates
the underlying racial disparity, and closing the voting-technology
divide would reduce it—but would not eliminate it."122 He
recommended adoption of equipment that provides feedback to
voters.123

112. As a rule of thumb, the Carter-Ford Commission report recommended that
the benchmark for residual vote rates in the next election cycle be set for no higher
than 2%. Id. at 53.
113. Minority Staff, U.S. House of Representatives, Income and Racial Disparities
in the Undercount in the 2000 Presidential Election (2001) [hereinafter House
Minority Report].
114. Id. at 1.
115. Id.
116. Id. at 7.
117. See Richard L. Hasen, Bush v. Gore and the Future of Equal Protection Law in
majority opinion "eviscerated the distinction between nuts-and-bolts questions and
big picture questions," for purposes of Fourteenth Amendment analysis).
118. Mulroy, supra note 4, at 357-58.
(2002).
120. Id. at 633.
121. Id. at 636.
122. Id. at 643.
123. Id. at 696.
3. Voting Equipment in the Courts

Relying on evidence of voting equipment problems, especially with punch cards, voting rights advocates in several states filed lawsuits seeking to require the replacement of antiquated systems. While the specifics of these lawsuits varied, they all relied on Bush v. Gore, arguing that the use of different types of voting equipment with different levels of accuracy within a state violated the Fourteenth Amendment. In addition, the post-2000 lawsuits alleged that the use of unreliable voting equipment resulted in racial disparities, violating section 2 of the Voting Rights Act.

As the dust from the 2000 election controversy began to settle, the American Civil Liberties Union ("ACLU"), NAACP Legal Defense and Education Fund, and other advocacy groups, brought suit on behalf of Florida voters to end punch-card voting in that state. The ACLU subsequently brought lawsuits in Georgia, Illinois, California, and Ohio on similar grounds. In each of these lawsuits, plaintiffs argued that the continuing use of punch-card voting equipment denied their rights under the Fourteenth Amendment and the Voting Rights Act. In both the California and Illinois cases, federal district court judges denied state defendants' motions for dismissal at the pleading stage.

In addition to the cases seeking elimination of punch-card voting equipment, one case has sought postponement of an election based on disparities arising from its use. In Southwest Voter Registration Education Project v. Shelley, voting rights groups brought suit, seeking to postpone the October 2003 California recall until punch cards could

125. 531 U.S. 98 (2000).
126. Second Amended Complaint at 21-25, Stewart; Common Cause, 213 F. Supp. 2d at 1108-10; McGuffage, 209 F. Supp. 2d at 897-99; Complaint at 31, Harris; Complaint at 6, Andrews.
127. Second Amended Complaint at 26-27, Stewart; Common Cause, 213 F. Supp. 2d at 1110; McGuffage, 209 F. Supp. 2d at 896-97; Complaint at 31, Harris; Complaint at 8, Andrews.
128. See, e.g., Complaint, Harris. This case also sought to stop other practices alleged to deny the voting rights of African-Americans and other voters. Id. at 2 (summarizing barriers to voting challenged).
129. See Second Amended Complaint at 30, Stewart (identifying ACLU attorneys as counsel for plaintiffs in Ohio litigation); Mulroy, supra note 4, at 358-61 (describing progress of litigation in California, Illinois, and Georgia); Tokaji, First Amendment Equal Protection, supra note 11, at 2510 & n. 499.
130. See supra notes 126-27.
131. See Common Cause, 213 F. Supp. 2d at 1110; McGuffage, 209 F. Supp. 2d at 881. These opinions are discussed infra Parts II.A, IV.A.
After the district court declined to issue a preliminary injunction postponing the recall, a three-judge panel of the U.S. Court of Appeals for the Ninth Circuit reversed and enjoined the recall from proceeding on the scheduled date. That opinion, however, was vacated one week later by the en banc court. The en banc court did not rule squarely on whether the state's deployment of voting equipment with substantially different levels of accuracy violates equal protection. It instead rested on the deferential standard applicable to preliminary injunctions and the harm to the State of California that would result from postponing an election that had already begun. In effect, the court punted, leaving for another day the applicability of the Equal Protection Clause and Voting Rights Act in cases where inaccurate voting equipment is employed.

4. State Legislative Responses

As lawsuits seeking to end the use of punch cards were proceeding, legislative bodies in a handful of states began to examine whether their voting systems might be improved. Florida was one of the first to act. In 2001, Governor Jeb Bush signed into law the Florida Election Reform Act of 2001, which banned the use of punch-card ballots and required the purchase of either optical-scan or electronic voting technology by 2002. Individual counties in Florida were left to decide which type of equipment to purchase. Florida's law provided $24 million for new voting equipment, with additional

132. Southwest Voter Registration Educ. Project v. Shelley, 344 F.3d 914 (9th Cir. 2003) [hereinafter SVREP IV].
134. SVREP II, 344 F.3d 913, 913 (9th Cir. 2003).
135. SVREP IV, 344 F.3d at 920.
136. The Ninth Circuit’s cursory discussion of the equal protection issue states “[t]hat a panel of this court unanimously concluded the claim had merit provides evidence that the argument is one over which reasonable jurists may differ.” Id. at 918. The Ninth Circuit proceeded to find that the district court had not abused its discretion in finding that plaintiffs had not shown a “clear probability of success” at the time of their preliminary injunction motion. Id. As one commentator has put it, the court “neither accepted nor rebutted the equal protection claim.” Ninth Circuit Affirms, supra note 5, at 2028.
137. See SVREP IV, 344 F.3d at 919-20. The court noted that hundreds of thousands of absentee votes had already been cast for the October 2003 recall election. Id. at 919.
139. See Schwartz, supra note 119, at 694. Florida made this decision despite the recommendation of a state task force recommending that it move to uniform technology statewide. See generally The Governor's Select Task Force on Election Procedures, Standards and Technology, Revitalizing Democracy in Florida (2001) (on file with author).
amounts for poll worker training, voter education, and creation of a voter registration database.\footnote{140}

Georgia and Maryland also enacted election reform legislation in 2001.\footnote{141} Unlike Florida, both of these states made the decision to move to uniform voting technology. Until 2000, Georgia had used a variety of different voting equipment, including punch cards, optical scans, lever machines, and paper ballots, which resulted in widely divergent undervote and overvote rates across the state.\footnote{142} Its 2001 legislation required uniformity in technology,\footnote{143} and the state implemented DRE technology statewide for the 2002 elections.\footnote{144} Maryland's legislation also required uniformity in voting technology.\footnote{145} And like Georgia, Maryland converted to DRE equipment.\footnote{146}

In March 2002, California voters narrowly approved Proposition 41, the Voting Modernization Bond Act of 2002.\footnote{147} The law made available $200 million to allow counties to purchase updated voting equipment.\footnote{148} The law did not mandate uniformity of voting equipment statewide, nor did it require the replacement of punch cards or any other particular type of voting equipment. Anticipating the "paper trail" controversy that would later erupt over electronic voting, Proposition 41 provided that any voting system that did not require voters to mark their ballots must produce "a paper version or representation of the voted ballot or of all the ballots cast . . . ."\footnote{149} The law did not require that this paper record be printed out at the time of voting. Rather, it allowed the paper printout to be generated either

\footnotesize{\begin{itemize}
\item[140.] Florida Election Reform Act of 2001, 2001 Fla. Law ch. 2001-40 § 76 (indicating the amount on a per-precinct basis); see also Brad Hahn, Goodbye Chad: Bush Signs Bill, Punch Cards Knocked Out, Sun Sentinel (Ft. Lauderdale, Fla.), May 10, 2001, at A1 (noting that election reform bill included $24 million to help sixty-seven Florida counties buy new voting equipment).
\item[144.] Cox, supra note 142.
\item[147.] See Cal. Elec. Code § 19230-19245 (West 2002); see also Julie Tamaki et al., Election 2002: New Challenge to Legislative Term Limits Vowed; Propositions: Teachers Union Suffers Upset on Sales Tax Measure Despite Extensive Advertising Against It, L.A. Times, Mar. 7, 2002, pt. 2, at 7 (reporting that Proposition 41 received 51.5% of the vote).
\item[148.] Cal. Elec. Code § 19234(a).
\item[149.] Id. § 19234(e).
\end{itemize}}
"at the time the voter votes his or her ballot or at the time the polls are closed." Thus, the California law required that any electronic equipment purchased with state funds print out a paper record, though not necessarily a contemporaneous paper record, of the electronically voted ballot.

5. The Help America Vote Act ("HAVA")

Although Congress began considering legislation to overhaul the nation's election system in early 2001, HAVA was not actually signed into law until October 29, 2002. Enactment of what would ultimately become HAVA was slowed by partisan disagreements over several facets of the bill. Among them was whether to set minimum standards for voting equipment that all jurisdictions must meet, with Democrats pressing for mandates and Republicans arguing against them.

The legislation eventually enacted sets modest mandates for voting systems, while attempting to give the states incentives to upgrade to better technology. HAVA does not require the replacement of punch cards, or any other specific type of voting equipment. To the contrary, it includes a provision specifically stating that it shall not be interpreted to prohibit jurisdictions from using the same kind of voting equipment that they had in November 2000. Instead, HAVA provides funds for the replacement of punch-card and lever systems, while imposing some general requirements that all voting systems must meet.

Title I of HAVA authorizes $650 million in payments to the states, half of which is for the replacement of punch-card ballots and lever voting machines. States that choose to receive payments under Title I are obligated to replace their punch-card and lever voting equipment by November 2004, although this deadline may be extended for good

150. Id.
153. David Nather, Election Overhaul May Have to Wait in Line Behind Other 'Crisis' Issues, 60 Cong. Q. Wkly. 2034 (2002) (reporting that Democrats sought measures to promote access for voters of color and of low income, while Republicans were less interested in promoting access than strengthening protections against fraud).
154. See David Mark, With Next Election Only a Year Away, Proponents of Ballot Overhaul Focus Their Hopes on 2004, Cong. Q. Wkly., Oct. 27, 2001, at 2532.
157. Id. § 15304(a); Leonard M. Shambon, Implementing the Help America Vote Act, 3 Election L.J. 424, 428 (2004).
cause until 2006.\textsuperscript{158} As of January 2004, a total of twenty-four states had sought such a waiver.\textsuperscript{159}

Title III prescribes standards that all voting equipment must meet. It states that, by January 1, 2006, voting systems must allow voters to verify their choices and provide them the opportunity to correct their choices, before votes are cast.\textsuperscript{160} There is also a provision requiring that voting systems notify voters of overvotes.\textsuperscript{161} While this provision would appear to ban many current systems, HAVA takes away with one hand what it seems to give with the other. The Act provides that jurisdictions using paper-based systems (such as punch cards) may meet the “notice” requirement through a voter education program that gives instructions on how to correct mistakes and informs voters of the effect of overvoting.\textsuperscript{162} Thus, HAVA does not actually require that voting systems provide actual notice and the opportunity to correct mistakes.

HAVA does require that all voting systems have an “audit capacity,” and that they produce a “permanent paper record” that can be used for manual audits—though not the contemporaneous paper record that some advocates now demand.\textsuperscript{163} People with disabilities must also be accommodated, through voting machines that “provide[] the same opportunity for access and participation (including privacy and independence) as for other voters.”\textsuperscript{164} Jurisdictions can meet this requirement by providing at least one DRE unit or other accessible voting machine in each polling place.\textsuperscript{165} Voting systems must also allow alternative language access, for people whose primary language is not English.\textsuperscript{166}

HAVA entrusts significant responsibilities in the area of voting technology to the EAC, a four-member body created by the Act, and to related boards created by the Act.\textsuperscript{167} Among the EAC’s responsibilities are administering the “requirements payments” to the states, provided for under Title II of the Act.\textsuperscript{168} A total of $3 billion in requirements payments are authorized for distribution to states under Title II for the fiscal years 2003 through 2005.\textsuperscript{169} These monies are to be used for meeting HAVA’s requirements, which include not only voting equipment but also the creation of a statewide voter

\textsuperscript{158} Shambon, \textit{supra} note 157, at 428.
\textsuperscript{160} 42 U.S.C.S. § 15481(a)(1)(A).
\textsuperscript{161} Id. § 15481(a)(1)(A)(iii).
\textsuperscript{162} Id. § 15481(a)(1)(B)(i).
\textsuperscript{163} Id. § 15481(a)(2)(A)-(B).
\textsuperscript{164} Id. § 15481(a)(3)(A).
\textsuperscript{165} Id. § 15481(a)(3)(B).
\textsuperscript{166} Id. § 15481(a)(4).
\textsuperscript{167} Id. § 15341.
\textsuperscript{168} Id. § 15402.
\textsuperscript{169} Id. § 15407(a).
registration database, implementation of provisional voting, and effectuation of HAVA's mandate that certain first-time voters provide identification at the polling place.\textsuperscript{170}

In sum, HAVA provides substantial funding to upgrade voting technology and make other improvements in voting systems. But it provides only limited guidance on what type of voting equipment should be implemented, with few binding mandates. Many of the details are left to the states and counties. States that receive Title I funds for the buyout of punch cards and lever machines must get rid of this equipment, but the law does not require the implementation of electronic voting or any other particular type of equipment—except to say that, by 2006, at least one DRE machine or other accessible unit be made available at each polling place.\textsuperscript{171}

6. Controversy over Electronic Voting

Congress was aware of the security issues surrounding electronic voting at the time it enacted HAVA, as evinced by its inclusion of a requirement that there be a paper audit trail\textsuperscript{172} and by its provision for further study of security problems.\textsuperscript{173} Since 2002, the security of DRE voting equipment has come under intense scrutiny, generating a heated public debate that has spilled from computer scientists' websites\textsuperscript{174} onto the editorial pages of major newspapers.\textsuperscript{175} The debate has focused on touchscreens and other second-generation electronic voting equipment.

While some raised concerns about DRE security before HAVA's passage,\textsuperscript{176} the controversy over paperless electronic voting reached a

\begin{itemize}
\item \textsuperscript{170} Id. § 15407. These HAVA requirements can be found at id. §§ 15482-83. Although my focus here is on HAVA's provisions relating to voting technology, a forthcoming article deals with the equal protection implications of HAVA's provisions regarding registration, provisional voting, and the ID requirement. Daniel P. Tokaji, Early Returns on Election Reform: Discretion, Disenfranchisement, and the Help America Vote Act, 73 Geo. Wash. L. Rev. (forthcoming Aug. 2005).
\item \textsuperscript{171} 42 U.S.C.S. § 15481(a)(3).
\item \textsuperscript{172} Id. § 15481(a)(2).
\item \textsuperscript{173} See id. § 15381(a)(2).
\item \textsuperscript{176} For example, the Caltech/MIT Voting Technology Project’s report noted it is “extremely important” that election officials be able to conduct a reliable audit, and that first-generation DREs offer “no auditability.” But the VTP report also noted
\end{itemize}
fevered pitch in 2003. Professor David Dill of Stanford University’s computer science department led the charge, arguing that paperless DRE voting machines are error prone and vulnerable to fraud. As summed up by Professor Dill: “[E]lection technology has not advanced to the point where it can provide us with electronic systems that are reliable enough to trust with our democracy. In other words, we just aren’t there yet.”

These concerns assumed new prominence with a 2003 study analyzing the source code used on Diebold’s DRE system. Diebold was the vendor awarded contracts to install DRE technology statewide in both Georgia and Maryland. Four computer scientists, including Professor Avi Rubin of Johns Hopkins University, conducted an analysis of the source code used in that system. This report (the “Hopkins Report”) concluded that the source code had security flaws that could allow election workers, voters, software developers, or hackers to tamper with elections.

The Hopkins Report fueled calls for state and federal legislation to require a “voter verified paper audit trail” (“VVPAT”). To comply with such a requirement, electronic voting machines would have to be equipped with attached printers capable of generating a paper record of the electronic ballot at the time of voting. As noted above, HAVA requires that, by 2006, all voting equipment produce a “permanent paper record with a manual audit capacity.” It does not, however, require that this paper record be produced at the time of voting. The concern expressed by some DRE skeptics is that, without a contemporaneous record that the voter can see, malicious codes in the DREs software could result in the voter’s intended choice
appearing on the screen, while a different selection is recorded in the machine's memory. A contemporaneously generated paper record would, it is argued, eliminate this possibility. If there is a discrepancy between the paper record and the intended choices, then the voter could either revise her choices or call the discrepancy to the attention of the poll worker. If a candidate or voter suspected foul play, then a recount of the paper records could be conducted. At least in theory, then, the contemporaneous paper record would provide a secure and auditable record of voters' intended choices.

Citing the possibility of fraud and error with paperless electronic machines, a growing group of advocates, technologists, and editorial pages have argued that the contemporaneous paper record is needed to promote public confidence in electronic voting. Supporters argue that this device is essential for use in the event of a recount. Others have gone further, calling for a complete ban on electronic voting. Although there has been no documented instance of any fraud or attempted fraud with these machines, these concerns have cast a cloud over efforts to move to paperless DRE systems. In California, they prompted the Secretary of State to convene a task force which considered the security vulnerabilities of electronic voting, and ultimately led to conditional decertification of the DRE machines used in that state.

On the other hand, many election officials and some civil rights advocates have opposed a contemporaneous paper record requirement, arguing that it is unnecessary, burdensome, and likely to discourage adoption of accessible voting technology. The four principal co-sponsors of HAVA have publicly opposed imposition of a contemporaneous paper record requirement. At least seven states, however, have plans to implement the contemporaneous paper

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186. Fischer, supra note 27, at 15.
187. See id. at 28-29.
188. See Verifiedvoting.org, supra note 88.
189. See id. (arguing that electronic voting systems are insecure and advocating adoption of voter-verified audit trail).
191. Shelley, supra note 17, at 18 ("[T]he Task Force agrees that there is no proven instance of such an attempt at fraud that has happened in the number of years that DRE voting equipment has been in use.").
192. See generally id.
194. See Pointless Paper Chase, supra note 175.
7. Voting Technology in 2004

Although substantial changes in the equipment used for voting have occurred in the past four years, three-quarters of voters nationwide used the same equipment in 2004 that they did in 2000. Appendix A summarizes each state’s HAVA plan in the area of voting equipment, showing the significant changes that either are planned or have taken place. The percentage of registered voters in jurisdictions using each type of technology in 2004 (with 2000 figures given for comparison) was as follows:

<table>
<thead>
<tr>
<th>Technology</th>
<th>2000</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Votomatic Punch card</td>
<td>28.6%</td>
<td>12.0%</td>
</tr>
</tbody>
</table>


The number of registered voters living in jurisdictions that used Votomatic punch cards declined from over 44 million in 2000 to less than 19 million in 2004. The opposite trend occurred with electronic voting, with the number of registered voters in counties using this type of system going from just under 19 million to over 46 million between 2000 and 2004—although fewer voters used electronic voting than optical-scan equipment in 2004. Despite these changes, voters in several states (including Ohio, Missouri, Illinois and Utah) continued to use punch cards in 2004. HAVA has thus produced significant changes, but has not yet affected a complete overhaul of voting equipment in all of the states.

There are at least two reasons for the less-than-complete transformation of voting technology between 2000 and 2004. The first is the delay in making federal funds available to states and counties for the replacement of existing equipment. This was partly the result of President George W. Bush’s failure to appoint the four EAC commissioners on the timetable contemplated by HAVA. Although HAVA set a deadline of February 26, 2003, the nominations were not formally made until October 3, 2003 and the commissioners were not confirmed until October 28, 2003. In addition, Congress appropriated only $833 million of the $1.4 billion in HAVA in Title II money that Congress authorized for fiscal year 2003. This shortfall was made up for with a larger fiscal year 2004 appropriation, but the delay in receiving these funds caused states—many of which were

<table>
<thead>
<tr>
<th>Voting Method</th>
<th>2000</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Datavote Punch card</td>
<td>2.7</td>
<td>1.1</td>
</tr>
<tr>
<td>Optical scan</td>
<td>30.8</td>
<td>35.7</td>
</tr>
<tr>
<td>Lever</td>
<td>17.4</td>
<td>13.8</td>
</tr>
<tr>
<td>Electronic</td>
<td>12.2</td>
<td>29.6</td>
</tr>
<tr>
<td>Paper</td>
<td>1.5</td>
<td>0.6</td>
</tr>
<tr>
<td>Mixed</td>
<td>6.7</td>
<td>7.2</td>
</tr>
</tbody>
</table>

200. Election Data Servs., Voting Equipment Report, Year: 2000 (on file with author); Election Data Servs., supra note 3, at 1-2. “Mixed” refers to voters living in counties that use more than one type of voting equipment for in-precinct voting.

201. Election Data Servs., supra note 200; Election Data Servs., supra note 3, at 1-2.

202. Election Data Servs., supra note 200; Election Data Servs., supra note 3.

203. Electionline.org, supra note 159, at 35, 39, 43, 46.


206. Shambon, supra note 157, at 437.
already facing revenue shortages—to be cautious in moving forward.\(^{207}\)

The second reason for the delay in replacing existing voting equipment has been the controversy over electronic voting.\(^{208}\) The questions surrounding DRE security largely arose after the completion of the major commission studies. The lack of certainty as to its resolution, and in particular the "paper trail" controversy, has caused hesitation among election officials considering whether to purchase new equipment.\(^{209}\)

In Ohio, for example, approximately 74% of voters lived in counties using punch cards in 2000.\(^{210}\) This system resulted in substantially more uncounted votes than other voting equipment, particularly in African-American precincts.\(^{211}\) Plans to rid the state of punch cards in time for the 2004 election were abandoned, however, as the result of a report finding numerous security concerns with electronic voting.\(^{212}\) The legislature’s subsequent decision to require a VVPAT further delayed the replacement of punch cards in Ohio, with most counties deciding to stand pat with punch cards in 2004 rather than convert to electronic voting.\(^{213}\) Only four of the thirty-one counties eligible to make the shift by 2004 elected to do so.\(^{214}\) Subsequently, three of those four counties were forced to keep using punch cards when the Ohio Secretary of State decided not to allow the use of the Diebold’s DRE machine, due to security concerns.\(^{215}\) As a result, about 72% of voters used punch-card ballots in 2004, almost all of them Votomatic punch cards, and the number of uncounted votes was comparable to that in 2000.\(^{216}\)

\(^{207}\) Electionline.org, supra note 159, at 22; see also Shambon, supra note 157, at 438.

\(^{208}\) Shambon, supra note 157, at 438.

\(^{209}\) See id. at 439.

\(^{210}\) Rowland, supra note 3.


\(^{212}\) Electionline.org, supra note 159, at 15-16.


So how did electronic voting fare in comparison to other technologies in the 2004 election? Although DRE skeptics mounted an intensive and organized effort to monitor problems with electronic voting equipment, the process of analyzing the performance of different voting technologies in that election is only beginning as this Article goes to press. As in previous elections, there have been many allegations of fraud and some problems, but no documented instances of foul play arising from the use of electronic voting.217 A few days after the election, the Caltech/MIT Voting Technology Project issued a report debunking the claim, widely circulated through internet blogs, that electronic voting had been used to “steal the 2004 election for President Bush.”218

Nevertheless, electronic voting skeptics have called attention to a handful of problems that occurred in the 2004 election. Most noteworthy among these are incidents in two states. In Carteret County, North Carolina, the electronic voting machine used failed to record more than 4500 votes, apparently because its memory was full.219 And in Franklin County, Ohio, one precinct reported almost 4000 excess votes for President Bush in a precinct with less than 800 voters.220 Although election officials promptly corrected and detected this error, these incidents have intensified the considerable pre-existing anxiety regarding the implementation of electronic voting.

On the other hand, there is evidence that jurisdictions that switched from paper-based systems to electronic voting have reduced their number of uncounted votes. In Florida, for example, the state’s replacement of punch-card and central-count optical-scan ballots with electronic and precinct-count optical scans is reported to have considerably reduced the number of uncounted votes.221 And in Georgia, the replacement of the state’s hodgepodge of voting equipment with a uniform touchscreen voting system has had an even more dramatic impact, with the statewide rate of uncounted votes declining from 3.5% to .39%.222 Some of the biggest improvements in the 2004 election were in heavily African-American precincts that had

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220. Id.
221. Andres Viglucci, Touch Screens Reduced Spoiled Ballots, Miami Herald, Nov. 22, 2004, at 1A.
formerlly used punch cards.\textsuperscript{223} Despite these improvements, the debate over electronic voting shows little sign of abating.

