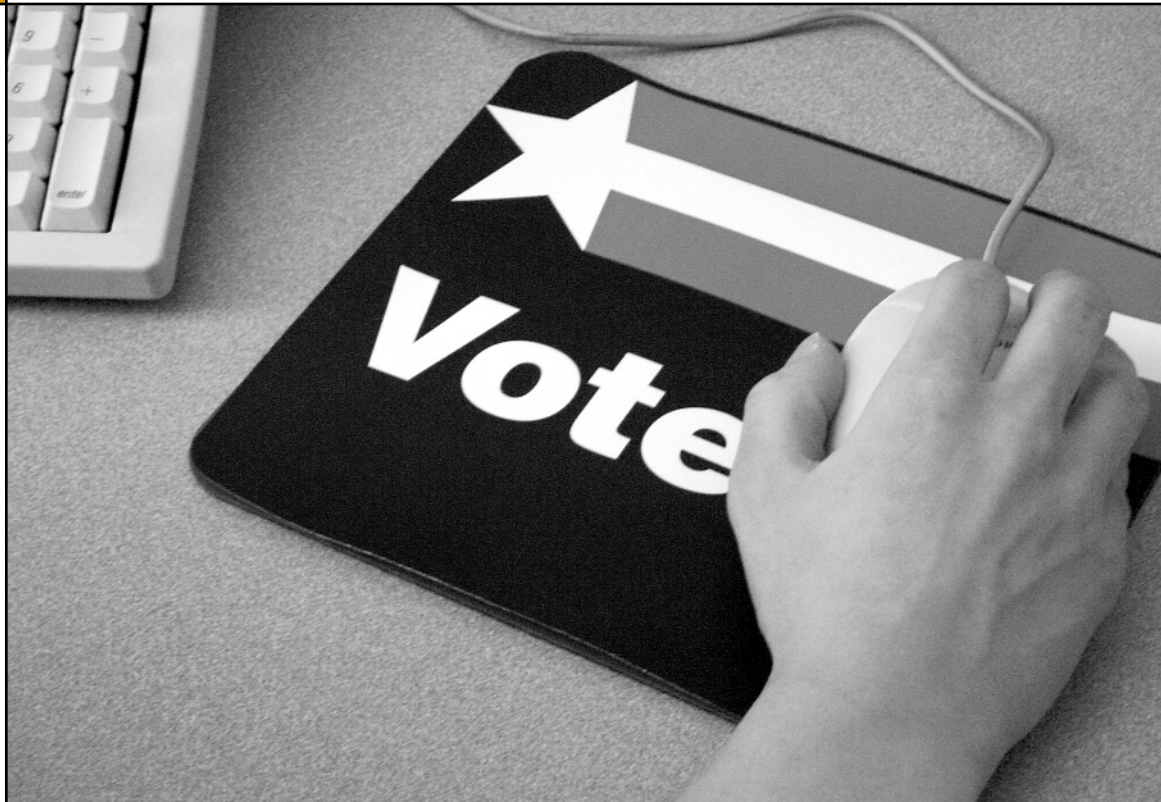


Internet Voting: Bringing Elections to the Desktop



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The PricewaterhouseCoopers Endowment for
The Business of