II. TECHNOLOGY AND EQUALITY

Having described the current state of play, I now turn to the core democratic values that should guide the assessment of voting technology. My starting point is to define four equality norms embodied in the Constitution and federal voting rights laws. Viewing the voting technology debate in light of these equality norms reveals serious deficiencies in existing paper-based equipment, including not only the infamous punch card, but also central-count optical-scan ballots. As explained below, the present generation of electronic voting equipment performs much better. In particular, DREs can reduce uncounted votes and virtually eliminate the "racial gap" that tends to exist with other types of equipment. They also have the potential to expand access for people with disabilities and for voters with limited English proficiency.

A. Four Equality Norms

Embodied in federal voting rights laws are four equality norms germane to the assessment of available voting technologies. First, under section 2 of the Voting Rights Act, jurisdictions may not employ election practices that result in vote denial on account of race.\textsuperscript{224} Second, under both the Americans with Disabilities Act of 1990 ("ADA") and HAVA, election officials must provide equal access to people with disabilities.\textsuperscript{225} Third, the Voting Rights Act and HAVA protect language minorities by requiring that voting materials be provided in languages other than English where there are significant numbers of non-English proficient citizens residing in a state or political subdivision.\textsuperscript{226} Fourth, the Equal Protection Clause stands for the principle that equal weight be given to each vote and equal dignity accorded to each voter.\textsuperscript{227} While the precise scope of this principle remains a matter of considerable controversy, at the very least it forbids certain election practices that systematically disfavor voters residing in particular geographical areas within a state.\textsuperscript{228}

\textsuperscript{224} See Farrakhan v. Washington, 338 F.3d 1009, 1011-12 (9th Cir. 2003).
\textsuperscript{228} See, e.g., Reynolds v. Sims, 377 U.S. 533 (1964).
Before describing these four norms, some clarifications and qualifications are in order. First, I take these norms to be ones that are generally shared by those with radically different conceptions of democracy—and of the role that courts should play in overseeing the administration of elections. But I defer until Part IV the question of whether courts or other institutional actors are best suited to promote these norms. Also, I do not mean to suggest that this is an exclusive list of equality norms or to engage in a searching inquiry into the theoretical basis for them. Undoubtedly, those with different conceptions of democratic politics will have varied ideas as to the precise scope of these norms, and the relative weight that each should be given. Finally, in setting forth these equality norms, I do not mean to imply that other values, such as security and transparency, must unyieldingly bend to them. My goal here is simply to describe four equality norms embedded in federal law that should, at the very least, inform the comparison of available voting technologies.229

1. Racial Equality

The first legal norm germane to the debate over voting technology is racial equality. This norm is embodied in the Voting Rights Act of 1965 ("VRA"), which prohibits state and local governments from engaging in voting practices that result in the denial or dilution of minority votes. Specifically, section 2 of the VRA provides that no voting qualification or prerequisite to voting or standard, practice, or procedure shall be imposed or applied by any state or political subdivision in a manner which results in a denial or abridgement of the right of any citizen of the United States to vote on account of race or color.230

The Act specifically provides that all actions "necessary to make a vote effective," including "casting a ballot and having such ballot counted properly," are covered.231 Courts are to examine the "totality

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229. Professor Hasen describes three core equality principles that should guide judicial intervention on constitutional grounds. Hasen, supra note 5, at 381-92. Equality claims that fall outside of the core, he argues, should come from legislative bodies rather than the judiciary. Id. The approach taken in this Article differs from that of Professor Hasen, in that my focus is on statutory norms, as well as constitutional equality norms. The equality norms upon which I focus here nevertheless could be categorized as falling within the "essential political rights principle" that he defines as encompassing the right not to be denied the right to vote on the basis of characteristics such as race, gender, literacy, and national origin. Id. at 382-86. This is not to deny the other two equality principles that Professor Hasen discusses (anti-plutocracy and collective action). These principles, however, do not appear to be particularly germane to the debate over voting technology. In addition, the focus of this Article is not simply on judicial enforcement of these equality norms, but also on what legislative bodies, administrative agencies, and election officials should do to promote democratic equality and other values.


231. Id. § 1973(l)(c)(1).
of circumstances” in determining whether there has been a violation of section 2.\textsuperscript{232}

Section 2 has been interpreted to prohibit not only practices that are intended to discriminate against minority voters, but also those that have the result of denying or diluting minority voters’ power.\textsuperscript{233} There must be a causal connection between the challenged election practice and the racially discriminatory result.\textsuperscript{234} Thus, to the extent that election practices disproportionately deny the votes of racial minorities, they may violate section 2.

Three federal district courts have held that a section 2 violation may be shown where the use of certain voting equipment results in the disproportionate denial of minority votes. Two of them are post-	extit{Bush v. Gore} challenges to punch cards. In 	extit{Black v. McGuffage}, the Court denied a motion to dismiss a section 2 claim by Illinois voters, challenging the use of punch-card voting systems.\textsuperscript{235} And in 	extit{Common Cause v. Jones}, the court refused to dismiss a similar challenge, alleging that voters of color were disproportionately denied their voting rights due to the use of punch cards.\textsuperscript{236} The other case is 	extit{Roberts v. Wamser},\textsuperscript{237} a 1987 challenge to the implementation of punch-card voting equipment in St. Louis. Although later reversed by the Eighth Circuit for lack of standing,\textsuperscript{238} the district court in 	extit{Roberts} held that the failure to manually review punch-card ballots had a disproportionate impact on African-American voters.\textsuperscript{239}

In each of these cases, the parties have disputed how section 2’s “totality of the circumstances” test should apply in the context of voting equipment challenges. No appellate court has yet ruled on the merits of a section 2 case arising from the use of voting equipment that has a disparate impact on voters of color.\textsuperscript{240} There is, accordingly, some uncertainty as to the precise legal standard that ought to apply in this context. Nevertheless, there can be little question that voting systems that “result[] in”\textsuperscript{241} the disproportionate denial of minority votes can violate section 2, at least in some circumstances. Whatever the precise standard governing section 2 claims in this area, the goal of avoiding the disproportionate denial of minority votes should be

\begin{thebibliography}{99}

\bibitem{232} Id. § 1973(b).
\bibitem{233} Thornburg v. Gingles, 478 U.S. 30, 35 (1986); Farrakhan v. Washington, 338 F.3d 1009 (9th Cir. 2003).
\bibitem{234} Farrakhan, 338 F.3d. at 1016-20.
\bibitem{238} Roberts v. Wamser, 883 F.2d 617, 617 (8th Cir. 1989).
\bibitem{239} Roberts, 679 F. Supp. at 1532.
\bibitem{240} See SVREP IV, 344 F.3d 914, 918 (9th Cir. 2003). Without expressly ruling on the section 2 claim, the en banc Ninth Circuit in SVREP IV indicated its view that plaintiffs had made a stronger showing on this claim than on their equal protection claim against punch-card voting machines. Id. at 918-19.
\end{thebibliography}
taken into consideration in assessing different types of voting technology.

2. Disability Access

The second equality norm that should be considered in assessing voting technologies is accessibility to citizens with disabilities. Technology is of course only one of the things that may promote equal access to the democratic process for people with disabilities. In fact, technology has not been the principal focus of efforts to improve voting access, at least until recently. Most of the attention has instead been directed at physical barriers to access to the polling place for people with mobility impairments, most notably in a survey of polling places conducted by the General Accounting Office in the 2000 election. None of the polling places examined in that survey offered voting equipment adapted to voters with visual impairments. But for visually impaired voters, as well as for voters who have manual dexterity or cognitive impairments, technology may be vital in ensuring that they are able to vote secretly and independently.

There are several statutes that incorporate the norm of equal access for people with disabilities. For purposes of voting technology, the most important of these statutes are the ADA and HAVA. The ADA prohibits discrimination against people with disabilities in numerous aspects of public life, including the voting process. Title II of the ADA forbids the exclusion of people with disabilities from services, programs, or activities of public entities. At the time it enacted the ADA, Congress specifically found that voting was one of the areas in which discrimination against people with disabilities persisted.

243. Id. at 32.
244. Three other statutes also address disability access in the context of voting, but provide more limited protection. The VRA requires that voters requiring assistance due to a disability be given that assistance by persons of their choice. 42 U.S.C. § 1973aa-6 (2000). The Voting Accessibility for Elderly and Handicapped Act requires that polling places be accessible, but does not specifically address the technology used for voting. Id. § 1973ee. Finally, § 504 of the Rehabilitation Act of 1973 prohibits the exclusion of people with disabilities from activities receiving federal funding. 29 U.S.C. § 794 (2000).
246. Id. § 12101(a)(3); see also Staff of Senate Subcomm. on Handicapped of the Comm. on Labor and Human Resources & Staff of House Subcomm. on Select Educ. Of Comm. on Educ. & Labor, 101st Cong. 941 (Comm. Print) (statement of Rep. Tony Coelho) ("As the Council found, unfair discrimination is the daily experience of many of the 43 million Americans with disabilities. Every sphere of life is affected: housing, employment, recreation, transportation; even the ability to operate independently in the commercial sphere, or to vote, or to raise children." (emphasis added)).
As Professor Michael Waterstone has suggested, the ADA can be interpreted as requiring "secret and independent" voting for people with disabilities. Among the voters who may benefit from accessible voting technology are: (1) visually impaired voters who are unable to read printed ballots, (2) voters with manual dexterity impairments who cannot punch holes in or mark paper ballots, and (3) voters with cognitive impairments that prevent them from reading paper ballots. Unfortunately, there is relatively little published research on how well existing technologies serve the needs of voters with these types of disabilities—or on how these technologies might be adapted or improved to better meet their needs.

Much of the available information regarding the accessibility of voting equipment comes from judicial opinions. In two states, disabled citizens have brought suit under the ADA, challenging the failure to provide accessible voting technology. In American Association of People with Disabilities v. Hood, individuals with disabilities brought a class action against Duval County, Florida officials, asserting that the failure to provide DRE voting systems violated plaintiffs' rights under the ADA. Plaintiffs argued that the paper-based systems used by the county did not allow people with visual and dexterity limitations to vote independently. They cited regulations promulgated under the ADA that specifically protect the right to communication and auxiliary aids.

Relying on Title II and the regulations promulgated under that statute, the district court ruled: "[W]hile the ADA and the Rehabilitation Act do not necessarily create a comprehensive federal right to vote without assistance, the application of the ADA and the Rehabilitation Act in a particular case may have the effect of requiring equipment that allows voters to vote without assistance." In so holding, the district court expressly rejected suggestions that language in the VRA or HAVA could be interpreted to absolve public entities of their responsibilities under the ADA.

In a subsequent opinion, the American Association of People with Disabilities court granted declaratory judgment against counties

250. Id. at 1350-51.
failing to provide accessible voting equipment. The court found that it was technologically feasible to provide accessible equipment—and specifically that touchscreen DRE systems had the capacity to allow visually and manually impaired citizens to vote without assistance. Under this decision, counties may be subjected to liability under the ADA, if they fail to provide equipment that allows people with disabilities to vote independently.

On the other hand, a California federal court recently denied a temporary restraining order application sought by people with disabilities under the ADA. While agreeing that Title II of the ADA covers the vote, the court disagreed with plaintiffs' contention that it protected the right to vote “independently and secretly.” The court provides little in the way of explanation—perhaps because of the early stage in proceedings—to support its conclusion that the right to cast a secret and independent ballot falls outside the scope of the ADA.

Whatever the ADA's scope when it comes to voting, accessible technology will have to be provided by 2006. HAVA requires that voting systems “be accessible for individuals with disabilities, including nonvisual accessibility for the blind and visually impaired, in a manner that provides the same opportunity for access and participation (including privacy and independence) as for other voters.” This provision may be met by having at least one DRE or other voting system equipped for persons with disabilities at each polling place. This requirement becomes effective January 1, 2006. Furthermore, any equipment purchased with funds made available under Title II of HAVA after January 1, 2007 must be accessible to people with disabilities.

It is abundantly clear that there is a pressing need for further research into the ability of technology to facilitate independent voting by people with certain types of disabilities. In fact, one of the areas in which HAVA calls for periodic studies is accessible voting for people with disabilities, including those who are blind or visually impaired. HAVA specifically directs the EAC and the National Institute on Standards and Technology (“NIST”) to conduct “human factor research,” on the usability of different types of voting equipment,
Technology is certainly not the answer to every access problem. It does not, for example, obviate the need to address issues of polling place access for people with mobility impairments. But for individuals with other kinds of impairments, technology can be essential to independent voting. Whether or not the failure to provide accessible technology to people with visual, manual, or cognitive disabilities would give rise to liability under the ADA, it is clear that it is an important goal. Moreover, under HAVA, all jurisdictions are required to provide technology that allows private and independent voting for people with disabilities by 2006. Accordingly, disability access is among the equality norms that must be taken into consideration in evaluating different voting technologies.

3. Multi-Language Access

The third equality norm is accessibility of voting technology to individuals who are not proficient in English. This norm is embodied in both the VRA and HAVA. The VRA provides: "No voting qualification or prerequisite to voting, or standard, practice, or procedure shall be imposed or applied by any State or political subdivision to deny or abridge the right of any citizen of the United States to vote because he is a member of a language minority group."263

The first provisions protecting language minorities were adopted in 1975. They were extended for ten years in 1982 and for another fifteen years in 1992.264 In enacting these provisions, Congress found that language minorities had been "effectively excluded from participation in the electoral process" as the result of various practices.265 Congress also noted the high illiteracy and low voting participation rates among language minorities.266

Under section 203 of the VRA, bilingual voting materials must be provided in any jurisdiction where more than 5% of the voting age population or more than 10,000 citizens of voting age are not English proficient.267 Although the requirements of section 203 have been in

262. Id. § 15383.
263. Id. § 1973b(f)(2).
266. Id.
267. Id. § 1973aa-1a(b)(2)(A)(i). For implementing regulations describing in greater detail the criteria for coverage, see 28 C.F.R. § 55.6 (2005). For a list of
place for many years, ballots are not always readily accessible to people whose first language is not English. As one commentator explains, "translations on ballots are often faulty, too small to read, contain misleading layouts, and incorrectly transliterate candidates' names." In addition, the inadequate number of interpreters available to serve at polling places remains an issue.

As in the area of disability access, there is relatively little available research on how technology might improve access for non-English speaking individuals. HAVA contemplates that technology may play some role in improving language accessibility, requiring that by 2006, voting systems "provide alternative language accessibility." While HAVA's formal requirements for language access do not extend beyond those set forth in the VRA, the new law clarifies Congress's intent that these requirements apply to voting technology. In addition, HAVA requires the EAC to study means of improving access for voters with limited English proficiency. As with the federal disability access requirements, the VRA and HAVA's provisions regarding access for non-English proficient voters should be viewed as a floor and not a ceiling. They prescribe the minimum for what states and counties must do to protect the voting rights of non-English speaking voters, but not the maximum for what they can do.

4. Inter-Jurisdictional Equality

The fourth voting right is the most difficult to define, and might be thought of as the wild card in the deck of equality norms. The Supreme Court has long held that the right to vote is a "fundamental political right" because it is preservative of all other rights. For this reason, the Court has closely scrutinized certain election practices which deny or dilute the right to vote, especially when they disadvantage an identifiable group of voters based upon wealth or place of residence.

As Professor Richard H. Pildes recently observed, the last generation has witnessed "the constitutionalization of democratic politics," as issues regarding the processes of democracy have increasingly become the subject of constitutional litigation. Voting

jurisdictions covered under this provision, see Committee for Purchase from People Who Are Blind or Severely Disabled, 67 Fed. Reg. 48871-77 (July 26, 2002).

268. Magpantay, supra note 264, at 38.
269. Id. at 43.
271. Id. § 15381(a)(1).
274. Pildes, supra note 13, at 31 (internal quotations omitted).
technology and other facets of election administration have not, of
course, been immune from this phenomenon. Yet defining the
constitutional norms that should guide assessment of voting
technology remains a difficult enterprise, particularly given the
Court's failure to speak with clarity on the subject.

The logical starting point is *Bush v. Gore*, which was decided
against the backdrop of a dispute over which punch-card ballots
should be counted. A great deal has been written about the Court's
opinion in *Bush v. Gore*, much of it highly critical. It is not the
purpose of this Article to join the heated debate over whether the
Court decided the case properly or should have decided it in the first
place. Instead, the purpose here is to assess the applicability of the
equality principle articulated in *Bush* to the debate over voting
technology. As it turns out, the cases that preceded *Bush v. Gore*
are more enlightening than is *Bush* itself.

The Court in *Bush* rested on the equality principle articulated in the
"one person, one vote" line of cases. As I have elsewhere noted,*Bush* goes beyond these precedents, insofar as it finds a violation in the
absence of any evidence that a definable class of voters had been
treated unfairly. There was no showing, for example, that voters
residing in urban jurisdictions had been treated less favorably than voters in rural jurisdictions, or that poor voters had been treated
less favorably than well-off ones. The basic principle on which *Bush*
rests—namely, "equal weight" to each vote and "equal dignity" to
each voter—is hardly novel. But it is also not particularly helpful in
defining what sorts of inequalities are constitutionally intolerable.

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275. See id. at 32 ("[I]ssues of voting technology and vote-counting procedures might now be matters of constitutional law.").
278. For an analysis of this question, see generally Mulroy, supra note 4.
279. *Bush*, 531 U.S. at 104 ("When the state legislature vests the right to vote for President in its people, the right to vote as the legislature has prescribed is fundamental; and one source of its fundamental nature lies in the equal weight accorded to each vote and the equal dignity owed to each voter.").
284. In fact, it is not at all clear that a concern with individual equality rights are really what was motivating the Court. See Pildes, supra note 13, at 49 (noting that, although *Bush* speaks in the language of individual rights, its "central elements...are more consistent with [a] structural concern for partisan capture of election processes than with any individual right to an equally weighted vote").
What is novel about *Bush* is not its statement of this equality principle, but rather its application of the principle. The Court concluded that Florida’s manual recount, conducted without clear standards dictating which votes should count, violated equal protection. According to the Court, the problem was the absence of “specific standards to ensure its equal application.”

The Court was careful to limit the scope of its holding, emphasizing that the “problem of equal protection in election processes generally presents many complexities.” In particular, the Court noted that the issue before it was not whether “local entities, in the exercise of their expertise, may develop different systems for implementing elections.” It would be a mistake, however, to take from *Bush v. Gore* the lesson that substantial differences in the accuracy of different voting equipment are immune from equal protection scrutiny. The Court did not, after all, say that such differences raise no constitutional problem. Instead, the Court quite properly noted that the constitutionality of such differences was not the issue before it. It articulated a broad principle—equal treatment in the voting process—leaving it to future courts to determine the applicability of this principle to such issues as discrepancies in voting technology.

This leaves open the question of what exactly the Equal Protection Clause demands when it comes to discrepancies in voting technology. It is surely speculative at best to assess how the Supreme Court would address this question, or whether it will do so anytime soon. Nevertheless, some guidance may be drawn from the four opinions upon which *Bush* relies. One of those cases is *Harper v. Virginia Board of Elections*, in which the Supreme Court struck down a state’s poll tax on the ground that it contravened the right to political equality: “Wealth, like race, creed, or color, is not germane to one’s ability to participate intelligently in the electoral process.” In the three other cases, the Court struck down apportionment schemes that accorded different weight to voters in different jurisdictions. For

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285. A careful reading of the Court’s opinion reveals five specific problems: (1) from one county to another, different standards for determining which votes should count were being applied; (2) even within certain counties (the opinion specifically mentions Miami-Dade and Palm Beach), inconsistent standards were being applied; (3) in some but not all counties, the recounts included undervotes but not overvotes; (4) there was no assurance that the recounts included in the final tally would be complete; and (5) the Florida Supreme Court’s manual recount order did not specify who would recount the ballots. *Bush*, 531 U.S. at 105-08; see also Hasen, *supra* note 5, at 5 (identifying the different flaws that the Court found to exist with Florida’s recount process).


287. *Id.* at 109.

288. *Id.*

289. See Amar, *supra* note 5.

290. See Hasen, *supra* note 5.

example, in *Gray v. Sanders*, the Court invalidated a system of vote-counting that gave rural county votes greater weight than urban county votes.\(^{292}\) This line of cases established the rule that citizens' votes should not be given significantly less weight due to the happenstance of where they reside. As the Court put it in *Reynolds*, "[d]iluting the weight of votes because of place of residence impairs basic constitutional rights under the Fourteenth Amendment."\(^{293}\)

In all of these cases, the Court focused on the disparate treatment accorded to identifiable groups of voters. In *Harper*, that group was defined by poverty (those too poor to afford the poll tax).\(^{294}\) In the "one person, one vote" line of cases, the affected group was defined by geography (those who resided in larger districts).\(^{295}\) In both sets of cases, "an identifiable class of voters" was accorded less favorable treatment.\(^{296}\) Moreover, each of these cases occurred against a backdrop of racial inequality.\(^{297}\)

The *Bush v. Gore* equal protection holding goes beyond this precedent in two significant respects. First, the Court holds there to be an equal protection violation without evidence that an identifiable group of voters had been accorded less favorable treatment than another.\(^{298}\) In contrast to *Harper*, there was no evidence that people of lesser means had been denied the right to vote; and in contrast to *Reynolds* and *Gray*, there was no evidence that the votes of those in larger urban counties had been diluted.\(^{299}\) What the *Bush* Court instead found problematic was the broad discretion afforded to public officials to determine whose vote would count. As I have previously argued, this aspect of the Court's reasoning borrows from First Amendment jurisprudence, which looks with disfavor upon licensing schemes that afford public officials broad discretion to regulate

\(^{294}\) *Harper*, 383 U.S. at 266-67.
\(^{295}\) See, e.g., *Reynolds*, 377 U.S. at 562.
\(^{296}\) *Id.*
\(^{298}\) Tokaji, *First Amendment Equal Protection*, supra note 11, at 2483-84.
\(^{299}\) *Id.* at 2489.

Id.

\(^{296}\) Id. at 2489.

\(^{298}\) *See id.* (contrasting *Bush v. Gore* with cases involving differential treatment of a discernible class of voters). Nor was there any suggestion that the recount was denying a particular racial group equal treatment. *See id.* If anything, the decision to stop the manual recounts may have resulted in the disproportionate failure to count the votes of African-Americans, who tend to cast invalid votes at higher rates than whites. *See Tomz & Van Houweling*, *supra* note 15, at 47.
But one need not rely on the First Amendment aspect of Bush to conclude that the use of voting machines disfavoring identifiable groups of voters, defined by place of residence, is constitutionally problematic. Thus, to the extent that there is direct evidence showing that a particular group of voters—for example, those residing in urban areas—is disfavored by the use of a particular voting technology, the “one person, one vote” cases actually provide a closer analogue than does Bush.

The second respect in which Bush v. Gore expands upon precedent is in applying the “one person, one vote” rule to the “nuts-and-bolts” of elections. While prior cases had focused on such big picture issues as how districts were drawn, Bush identifies the procedures and mechanisms used to conduct elections—and more specifically the vote-counting process—as the proper subject of an equal protection challenge. The opinion in Bush reserves the issue whether discrepancies in voting equipment violate equal protection. But as some commentators have observed, its equal protection logic leads to that conclusion. For if discrepancies in the manual recount process may violate equal protection, it is difficult to see why other discrepancies in the administration of elections may not.

Disparities in voting equipment raise a serious equal protection problem, at least to the extent that they bear more heavily upon voters in certain geographic areas. As noted above, voters and civil rights advocates in at least five states have brought lawsuits challenging discrepancies in the voting equipment used within those states. All these cases have alleged that voters in counties relying on unreliable voting equipment, such as the punch card, are denied equal protection. In the California and Illinois litigation, the courts found these allegations sufficient to survive a motion to dismiss. In the Ohio litigation, however, a district court judge rejected challenges

300. Tokaji, First Amendment Equal Protection, supra note 11, at 2488; see also Greene, supra note 11 (manuscript at 43-55) (explaining Bush v. Gore as an extension of First Amendment cases striking down administrative decisions affecting rights of political expression under discretionary standards).

301. Hasen, supra note 117, at 378.

302. Id.

303. See id.; see also Balkin, supra note 277 at 1428 (asserting that “technological differences among counties” are “probably the greatest source of unequal treatment, particularly between more affluent counties and less affluent ones”).


305. McGuffage, 209 F. Supp. 2d at 889; Common Cause, 213 F. Supp. 2d at 1106.
to punch-card and central-count, optical-scan voting equipment after a bench trial.\textsuperscript{306}

Whether or not one agrees that the use of punch cards violates equal protection, the cases preceding \textit{Bush} established a principle forbidding election practices that disfavor certain geographically defined groups within a state—at least where there is statistical evidence of less favored treatment.\textsuperscript{307} It would surely contravene equal protection, for example, were a state to employ a counting mechanism that randomly rejected half the votes in one county, while counting all of those in a neighboring county. The only real question is the degree of inequality that is constitutionally tolerable. The equal protection argument made in the ACLU’s voting machine cases is, in this sense, less novel than those at issue in \textit{Bush v. Gore}. In contrast to \textit{Bush}, the ACLU cases do not demand that courts deem discretion over elections to be constitutionally problematic in itself. Rather, as in cases challenging malapportioned districts, the plaintiffs rely upon evidence of unequal treatment affecting a geographically defined class of voters within the state.\textsuperscript{308}

The equal protection argument against unreliable voting equipment is thus more similar to “one person, one vote” cases than is \textit{Bush} itself. Accordingly, I define the fourth equality norm that should guide our consideration of voting equipment as inter-jurisdictional equality. My point is not that other inequalities—such as racial disparities or the denial of access to people with disabilities—fall


\textsuperscript{307} See, e.g., Moore v. Ogilvie, 394 U.S. 814, 819 (1969) (striking down Illinois law providing that voters in “counties which contain 93.4% of the registered voters may not form a new political party and place its candidates on the ballot” while allowing “25,000 of the remaining 6.6% of registered voters properly distributed among the 53 remaining counties [to] form a new party to elect candidates to office”); Reynolds v. Sims, 377 U.S. 533, 550 (1964) (describing Alabama legislature’s apportionment plan, under which each representative in eight rural counties would represent less than 20,000 people, while each representative in two larger counties would each represent approximately 52,000). Relying on \textit{Harper v. Virginia Board of Elections}, 383 U.S. 663 (1966), one might also argue that inequalities bearing more heavily on the poor should also be among the list of equality norms protected by the Equal Protection Clause. Thus, to the extent that certain voting technologies have a disparate impact on people of lesser wealth or income, they might trigger some form of heightened judicial review. Such review might further be justified on the ground that those of lesser means are more likely to find their interests neglected by policymakers. While I do not mean to dismiss the possibility that such inequalities might contravene some constitutional norm, I have omitted it from my list of four equality norms described in this part because, aside from such direct impediments to the franchise as the poll tax, I suspect that there is substantial disagreement over whether election practices that disproportionately affect poor people violate equal protection.

\textsuperscript{308} McGuffage, 209 F. Supp. 2d at 893 (describing variations in uncounted vote rates among Illinois jurisdictions); \textit{Common Cause}, 213 F. Supp. 2d at 1107 (describing plaintiffs’ allegations that “individuals living in counties where the punch-card system is used are substantially less likely to have their votes counted”).
outside the scope of the Equal Protection Clause. Nor is it to deny that *Bush* should be interpreted to reach other areas, in which excessive discretion over the administration of elections is vested in state and local officials.\(^{309}\) Finally, I do not mean to suggest a "zero tolerance" policy that would prohibit even the most trivial inter-jurisdictional inequalities within the state.\(^{310}\) Whatever else the equal protection line of cases leading up to *Bush* may stand for,\(^{311}\) they clearly stand for the idea that there are limits upon the state's ability to accord differential treatment to its voters based on the jurisdiction where they reside. That is particularly true where there is also reason to believe that a particular subgroup, such as racial minorities, bears a disproportionate burden from the challenged practice.

**B. Empirical Research on Electronic Voting**

In the ongoing debate over electronic voting, surprisingly little attention has been given to the important work that social scientists have conducted in the area of voting technology since 2000.\(^{312}\) Although this literature has barely penetrated the legal and public policy discourse, it provides considerable guidance in assessing the degree to which different types of voting technology serve the equality norms set forth above. On the whole, the social science research on voting technology shows that implementation of present-generation electronic voting equipment tends to considerably reduce the number of uncounted votes. In addition, there is increasing evidence that electronic voting can reduce the "racial gap" in uncounted votes, thereby avoiding the disproportionate loss of votes among people of

\(^{309}\) See Greene, *supra* note 11; Tokaji, *First Amendment Equal Protection, supra* note 11.

\(^{310}\) On a related point, the above analysis does not speak to the level of scrutiny that should govern the assessment of inter-jurisdictional inequalities arising from different voting technologies. Some cases in the "one person, one vote" line suggest that strict scrutiny is the appropriate standard. Reynolds v. Sims, 377 U.S. 533, 562 (1964) ("[A]ny alleged infringement of the right of citizens to vote must be carefully and meticulously scrutinized."). On the other hand, other cases suggest a balancing test under which the rigorousness of judicial scrutiny depends on the magnitude of the restriction upon the right to vote. Burdick v. Takushi, 504 U.S. 428, 434 (1992) ("[T]he rigorousness of our inquiry into the propriety of a state election law depends upon the extent to which a challenged regulation burdens...Fourteenth Amendment rights."). My point here is simply that, whether heightened scrutiny or some lesser standard of review applies, there is a constitutional norm against inter-jurisdictional inequalities.

\(^{311}\) See Tokaji, *First Amendment Equal Protection, supra* note 11, at 2483-90 (describing "one person, one vote" cases and *Bush v. Gore's* extension of their rationale).

\(^{312}\) The major exception is Professor Schwartz's article. Schwartz, *supra* note 119. There has, however, been substantial empirical research conducted since then, as described below, which sheds significant light on the performance of electronic voting technology in particular.
color that tends to result from at least some types of paper-based equipment.\footnote{313}

1. Technology and Residual Votes

The measure that empirical researchers generally use to assess voting equipment performance is “residual votes.”\footnote{314} This term refers to the sum of undervotes and overvotes. This metric clearly has its limitations. For one thing, it cannot measure ballots (paper-based or electronic) that are never captured in the first place—for example, voted ballots that are not deposited in the correct ballot box or electronic ballots that are not recorded by the machine.\footnote{315} In addition, this measure does not indicate how many voters mistakenly select the wrong candidate, something that is very difficult to measure without compromising voter anonymity. Finally, some voters in every election, of course, \emph{intentionally} choose not to vote.

Despite its limitations, the percentage of residual votes provides some useful information, particularly in “top-of-the-ticket” races.\footnote{316} In presidential races, the number of intentional non-votes tends to be very small. Stephen Knack and Martha Kropf have estimated that a very small percentage of voters—between 0.23\% and 0.75\%—intentionally undervoted in presidential races between 1980 and 2000.\footnote{317} If that is true, then the vast majority of residual votes in

\footnote{313. Tomz & Van Houweling, supra note 15, at 47.}
\footnote{314. Brady et al., supra note 23, at 8 (internal quotations omitted).}
\footnote{315. One example of the latter is the over 4000 electronic ballots voted in a North Carolina county in the 2004 general election, which were not recorded because the memory on the electronic voting machine was full. More Than 4,500 North Carolina Votes Lost Because of Mistake in Voting Machine Capacity, USA Today, Nov. 4, 2004, at http://www.usatoday.com/news/politicselections/vote2004/2004-11-04-votes-lost_x.htm.}
\footnote{316. By “top-of-the ticket” races, I mean ones—such as presidential and gubernatorial races—that appear at the start of the ballot, as opposed to those further down the ballot. See Brady et al., supra note 23, at 8 (noting that voters are more likely to abstain on races “farther down the ballot” than for those at the “top of the ballot”).}
\footnote{317. Stephen Knack & Martha Kropf, Roll-Off at the Top of the Ballot: Intentional Undervoting in American Presidential Elections, Pol. & Pol'y, Dec. 2003, at 587. Knack and Kropf found little variation in intentional undervoting in the presidential race based on race, ethnicity, and party affiliation. Id. at 580. They did find that older and poorer voters are somewhat more likely to skip the presidential contest, but even for these voters the intentional undervoting rate was 1.54\% or less. Id. While intentional undervotes for president are uncommon, it is more difficult to estimate how many voters intentionally skip down-ballot races. Brady et al., supra note 23, at 9. Even for senatorial and gubernatorial races (in which voters are choosing among the same candidates statewide), it is difficult to say with confidence how many voters are intentionally undervoting, since there has been to date no systematic study of these races similar to that which Knack and Kropf conducted for the presidential contest. For races further “down-ballot”—such as U.S. House of Representatives, state legislative, and local races—the reliability of residual votes is much more problematic, both because of intentional undervoting and because different voters are voting for different candidates in different parts of each state. See id. at 8-9, 48 (noting problems...}
presidential races are not intentional, but instead arise from the failure (either on the part of the voter or the equipment used) to accurately record the voter's intended choice.

Dr. Henry Brady and his colleagues at the U.C. Berkeley Survey Research Center examined the residual vote rates arising from the use of different types of voting systems in California and throughout the country. The Brady study analyzed data from 2219 U.S. counties in the 2000 general election. Brady and his colleagues found that DRE machines, lever machines, optical-scan ballots, and paper ballots all produce significantly fewer residual votes than punch cards. Punch cards had a residual vote rate of 2.64%, compared to 1.68% for DREs, and 1.37% for optical-scan ballots.

The intrastate disparities resulting from the inequalities in voting technology are dramatic. For example, the residual vote rate in Los Angeles County, one of the most racially and ethnically diverse counties in the country, was 2.7% in the 2000 presidential election. By contrast, neighboring Riverside County—which used second-generation DREs of the touchscreen variety in the 2000 election—had a residual vote rate of 0.59%.

In a further effort to test whether the equipment was really responsible for the discrepancies in residual votes, Dr. Brady and his colleagues have also examined what happens when counties move with relying on residual votes in races other than the Presidential election. Accordingly, the rate of unintentional undervoting (and therefore the overall residual vote rate) may vary dramatically for reasons having nothing to do with the equipment used. It is for this reason that empirical researchers studying the performance of voting equipment have focused on presidential residual votes and, to a lesser extent, gubernatorial and senatorial undervotes. For presidential undervotes, the incidence of intentional undervoting is small and does not vary significantly based on the voter's race, or party affiliation. Knack & Kropf, supra, at 580. While the precise level of intentional undervoting has not been studied for gubernatorial and senatorial races, voters are at least choosing between the same candidates in different parts of the state—thereby eliminating the possibility that variations in residual vote rates result from differences in the competitiveness of the race, rather than the voting equipment used.

318. Brady et al., supra note 23.
319. Id. at 1. This study did not look at previous years’ elections because that data could not be thoroughly audited. Id.
320. Id. at 29. For the five general categories of voting equipment, the average residual vote rates were as follows:
   - Punchcards 2.64%
   - DREs 1.68
   - Optical Scan 1.37
   - Lever Machine 1.72
   - Paper Ballot 1.99
Id. As was the case with the Caltech/MIT study, the dataset used by Brady and his associates did not allow first- and second-generation DREs results to be disaggregated.
322. Id.
from one type of equipment to another. Focusing on three California counties that moved from Votomatic-style punch cards to precinct-count optical-scan equipment between 1996 and 2000, Dr. Brady found significant reductions in the residual vote rate within each county. He also found that a California county shifting from central-count optical-scan ballots to touchscreen DRE equipment reduced its residual vote rate by more than half (from 1.21% to 0.59%).

The differences in the 2003 California recall election reveal an even more striking discrepancy between punch cards and other voting systems. On the first ballot question (whether to recall Governor Gray Davis), Dr. Brady found that Votomatic-style punch cards had a residual vote rate of 7.77%, compared to 2.33% for optical scans and 1.34% for electronic voting equipment, in California’s twenty largest counties. Of those twenty counties, all five of the remaining punch-card counties had residual vote rates higher than the counties using other technology. Comparing these residual vote rates to exit polling data, Dr. Brady estimated that at least 176,000 votes were lost due to the continued use of punch-card voting machines. Counties that converted from punch cards to DREs or precinct-count optical scans saw a dramatic improvement. For example, racially diverse Alameda County—which, when it used punch-card machines, had one of the higher residual vote rates in the state—had one of the lowest residual vote rates (0.74%) when it switched to DREs for the 2003 recall election.

323. Henry E. Brady, Initial Declaration of SVREP v. Shelley (Aug. 11, 2003), at http://ucdata.berkeley.edu/new_web/recall/initaclu.pdf. In Fresno County, for example, the average residual vote rate declined from 3.35% to 0.70% after moving from punch cards to precinct-count optical-scan ballots. Brady et al., supra note 23, at 44. Dr. Brady found similar results for two other counties that moved from punch cards to precinct-count, optical-scan systems (Marin and San Francisco). Id. at 7-8.

324. Brady et al., supra note 23, at 44.


326. Brady, supra note 325, at 2.

327. Id. at 1.

328. Id.

329. Materials from Assembly Committee on Elections, supra note 321.

330. Brady, supra note 325, at 2. Another study of the California recall election found evidence that many voters had mistakenly cast votes for the wrong candidate in that election. Thomas Dee found an unusually large number of votes cast for candidates whose names appeared adjacent to the two major candidates (Schwarzenegger and Bustamante), among voters using punch cards. He concluded, based on this evidence, that punch cards increase the rate of voter errors by at least a third. Thomas S. Dee, Do Punch Cards Promote Voter Errors? Evidence from the California Recall Election 2 (2004), available at http://www.swarthmore.edu/socsci/tdeel/Research/bookends0404.pdf.
Other empirical analyses confirm that pre-scored punch cards consistently result in higher residual vote rates than other types of equipment. The General Accounting Office’s (“GAO”) 2001 study yielded results similar to those found by Brady and his colleagues. The GAO concluded that the “type of voting equipment that counties used in the 2000 general election... had an effect on uncounted presidential votes.” While paper ballots, lever machines, optical-scan ballots and DRE machines all had roughly similar levels of residual voting, higher levels were found in punch-card counties. The GAO also found that precinct-count optical-scan equipment with error correction yielded significantly better results than punch-card technology.

In its study of elections between 1980 and 2000, the Caltech/MIT Voting Technology Project likewise found high residual vote rates with punch cards, but found that the residual vote rate for DREs was almost as high. The Caltech/MIT report, however, expressly rejected the conclusion that DRE technology is “inherently flawed and should not be used.” It suggested that the high residual vote rate with DREs may have resulted from the poor user interface with some types of DREs, particularly the earlier “push button” model. In fact, the report noted that, even in 2000, two-thirds of DRE counties were still using first-generation DRE equipment.

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332. Id. at 8.
333. Id. at 3. This is consistent with the results from Florida reported in Professor Schwartz’s article. See Schwartz, supra note 119, at 631-40.
334. See Caltech/MIT, supra note 30, at 21, 23. The Caltech/MIT report found the following residual vote rates in the presidential contests between 1980 and 2000, from highest to lowest:
   - Punch Card 2.5%
   - DRE 2.3
   - Paper Ballot 1.8
   - Optical Scan 1.5
   - Lever Machine 1.5

Id. at 21-22; see also Stephen Ansolabehere, Voting Machines, Race, and Equal Protection, 1 Election L.J. 61, 63 (2002).
335. Caltech/MIT, supra note 30, at 23.
336. Id.
337. Id. at 19-20. A prior report of the Voting Technology Project supports the conclusion that the relatively high rate of residual voting with DREs used from 1980 to 2000 are largely due to the first-generation DREs that were predominantly used in pre-2000 elections. Caltech/MIT Voting Technology Project, Residual Votes Attributable to Technology 11 (2001), available at http://www.hss.caltech.edu/~voting/CalTech/MIT_Research_Report_Version2.pdf. According to a March 2001 report, the residual vote percentages with the four most common systems in 2000 were:
   - Punch Card
     - “Votomatic” 3.0%
     - “Datavote” 1.0
   - Optically scanned 1.2
   - Lever Machine 1.7
Until recently, there was no empirical research disaggregating first- and second-generation DREs. The Berkeley report, the Caltech/MIT report, and the GAO report each group DREs together, presumably because it could not easily be determined from the data whether jurisdictions were using first- or second-generation equipment. And a comparison of how different types of DREs fare is still in a relatively nascent state.

The only available nationwide study to disaggregate different types of DREs and optical scans is an as yet unpublished analysis by Professor David Kimball.\textsuperscript{3} Examining data from the 2002 gubernatorial elections, Professor Kimball found the following residual vote rates:

\begin{itemize}
  \item Punch Card—Votomatic 3.5%
  \item Punch Card—Datavote 2.8
  \item Paper Ballot 2.3
  \item Lever Machine 2.2
  \item Optical Scan—Central Count 2.0
  \item Optical Scan—Precinct Count 1.3
  \item Older DRE (full-face) 2.2
  \item Newer DRE (touch-screen) 1.2\textsuperscript{339}
\end{itemize}

As in other studies, Votomatic-style punch-card voting equipment performed worst, increasing residual votes by 58\% in comparison with central-count optical-scan ballots.\textsuperscript{340} The best-performing equipment, according to Professor Kimball's study, were present-generation DREs, which reduced residual votes by 41\% in comparison to central-count optical scans.\textsuperscript{341} By contrast, first-generation DREs performed

\textsuperscript{3} See Kimball, supra note 22. Professor Kimball’s study examined 1846 counties out of a total of 2184 that cast votes for governor in 2002. \textit{Id.} at 11.

\textsuperscript{339} Id. at 28 tbl. 2. I have omitted the results for "mixed" counties—that is, counties in which more than one type of equipment is used.

\textsuperscript{340} \textit{Id.} at 17-18.

\textsuperscript{341} \textit{Id.} at 13-18.
worse than other voting equipment—including both central-count optical scans and lever machines.342

While further research on this question is necessary, Professor Kimball's analysis highlights the importance of disaggregating different kinds of equipment within the five general categories identified above. Conducting further analyses of this nature, in the 2000 election and beyond, is imperative in order to ascertain just how well each type of equipment performs. But there is at least some evidence to suggest that present-generation DREs fare considerably better than earlier models in terms of reducing the number of residual votes.343

2. Race and Voting Technology

Empirical research conducted since the 2000 election has also examined the racial implications of the use of different voting technologies.344 There are at least two possible ways in which voting technology might interact with race.345 The first is that voters of certain racial or ethnic backgrounds may be more likely to reside in counties using that equipment. Put another way, inferior voting technology may be disproportionately concentrated in counties with larger numbers of minorities. The second possibility is that the use of certain types of voting equipment, such as the punch card, may have a more severe impact on some voters than others. For example, to the extent that people with lower educational or income levels have more difficulty using a certain type of equipment, it may result in a "racial gap" in uncounted votes. I refer to the first issue as the usage of voting equipment, and the second as the impact of voting equipment. Both must be examined, in order to assess whether use of different voting technologies results in the disproportionate loss of votes among people of different races or ethnicities.

342. Id. at 18. Professor Kimball also examined changes in residual vote rates among those counties that changed voting equipment between 2000 and 2002. Unsurprisingly, he found that counties that abandoned their punch-card equipment experienced dramatic reductions in their residual vote rates. See id. at 22. Counties that moved to precinct-count optical-scan or second-generation DRE equipment saw significant reductions in their residual vote rates. See id. at 21. By contrast, those that moved from paper ballots, lever machines, or Datavote punch cards to either central-count optical scans or first-generation DREs actually experienced a slight increase in residual votes. Id.

343. Id. at 28 tbl. 2.


345. See Ansolabehere, supra note 334, at 64-67.
a. The Usage of Voting Technology

On the first question, the available evidence paints a more complicated picture than has often been supposed. It is not, as some commentators have asserted, unambiguously true that racial minorities are more likely to use unreliable voting equipment than are white voters. In his analysis of the 2000 Florida election, Allan Lichtman found that African-Americans were somewhat more likely than whites to reside in counties using inferior voting technologies. This is not, however, the case within all states.

Nationwide, blacks and whites are almost equally likely to use punch-card ballots. Relying on 1998 data, Knack and Kropf found that 31.9% of whites and 31.4% of blacks lived in counties using punch-card equipment. Latinos were more likely to reside in punch-card counties, with 44.3% doing so in 1998. However, they found that this difference was “entirely attributable” to Los Angeles County (home to almost one seventh of the nation’s Latino voters), which eliminated its punch cards effective March 2004. Blacks were somewhat more likely than whites to use electronic voting equipment, who were in turn more likely than Latinos to vote electronically. Therefore, on a national basis, the racial differences in the usage of punch-card and electronic voting equipment are fairly small.

For the purpose of determining whether the usage of different voting technologies has a racial impact, however, the critical question is not whether there are nationwide differences in the usage of different technologies across states. That is because elections, for


347. Lichtman, supra note 104, at 4 (finding that 70% of blacks used punch-card and central-count optical-scan technologies, as opposed to 64% of non-blacks).


349. Id.

350. Id.


352. Id.

353. For a similar conclusion, see Gen. Accounting Office, supra note 331, at 12 (finding that “minorities and persons with lower income were not more likely than others to reside in counties that used punch cards”). Another analysis found some racial differences in the usage of voting technology. Ansolabehere, supra note 334, at 64-68. Professor Ansolabehere found “no apparent tendency for counties with larger minority populations to be less likely to use the latest technology [DREs].” Id. at 66 (emphasis added). But he did find that minority voters were more likely to use punch cards than white voters. Id. at 67. Because counties differ dramatically in population size, “the likelihood that a county uses a technology may not mirror the likelihood that a voter uses that technology.” Id. at 66. Ansolabehere found that 36% of white voters used punch cards, while 44% of non-white voters used them. Id. at 67. Overall, non-white voters were 20% more likely to reside in counties using punch cards. Id.
President as well as lower offices, are conducted within states rather than across states. In the presidential race, the Electoral College system accords a fixed number of votes to each state, which does not depend on how many valid votes are cast. As Knack and Kropf put it, "differences in voting technology that are purely cross-state cannot disadvantage a state's voters relative to other states." What can disadvantage voters are intrastate differences in the equipment used. The critical question, then, is whether there are significant racial differences in the usage of punch cards within particular states, rather than across the several states.

On this point, the evidence shows that voters of color are more likely to use inferior voting equipment in some but not all of the states. Overall, Knack and Kropf found that there were twenty-nine states in which different types of voting equipment, including punch cards, were used within the state. In eleven of those states, blacks were more likely than whites to live in punch-card counties; and in eight of those states, Latinos were more likely than whites to live in punch-card counties.

In some states, the usage of voting equipment shows little variation across racial and ethnic groups. For example, in Ohio, 74.5% of whites used punch cards, compared to 73.8% of blacks and 71.2% of Latinos. But in others, the intrastate racial disparities in equipment

354. See Knack & Kropf, supra note 348, at 545.

355. Professor Ansolabehere suggests that the evidence regarding punch card usage runs contrary to the equal protection arguments made against this type of equipment. Ansolabehere, supra note 334, at 65 (stating that lower usage of punch cards in counties with higher minority populations tends to "run contrary to the premises" of the California litigation, Common Cause v. Jones, 213 F. Supp. 2d 1106 (C.D. Cal. 2001), challenging use of punch cards). But the equal protection claim made in Common Cause and the other ACLU punch-card cases does not depend upon the existence of racial discrimination. Id. at 1108. Instead, the constitutional claim rested on the inter-county disparities arising from the use of punch cards in some counties but not others. Id. at 1107. The other claim made in these cases is that the use of punch cards, made under section 2 of the VRA, does depend on the racial disparities arising from the use of punch-card voting equipment. See id. at 1108, 1110. Section 2 requires a showing that voting practices "result[ ] in" the denial of minority votes, but not on a showing of intentional discrimination. 42 U.S.C.S. § 1973(a) (LexisNexis 2004). This statutory claim, moreover, relies solely on intra-state disparities in the usage of punch-card voting equipment. In particular, plaintiffs in those cases allege that the use of punch cards results in the disproportionate loss of minority votes. Common Cause, 213 F. Supp. 2d at 1108. Thus, the fact that punch cards are not used with more frequency in predominantly minority counties nationwide is irrelevant to the race discrimination claims made in those cases. So too, the existence or nonexistence of intentional discrimination is irrelevant to the section 2 claim.

356. Knack & Kropf, supra note 348, at 545. But see id. (noting also that in eighteen of twenty-nine states, whites were more likely than blacks to live in punch-card counties, and that in twenty-one of twenty-nine states whites were more likely to live in punch-card counties than Latinos).

usage were pronounced. For example, in California (one of the states in which race discrimination claims under Section 2 of the VRA were brought), 80.8% of African-American voters used punch cards, compared to 58.3% of whites and 66.6% of Latinos.\(^{358}\) In sum, the evidence shows that there are some intrastate racial disparities in the usage of voting equipment, though they are far from uniform nationwide.

b. The Impact of Voting Technology

The second way in which voting technology may result in racial disparities is if the same equipment results in more lost votes among some groups than others. On this point, the picture is considerably clearer. The available evidence shows that certain types of voting equipment do generate a significant "racial gap," resulting in more lost votes among non-white voters than among white voters.\(^{359}\) The empirical research also shows that some types of voting technology—including DREs and possibly precinct-count optical scans—can reduce, if not entirely eliminate, this racial gap.\(^{360}\) In short, when it comes to racial disparities, the differential usage of voting equipment is far less important than the differential impact of certain types of voting equipment on people of different races.

As noted above, Allan Lichtman's study for the U.S. Commission on Civil Rights found an especially strong correlation between race and residual voting in counties using punch-card and central-count optical-scan technology.\(^{361}\) Subsequent studies have looked beyond Florida, examining nationwide data in an attempt to assess the racial impact of different voting technologies. D.E. "Betsy" Sinclair and R. Michael Alvarez, for example, examined precinct-level data from Los Angeles County, and concluded that Latino, African-American, and Asian-American voters were all more likely to cast residual votes than white voters.\(^{362}\)

Examining data from the 1996 election, Knack and Kropf found that the level of residual voting tended to rise with the percentage of

\(^{358}\) Id. Although the state-by-state usage of voting equipment is not set forth in the final version of Knack & Kropf's analysis, they are available in an earlier version.\(^{1763}\)

\(^{359}\) See infra notes 364-92 and accompanying text.

\(^{360}\) See infra notes 364-92 and accompanying text.

\(^{361}\) Lichtman, supra note 104, at 4; see also Posner, supra note 102, at 20 ("The choice of some counties of punchcard technology, and of centralized vote counting, not only hurt Gore but hurt him through disenfranchising a disproportionate percentage of blacks who were eligible to vote.").

minorities in a county. However, they also found that "the link between African American population share and voided ballots disappears in counties using types of voting technology that can be programmed to prevent overvoting." Knack and Kropf qualified their analysis, however, to note that because their results were based only on county-level data, it could not be inferred that minorities were more likely to have their ballots voided based solely on their results. It is possible, at least in theory, that the relatively high rate of residual voting in counties with large minority populations could be the result of ballots cast by white voters. Put another way, individual behavior cannot necessarily be inferred from aggregate results—especially when those results come from large and heterogeneous populations, such as those often found at the county level.

Notwithstanding the limitations of county-level data, other social scientists have also attempted to use it in order to estimate the degree to which voting technologies have a differential racial impact. Professors David Kimball, Chris Owens, and Katherine Keeney examined unrecorded votes cast in 2895 counties in 2000, and found results similar to Knack and Kropf's results. In particular, they found that DREs, precinct-count, optical-scan, and lever machines reduced the racial gap as compared to punch cards and central-count optical scans.

Two other studies examining county-level data have yielded somewhat different results. Studies by the GAO and Professor Ansolabehere both found that counties with higher percentages of minorities had higher percentages of residual votes. The GAO was careful to qualify its results, by noting that it had examined only county-level data, which as noted above may obscure the racial impact of voting technology. In addition, both studies attempt to estimate the racial gap in uncounted votes after controlling for factors such as education, poverty, and experience voting. But in the real world, there are differences among racial groups in terms of these characteristics. Accordingly, controlling for these variables in

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364. Id. at 882. This is specifically true for DREs and precinct-count optical-scan equipment. Id. at 892.
365. Id. at 894.
366. Id. Social scientists refer to this problem as the "'ecological fallacy.'" Id. (citation omitted). Nevertheless, although it is theoretically possible that the larger residual vote rates in high-minority counties are caused by non-minorities, Knack and Kropf find this explanation "implausible." Id.
368. Id. at 35.
369. Gen. Accounting Office, supra note 331, at 9-11, 12; see also Ansolabehere, supra note 334, at 64.
conducting a racial analysis may actually obscure the differential impact of voting equipment given the different characteristics that real voters actually have.\textsuperscript{371}

In an effort to more carefully study the interaction between race and voting technology, other studies have undertaken \textit{precinct-level} analyses. Rather than simply examining whether there is a correlation between minority population and residual vote rates across counties, they have examined the correlation across precincts within counties, to determine whether residual vote rates tend to increase with the percentage of minorities. The advantage of this approach is that it helps deal with the ecological fallacy. In addition, these studies have presented their results without controlling for education, poverty, or voter experience. This has the advantage of showing the differential impact that voting equipment actually has in the real world, given the varying degrees of white and minority voters' education, poverty, and voting experience.

In an effort to develop a clearer picture of the relationship between race and residual voting, Michael Tomz and Robert P. Van Houweling conducted a precinct-level analysis of voting technology.\textsuperscript{372} They examined racial disparities arising from the use of different voting equipment, using precinct-level data from South Carolina and Louisiana.\textsuperscript{373} Tomz and Van Houweling found that the incidence of overvotes with both punch-card and optical-scan equipment increased with the percentage of African-Americans.\textsuperscript{374} But when electronic or lever systems are used, the gap in unintentional nonvoting (in other words, those residual votes arising from human error rather than the intent to abstain) disappears almost entirely.\textsuperscript{375} As Tomz and Van Houweling explain: "[T]he black-white gap in voided ballots was substantially lower with DRE and lever machines than with punch cards and optical scanners."\textsuperscript{376} This may be explained by the error-correction protection that DREs have to prevent accidental overvotes and undervotes.\textsuperscript{377} In South Carolina, one of the states examined in their studies, the racial gap with punch-card machines was 4.2\%, and with optical scans it was 6.2\%.\textsuperscript{378} With DRE systems, by contrast, the racial gap dropped to 0.3\%.\textsuperscript{379} Overall, "DRE and lever machines cut [the racial gap in uncounted votes] by a factor of ten."\textsuperscript{380} Tomz and

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\textsuperscript{371} See Tomz & Van Houweling, \textit{supra} note 15, at 49.
\textsuperscript{372} Id.
\textsuperscript{373} Id. at 46.
\textsuperscript{374} Id. at 47 (citing previous studies finding higher rates of residual voting among black voters than white voters).
\textsuperscript{375} Id.
\textsuperscript{376} Id. at 52.
\textsuperscript{377} Id. at 48.
\textsuperscript{378} Id. at 55 tbl. 4.
\textsuperscript{379} Id.
\textsuperscript{380} Id. at 58.
Van Houweling conclude that the small gap that remains with DRE and lever machines (which they estimated at 0.3% to 0.7%) may result from intentional undervoting (choosing not to cast a vote for any office), which African-Americans tend to do at a slightly higher rate than whites. These findings demonstrate that, when it comes to eliminating the racial disparity in uncounted votes, DREs do significantly better than their paper-based counterparts. In fact, DREs "nearly eliminate the difference between black and white [vote] invalidation rates."382

Other studies examining the racial impact of voting technology have likewise found a significant racial gap arising from the use of some paper-based voting equipment.383 Research also demonstrates that the racial gap decreases, in counties that move to electronic voting technology.384 Less clear is whether the use of precinct-count, optical-scan equipment can similarly reduce the racial gap in uncounted votes. Some research tends to show that precinct-count optical scans can reduce the correlation between race and residual votes.385 But Tomz and Van Houweling's examination of counties in which precinct-count optical-scan equipment was used yielded inconsistent results.386

A variety of explanations have been offered for the racial disparity in uncounted votes, including socioeconomic status, educational attainment levels, illiteracy rates, and the quality of poll worker assistance.387 Some have suggested that African-Americans may be less likely than whites to obtain assistance, especially in jurisdictions where there is a history of voter intimidation or harassment.388 Whatever the explanation, there is no question that there is a racial

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381. Id.
382. Id. at 59.
383. See, e.g., Buchler et al., supra note 344, at 517 (finding minority voters less likely than white voters to have their votes recorded correctly with punch cards); Sinclair & Alvarez, supra note 362, at 24 ("Nonwhites have higher residual vote rates, especially when they use punchcard voting systems like 'Votomatic.'").
384. See Brady et al., supra note 23, at 44 (finding a decrease in residual vote rate in a county that moved from central-count optical-scan to touchscreen DRE); Kimball et al., supra note 367, at 35; see also Expert Report of Richard L. Engstrom, Stewart v. Blackwell, No. 5:02-CV-2028, mem. op. (N.D. Ohio Dec. 14 2003) (on file with author) (examining four demographically similar Ohio counties and finding that the one using DREs had significantly fewer uncounted votes than the other three, which used punch cards).
385. See Tomz & Van Houweling, supra note 15, at 49 n.2 (citing studies finding that "correlation between race and invalidation is substantially weaker where voters use precinct-counted optical ballots than where they either use punch cards or centrally counted optical ballots"); see also House Minority Report, supra note 113, at 8 (reporting that the City of Detroit's residual vote rate declined significantly when it moved from punch cards to central-count optical-scan technology); Brady et al., supra note 23, at 44 (finding a decrease in the residual vote rate in a county that moved from punch cards to precinct-count optical scan).
387. Id. at 47.
388. Id.
gap that results from the use of at least some paper-based voting technologies.

Technology is not, of course, the only factor that causes higher residual vote rates among voters of color. Nor can technology improvements alone be expected to eliminate the racial gap in uncounted votes.\textsuperscript{389} The available evidence does, however, indicate that conversion to electronic voting can considerably reduce the disparities that arise from the use of some, if not all, paper-based voting equipment.\textsuperscript{390}

3. Implications of the Empirical Research

The considerable empirical research that has been conducted on voting technology allows the electronic voting debate to be seen in a much different light. While the public discourse has largely focused on the security flaws in electronic voting, this research reveals that second-generation DREs offer considerable advantages when it comes to the equality norms defined above.\textsuperscript{391} Implementation of DRE voting technology thus advances the norm of inter-jurisdictional equality that, as noted above, inheres in the Equal Protection Clause.\textsuperscript{392}

That is not to say that the Fourteenth Amendment commands that counties move to the best available voting technology, particularly given the intense disagreement over what the best available technology is and how it should be measured. As set forth above, the Equal Protection Clause is most plausibly understood as creating a norm of inter-jurisdictional equality when it comes to voting equipment.\textsuperscript{393} But there is more than one way of achieving this objective. In fact, the statewide implementation of any type of voting technology, even the most inaccurate kind, would at least in theory ensure inter-jurisdictional equality because voters in different counties would be treated the same. Thus, a state that used punch cards in some counties but used DREs in other counties could, theoretically, cure this inter-jurisdictional inequality in one of two ways: (1) all counties could convert to punch cards, or (2) all counties could convert to DREs. Few would argue, however, that converting to less accurate voting equipment is a sensible way of remedying an existing inter-jurisdictional inequality. Moreover, there can be substantial inter-county disparities even among counties using the same type of unreliable equipment, depending upon the demographic characteristics of those counties. Accordingly, for states using

\textsuperscript{389} See Lichtman, supra note 104, at 17.
\textsuperscript{390} See supra Part II.B.2.b.
\textsuperscript{391} See supra Part II.A.
\textsuperscript{392} See supra Part II.A.4.
\textsuperscript{393} See supra Part II.A.4.
multiple systems, implementation of DRE voting equipment provides a more plausible means of advancing the norm of inter-jurisdictional equality than converting to less accurate technology.

Georgia’s experience provides a graphic example of how implementation of DREs can advance this equal protection norm. In the 2000 election, Georgia employed a hodgepodge of voting equipment, including punch-card ballots, optical-scan ballots, lever machines, and hand-counted paper ballots. Implementation of DREs dramatically reduced the number of uncounted votes. Statewide, implementation of DRE technology reduced the senatorial residual vote rate from 4.8% to 0.88%. Residual vote rates declined dramatically in the rural and urban counties that had experienced the highest rates of over and undervoting in 1998 and 2000. The consequence of Georgia’s transition to a uniform DRE system statewide was therefore to reduce the inter-county disparities in uncounted votes.

The empirical research also has obvious implications for the norm of racial equality. The evidence shows that implementation of electronic voting can considerably reduce the gap in uncounted votes that paper-based voting equipment tends to produce. Precinct-level studies leave little doubt that, from the perspective of racial equality, DREs are superior to both punch-cards and central-count optical-scan systems. Accordingly, the norm of racial equality as well as the norm of inter-jurisdictional equality supports the implementation of electronic voting or precinct-count optical-scan systems.

C. Technology and Accessibility

In addition to advancing the goals of racial equality and inter-jurisdictional equality, present-generation DRE technology also offers significant advantages over paper-based voting equipment from the perspective of disability and multilingual access. While there has been relatively little empirical research on the accessibility benefits of different voting technology, DREs provide accessibility features that are not available with other types of equipment.

394. Cox, supra note 142.
396. Cox, supra note 142.
397. Id.
398. See id.
399. See supra notes 375-89 and accompanying text.
400. HAVA calls for the EAC and NIST to conduct such research. 42 U.S.C.S. §§ 15381(a)(1), 15383 (LexisNexis 2004).
401. See supra notes 252-57 and accompanying text. Because lever machines are no longer manufactured and paper ballots are ill-suited to all but the smallest counties, I focus on the other three types of machines in the discussion that follows.
From a disability access perspective, contemporary DRE voting machines offer significant advantages. Most important among these advantages is that they allow a secret and independent ballot for people with disabilities.\footnote{See Michael Waterstone, Civil Rights and the Administration of Elections—Toward Secret Ballots and Polling Place Access, 8 J. Gender Race & Just. 101, 104 (2004) (arguing that federal voting rights laws should be interpreted to protect the right of disabled citizens to vote “in the same manner as their fellow citizens”).} Until now, people with disabilities have been forced to rely on friends, relatives, or poll workers to mark their ballots for them.\footnote{See id. at 107.} Voters relate stories of those third parties questioning their choices and even attempting to persuade them to change their minds.\footnote{Id. at 107-08.} To the extent that casting a secret ballot is considered an integral component of the right to vote, the failure to allow secret voting by people with disabilities raises serious equality concerns.

Disability access to the vote may also affect the results of elections. A nationwide Harris poll conducted in 2000 revealed that people with disabilities were 20% less likely to vote than able-bodied Americans.\footnote{Wis. Coalition for Advocacy, Disability Considerations in the Help America Vote Act (2004), available at www.nls.org/conf2004/hava.htm.} The same poll also revealed that people with disabilities favored then-Vice President Gore over then-Governor Bush by an 18% margin.\footnote{Id. at 107-08.} If the turnout for people with disabilities had been equivalent to that of non-disabled voters, then Al Gore would likely have carried Florida and won the election.\footnote{This assumes that Florida’s disabled voters turned out at the same rate as did disabled voters nationally, and that Florida’s disabled voters favored Gore over Bush by the same margin as disabled voters nationally.}

As I have previously stated, electronic voting technology can help accommodate voters with at least three different types of disabilities: (1) visual impairments, (2) cognitive impairments, and (3) manual dexterity limitations.\footnote{Feldman & Hyman, supra note 16, at ii-iv, 28-32, 33-34.} Several DRE models now on the market have an audio capacity for those who are blind or have visual impairments.\footnote{See id. at 6-34 (describing features of currently available DRE systems); Gen. Accounting Office, Voters with Disabilities: Access to Polling Places and Alternative Voting Methods 30 (2001); Waterstone, supra note 247, at 362.} This capacity may also allow independent voting by those with cognitive impairments that prevent them from reading. Some DRE systems also have devices such as a “sip and puff tube” or “jelly switch” that allow people with manual dexterity impairments to cast votes independently.\footnote{See Paul S. Herrnson et al., Characteristics of Contemporary Voting Machines (2003), available at http://www.capc.umd.edu/rpts/md_evote ContempVotingMach.pdf.} They may also be positioned in order to
accommodate people with mobility impairments. Finally, they can be taken outside the polling place for "curbside voting" by those who cannot enter their local polling place, or even to voters’ homes.

Paper-based voting systems, by contrast, do not have an audio capacity, thereby preventing people with visual impairments or those who cannot read from voting independently. Both punch-card and optical-scan systems require that voters be able to hold an object (either a stylus or a pencil) to punch or mark the ballot, preventing people with manual dexterity impairments from voting independently. And paper-based systems may also be more difficult for those with mobility impairments, such as people in wheelchairs, since they require the ability to reach the stylus or pencil and the ballot device.

HAVA recognizes the superiority of DRE systems when it comes to accommodating people with disabilities. As noted above, the law requires that each jurisdiction provide one DRE unit “or other voting system equipped for individuals with disabilities” by January 1, 2006. And as of January 1, 2007, any new equipment purchased with Title II funds must be accessible to people with disabilities.

Optical-scan systems do not, as a general rule, allow independent voting by people with disabilities. Braille ballots are one option, but their capacity to improve accessibility is limited because it is believed only about 10% of people who are blind read Braille. There is a system relying on tactile ballots and audiotapes to accommodate visually impaired voters. While this system, at least in theory,

412. Hollister Bundy, Election Reform, Polling Place Accessibility, and the Voting Rights of the Disabled, 2 Election L.J. 217, 218 (2003); see also Feldman & Hyman, supra note 16, at 27 (describing accessibility features of different DRE models, including whether they allow curbside voting).
414. 42 U.S.C.S § 15481(a)(3) (LexisNexis 2004). Jurisdictions could comply with HAVA’s mandate by moving to a dual system in which one type of equipment is provided for people with disabilities and another is provided to able-bodied voters. As a policy matter, it is dubious whether jurisdictions should implement dual voting systems designating one machine for disabled people and another for all others. It is likely to arouse resentment on the part of non-disabled voters, and will also prevent multiple disabled voters from voting at the same polling place at the same time.
416. Herrnson et al., supra note 410, at 4-10 (listing features of optical-scan and DRE voting equipment, including accessibility features); see also Am. Ass’n of People with Disabilities v. Hood, 310 F. Supp. 2d 1226, 1231 (M.D. Fla. 2004) (describing non-accessible, optical-scan equipment purchased by Duval County, Florida).
417. Feldman & Hyman, supra note 16, at v; see also Gen. Accounting Office, supra note 409, at 36.
418. See Waterstone, supra note 247, at 363. The equipment relies on raised dots that voters feel in order to make their choices. See Global Initiative to Enfranchise People with Disabilities, Best Practices, Ballot Templates, at http://www.electionaccess.org/Bp/Ballot_Templates.htm (last visited Jan. 18, 2005)
allows people with visual disabilities to vote independently, it is time consuming and does not allow them to verify that they have marked their ballots correctly.\textsuperscript{419} One voting equipment vendor, however, is now marketing a machine that it advertises as allowing people with visual and manual impairments to mark ballots independently.\textsuperscript{420} This system is best thought of as a hybrid between a DRE and optical scan. Disabled voters would make their choices through a DRE-like device; the machine would then print a paper ballot, to be read by an optical scanner.\textsuperscript{421} Although a promising technology, this equipment has yet to be implemented in any actual election.

From the standpoint of language access, DREs may also provide significant advantages over their paper-based rivals, although there is a pressing need for further research on this subject. DREs can accommodate multiple languages with relative ease.\textsuperscript{422} As with an ATM, the voter may simply select the language in which he or she wishes to vote at the start of the voting process. The advantage of DREs, in comparison with other systems, is that they allow the non-English proficient voter to cast his or her vote secretly and independently, without relying on assistance from a poll worker or other third party.\textsuperscript{423} With precinct-count, optical-scan equipment, by contrast, the voter may need assistance from a poll worker in determining how to place the ballot through the counter and in determining what should be done, in the event that the counter indicates that there has been an overvote or undervote.\textsuperscript{424}

The opportunity to vote independently can be especially valuable in jurisdictions where immigrant voters may be subject to harassment, intimidation, or simply less-than-hospitable treatment from those working the polls. It may also be useful in those jurisdictions in which there are an inadequate number of poll workers who speak the native language of non-English proficient voters.

\textsuperscript{419} Gen. Accounting Office, supra note 409, at 35-36; see also Disability Rights Educ. and Def. Fund, supra note 413 ("Voters who are blind or have vision limitations that interfere with their ability to read cannot use this voting method [optical scan] either independently or privately.").


\textsuperscript{421} Id.


\textsuperscript{423} See id.

\textsuperscript{424} See also Disability Rights Educ. and Def. Fund, supra note 413 (describing precinct- and central-count optical-scan voting, and noting that optical-scan voting does not allow secret and independent voting for people with disabilities).
In addition, DRE systems would make it more economical for counties to provide multilingual access in situations where they would not be required to do so because DRE systems avoid the costs associated with printing ballots in multiple languages. If, for example, a voting jurisdiction is just below the 5% or 10,000 voter threshold under the VRA, concerned citizens may still ask that the county exceed its minimum obligations under the VRA. This is particularly appropriate in a case where a language minority group, such as Thai speakers, is geographically concentrated within a part of the county. Under these circumstances, it would be much easier for counties using DRE systems to exceed their VRA obligations by providing language accessibility, than it would be for counties using paper-based systems to do the same. DREs avoid the higher printing costs that would be required to provide dual or multi-language ballots with paper-based systems.

That is not to say that jurisdictions that choose to use paper-based voting equipment would be in violation of section 203. It is certainly possible to comply with the mandates of the VRA and HAVA with the implementation of optical-scan ballots. But in terms of promoting the goal of providing equal access to disabled and non-English proficient voters, then, DREs may offer significant advantages.

D. Tallying the Results

The evidence identified above allows for a qualitative comparison of different voting technologies to be made in terms of each of the four equality norms identified above. The chart below assesses the performance of punch cards, central-count optical scans, precinct-count optical scans, first-generation DREs, and second-generation DREs, according to each of these norms. A “+” is used to indicate that the technology performs well in this area, and a “−” to indicate relatively poor performance.

425. See supra Part II.A.
426. Hand-counted paper ballots, lever machines, and Datavotes are omitted due to the limitations of these technologies, which makes jurisdictions unlikely to move to them.
427. “Accuracy” is used as shorthand for the goal of avoiding unintentional residual votes. As noted above, this is different from the goal of inter-jurisdictional equality, which can at least theoretically be achieved through the implementation of any type of voting technology, including ones that are inaccurate. But to the extent that there are differences in accuracy among different types of equipment used within a state, conversion to the more accurate form of equipment provides the more plausible means of remedying this inequality.
This chart is necessarily rough, particularly given the need for further research on the accessibility features of different voting equipment. It nevertheless captures the fact that, as set forth in the preceding discussion, present-generation DREs offer significant benefits from an equality perspective, in comparison to their paper-based rivals.428 Newer DREs and precinct-count optical-scan systems both appear to perform well, in terms of reducing undervotes and overvotes.429 Both these systems may also reduce the racial gap in uncounted votes, although the evidence on precinct-count optical scans is somewhat ambiguous.430 When it comes to promoting disability access, DREs appear to fare better than any paper-based technology. They also have the potential to improve language access.

There is unquestionably a pressing need for further research on how different voting technologies perform with respect to each of these norms, particularly disability access and multi-language access.431 This must include an assessment of how people interact with the technology in real world election environments. Nevertheless, the information presently available indicates that, from the perspective of promoting equality, electronic voting enjoys considerable advantages over existing paper-based technology.

III. SECURITY, TRANSPARENCY, AND ELECTRONIC VOTING

Equality is a central consideration in assessing different voting technology. But it is not the only consideration. This part considers two other democratic values that should also be taken into account in considering voting technologies: security and transparency. It summarizes the concerns of those who have been most critical of

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428. See supra Parts II.B-II.C.
429. See supra Part II.B.2.b.
430. See Tomz & Van Houweling, supra note 15, at 49 n.2, 52 (finding the black-white gap to be substantially higher with electronic and lever machines than with punch card and optical-scan system, but noting other studies finding that precinct-count optical-scan reduces gap).
431. Paul Herrnson and his colleagues with the Center for American Politics and Citizenship are currently undertaking a project, funded by the National Science Foundation, to test the usability of DRE and optical-scan voting equipment, including their accessibility features. See Ctr. for Am. Politics and Citizenship, Univ. of Md., Research on Voting Technology and Ballot Design, at http://www.capc.umd.edu/rpts/VotingTech_par.html (last visited Jan. 18, 2005).
existing DRE technology, as well as the analyses that have been conducted of security vulnerabilities. I then consider the vulnerabilities of paper-based voting, in an effort to provide a comparative perspective on the relative risks associated with different technologies. I conclude that, while there are legitimate reasons to be concerned about the implementation of DRE voting, paper should not be considered the gold standard. In particular, it is questionable whether adding printers to DRE machines is either a workable or effective solution to the vulnerabilities that exist.

A. The Risks of Electronic Voting

1. Two More Democratic Values

In addition to equality, two other democratic values also warrant attention in comparing different types of voting technology. The first is security, which I use here to mean the resistance of votes and vote totals to fraud and other forms of manipulation. This value encompasses a set of related concerns that have been raised about present-generation DRE technology. These include the possibility that malicious code could be inserted into the software to alter the results of an election, that DRE units could be subjected to attacks on the day of the election, and that the vote tallies could be manipulated at the central counting location.\textsuperscript{432} Recent allegations that votes were mysteriously added to George W. Bush's 2004 vote totals in Florida counties using electronic voting have given further fuel to these concerns.\textsuperscript{433} Although these allegations were debunked almost as quickly as they emerged,\textsuperscript{434} serious concerns regarding the security of electronic voting remain.

The second value is transparency, by which I mean the technology's capacity to produce auditable results, in which both candidates and voters can justifiably have confidence.\textsuperscript{435} This value is related to

\textsuperscript{435} A national survey of public attitudes found mixed views when it comes to the integrity of electronic voting. Thad E. Hall & R. Michael Alvarez, Center for Pub. Pol'y & Admin. Univ. of Utah, American Attitudes About Electronic Voting: Results of a National Survey (Sept. 9, 2004), available at http://www.vote.caltech.edu/Reports/fall04survey.pdf. Of those surveyed, 38.3% said they were most comfortable with electronic voting, while 29.5% report that they are
security, insofar as a system that allows for effective auditing will be less vulnerable to tampering. I categorize it as a distinct democratic value to emphasize its importance not only for a voting system to be resistant to manipulation, but also for the polity to have assurance that elections are conducted on the square. It is at least theoretically possible to have a system that is in fact resistant to fraud and error, but which nevertheless fails to provide assurances to citizens that their votes were accurately counted, resulting in a loss of public confidence.

2. Identifying Vulnerabilities

Much has been said about the security of electronic voting technology over the past two years. The concerns arise from the fact that, with contemporary DRE machines, the voter does not see an actual paper ballot but instead an electronic representation of that ballot. The ballot itself is stored in redundant internal locations within the DRE. In this respect, DREs are similar to lever machines, in which voting requires moving “counters” that are not visible to the voter. The difference is that DREs are much more complicated, relying on complex software that only sophisticated technical analysts are capable of understanding. Some have argued that this would make it easier to insert malicious software, such as a so-called Trojan Horse, that could alter election results while escaping detection.

When addressing the security of DRE voting technology, it is important at the outset to identify and differentiate the specific risks that exist. The Hopkins Report and subsequent studies have identified three general areas in which present-generation DREs may be vulnerable to fraud or other forms of manipulation.

a. Insertion of Malicious Code

The first area of vulnerability, which has received the most intensive scrutiny from the technical community, is the code upon which DREs rely. The Hopkins Report itself was based solely upon source code
for Diebold's TS voting machine, which was left on an open website.\textsuperscript{443} The study's analysis concluded that the code had serious flaws that could permit tampering by software developers and others.\textsuperscript{444} The study made certain assumptions (some of which turned out to be incorrect) about how the system would be operated in actual elections.\textsuperscript{445} It nevertheless generated considerable concern that a machine manufacturer or software developer could deliver software to the jurisdiction that is programmed to switch votes to a favored candidate.\textsuperscript{446}

In theory, the software could be programmed to correctly display to voters their choices, but record their choices differently. For a voter intending to vote for Bush, for example, the screen that appears at the end of the voting process would display the voter's intended choice, but could be programmed to switch every fifth Bush vote to a Kerry vote in the redundant internal memory. Due to the length of the source code, some technologists argue, such malicious code might not be detected before an election.\textsuperscript{447} Some have warned that malicious source code might be hidden to avoid detection even after an election.\textsuperscript{448} Through this means, some computer scientists hypothesize, an election could be "stolen" without anyone knowing it.\textsuperscript{449}

b. Attacks on Individual Machines at the Polling Place

The second category of vulnerability is that individual DRE units could be subjected to an attack, before or during an election.\textsuperscript{450} This was one of the principal vulnerabilities upon which the Hopkins Report focused. Such an attack could be as crude as taking a sledgehammer to the voting machine or, somewhat more plausibly, attempting to open the machine by force.\textsuperscript{451} An attack on individual machines might also be accomplished through more subtle means. As noted above, present-generation DREs are typically activated by inserting a credit card-sized "smartcard" into the voting unit, which in turn causes an image of the ballot to be displayed upon the screen.\textsuperscript{452} The Hopkins Report raised the possibility that voters could "homebrew" smartcards and use them

\textsuperscript{443} Kohno et al., supra note 77, at 4.
\textsuperscript{444} Id. at 21.
\textsuperscript{446} Shamos, supra note 432, § 1.2(4).
\textsuperscript{447} See Fischer, supra note 27, at 13.
\textsuperscript{448} See Shamos, supra note 432, § 1.2(4).
\textsuperscript{449} Id.
\textsuperscript{450} Id. § 1.2(2).
\textsuperscript{451} Id. § 1.2(1).
\textsuperscript{452} See supra notes 78-79 and accompanying text.
in the voting terminal.\textsuperscript{453} This would, in theory, allow the attacker to cast multiple votes without detection.\textsuperscript{454}

The report also raised the possibility that an attacker could homebrew "administrator" cards, which would give access to the unit's controls.\textsuperscript{455} This would allow the attacker to incapacitate the machine and, again theoretically, shut down polling places. While access to administrative controls requires a personal identification number ("PIN"), the Hopkins Report asserted that this number could easily be ascertained by anyone who knew the system's protocol.\textsuperscript{456}

c. Tampering with Election Results

The third area of vulnerability is on the back-end of elections, after the votes have been cast but before they are tallied. The Hopkins Report suggested that votes stored on individual DRE units would be transmitted from the polling place to a central location over a network connection or through the internet.\textsuperscript{457} The report identified the possibility that an attacker might "inject fake votes to a back-end tabulating authority by impersonating a legitimate voting terminal."\textsuperscript{458} By so doing, the attacker could either alter existing votes or create new ones.\textsuperscript{459} Thus, even though the vote was correctly recorded by the machine, erroneous votes might be transmitted to the jurisdiction's central counting location, thereby resulting in alteration of the election results.\textsuperscript{460}

3. Analyzing Vulnerabilities

The source code used by DREs is, of course, only one component of the machine. Moreover, the machine itself is just one component of the larger election system within which it operates. An analysis of the security risks with DREs (or, for that matter, any other voting technology) therefore cannot be understood in isolation from this system, of which the hardware and software is only a part.\textsuperscript{461}

In July 2003, the California Secretary of State released a task force report, which found that "in theory, there is a possibility of a security threat with DRE voting equipment."\textsuperscript{462} While the task force was unanimous in finding that there was "no proven instance of such an attempt at fraud" in the years that DRE equipment had been in use,

\begin{thebibliography}{99}
\bibitem{453} Kohno et al., \textit{supra} note 77, at 9-10.
\bibitem{454} \textit{Id.} at 10.
\bibitem{455} \textit{Id.} at 10-11.
\bibitem{456} \textit{Id.}
\bibitem{457} \textit{Id.} at 12.
\bibitem{458} \textit{Id.} at 15.
\bibitem{459} \textit{Id.}
\bibitem{460} See Shamos, \textit{supra} note 432, § 1.2(3).
\bibitem{461} See Saltman, \textit{supra} note 71, at 3.
\bibitem{462} Shelley, \textit{supra} note 17, at 18.
\end{thebibliography}
some members of the task force believed that there was a high risk of attack.463 The task force report included a number of recommendations on how DRE security should be improved.464 It recommended that some sort of voter-verifiable audit trail should be required for machines purchased as of 2007. However, the task force majority did not recommend that a voter-verifiable paper audit trail be required, recognizing instead that there might be other means by which to audit election results, and thereby ensure transparency.465

Prompted by the Hopkins Report, Maryland commissioned Science Applications International Corporation ("SAIC") to conduct a risk assessment report of Maryland's Diebold AccuVote TS system (the "SAIC Report").466 SAIC found that many of the statements made in the Hopkins Report were technically correct, but that its authors lacked a thorough understanding of the environment in which the equipment was to be implemented.467 In particular, the Hopkins Report did not take into account the procedural controls followed in running a real-life election.468 The Hopkins Report also raised the possibility that "voting terminals could potentially communicate over insecure phone lines,"469 when in fact the DRE units in Maryland are not attached to the network.470 Notwithstanding the counterfactual assumptions of the Hopkins Report's analysis, the SAIC report found several flaws in the Diebold system.471 It also recommended a number of measures to reduce the security risks associated with the Diebold system.472

463. Id.
464. Among the California task force's recommendations were: (1) improvement of federal testing standards and procedures, (2) enhancement of the state certification process, (3) random audits of machines to check the software code, (4) parallel testing of machines, (5) improved logic and accuracy testing, (6) tightly controlling system software, (7) requiring background checks of vendors, and (8) providing a "review screen" on all DREs for voters to check their votes. Id. at 30-36.
465. Id. at 36-46.
466. SAIC Report, supra note 445.
467. Id. at 9; see also RABA Innovative Solution Cell, Trusted Agent Report: Diebold AccuVote-TS Voting System 7-9 (Jan. 20, 2004) [hereinafter RABA Report].
468. For example, the Hopkins Report expressed concern about the possibility that smartcards used to operate DRE machines would be sent through the mail, which they are not. SAIC Report, supra note 445, at B-6; see also id. at III ("The State of Maryland procedural controls and general voting environment reduce or eliminate many of the vulnerabilities identified in the Rubin report."). After working as a poll worker in a Maryland county, one of the Hopkins Report's principal co-authors has since acknowledged that using homebrewed smartcards to cast multiple votes is unlikely to occur without being detected, given the procedures followed there. See Avi Rubin, My Experience As an Election Judge in Baltimore County, at http://avirubin.com/judgel.html (Mar. 2, 2004).
469. Kohno et al., supra note 77, at 4.
471. Id. at III.
472. Id. at IV-V. The recommendations included: (1) bringing the system into compliance with existing state security standards, (2) applying cryptographic protocols to protect vote tally transmissions, (3) establishing a formal process for the
Maryland subsequently commissioned a second report, authored by RABA technologies ("RABA Report"). For the RABA Report, a "red team" of computer experts were given access to DRE voting units and allowed to experiment with a variety of attack scenarios. This report thus focuses on the second type of security vulnerabilities identified above. Like the SAIC Report, the RABA Report found that Diebold's DRE system was subject to several vulnerabilities, including: (1) duplication of smartcards and supervisor cards, (2) opening up the machines to access the hardware and software components used to register votes, (3) removal of the memory card used to record voters' cast ballots, and (4) using a disabled access card to "crash" a DRE terminal. The RABA Report also identified vulnerabilities in the software used to collect and tally precinct results.

The likelihood of such an attack in an actual election nevertheless remains the subject of intense disagreement. This is partly because the RABA Report, while avoiding the mistaken assumptions set forth in the earlier Hopkins Report, had an open access to DRE machines that is unlikely—if not impossible—in a real election if proper procedures are followed.

In a paper assessing the relative risks of paper and electronic voting records, Professor Michael Shamos of Carnegie Mellon University's computer science department examines each of the three categories of security vulnerabilities identified above. He concludes that while the hypothesized threats are not beyond the realm of possibilities, precautions can be taken—and at least in some cases are already being taken—that considerably lessen the likelihood of their occurrence. Thorough testing of both hardware and software can decrease the likelihood of malicious sources being used to alter votes. Professor Shamos also notes that contemporary DREs store ballot images both within the machine and on redundant memories, in individual modules that can be transported. For this reason, an attack on the transmission of data from precincts to a central-count

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473. RABA Report, supra note 467.
474. Id. at 16.
475. Id.
476. Id. at 16-20.
477. Id. at 20-22.
478. See Rubin, supra note 468.
479. See supra Part III.A.2. (identifying the three categories).
480. Shamos, supra note 432, § 1.2.
481. Id. §§ 3.1-3.6.
482. Id. §§ 1.4, 3.5.
483. Id. § 1.2(3).
location is unlikely to be successful, given that the electronic ballots are already sorted in redundant locations. While no one suggests the use of DREs is free from risk, procedural safeguards can reduce the possibility of attacks occurring in real world elections.

At the same time, the lack of auditing transparency creates a legitimate concern. Even if the machines are resistant to fraud and other forms of manipulation, it is important that voters be provided with reasonable assurance that their votes will be counted accurately. This does not mean that they must understand the inner workings of the machine. If that were the standard, then no system ever developed would be satisfactory because voters may well be unfamiliar with precisely how voting systems operate. For example, prior to the 2000 election, it is doubtful that many citizens had much understanding of the process by which votes are counted. What it does mean is that the voting system should be reasonably open to public scrutiny, so that the process through which votes are cast and counted remains accountable to the citizenry.

B. Is Paper the Answer?

The flurry of attention to DRE security has caused many advocates to call for a "voter-verified paper audit trail," prompting bills to mandate this device in both the House and the Senate. HAVA already requires that voting machines produce a permanent paper record that can be used in the case of manual audits. The new legislation, however, would go further, requiring attached printers that would generate a paper replica of the electronic ballot at the time of voting—the contemporaneous paper record—which the voter could review before casting his or her vote.

While the goals of security and transparency are vital, it is questionable whether the contemporaneous paper record is a workable or effective solution to the legitimate concerns that exist regarding present-generation DRE technology. As set forth below, there are three problems with the argument to require a contemporaneous paper record. First, it relies on the false assumption that paper-based systems are inherently more accurate and reliable than paperless ones. Second, it disregards both long and recent experience demonstrating the vulnerability of paper-based systems to fraud and error. Third, it fails to comprehend the practical problems in actually implementing a system that is capable of printing out a

484. Id.
contemporaneous paper record, yet preserves voter privacy and election security.

1. A Comparative Perspective

What has largely been missing from the voting technology debate is a comparative assessment of the relative risks and benefits of different voting technologies. Just as the public discourse has largely overlooked the comparative benefits of DREs, in terms of advancing voting equality, it has also failed to examine the comparative risks of DREs compared with paper-based systems.

A published opinion of the U.S. Court of Appeals for the Ninth Circuit properly recognizes the importance of a comparative analysis when considering the risks of voting technology. In Weber v. Shelley, the court rejected a constitutional challenge to the use of DRE equipment that did not generate a contemporaneous paper record.\textsuperscript{488} In support of the argument that paperless DREs denied her voting rights, the plaintiff submitted declarations from leading supporters of the contemporaneous paper record requirement.\textsuperscript{489} The Ninth Circuit concluded that the plaintiff had raised "at most a hypothetical concern about the ability to audit and verify election results."\textsuperscript{490} Completely absent from the plaintiff's evidentiary case, including her expert declarations, was any indication that the paperless DRE was "inherently less accurate, or produces a vote count that is inherently less verifiable, than other systems."\textsuperscript{491} What was missing, in other words, is any evidence showing that DREs are comparatively less accurate or reliable than other systems. The opinion proceeded to note that no voting system is perfect, and that the "unfortunate reality is that the possibility of electoral fraud can never be completely eliminated, no matter what type of ballot is used."\textsuperscript{492}

That is not, of course, to say that paperless electronic systems are without risks. In arguing that DRE voting technology should be required to generate a contemporaneous paper record, DRE skeptics have pointed to a number of problems that have emerged in the implementation of electronic voting. These include: (1) voters being given incorrectly coded smartcards, causing the wrong ballot to be brought up on the screen, (2) the machine used to encode smartcards not functioning properly and thereby causing delays in polls opening, and (3) discrepancies between the number of voters signing in at the polling place and the number of ballots recorded.\textsuperscript{493}

\textsuperscript{488} Weber v. Shelley, 347 F.3d 1101 (9th Cir. 2003).
\textsuperscript{489} Id. at 1105.
\textsuperscript{490} Id. at 1103.
\textsuperscript{491} Id. at 1105.
\textsuperscript{492} Id. at 1106.
\textsuperscript{493} See Brief of Amicus Curiae Electronic Frontier Foundation et al. at 3-8, Stewart v. Blackwell, No. 5:02CV-2028 (N.D. Ohio Aug. 5, 2004) (itemizing alleged
The significance of the problems that have occurred in the implementation of DRE systems should not be minimized. At the same time, such difficulties in the implementation of voting technology must be distinguished from the concerns of attacks upon the machines (for example, through the insertion of malicious source code). Requiring a contemporaneous paper record would do nothing to address the implementation difficulties that have marred the introduction of electronic voting in some jurisdictions. Moreover, as explained below, it is far from clear that adding paper to the voting process would effectively address the security vulnerabilities of DRE voting technology.

2. Historical Problems with Paper

Even the most vigorous critics of DRE technology acknowledge that paper ballots are susceptible to manipulation. As Professor Shamos notes, "[e]very form of paper ballot that has ever been devised can and has been manipulated, in general with considerable ease." Fraudulent manipulation of paper ballots stretches back to the use of hand-counted paper ballots.

Among the most famous voting incidents of the last century was Lyndon B. Johnson's 1948 election to the U.S. Senate. Several days after the election, in what was still a neck-and-neck race, 203 additional votes (202 of them cast for Johnson) were found, giving the election to Johnson by a margin of eighty-seven votes statewide. The court reports, history books, and newspapers are filled with similar accounts of paper ballots being manipulated. While the following list is not intended to be comprehensive, it illustrates the types of problems that have occurred with paper ballots:

In *Ex parte Siebold*, an 1879 Supreme Court decision, the Court let stand fraud convictions for placing extra ballots in a ballot box during the 1878 Maryland congressional election.

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495. Shamos, *supra* note 432, § 2.3.

496. In New York City's 1844 election, for example, some 55,000 people cast ballots, despite the fact that its entire voting pool consisted of 41,000 people. Larry J. Sabato & Glenn R. Simpson, Dirty Little Secrets: The Persistence of Corruption in American Politics 276 (1996).

497. *Id.* at 278.

In a 1937 decision by a federal district court in Missouri, testimony revealed that clerks and judges had altered more than one hundred ballots in a Kansas City precinct.\textsuperscript{499}

The U.S. Supreme Court in \textit{United States v. Saylor} upheld convictions arising from the 1942 Kentucky senatorial election for tearing unvoted ballots from the official ballot book and stub book, and inserting the false votes into the ballot box.\textsuperscript{500}

Court decisions during the 1970s report ballot recount ballot-box stuffing in various states, including West Virginia, New Hampshire, and Illinois.\textsuperscript{501}

Chicago's 1982 mayoral race, during which there were over one hundred incidents of voting irregularities, including ballot spoilage, pre-marked ballots, disparities in the number of votes cast, double voting, and election judges punching straight party tickets before voting.\textsuperscript{502}

In Philadelphia's 1993 election for a state senatorial seat, fraudulent absentee ballots were cast by one side's campaign, including 600 absentee ballots cast after the deadline by people who were not registered.\textsuperscript{503}

During a 1994 election for Chief Justice of the Alabama Supreme Court, ballot boxes were missing, seals on vote containers had been broken, and ballot boxes were left open in unwatched public rooms.\textsuperscript{504}

Nor can security breaches with paper-based voting be dismissed as a thing of the past. Even aside from Florida's experience in the 2000 election, numerous incidents of fraud or error with paper ballots have been reported in the past four years:

In New Mexico's 2000 presidential vote, some 252 early-voting ballots were reported missing and another 1300 to 1600 "damaged votes" were rejected because of stray marks or other problems.\textsuperscript{505}

\begin{itemize}
\item \textsuperscript{499} United States v. Clark, 19 F. Supp. 972, 973 (W.D. Mo. 1937).
\item \textsuperscript{500} United States v. Saylor, 322 U.S. 385 (1944).
\item \textsuperscript{502} The Need for Further Federal Action in the Area of Criminal Vote Fraud: \textit{Hearing Before the Subcomm. on the Constitution of the Senate Comm. on the Judiciary}, 98th Cong. 75-79 (1983); see also United States v. Olinger, 759 F.2d 1293 (7th Cir. 1985) (upholding convictions for election fraud in the 1982 Chicago election).
\item \textsuperscript{503} Sabato & Simpson, \textit{supra} note 496, at 278-83; see also Marks v. Stinson, No. 93-6157, 1994 U.S. Dist. LEXIS 5273 (E.D. Pa. Apr. 26, 1994).
\item \textsuperscript{504} Sabato & Simpson, \textit{supra} note 496, at 283-88.
\item \textsuperscript{505} Leslie Hoffman, \textit{Gore's Lead Plummet in New Mexico}, Albuquerque Trib., Nov. 10, 2000, at A1.
\end{itemize}
During a 2000 election in Benton County, Arkansas, a ballot box was "misplaced," only to reappear after some twelve hours with its label peeled off and the box wet from sitting out in the overnight rain.\textsuperscript{506}

The City of San Francisco has had a sordid history of election problems, which includes eight ballot-box lids found floating in the San Francisco Bay and 240 uncounted ballots found stuck in machines in the 2001 election.\textsuperscript{507}

In a 2002 Illinois assembly election, ballots cast in one of the precincts could not be located at all, causing the trial judge to order a new election.\textsuperscript{508}

In Broward County, Florida, a box containing 268 unopened ballots was found in a file cabinet approximately four months after the September 2002 election.\textsuperscript{509}

Early in 2004, in Hamilton County, Tennessee, a box of 189 ballots went uncounted and another 2591 ballots were not included in the final election tally.\textsuperscript{510}

The point of this list is not to demonstrate that paper-based voting equipment is inherently insecure. Instead, the purpose of providing this non-exhaustive list of examples is to demonstrate that no form of technology—either paper-based or electronic—is immune from fraud and error. At the very least, the examples should caution against assuming that a paper replica of the electronic ballot will ensure security and transparency.

3. Problems with the Contemporaneous Paper Record

Largely overlooked in the debate over whether to require that DREs print out a contemporaneous paper record are the practical difficulties in making such a system work. The limited experience that exists with the contemporaneous paper record thus far reveals serious questions about (1) whether it is a practicable solution, and (2) whether it is an effective means of preventing fraud, and thereby promoting the values of security and transparency.

\textsuperscript{506} Laura Kellams & Kirstan Conley, Little Flock's Vote Box Misplaced for 12 Hours, Wet Label Peeled Off Container, Delayed Count, Ark. Democrat-Gazette, Nov. 9, 2000, at A1.

\textsuperscript{507} San Francisco Finds Ballots in Machines, N.Y. Times, Nov. 30, 2001, at A18.

\textsuperscript{508} Graham v. Reid, 779 N.E.2d 391 (2002). Although there was no dispute as to the missing ballots, the appellate court reversed the order for a new election. Id.

\textsuperscript{509} Scott Wyman, Oliphant Fires Another Staffer; Elections Chief Hires Accounting Firm, Sun-Sentinel (Ft. Lauderdale, Fla.), Oct. 9, 2003, at 1B.

\textsuperscript{510} Andy M. Drury, Election Records Unsealed; TBI Probe Continues, Chattanooga Times Free Press, Apr. 8, 2003, at B1.
a. Practicability

The anonymity required in the process of voting makes the implementation of a paper ballot printout more complicated than an ATM transaction, to which it has often been compared. The purpose of an ATM receipt is to provide the voter with a record of the transaction that he or she may take away. By contrast, the purpose of the “voter-verified paper audit trail” (as the name suggests) is to provide an audit trail for election officials that can be used to reconstruct voters’ intended choices and to compare them to the electronic record. In order to preserve the integrity of that audit trail, the printed paper record must be generated in such a way that the voter can see it but not touch it.

This is also necessary, in order to prevent voters from walking off with the paper copies of the electronic ballot—which could then be used in vote buying schemes, compromising the integrity of elections.\footnote{See Ted Selker & Jon Goler, Security Vulnerabilities and Problems with VVPT 2 (Apr. 2004), at http://www.vote.caltech.edu/Reports/vtp_wp13.pdf (Apr. 2004) (VTP Working Paper).} It is therefore incorrect to refer to the paper record generated by DREs as a “receipt,” since the voter does not actually receive a copy of the paper record. Instead, in the most commonly discussed model, he or she would view it behind glass or a screen—which allows the paper record to be seen but not touched.\footnote{See id.}

The experience of jurisdictions that have attempted to implement DREs capable of generating a contemporaneous paper record illustrates the practical difficulties inherent in making such a system work in a real world election. Introducing an additional piece of equipment can complicate the voting process, resulting in confusion on the part of both voters and poll workers. The contemporaneous paper record has proven to be no exception. And as described below, the device has proved problematic at best in jurisdictions that have attempted to use a contemporaneous paper record system on a limited basis.

Sacramento County, California used DREs with attached printers for early voting in its 2002 election. While voters in Sacramento reacted favorably to touchscreen voting, as have voters in other jurisdictions, “[a]dding a printer and paper to the voting process was a challenge.”\footnote{Memorandum from Ernest Hawkins, Registrar of Voters Sacramento County, to Bob Jennings, Chairman, Voting Systems and Procedure Panel, Early Voting Using the Avante System (Nov. 15, 2002) (on file with author).} As the Sacramento registrar explained:

It was new for the voter and some did not even want to see the printed record. Some voters liked the option of reviewing the printed record, some did not care and some did not want to take the
extra seconds to see it. It was confusing for some because they thought they could take it with them.

If the printed record jams, the machine is out of service until someone can take care of the problem. A few times when the printed record stuck they had to be extracted with many creative tools that were on hand at the early voting site such as a windshield wiper or back scratcher.

The voter viewed the printed record through a plastic shield on the front of the machine. Voters complained that it was difficult to read because of the length of the ballot, size and darkness of the print and the location of the shield. Most voters wanted to remove the paper copy and check it out before it went back into the machine.

There was concern that the machines would have problems storing the voter's printed receipts. It was decided to empty the tray every ten voters. This procedure was stopped. The machines must not be opened during the day to empty the tray.

Sacramento's experience highlights the practical difficulties in implementing a DRE system capable of generating the voter-verifiable paper trail. Even when used in early voting—which includes a much smaller number of voters than in a regular election and can be conducted in a more controlled location—practical impediments to effective implementation emerged, including: (1) voters trying to take the paper records with them; (2) printed ballot replicas being removed from the tray where they are held; (3) voter privacy being compromised when the tray is opened during the voting day; (4) voters declining to review the paper records before casting their votes; (5) printers jamming; (6) scarce polling place resources being consumed by fixing printer jams; (7) difficulty reading paper ballot records; and (8) voter confusion.

A contemporaneous paper record system was also tested on a limited basis in Wilton, Connecticut's November 2003 election. After that election, the deputy registrar commented that the "ease of use and human factors... are appalling." The voting system created "numerous problems for the voters and placed great stress on the poll workers."

While some of these difficulties may ultimately be resolved through refinement of the machines and voter experience, there can be little doubt that adding a printer would place an additional strain on poll worker resources, and thus strain this component of our election systems even further. Reports published in the wake of the 2000

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514. Id.
515. Id. at 2-3.
517. Id.
election document that poll worker resources in many communities, especially urban ones, are already stretched thin.\textsuperscript{518} Adding on another piece of equipment that poll workers (many of them elderly) will have to deal with can be expected to complicate the election process.

A recent paper by Ted Selker and Jon Goler of MIT assesses the practical problems with the contemporaneous paper record.\textsuperscript{519} They find that:

\begin{quote}
[The contemporaneous paper record] complicates two of the top three problems that have compromised more than one percent of American votes in 2000: equipment problems and polling place operations. It complicates the setup, teardown, and operation of the ballot place. It complicates polling place procedures during the vote. It gives extra and difficult tasks for a person to do and increases the problems with the user experience and the user interface. It also increases the length of time of voting, which makes it, with more steps, easier to make mistakes.\textsuperscript{520}
\end{quote}

Implementation of the contemporaneous paper record is thus considerably more difficult than some advocates’ public statements might suggest. The difficulties relate not only to costs, for which no reliable estimates are available, but also to the practical imperatives of election administration. While touchscreens are sometimes compared to ATM machines, ATMs need not be transported to and from hundreds of precincts each election day. Voting machines must be transportable. When they break, longer lines at polling stations will result. As numerous reports since the 2000 election have documented, the nation’s polling places are dramatically understaffed, often by elderly poll workers.\textsuperscript{521} Requiring the transportation and implementation of an add-on device would considerably complicate an already complicated process, and further deplete already scarce poll worker resources. Worse still, because of the practical difficulties and uncertain costs of implementing touchscreens with a contemporaneous paper record that is accessible to people with disabilities and language minorities, the likely result of imposing such a requirement is to force counties to stick with inferior paper-based systems such as the discredited “hanging chad” punch card.

This does not mean that the contemporaneous paper record is unworthy of further experimentation. Nevada, for example, experimented with a contemporaneous paper record system in the 2004 election.\textsuperscript{522} While some early reports on the use of this

\begin{footnotes}
\item[518] See House Minority Report, supra note 113.
\item[519] See Selker & Goler, supra note 511.
\item[520] Id. at 8.
\item[521] Caltech/MIT, supra note 30, at 33.
\end{footnotes}
equipment have been favorable, election officials continue to express serious doubts about whether the contemporaneous paper record will function effectively—particularly in urban areas where there are insufficient poll worker resources.  It thus remains uncertain at best whether the contemporaneous paper record is a workable solution to the vulnerabilities that have been identified with DRE technology.

b. Efficacy

The argument that the contemporaneous paper record would serve as an effective means of policing fraud and error depends upon the electronic vote tallies being checked against the paper copies of ballots in a recount. Two states that have enacted VVPAT legislation (California and Ohio) have proposed standards providing that, in the event of a discrepancy between the paper and electronic record, the paper record will govern. The idea behind this requirement, presumably, is to provide assurance against tampering with the electronic record. Yet the belief that the contemporaneous paper record is to provide an effective check against possible foul play necessarily rests on three assumptions: (1) some form of recount will actually be conducted, (2) voters will actually check and thereby “verify” the accuracy of the paper records, and (3) the integrity of the paper record will be preserved from the time it is generated until the time it is counted, to ensure that it does indeed provide a reliable record of voters’ intended choices—or at least more reliable evidence than the electronic record. All of these assumptions are open to question.

It is not clear, as an initial matter, that recounts will serve as an effective check on DRE security—and therefore that they will do much to improve transparency—in real world elections. For the contemporaneous paper record to serve as an effective check on DRE security, a recount must actually be conducted. In fact, very few states have laws requiring even limited manual recounts, unless the election is very close or a candidate or voter requests it (often at their own expense). As the chart displayed in Appendix B shows, only four states’ laws require automatic recounts. For example, in Maine, a
recount is triggered where the margin of victory is less than 1%. If the hypothetical hacker were clever enough to insert malicious code into DREs, it is logical to assume that she would also be clever enough to ensure that the number of votes altered is large enough to avoid triggering an automatic recount—or even suspicion of wrongdoing that would lead to a candidate-initiated recount.

Even in those states where an automatic recount is required, regardless of whether the election is close, that recount is unlikely to serve as an effective check on manipulation of the type that has been hypothesized, given that even those states that require a recount only require a partial recount of voted ballots, which is unlikely to detect manipulation of the results. California, for example, has a law requiring a manual recount of 1% of voted precincts. Such a limited manual recount will provide little assurance that the election was conducted fairly. In a congressional race, a full recount of at least 250 precincts would be required to verify accuracy at a 90% confidence level (and even then, it would only do so with a 1.2% error margin). Thus, unless jurisdictions are prepared to conduct a manual recount of some significant portion of the paper records on a routine basis, something that no one seriously advocates, the contemporaneous paper record will not provide an effective check on electronic voting results in close elections. It is also open to question whether electronic records will be more accurate than the electronically voted ballots, given the likely prospect that printers will sometimes fail and the vulnerability of paper ballots to fraud and error.

The SAIC Report addresses the contention that a voter-verifiable audit trail would solve the DRE security problem. The Hopkins Report asserted that “the best solution[]” to the asserted flaws in DRE systems is the introduction of “a ‘voter-verifiable audit trail.’” But as the SAIC Report correctly notes, “a printed paper ballot would still be subject to fraud.” Assuming the machines were rigged, a voter-verifiable paper trail would do little to solve the problem:

A compromised machine could be programmed to record votes incorrectly, but provide a correct paper ballot to the voter. Only in the event of a total recount would this be discovered. Additionally,
the process of hand counting the millions of votes is time consuming and is prone to error.\textsuperscript{533}

Roy Saltman likewise concludes that it would be an error to assume that a paper trail is an effective solution for the problems that may occur with DRE voting technology:

If the intention of a printout from a DRE machine is to give the voter a sense of confidence that his or her vote was properly cast and properly processed, that confidence would be false. Due to the fact that the printout is created by the computer and is not a document-ballot, such a printout is a sop to the layperson ignorant of the inner workings of the computers.\textsuperscript{534}

Nor is there any reason to believe that voters would actually check to determine whether the paper record accurately records their intentions. This would be extremely difficult with the contemporaneous paper record technology now being made available because it could generate printouts as long as fifty-seven inches in jurisdictions with a large number of items on the ballot. Saltman notes that, while a working DRE that incorporates a contemporaneous paper trail might be developed, such a solution would necessitate attaching a printer to each terminal and would “negat[e] the value of a DRE because it uses paper ballots.”\textsuperscript{535}

Electronic voting critics have pointed to problems that have occurred in the implementation of electronic voting in some jurisdictions. But the contemporaneous paper record would do little to remedy most of the problems that have actually occurred. For example, in the March 2004 election, three California counties (Alameda, Orange, and San Diego) experienced problems in the implementation of new electronic systems.\textsuperscript{536} The contemporaneous paper record would not have done anything to prevent the sort of

\textsuperscript{533} Id. at B-2.
\textsuperscript{534} Saltman, supra note 71.
\textsuperscript{535} Id. at 4-5. He proceeds to suggest other, more viable alternatives to a contemporaneous paper trail, including recording of the votes on a removable diskette for use in the event of recounts, reconciliation of votes and overvotes, providing an opportunity for the voter to review his or her choices, more thorough testing of hardware and software, and an audit trail for software handling as possible solutions. Id. at 5-7.
problems that occurred in these three counties. In Orange County, some voters were given the wrong smartcard, causing the wrong electronic ballot to be displayed. A paper copy would not have solved this problem, but would only have replicated it. So too, the difficulties encountered in Alameda and San Diego counties with Diebold's system could have been avoided through better procedures—in both counties, the precinct-control modules ("PCMs") used to encode smartcards reportedly failed to boot properly. Had poll workers been trained on the relatively simple "four-click" process for bringing up the correct screen, the problem encountered could quickly have been corrected in a matter of minutes. A contemporaneous paper record requirement, on the other hand, would not solve these problems.

C. Alternatives to Paper

The present answer to the question of whether paper is the solution must therefore be "no"—or at least not clearly "yes." That is not, however, to deny that it is vital to address the vulnerabilities of election systems relying on DRE technology. While a thorough exploration of the alternative means to improve DRE security and transparency is beyond the scope of this Article, some of the most promising proposals are summarized below, listed roughly in order of ease of implementation. Those that could be implemented now with relatively little disruption of existing election systems are listed first, with changes that would require more substantial modifications to existing election ecologies listed later.

1. Tighter Procedures

Among the changes most likely to enhance security and transparency are improvements to election procedures. In fact, changes to administrative procedures are at the top of the list of reforms recommended by the reports commissioned by the states of Maryland and California. Foremost among these is a "chain of custody" for both software and the machines. Another suggestion is "parallel testing" of machines on election day to make sure that they are properly recording votes as intended. Such testing was actually conducted in counties using DREs in California's March 2004

[537. Pfeifer, supra note 536 (reporting that "many [voters] were given ballots with candidates from the wrong political parties or wrong districts").
538. Hoffman, supra note 536; Press Release, supra note 536.
539. See Press Release, supra note 536.
540. See RABA Report, supra note 467; SAIC Report, supra note 445; Shelley, supra note 193, at 9-10.
541. Shamos, supra note 432, § 3.3(1).
542. Id. § 3.5.]
It revealed that the DRE machines tested recorded votes with 100% accuracy. Another key procedural recommendation is that DRE terminals not be connected to a network and certainly not connected to the internet. Even with a contemporaneous paper record, testing, training, and adherence to procedures are essential if the system is to function properly.

2. Improved Standards and Testing

One of the recommendations for improving the security of electronic voting is to reform the standards and certification process. Before enactment of HAVA, the Federal Election Commission ("FEC") was responsible for promulgating standards for hardware, software, and other aspects of voting systems. Compliance with the FEC standards is voluntary, but they are followed by thirty-six states. The testing itself is performed by independent testing agencies ("ITAs"), private companies that contract with election authorities at the state and local level. Critics have argued that both testing standards and the closed-door process by which testing is conducted leaves much to be desired. HAVA requires changes in the process for developing standards through the EAC and related entities. Due to the delays in establishing the EAC, and Congress’s failure to appropriate the full amount authorized for its budget, it is unclear whether new standards and guidelines will be in place by January 2006, the effective date of HAVA’s voting system standards.

3. Cryptography

An alternative to the contemporaneous paper record that might better achieve the goals of accessibility and transparency is to create an independent audit channel for electronically cast votes. Supporters of this method argue that it provides for greater transparency and

544. Id. at 4.
548. Shamos, supra note 432, § 1.3.
549. Id.
550. Id.
551. Fischer, supra note 27, at 25.
553. Fischer, supra note 27, at 24.
better auditability than the contemporaneous paper record. Under one model, the voter would receive a piece of paper at the time of voting. Instead of displaying the names of the candidates chosen, the receipt would contain encrypted information and, while in the voting booth, the voter would see the choices to which the encrypted information corresponds. Afterwards, each voter could determine if his or her vote was counted as intended by comparing the receipt to information publicly posted on the internet or elsewhere. In theory, this would provide a form of “voter verifiability,” without the difficulties inherent in printing paper ballots. In contrast to the contemporaneous paper record, which can only confirm that the vote was correctly captured by the DRE, this type of encrypted technology would (at least in theory) allow voters to determine whether their votes were correctly counted.

4. Paperless Audit Trails

While the contemporaneous paper record is one means of achieving a “voter-verifiable” audit trail, it may not be the only one. Put another way, voter verifiability is not synonymous with paper ballot replicas. Indeed, the California touchscreen task force recommended that a voter-verifiable audit trail be required for all DREs purchased after 2007, even though a majority wisely declined to recommend imposition of a requirement that this audit trail be paper-based. One proposal is for an audio audit trail. Under this proposal, a voter would actually listen to his or her choices during the voting process, as a tape recording is made. Such voter-verified audio transcripts would have the added advantage of allowing visually impaired and illiterate voters to verify their choices. Another proposal is the “votemeter,” a separate electronic device attached to the DRE that would record and display voters’ choices. The votemeter records could be tallied separately to avoid any possible collusion.

554. Id. at 30-31.
555. Id. at 30. The technology described is the VHTi, marketed by VoteHere. Information regarding this technology is available at www.votehere.net. For a description of a similar system, see David Chaum, Secret Ballot Receipts and Transparent Integrity, at http://notebook.geekdom.net/pages/87.html (May 8, 2003).
557. Id.
558. Id. at 31.
559. See Shamos, supra note 432, § 2.4.
560. Shelley, supra note 17, at 43-44.
562. Id. at 1.
563. Id.; see also Fischer, supra note 27, at 29.
5. Open Source

Another promising proposal for promoting both security and transparency in the long term is the development of voting technology that uses open source software. The software used would be open to public scrutiny which, in theory, would allow interested members of the public to inspect it for flaws. Until now, voting equipment vendors have claimed that their software is a trade secret and they have guarded against any attempts to make their source code publicly available. Thus, the code is now disclosed only to ITAs and other selected parties under nondisclosure agreements. Vendors have also argued that keeping source code secret provides security advantages, by limiting the number of people who can exploit any potential vulnerabilities. Others have criticized the “security through obscurity” approach, arguing that such stringent limitations on access to source code severely diminish the opportunity to expose vulnerabilities or malfeasance. While none of the major vendors are currently marketing open source products, a group called the “Open Voting Consortium” is developing an open source voting system.

All of these proposed reforms have the potential to address the vulnerabilities of DRE technology. My point in describing them, however, is not to suggest that any of them are a magic bullet. At this point, it cannot be said with confidence that any of them will be sufficient to fix the vulnerabilities that have been identified. Some of the measures described above may prove superior to the contemporaneous paper record; others may turn out to present similar or even greater difficulties. It is even possible that the questions regarding the workability and efficacy of the contemporaneous paper record may ultimately be resolved. It is too soon to say whether any of the above options, either alone or in combination, will prove workable or effective.

Considerable uncertainty thus remains on how best to promote the democratic values of equality, security, and transparency, when it comes to the implementation of electronic voting technology. The question to which I now turn is how the various public institutions with responsibility for safeguarding these values should proceed in light of this uncertainty.

565. Shamos, supra note 432, § 3.2.
566. Fischer, supra note 27, at 26.
567. Id.
568. Information regarding the Open Voting Consortium may be found at http://www.openvotingconsortium.org/ (last visited Jan. 17, 2005).
IV. BUILDING BETTER VOTING SYSTEMS

The competing democratic values identified in Parts II and III create a conundrum. On the one hand, there is considerable evidence that implementation of electronic voting technology can promote the core equality values of racial equality, disability access, multi-language access, and inter-jurisdictional equality. On the other hand, there are legitimate concerns about the election systems relying on present-generation DRE technology when it comes to both security and transparency. And there are serious reasons to doubt that a contemporaneous paper record provides either a workable or an effective solution to these problems. It is, moreover, quite unlikely that the perfect voting technology—one that ensures equality while providing airtight security and transparency—will come along any time soon.

While all of this may seem like an insoluble mess, it may also be viewed as an opportunity. Existing paper-based voting technology is not perfect. Neither are existing DREs, despite the significant advantages that they offer in terms of racial equality, disability accommodation, and multilingual access. The challenge is to find a way to encourage innovation, while at the same time safeguarding the basic equality rights protected by law. It is not only, and in fact not primarily, the courts that face this challenge. It is also a challenge that Congress, state legislative bodies, and administrative agencies (foremost among them the EAC) must meet in the coming months and years. Most important of all, it is a challenge that faces election officials in each of the fifty states, and the thousands of local entities with responsibility over our election systems.

Some have decried the “fragmented” character of our election systems under which authority is dispersed to thousands of local and state entities. Yet the decentralized character of our election systems provides an opportunity to innovate, while limiting the costs of that innovation. To be sure, experimentation in the context of election administration must be undertaken with the utmost care, given the fundamental character of the right to vote. At the same time, the unanswered questions that remain about the voting technologies now being used—and ones that will come into use in the coming months and years—make it inevitable that some further experimentation will take place. The State of California, for example, became the first to employ parallel testing on a statewide basis in the

569. Pastor, supra note 19, at 585.
March 2004 election. And Nevada experimented with the contemporaneous paper record in its 2004 elections.

Such experiments ought to be encouraged. The challenge facing the various government institutions with responsibility over election administration is to encourage innovation while at the same time safeguarding the basic equality rights protected by the Constitution and other voting rights laws. What follows are recommendations on how the courts, legislative and administrative bodies, and election officials can best further the democratic values implicated by the introduction of electronic voting, given the uncertain and rapidly changing technological landscape.

A. The Judiciary

The first question is what role the judiciary should play in promoting or slowing down the ongoing transformation of voting technology. I have already mentioned three types of legal challenges to existing voting equipment. The first type is exemplified by the ACLU lawsuits challenging the use of punch-card and other paper-based voting equipment under the Equal Protection Clause and the VRA. The second are lawsuits challenging the use of DRE equipment on the ground that it violates the Fourteenth Amendment or state law by failing to provide a paper record that can be used in the event of manual audits. The third type consists of lawsuits brought under the ADA and other civil rights laws challenging the failure to provide voting technology (specifically DREs) allowing people with disabilities to cast secret and independent ballots. Lawsuits of each type are pending in state and federal courts around the country.

All of these cases implicate the basic democratic values that I identified in Parts II and III. The ACLU and disability rights cases both implicate the core political value of political equality—and more specifically, the norms of racial equality, disability access, and inter-jurisdictional equality. The challenge to DRE voting technology implicates the values identified in Part III, with plaintiffs in those cases arguing that the use of equipment lacking a "paper trail" compromises security and integrity.

There is considerable disagreement among commentators on the role that courts should play in exercising judicial review over the

572. See supra Part I.B.3 (describing the ACLU's punch-card litigation).
573. See supra note 9 and accompanying text (noting legal challenges to paperless electronic voting).
574. See supra Part II.A.2.
democratic processes. Professor Richard L. Hasen has persuasively argued that courts have an important role to play in safeguarding “core... equality principles.”575 Outside of those core areas, he urges courts to tread carefully, and avoid constitutionalizing contested political rights. On the other hand, Professor Pildes suggests that courts should take into account “structural flaws in democracy” as well as equality rights in determining whether judicial review is appropriate.576

At least for purposes of assessing voting technology, it is not necessary to take sides in the rights-versus-structure controversy. Whatever one’s theory as to the role of the courts when it comes to the processes of democracy, there are some norms that are vital for courts to protect. These include both individual rights of access for people with disabilities and non-English speakers, as well as the broader interest in avoiding practices that disfavor certain groups—a distinction that I have elsewhere referred to under the rubric “atomistic” and “systemic” equality.577 The equality norms that I defined in Part II are designed to prevent the government from tilting the political playing field to the disadvantage of certain groups. Because they bear upon the right of citizens to participate as equals in the conversations of democracy, these norms have a foundation in the First Amendment as well as the Fourteenth. They are an integral part of what I have labeled “First Amendment Equal Protection,” an area in which courts have traditionally—and for good reason—been especially jealous in guarding against threatened inequalities.578

For this reason, there is a strong case for intervention in cases where the use of certain voting equipment is shown to undermine a core equality norm. The use of punch-card voting equipment, which has a clear impact on voters who use it—and an especially negative impact on racial minorities—is one example.579 Another example is the state’s failure to make accessible technology available to voters with disabilities. On the other hand, courts should exercise restraint in determining the appropriate remedy for the voting rights violation at issue. For example, in a case challenging the continued use of punch-card voting machines within a state, it would be appropriate for a court to enjoin the use of this technology given its well-established

575. Hasen, supra note 14, at 74.
576. Pildes, supra note 13, at 42.
577. For a more thorough discussion of the distinction between atomistic and systemic equality, see Tokaji, First Amendment Equal Protection, supra note 11, at 2428-29, 2502-07. Greg Magarian employs a similar distinction, using the terminology of “public rights” and “private rights.” Gregory P. Magarian, Regulating Political Parties Under a “Public Rights” First Amendment, 44 Wm. & Mary L. Rev. 1939 (2003); see also Tokaji, First Amendment Equal Protection, supra note 11, at 2428 n.90.
578. See generally Tokaji, First Amendment Equal Protection, supra note 11.
579. See supra Part II.B.2.b.
consequences for racial and inter-jurisdictional equality. Courts should be reluctant to mandate any particular type of technology, however, in light of the evidence that both electronic voting machines, and at least some types of optical-scan technology can redress these problems and the considerable uncertainty that remains regarding the best technological means by which to address the values of security and transparency.

Recent litigation within each of the three types noted above illustrates the proper judicial approach to voting technology. Common Cause v. Jones and Black v. McGuffage implicated the core equality norms of racial equality and inter-jurisdictional equality—more specifically, the idea that voters should not be denied an equal opportunity to have their votes counted based on their race or where they live. In both of these cases, the courts acted properly in affirming these norms and recognizing their applicability to the voting technology used. Yet these decisions both exemplify a commendable restraint. They do not demand uniformity of equipment. Instead, they characterize the equal protection violation as "whether a state may allow the use of different types of voting equipment with substantially different levels of accuracy." This standard allows states to experiment with different types of voting equipment, while protecting the core of political equality.

In this respect, the equality standard set forth in Black bears comparison to the standard that the Supreme Court has set in its “one person, one vote” cases decided under the Fourteenth Amendment. This standard requires that electoral districts be of roughly equal size, while allowing “minor deviations” from precise numerical equality. So too, courts in voting technology cases should not require that voting technology used throughout the state yield precisely the same results—either across districts or among people of different races—a standard that would be practically impossible to meet. The better standard is articulated in Black, which forbids the use of voting technologies with substantially different levels of accuracy, while allowing minimal deviations from precise equality.

580. See supra Part II.B.3.
581. On this point, a comparison might be drawn to the area of judicial intervention when it comes to campaign finance reform. As Spencer Overton observes, the empirical uncertainty that exists with respect to the consequences of particular regulations of campaign finance should make courts cautious about invalidating those reforms. Spencer Overton, Restraint and Responsibility: Judicial Review of Campaign Reform, 61 Wash. & Lee L. Rev. 663, 718-19 (2004).
For similar reasons, the Common Cause court showed commendable restraint when it came to the remedy imposed. The court did not require that California implement any particular form of voting technology statewide. Instead, the court decertified the equipment that was alleged to contravene equality norms (namely, Votomatic-style punch cards), while leaving it to the state and counties to fashion a remedy. In particular, the court made a determination as to when the unreliable equipment could feasibly be replaced, but allowed that equipment to be replaced by any certified voting technology—either electronic or paper-based.

On the other hand, the Ninth Circuit’s en banc opinion in the California recall case, Southwest Voter Registration Education Project v. Shelley is a disappointment, even if one agrees with its result. The en banc court affirmed the denial of the preliminary injunction postponing the California recall, pending the replacement of punch cards. This opinion followed a three-judge panel’s opinion concluding that the use of punch cards in some, but not all, California counties denied equal protection. The three-judge panel had engaged in a thorough discussion of the equal protection merits. By contrast, the en banc court issued a brief opinion that avoided the issue, stating that it was one on which reasonable jurists might disagree without specifying the standard according to which the claim should be judged. Instead, the en banc opinion relied on the deferential standard traditionally accorded preliminary injunctions and the harm to the state that would result from postponing the recall.

The reluctance to postpone an election that has already begun is understandable. The en banc court dropped the ball, however, by failing to provide clear guidance on the important constitutional and statutory voting rights issues raised. Both these claims implicated core equality norms. A better approach would have been for the court to have ruled definitively on the Fourteenth Amendment and VRA claims, and then to have weighed the severity of any voting rights violation found against the hardship to the state that would arise from issuance of the requested relief—as the preliminary injunction

589. Common Cause, 213 F. Supp. 2d at 1115 (decertifying punch-card technology without specifying the type of voting equipment that it should be replaced with).
590. Id.
591. Id. The parties in Common Cause had stipulated that the Votomatic-style punch cards should be decertified and left it to the court to determine the date by which it was feasible to replace that equipment. Id.
592. SVREP IV, 344 F.3d 914 (9th Cir. 2003) (en banc).
593. Id. at 920.
594. SVREP II, 344 F.3d 882 (9th Cir.), vacated, 344 F.3d 913 (9th Cir. 2003) (en banc).
595. SVREP II, 344 F.3d at 894-901.
596. SVREP IV, 344 F.3d at 918.
597. Id. at 919-20.
standard allows. Even if the result had been the same, addressing the merits would have provided guidance to future courts on the scope and applicability of the equality norms in question.

More impressive is the decision in Weber v. Shelley, another Ninth Circuit case. Weber was a type two case, in which the plaintiff challenged the use of a paperless touchscreen voting system. As the court properly noted, every voting regulation will have some impact on the right to vote. Only those that impose "severe" restrictions on the right to vote, as opposed to "reasonable, nondiscriminatory" restrictions, should be subject to heightened scrutiny. In contrast to such cases as Common Cause and Black, the plaintiff in Weber failed to come forward with evidence showing that citizens using the challenged type of equipment were less likely to have their votes counted. There was, for example, no evidence that Riverside County's electronic voting resulted in their voters being less likely to have their votes counted, nor was there any evidence that it generated a racial disparity. To the contrary, the evidence available shows that the present generation of DREs are more likely to record votes accurately than other types of equipment and that they can significantly reduce the racial gap in uncounted votes. And as Riverside County concluded at the time it purchased touchscreens, this technology facilitates voting by disabled and non-English proficient voters. In short, the Weber court acted correctly, given the plaintiffs' failure to demonstrate that the challenged voting technology violated any core equality norm.

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598. 347 F.3d 1101 (9th Cir. 2003).
599. Id. at 1106.
600. Id. (quoting Burdick v. Takushi, 504 U.S. 428, 434 (1992)).
601. Id.
604. Weber, 347 F.3d at 1105 ("[T]here is no indication that the [challenged electronic voting equipment] is inherently less accurate, or produces a vote count that is inherently less verifiable, than other systems.").
605. See supra Part II.B.2.b.
606. Weber, 347 F.3d at 1104.
607. A recent state court decision from Maryland likewise illustrates the propriety or restraint in type two voting technology cases. Although based on state rather than federal law, Schade v. Maryland State Board of Elections, No. C-04-97297, slip op. (Md. Sept. 1, 2004), raises issues similar to those implicated by Weber. Plaintiffs argued that the Diebold DRE system used in Maryland failed to protect the security of the voting process and failed to count votes accurately. Id. at 1. After reviewing the expert evidence submitted by both sides, the circuit court declined to grant a preliminary injunction. Id. at 7. It found that "the use of paper ballots is the least accurate of all systems and lends itself to the most chicanery," while DREs "if untampered...are the most accurate in recording and counting votes." Id. at 3. It also recognized the accessibility advantages of DREs, pointing out that they allow blind and visually impaired citizens to vote independently. Id. Most important, the court properly recognized that no voting technology is perfect and that imposing a standard of perfection would effectively paralyze government entities attempting to
Type three cases challenging the failure to implement DRE voting equipment bring to the fore the equality norm of disability access. The ability to cast a secret and independent ballot on an equal basis with other citizens is integral to the right to vote, and courts should enforce this equality norm. It is appropriate to require that DREs be made available to people with disabilities. On the other hand, courts should exercise caution when it comes to the remedy. The best course of action is to make at least one DRE unit available for citizens with disabilities at each polling place (as HAVA requires effective January 1, 2006), while leaving it up to counties to determine whether to institute DRE technology for able-bodied voters. This will protect a disabled citizen’s right to a secret and independent ballot without unduly intruding into state and county election officials’ authority to safeguard other democratic values in the voting process.

In sum, courts considering legal challenges to voting technology should focus on whether the challenged system contravenes one of the core equality norms that I have identified. If it does, then they should not hesitate to declare that the use of that technology violates statutory or constitutional voting rights. But in crafting remedies, courts should exercise restraint in order to ensure that election officials retain the authority needed to serve the democratic values of equality, security, and transparency.

B. Legislative and Administrative Bodies

While courts have an essential role to play in protecting core equality norms, the role of the legislative branch is to provide a structure that will promote the democratic values I have identified. In exercising this responsibility, it is imperative that legislative bodies, like the courts, proceed with caution. Given the unanswered questions that remain about how best to secure voting technology, it is a serious mistake to insist upon legislation mandating any particular technological fix, such as the contemporaneous paper record. That would lock states into a remedy that may not be workable or effective.
Instead, Congress and state legislatures should work within the structure provided by HAVA. That means providing funding that will allow state and local entities to implement—and experiment with—new voting technologies. It also means reexamining laws written with paper-based systems in mind, and considering how they should be revamped to promote security and transparency in an election environment increasingly dependent on paperless electronic voting technology.

Much of the post-HAVA legislative discussion has focused on whether to require that electronic voting units generate a contemporaneous paper replica. In Congress and several states, legislation has been introduced to require a “voter-verified paper audit trail.” The centerpiece of these efforts has been a bill sponsored by Representative Rush Holt (the “Holt Bill”).

Enactment of this legislation would likely do more harm than good. As a practical matter, the contemporaneous paper record required by the Holt Bill would do little to enhance election security. It is also unclear whether it is practically feasible for voting machines to produce a contemporaneous paper replica that the voter can see but not touch. To enact this legislation at this stage, moreover, would place states and counties that have not already upgraded their voting technology in a bind. The states that received money under Title I of HAVA and that were granted a waiver of the statute’s 2004 deadline are required to replace their punch-card and lever voting equipment by 2006. If states fail to meet this deadline, they may be forced to repay the funds already received. It would also complicate the requirement that each polling place have at least one disability-accessible unit by 2006. Given the unanswered questions regarding the contemporaneous paper record, the foreseeable consequence requiring this device is to discourage counties from moving to electronic voting technology at all.

Worse still, imposition of this requirement would stifle innovation. Manufacturers forced to tailor their voting equipment to meet this requirement would forego other potential means of enhancing security. This would be unfortunate, as many of these show much greater promise than the contemporaneous paper record.

614. Id. § 15302(d).
615. Id. § 15481(a)(3)(B).
616. As explained supra Part III.B.3, electronic voting machines with a contemporaneous paper record have been used on a limited basis in elections in California and Connecticut.
617. Potential alternative means are discussed in the California Secretary of State Kevin Shelley’s report, supra note 17. That task force, as discussed below, accepted
Legislation mandating a contemporaneous paper record at the state level can be expected to have some of the same deleterious effects. The Ohio legislature, for example, enacted a bill to require the contemporaneous paper record effective 2006.\textsuperscript{618} Partly as a consequence of that bill, Ohio's punch-card counties stuck with that equipment in the 2004 election.\textsuperscript{619} With this requirement looming on the horizon and uncertainty about whether existing DRE technology could be retrofitted to meet the contemporaneous paper record requirement, all of the state's remaining punch-card counties decided to stand pat.\textsuperscript{620} Whatever the risks of electronic voting, it can scarcely be contested that the Votomatic-style punch-card ballot is an outmoded method of voting that ought to be replaced.

While precinct-count optical-scan equipment presents a possible alternative, the implementation of this technology requires staff and poll worker resources that are simply unavailable to many urban jurisdictions. As a practical matter, then, the choice that such legislation imposes is to either (1) implement a DRE system capable of generating a contemporaneous paper record, despite the fact that this equipment has yet to prove either workable or effective; or (2) stick with the punch card and forfeit monies that have already been provided under Title I of HAVA. If election officials are put to this Hobson's choice, the big losers are likely to be those whose voting rights have most often been denied: people of color, disabled voters, and language minorities. For it is these voters who have the most to gain from implementation of DRE systems.

From the perspective of disability and language access, a contemporaneous paper record mandate raises especially glaring concerns. The California Attorney General's Office has taken the position that imposition of such a requirement would violate the ADA, given the absence of any means by which blind and visually impaired voters could "verify" that the choices on a printed ballot are accurate.\textsuperscript{621} Although two companies are currently marketing contemporaneous paper record systems that they claim to be accessible, this equipment has yet to be tested in a real election of any significant size.\textsuperscript{622} And in the only statewide experiment with the

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\textsuperscript{619} See supra notes 210-16 and accompanying text.


\textsuperscript{621} See Letter from Douglas J. Woods, Deputy California Attorney General, to Randy Riddle, Chief Counsel, Secretary of State (July 28, 2003).

contemporaneous paper record, Nevada's 2004 election, the equipment used was unable to print contemporaneous paper records in languages other than English. As a result, voters in the one Nevada county that is required to make voting materials available in both English and Spanish (Clark County) used DRE units that do not print out paper ballot replicas.623

These difficulties may eventually be resolved, as may the serious questions regarding the accessibility of the proposed contemporaneous paper record. It would be a mistake, however, for Congress to mandate this device before it has been proven effective in serving the core values of security and transparency. Even at the state level, legislative bodies are ill-advised to mandate this type of device until its workability and efficacy are established. There is little reason to believe that paper is a magic bullet—yet the legislation precipitously enacted in California and Ohio will effectively lock this technology in place, at least for those counties that opt for electronic voting.

Other states would be ill-advised to follow this example. Security and transparency are vital democratic values and paper may turn out to be one way of promoting them. But it need not be the only way.624 While it is important to have a reliable means of auditing elections, it is not at all clear that recounts of paper ballots are the best means of achieving this goal. A major project for state legislatures in coming years will likely be a reexamination of election code provisions, many of which are built around recounts of paper ballots.625 These laws may make sense in an environment where paper-based equipment dominates. But as this equipment is replaced with paperless voting technology, it will likely be necessary for states to rethink the means by which audits are conducted, so as to promote the twin values of security and transparency.

Instead of mandating a particular technological fix, legislative bodies would do best to work within the basic structure provided by HAVA. Although HAVA was enacted before the controversy over electronic voting exploded into the public consciousness, Congress was aware of the security and transparency issues surrounding electronic voting. Not only did HAVA require a paper record with a manual audit capacity, but it also created the EAC to serve as a national clearinghouse for compiling information on voting systems.626 To assist in the EAC's efforts, the legislation also created a standards board, a board of advisors, and a technical guidelines development committee.627 It also provides for the EAC to overhaul the standards

623. Werner, supra note 522.
624. See supra Part III.C.
625. For a chart summarizing state recount laws, see infra app. B.
627. Id. §§ 15343, 15344, 15361.
and process for certifying voting equipment. Perhaps more importantly, it provides for the EAC to conduct research on how best to promote secure electronic voting. Worthy avenues for the EAC to explore not only include standards for those jurisdictions that choose to require a contemporaneous paper record, but also other ways of achieving auditability—and thereby serving the values of security and transparency.

The EAC has now posted on its website "best practices" for different types of voting equipment. While this is a start, there is much more that the EAC can do—and must do under HAVA—to promote accessible, secure, transparent, and accurate electronic voting. Unfortunately, the ability of the EAC to undertake its important responsibilities has been stymied by the late appointment of the four commissioners and the failure to provide the commission with full funding. For the EAC to do its work adequately, it is imperative that Congress provide it with full funding.

More broadly, it is essential that both Congress and the state legislatures alter their perspective on election reform. For far too long, the decrepit condition of our democracy’s infrastructure was neglected. Rather than viewing the replacement of voting equipment as a generational occurrence, to take place only when the harsh light of public scrutiny forces alternation, legislative bodies must look upon the refurbishment of voting technology as an ongoing responsibility. This may require more resources, in addition to the $3 billion in federal funding authorized for fiscal years 2003 through 2005. As technology continues to evolve, voting systems must continue to adapt to those changes.

C. State and Local Election Officials

Primary responsibility for implementing new voting technology rests not with the courts, legislatures, or the EAC. For better or for worse, that authority lies mainly in the hands of secretaries of state, boards of election, and county registrars throughout the country.

Some commentators have decried the decentralization of our election system. In addition, the partisanship of some election officials—from Katherine Harris in Florida during the 2000 election to Ken Blackwell in Ohio during the 2004 election—has attracted considerable attention, much of it critical. The lack of electoral

628. Id. § 15371.
629. Id. § 15385.
632. See Pastor, supra note 19.
institutions capable of checking partisan self-interest is one of the critical flaws in our democracy, and commentators are beginning to examine the means by which to remove authority over critical election decisions from partisan players with an incentive to benefit their own side. In addition, the close ties between election officials and voting system vendors have been a subject of considerable criticism, with some observers decrying the fact that people charged with the administration of elections ultimately wind up in the employ of those whom they were once charged with regulating. Like other aspects of election administration, partisanship and the "revolving door" between the public and private sectors are causes for concern when it comes to the implementation of voting technology. Dealing with these problems is perhaps the most serious long-term challenge that confronts those concerned with improving the administration of elections.

Despite the faults of the current system, its decentralization of authority provides some advantages. Vesting authority over voting technology in local rather than state officials serves some useful purposes. Certain types of voting equipment may be appropriate for some jurisdictions but inappropriate for others. For example, a precinct-count optical-scan voting system (or even hand-counted paper ballots) may work well in a smaller county with few language minorities and plentiful poll worker resources. Such a system may work poorly, however, in understaffed, urban jurisdictions. In addition, the decentralized character of our election system allows for counties and townships to serve as true laboratories of democracy. They may experiment with different types of voting equipment, and different means of enhancing security—such as the contemporaneous paper record, non-paper audit trails, and perhaps even open source equipment. Decentralization may also provide some security, at least for statewide races, by making it more difficult for a malevolent insider to alter the results. Even if one county's election can be rigged, the decentralization of election systems may protect the integrity of the election since it would be much more difficult to rig several counties' elections.

On the other hand, there is a strong argument to be made for statewide uniformity of voting technology. Adoption of one type of

633. See Pildes, supra note 13, at 82-83 (identifying the need for the United States to create institutions other than the courts to "check the role of partisan self-interest in the design of democratic processes").
634. See, e.g., Christopher Elmendorf, Representation Reinforcement Through Advisory Commissions: The Case of Elections Law 32-92 (Dec. 4, 2004) (unpublished draft) (proposing the creation of standing advisory commissions that would have the power to recommend, but not to enact, laws regulating the political process).
636. For one proposal, see Elmendorf, supra note 634.
voting equipment throughout a state can avoid the equal protection problems arising from the use of substantially less accurate technology in some jurisdictions. It can ensure that citizens are not disfavored by the happenstance of where they reside. Moreover, mandating a particular type of equipment, such as DREs, can help promote equality by ensuring that citizens throughout the state have access to the best available voting equipment.

Two states (Maryland and Georgia) have now implemented the same type of DRE technology throughout the state. The chief benefit of the statewide approach is that it promotes uniform treatment of voters throughout the state. The downside is that it risks catastrophe, if the voting system chosen fails to perform as advertised. Maryland and Georgia have endured some criticism for moving too quickly, although the electronic voting technology they selected has performed well thus far. Whether Nevada's statewide experiment with a contemporaneous paper record system will prove equally successful remains to be seen.

In the end, there is no clear answer to the question whether states should implement uniform technology, or instead allow counties to experiment with different types of equipment. What is clear is that, in the process of upgrading technology, some problems are inevitable. When they occur, it is imperative that state and federal legislative bodies step in to provide funding to allow their correction rather than allowing election officials to muddle through with bad technology. Improving our election systems requires accepting the fact that some mistakes will be made along the way, and committing ourselves to righting those mistakes when they occur.

**CONCLUSION**

Voting technology is a moving target, and that reality is unlikely to change any time soon. The present generation of electronic voting has the potential to reduce the number of lost votes, while effecting substantial improvements in racial equality, disability access, and multilingual access. At the same time, the implementation of this technology poses serious risks, if unaccompanied by appropriate safeguards. There are also legitimate concerns about the transparency of present-generation electronic voting technology. Although the future of electronic voting is difficult to predict, next-generation

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637. See supra Part II.A.4.
639. Schade v. Md. State Bd. of Elections, No. C-04-97297, mem. op. at 7 (Md. Cir. Ct. Sept. 1, 2004) (finding that “[t]he votes have been counted accurately” with the Diebold electronic voting system used in Maryland); Stewart, supra note 223, at 3 (noting controversy over electronic voting but finding that Georgia’s electronic voting machines performed significantly better than other equipment used previously).
technology may well do better at ensuring equal access, while also promoting secure and transparent elections.

The difficult question for courts and policymakers alike is how best to proceed in light of this uncertainty. This Article has argued that certain core democratic values should inform the comparison of different voting technologies. State-commissioned studies of electronic voting have suggested several available means by which electronic voting security may be improved without jeopardizing the tremendous benefits that voters stand to gain from this technology. Nongovernmental entities are pursuing other promising alternatives, such as open source code and encrypted ballots. There is reason to believe that we need not sacrifice the voting rights of people of color, disabled voters, and non-English speaking citizens in order to achieve the admirable goal of enhancing election security and transparency.

The courts and legislative bodies have an essential role to play in promoting these democratic values. Courts should jealously guard the norms of racial equality, disability access, multilingual access, and inter-jurisdictional equality. At the same time, they should exercise caution in fashioning remedies. Legislatures should likewise allow state and local officials flexibility. It is a mistake to write into stone any particular security fix—such as the “voter-verified paper audit trail”—until it has proven workable, effective, and superior to other methods. Such legislation can only stifle innovation, while doing little to promote secure and transparent elections. Legislatures should instead focus on the need for auditability in an election environment where paperless technology increasingly predominates.

While the courts and legislative bodies have an important role to play in the ongoing transformation of voting technology, the most important responsibilities ultimately lie in the hands of state and local election officials. This is an inevitable consequence of the decentralized character of our election administration systems. But it is also an approach that provides significant advantages, allowing for innovation while limiting the consequences of the mistakes that inevitably will occur.

The Help America Vote Act is a start—but it is only a start. Better technology can mean more secure, transparent, accessible, and equal voting systems, but only if Congress and state legislative bodies provide the funding and oversight to make that possibility a reality. If we are to promote the democratic values of equality, security, and transparency, we must stop looking at election reform as a destination, and instead view it as an ongoing process that will continue for as long as better voting technologies continue to emerge.
APPENDIX A: SUMMARY OF STATE HAVA PLANS

The chart below summarizes the Help America Vote Act implementation plans of the fifty states, as well as those of the District of Columbia and Puerto Rico, in the area of voting equipment. It is based on voting system information obtained from state HAVA plans. Funding information is based on http://www.civilrights.org/issues/voting/havachart.pdf. The column labeled “current” indicates the type of equipment used at the time of the HAVA plan’s submission, while the chart labeled “proposed” indicates the type of equipment to which the state planned to convert. The last column indicates the amount, either in dollars or the percentage of HAVA payments received, that the state planned to devote toward new voting equipment.

<table>
<thead>
<tr>
<th>State</th>
<th>Current</th>
<th>Proposed</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>53 counties (precinct-level tabulation optical scan); 10 (central-tabulation optical scan); 3 DRE; 1 lever machine; never used punch cards</td>
<td>Replace mechanical lever voting machines in Bullock county; replace or modify voting machines in Mobile, Montgomery, and DeKalb counties; replace centralized-ballot counting systems in 9 counties; DRE requirement</td>
<td>$23,000,000 allocated</td>
</tr>
<tr>
<td>Alaska</td>
<td>163 precincts (hand-count paper ballots); 283 (optical-scan paper ballots [Accu-Vote OS 2000]); no DREs</td>
<td>Continue to expand the use of the optical-scan voting system in hand-count precincts; DRE requirement</td>
<td>$4,500,000 allocated</td>
</tr>
<tr>
<td>Arizona</td>
<td>9 counties (punch cards); 6 counties (no info.)</td>
<td>Replace punch-card voting systems in 9 counties; DRE requirement</td>
<td>Approximately 56% of funds</td>
</tr>
<tr>
<td>Arkansas</td>
<td>5 counties (DREs); 46 (central-tabulation optical scan); 3 (precinct-level optical scan); 8 (hand-count paper ballots); 13 (lever machines or punch cards)</td>
<td>Replace lever machines or punch-card systems with DREs; replace all systems with DRE if federal funding sufficient</td>
<td>$12,000,000-20,000,000 estimated, depending on federal funds</td>
</tr>
<tr>
<td>California</td>
<td>3 categories of systems:</td>
<td>Replace punch-card</td>
<td>Funds from HAVA as</td>
</tr>
<tr>
<td>State</td>
<td>Current</td>
<td>Proposed</td>
<td>Amount</td>
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<tr>
<td>Colorado</td>
<td>Systems: paper ballots, central-count optical scan, precinct-count optical scan, punch card; only 1 county continues to utilize punch cards but will probably opt for another voting system</td>
<td>Already meets/will meet requirements; DRE requirement</td>
<td>$10,100,000 allocated</td>
</tr>
<tr>
<td>Connecticut</td>
<td>3 municipalities (optical scan); 166 (lever machines)</td>
<td>Actively considering upgrading lever machines; replacement of all lever machines delayed by insufficient federal funding; DRE requirement</td>
<td>$20,500,000 estimated</td>
</tr>
<tr>
<td>Delaware</td>
<td>DREs [electronic 1242 (model 6T)]</td>
<td>Replaced punch cards and lever machines in 1996 with DREs; DRE requirement (DREs that meet accessibility requirement)</td>
<td>$5,700,000 estimated</td>
</tr>
<tr>
<td>Florida</td>
<td>Already replaced punch cards, lever machines, paper ballots, and central-count optical-scan systems with precinct-tabulated Marksense voting systems or DREs; 15 counties (DREs); 52 (precinct-level optical scan)</td>
<td>DRE requirement</td>
<td>$11,740,000 from § 102 for punch-card buyouts ($24 million was spent by state), $11,600,000 expected to be spent on DREs</td>
</tr>
<tr>
<td>Georgia</td>
<td>159 counties (DREs [Diebold])</td>
<td>Meets all requirements, including DRE requirement</td>
<td>Funds already expended: $53,900,000, to replace voting systems</td>
</tr>
<tr>
<td>Hawaii</td>
<td>All precincts use precinct-level optical</td>
<td>DRE requirement</td>
<td>Approximately 8,000,000 allocated</td>
</tr>
<tr>
<td>State</td>
<td>Current</td>
<td>Proposed</td>
<td>Amount</td>
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</tr>
<tr>
<td>Idaho</td>
<td>16 counties (paper ballot); 14 (optical scan); 14 (punch card)</td>
<td>Provide excess funds on optional grant program to upgrade systems; DRE requirement</td>
<td>No info</td>
</tr>
<tr>
<td>Illinois</td>
<td>90 counties (punch card); 2 (precinct-level punch card [PBC 2100]); 10 (precinct-level optical scan [Accu-Vote]); 3 (precinct-level optical scan [Optical Scan M100]); 3 (Marksense Optech IV-C); 2 (Marksense Optech III-Pe)</td>
<td>Replace punch cards; voter education if counties decide to retain central-count systems; DRE requirement</td>
<td>$42,000,000 allocated</td>
</tr>
<tr>
<td>Indiana</td>
<td>32 counties (punch card and lever machine); 60 counties (other systems)</td>
<td>Replace punch cards and lever machines; DRE requirement</td>
<td>Will set aside $39,200,000 to reimburse counties</td>
</tr>
<tr>
<td>Iowa</td>
<td>6 counties (lever machines); 1 (paper ballots); 59 (central-count optical scan); 18 (precinct-count optical scan); 15 (DRE)</td>
<td>Replace lever machines; DRE requirement</td>
<td>$42,000,000 estimated</td>
</tr>
<tr>
<td>Kansas</td>
<td>81 counties (optical scan); 21 (hand-count paper ballots); 3 (DRE); punch card and lever machines are not used</td>
<td>Voter education to make paper ballot and central-count optical-scan systems compliant; DRE requirement</td>
<td>No info.</td>
</tr>
<tr>
<td>Kentucky</td>
<td>96 counties (ELECTronic 1242 DRE); 17 (MicroVote MV-464 DRE); 1 (ACCU-VOTE ES Optical Scan Tabulation); 1 (lever machines); 5 (mechanical lever machines and MicroVote MV-464)</td>
<td>Replace lever machines; DRE requirement</td>
<td>Approximately $18,200,000 estimated</td>
</tr>
<tr>
<td>Louisiana</td>
<td>50 parishes (AVM-POM</td>
<td>Replace lever</td>
<td>Estimated 91.8% of</td>
</tr>
<tr>
<td>State</td>
<td>Current</td>
<td>Proposed</td>
<td>Amount</td>
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<tr>
<td>Maine</td>
<td>394 municipalities (hand-counted paper ballots); 109 municipalities (precinct-level optical-scan ballots [Accu-Vote ES-2000 (36 municipalities)]; [Optech IIIP (47 municipalities)]; [Optech IIIP Eagle (24 municipalities)]; [ES&amp;S Model 100 (2 municipalities)])</td>
<td>Modify current machines; DRE requirement</td>
<td>Estimated $5,000,000-$10,000,000</td>
</tr>
<tr>
<td>Maryland</td>
<td>4 systems: Optical Scan (ES&amp;S Optech IIIP Eagle and Diebold Model ES-2000) and DRE (Diebold AccuVote TS and Sequoia AVC Advantage)</td>
<td>In the process of meeting requirements; DRE requirement</td>
<td>$57,500,000 allocated</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>392 precincts (lever machines); 11 (Datavote systems); 1665 (optical scan [Accu-Vote (1042 precincts), Optech (176 precincts), and Optech Eagle (447 precincts)]; 90 (paper ballots))</td>
<td>Replace lever machines and Datavote machines; DRE requirement</td>
<td>100% of § 102 monies &amp; 15% of Title II monies</td>
</tr>
<tr>
<td>Michigan</td>
<td>445 precincts (lever machines); 98 (paper ballots); 866 (central-count punch cards); the rest of the 5405 total precincts use either DRE or precinct-level optical scan</td>
<td>Replace punch cards and lever machines; DRE requirement</td>
<td>Estimated $55,000,000 to be allocated</td>
</tr>
<tr>
<td>Minnesota</td>
<td>7 counties (hand-count paper ballots); 24 (central-count optical scan); 14 (precinct-</td>
<td>Implement a uniform, statewide voting system with locally-owned, precinct-based,</td>
<td>No info.</td>
</tr>
<tr>
<td>State</td>
<td>Current</td>
<td>Proposed</td>
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</tr>
<tr>
<td>Mississippi</td>
<td>tabulator optical scan; 42 (mixed systems)</td>
<td>Replace all non-DRE voting devices with DREs if full federal funding provided</td>
<td>Plans to spend approximately $15,000,000 in federal funds</td>
</tr>
<tr>
<td></td>
<td>8 jurisdictions (lever systems); 11 (punch cards); 1 (Opscan [combination OMR and punch card]); 8 (precinct-level optical mark reader systems); 51 (central-optical mark-reader systems); 1 (DRE); 2 (Shouptronic systems)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missouri</td>
<td>9 jurisdictions (lever systems); 11 (punch cards); 1 (Opscan [combination OMR and punch card]); 8 (precinct-level optical mark reader systems); 51 (central-optical mark-reader systems); 1 (DRE); 2 (Shouptronic systems)</td>
<td>Replace punch cards; DRE requirement</td>
<td>Unclear</td>
</tr>
<tr>
<td>Montana</td>
<td>9 jurisdictions (lever systems); 11 (punch cards); 1 (Opscan [combination OMR and punch card]); 8 (precinct-level optical mark reader systems); 51 (central-optical mark-reader systems); 1 (DRE); 2 (Shouptronic systems)</td>
<td>Replace punch cards; DRE requirement</td>
<td>Approximately $3,100,000 allocated</td>
</tr>
<tr>
<td></td>
<td>9 (punch cards); 70 (optical scan)</td>
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<tr>
<td></td>
<td>45 (optical scan); 5 (paper ballots)</td>
<td>Replace punch cards in 5 counties (1 county already replaced their system after the 2000 election); DRE requirement</td>
<td></td>
</tr>
<tr>
<td>Nebraska</td>
<td>Two methods: hand counting of paper ballots and central optical-scan system for paper ballots (no breakdown by counties)</td>
<td>Replace punch cards; DRE requirement</td>
<td>Approximately $5,300,000 allocated</td>
</tr>
<tr>
<td>Nevada</td>
<td>7 counties (punch cards); 9 (optical scan); 1 (DRE)</td>
<td>Replace all punch cards and optical-scan systems with DREs, if sufficient funding; DRE requirement</td>
<td>Approximately $8,500,000 allocated</td>
</tr>
<tr>
<td></td>
<td>162 polling places (optical scan [Optech IIIP (39); Accuvote OS ES-2000 (123)]; 147 (hand-count paper ballots)</td>
<td>Replace punched cards in 1986; DRE requirement</td>
<td>25% of available funds to be allocated</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>162 polling places (optical scan [Optech IIIP (39); Accuvote OS ES-2000 (123)]; 147 (hand-count paper ballots)</td>
<td>Replace lever machines and upgrade other systems; 2 counties replaced</td>
<td>To be determined; estimated $39,000,000 for complete upgrade</td>
</tr>
<tr>
<td>State</td>
<td>Current</td>
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<tr>
<td>New Mexico</td>
<td>DRE and optical scan (no info. on number of counties)</td>
<td>Already replaced punch card and lever machines; begin replacing older systems; DRE requirement</td>
<td>Initial $5,000,000 in Title II funds to be used for DRE purchases</td>
</tr>
<tr>
<td>New York</td>
<td>All 62 counties (lever machines)</td>
<td>Replace lever machines (19,843 systems); DRE requirement</td>
<td>$140,000,000 total budgeted</td>
</tr>
<tr>
<td>North Carolina</td>
<td>8 counties (punch card); 5 (lever machines)</td>
<td>Replace punch-card and lever machines; DRE requirement</td>
<td>$37,200,000 allocated</td>
</tr>
<tr>
<td>North Dakota</td>
<td>44 counties (optical scan); 8 (hand-count paper ballots); 1 (punch card)</td>
<td>Replace punch-card system in Williams county; DRE requirement</td>
<td>Estimated $5,000,000-6,000,000</td>
</tr>
<tr>
<td>Ohio</td>
<td>69 counties (punch cards); 2 (lever machines); 6 (electronic voting devices); 11 (optical scan)</td>
<td>Replace punch-card and lever machines, if sufficient funding; DRE requirement</td>
<td>Estimated $136,000,000</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>4 counties (optical scan); No info. on other counties</td>
<td>Upgrade current systems; replace all precinct-level and central-count devices in largest counties; DRE requirement</td>
<td>$33,400,000 allocated</td>
</tr>
<tr>
<td>Oregon</td>
<td>3 counties (punch cards); 33 (optical scan)</td>
<td>Replace punch cards; DRE requirement; additional DREs, if funding available</td>
<td>$3,550,000 allocated</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>5 counties (paper ballots); 24 (lever machines); 11 (punch cards); 24 (central-count optical scan); 8 (DRE)</td>
<td>Replace punch-card and lever machines; upgrade other systems; encourage DREs or, if not DREs, then encourage precinct-level optical scan; DRE requirement</td>
<td>Approximately $23,000,000 under § 102 funds; state will fully reimburse DRE purchases, part for other machines</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>All 39 cities (precinct-level optical scan)</td>
<td>Replaced entire system in 1998 with optical scan</td>
<td>Approximately $7,000,000 allocated for</td>
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<td>State</td>
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</tr>
<tr>
<td>South Carolina</td>
<td>[Optech III-PE]) scan; 2 DREs per precinct</td>
<td>Replace all machines with a statewide uniform electronic voting system (no info. on which system); DRE requirement</td>
<td>$36,600,000 allocated</td>
</tr>
<tr>
<td>South Dakota</td>
<td>Precinct-level and central-count optical scan; hand-count paper ballots, punch cards (no info. on number of counties)</td>
<td>Utilize precinct-level and central-count optical-scan ballots, hand-count paper ballots, and DREs; DRE requirement</td>
<td>Approximately $7,700,000 allocated</td>
</tr>
<tr>
<td>Tennessee</td>
<td>41 counties (DREs [Electronic Danaher or Microvote]); 11 (optical scan [ESS Central Count and ESS Precinct Count]); 43 (punch cards or lever machines)</td>
<td>Replace punch-card and lever machines; probably upgrade from central count to precinct-level optical-scan systems; DRE requirement</td>
<td>$19,500,000 allocated</td>
</tr>
<tr>
<td>Texas</td>
<td>90 counties (hand-count paper ballot); 150 (optical scan); 14 (punch cards); 3 (lever machines); 4 (DRE)</td>
<td>Replace punch-card and lever machines; DRE requirement</td>
<td>$31,800,000 allocated</td>
</tr>
<tr>
<td>Utah</td>
<td>23 counties (punch cards); 2 (optical scan); 4 (hand-count paper ballots)</td>
<td>Replace punch cards with DREs; DRE requirement</td>
<td>$20,500,000 allocated</td>
</tr>
<tr>
<td>Vermont</td>
<td>184 municipalities (hand-count paper ballots); 62 (optical scan)</td>
<td>Propose one type of optical-scan system; towns will be permitted to continue use of hand-count paper ballot; DRE requirement</td>
<td>$6,650,000 allocated</td>
</tr>
<tr>
<td>Virginia</td>
<td>28 precincts (hand-count paper ballots); 493 (optical scan); 1065 (lever machines); 275 (punch cards); 416 (DRE)</td>
<td>Replace punch-card and lever machines; DRE requirement</td>
<td>$33,100,000 allocated</td>
</tr>
<tr>
<td>Washington</td>
<td>16 counties (punch cards)</td>
<td>Replace punch cards;</td>
<td>$15,700,000 allocated</td>
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<td>State</td>
<td>Current</td>
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<td>cards); 23 (optical scan); 1 (mixed [optical scan and DRE])</td>
<td>DRE requirement; note: WA encourages absentee voting/voting by mail</td>
<td></td>
</tr>
<tr>
<td>West Virginia</td>
<td>10 counties (hand-count paper ballots); 3 (lever machines); 12 (punch cards); 29 (optical scan); 1 (DRE)</td>
<td>Replace punch-card and lever machines; DRE requirement</td>
<td>Estimated $16,500,000 allocated</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>87% of voters (optical scan); 10% (hand-count paper ballots); 3% (lever machines); note: also mentions that 3 counties used punch cards in 2000 election</td>
<td>Develop voter education for central-count optical-scan counties and paper ballots; replace lever machines; reimburse for replacement of punch cards; DRE requirement</td>
<td>$16,400,000 allocated</td>
</tr>
<tr>
<td>Wyoming</td>
<td>3 counties (lever machines); 5 (punch cards); 6 (central-count optical scan); 8 (precinct-level optical scan); 1 (DRE)</td>
<td>Replace punch cards, central count optical-scan systems, lever machines, and the Guardian Electronic 1242 DRE system; DRE requirement</td>
<td>No info.</td>
</tr>
<tr>
<td>D.C.</td>
<td>142 precincts (Optical-scan voting systems [Optech Eagle P III])</td>
<td>Meets requirements; DRE requirement met by 2004 [Sequoia Edge DRE]</td>
<td>$1,700,000 allocated</td>
</tr>
<tr>
<td>Puerto Rico</td>
<td>All voters use hand-count paper ballots</td>
<td>Probably replace the current system, but no decision</td>
<td>No info.</td>
</tr>
</tbody>
</table>
**APPENDIX B: SUMMARY OF STATE RECOUNT LAWS**

The chart below summarizes the recount laws of the fifty states. They are broken down into four categories: (1) automatic—recounts that take place automatically, regardless of the margin of victory, (2) candidate initiated-recounts that may be requested by a candidate, (3) voter initiated-recounts that may be requested by voters, and (4) close election—recounts that take place if the margin of victory falls beneath a prescribed numerical threshold.

<table>
<thead>
<tr>
<th>State</th>
<th>Type of Recount Provided for by Law</th>
<th>Description of State Recount Laws</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Automatic</td>
<td>Candidate-Initiated</td>
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<tr>
<td>Alabama</td>
<td>X</td>
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<tr>
<td>Alaska</td>
<td>X</td>
<td>X</td>
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<td>Arizona</td>
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<tr>
<td>State</td>
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<td>Automatic Initiated</td>
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<td></td>
<td>Candidate- Initiated</td>
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<td></td>
<td>Voter- Initiated</td>
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<tr>
<td></td>
<td>Close Election</td>
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</tr>
</tbody>
</table>

Arkansas  
- Any candidate voted for who may be dissatisfied with the returns from any precinct may petition for a recount of the votes cast therein.

California  
- During the official canvass of every election in which a voting system is used, the official conducting the election shall conduct a public manual tally of the ballots tabulated by those devices cast in one percent of the precincts chosen at random by the elections official. In addition, voters may file requests seeking a recount of the ballots.

Colorado  
- A recount of any election contest shall be held if the difference between the highest number of votes cast and the next highest number of votes cast is less than or equal to one-half of one percent of the highest vote cast in that election contest. Whenever a recount is not required an interested
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<tr>
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</thead>
<tbody>
<tr>
<td></td>
<td>Automatic</td>
<td>party (including a candidate who lost the election) may submit a notarized written request for a recount.</td>
</tr>
<tr>
<td>Connecticut</td>
<td>Candidate-Initiated Voter-Initiated Close Election</td>
<td>When the plurality of an elected candidate for an office over the vote for a defeated candidate receiving the next highest number of votes is either (1) less than a vote equivalent to one-half of one percent of the total number of votes cast for the office but not more than 2000 votes; or (2) less than 20 votes, there shall be a recanvass of the returns unless the defeated candidate submits a written waiver.</td>
</tr>
<tr>
<td>Delaware</td>
<td>X</td>
<td>Any candidate for a statewide office in a general election may apply for a recount if the number of votes separating such candidate and the closest opposing candidate is less than 1000 votes or less than one-half of one percent of all votes cast for the two candidates, whichever is less.</td>
</tr>
<tr>
<td>Florida</td>
<td>X</td>
<td>If a candidate for any office is defeated by one-half of one percent or less of the votes cast for such office the board responsible for certifying the results of the vote shall order a recount of the</td>
</tr>
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<td>State</td>
<td>Type of Recount Provided for by Law</td>
<td>Description of State Recount Laws</td>
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<tr>
<td></td>
<td>Automatic</td>
<td>Candidate-Initiated</td>
</tr>
<tr>
<td>Georgia</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Hawaii</td>
<td>None found.</td>
<td>X</td>
</tr>
<tr>
<td>Idaho</td>
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<td>State</td>
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<tr>
<td>Illinois</td>
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<td>Candidate-Initiated</td>
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<tr>
<td>Indiana</td>
<td>X</td>
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<tr>
<td>Iowa</td>
<td>X</td>
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<td>Kansas</td>
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<tr>
<td>Kentucky</td>
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<td>Louisiana</td>
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<tr>
<td>Maine</td>
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<td>Maryland</td>
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<td>Description of State Recount Laws</td>
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</tr>
<tr>
<td>Massachusetts</td>
<td>Automatic Candidate-Initiated Voter-Initiated Close Election</td>
<td>A voter-initiated petition for a recount may be filed on or before 5:00 p.m. on the tenth day following an election, provided that the written request for the recount is signed by the number of voters required by § 135 and is signed by the candidate on whose behalf the recount is being conducted. Statewide recounts may only be authorized if the difference between the number of votes cast for the two leading candidates for the office is one-half of one percent or less of the total votes cast for such office.</td>
</tr>
<tr>
<td>Michigan</td>
<td>X X X</td>
<td>A candidate for any office (with a few exceptions) may petition for a recount of the votes cast for that office in any precinct, provided that the petition is filed not later than forty-eight hours after the completion of the canvass of votes cast at an election. A qualified, registered elector who believes that there has been fraud or error committed by the inspectors of an election may also petition for a recount of the votes cast in any precinct, provided that the petition is filed not later than two days after the final certification of the canvass of votes. A</td>
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<tr>
<td>State</td>
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<td>Description of State Recount Laws</td>
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<td>Mississippi</td>
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<td>Missouri</td>
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- **Minnesota**: In a state general election when the difference between the votes of a candidate who would otherwise be declared elected and the votes of any other candidate for that office (1) is less than one-half of one percent of the total number of votes counted for that office; or (2) is ten votes or less if the total number of votes cast for that office is 400 votes or less the canvassing board shall recount the votes. A losing candidate may request a recount at the candidate’s own expense when the vote difference is greater than the difference stated above.

- **Mississippi**: None found.

- **Missouri**: Any contestant in an election contest who was defeated by less than one percent of the votes cast for the office, and any contestant who received the second highest number of votes cast for that office if two or more are to be elected and who was
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<td>Automatic</td>
<td>defeated by less than one percent of the votes cast shall have the right to request a recount of the votes cast for the office by filing the request with the Secretary of State no later than seven days after the certification of the election.</td>
</tr>
<tr>
<td>Montana</td>
<td>X</td>
<td>A recount must be conducted if a candidate for a congressional office, or a state or district office, voted on in more than one county, the legislature or judge of the district court is defeated by a margin not exceeding one-quarter of one percent of the total votes cast for all candidates for the same position and the defeated candidate, within five days after the official canvass, files a petition with the Secretary of State. If a candidate for public office is defeated by a margin exceeding one-quarter of one percent but not exceeding one-half of one percent of the total votes cast for all candidates for the same position, he may, within five days after the official canvass, file a petition and post a bond to cover all the costs of the recount.</td>
</tr>
<tr>
<td>Nebraska</td>
<td>X</td>
<td>If a candidate failed to be elected by a margin of (1) one percent or less of the</td>
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<td>Type of Recount Provided for by Law</td>
<td>Description of State Recount Laws</td>
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<td>Candidate-Initiated</td>
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<tr>
<td>Nevada</td>
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<tr>
<td>New Hampshire</td>
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A candidate defeated at any election may demand a recount of the vote if within three working days after the certification of the vote and the candidate files his demand in writing. Any voter may demand a recount of the vote for a ballot question if within three working days after the certification of the vote and the voter files his demand in writing.

Any person for whom a vote was cast and recorded for any office at a town election may, no later than
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<td>New York</td>
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<td>North Carolina</td>
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In a ballot item within the jurisdiction of the State
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<tr>
<th>State</th>
<th>Type of Recount Provided for by Law</th>
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<tbody>
<tr>
<td></td>
<td>Description of State Recount Laws</td>
</tr>
<tr>
<td></td>
<td>Board of Elections, a candidate may submit a written demand for a recount if the difference between the votes for that candidate and the votes for a prevailing candidate are not more than (1) for a non-statewide ballot item, one percent of the total votes cast in the ballot item or in the case of a multi-seat ballot item, one percent of the votes cast for those two candidates; or (2) for a statewide ballot item, one-half of one percent of the votes cast in the ballot item, or in the case of a multi-seat ballot item, one-half of one percent of the votes cast for those two candidates or 10,000 votes, whichever is less.</td>
</tr>
<tr>
<td>North Dakota</td>
<td>A recount must be conducted when a person failed to be elected in a general or special election by one-half of one percent or less of the highest vote cast for a candidate for that office. A demand for a recount may be made by any person who failed to be elected in a general or special election by more than one-half of one percent and less than two percent of the highest vote cast for a candidate for that office, provided that the demand be made in</td>
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<td>Type of Recount Provided for by Law</td>
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of votes cast for the
winning candidate
receiving the least number
of votes and the losing
candidate receiving the
greatest number of votes is
less than one percent of
the number of votes cast
for the winning candidate
receiving the least number
of votes cast for that
office. A recount shall
also be granted if a losing
candidate files an affidavit
alleging that fraud or error
occurred in the canvassing
of the votes. In addition, a
recount for votes of a
ballot proposition will be
made if requested in an
affidavit signed by twenty-
five electors registered in a
district voting on the
question or if the
proposition receives a
number of votes, greater
or lesser, within one
percent of the number of
votes required for passage.

<table>
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<tr>
<th>State</th>
<th>Type of Recount Provided for by Law</th>
<th>Description of State Recount Laws</th>
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<td>of votes cast for the winning candidate receiving the least number of votes and the losing candidate receiving the greatest number of votes is less than one percent of the number of votes cast for the winning candidate receiving the least number of votes cast for that office. A recount shall also be granted if a losing candidate files an affidavit alleging that fraud or error occurred in the canvassing of the votes. In addition, a recount for votes of a ballot proposition will be made if requested in an affidavit signed by twenty-five electors registered in a district voting on the question or if the proposition receives a number of votes, greater or lesser, within one percent of the number of votes required for passage.</td>
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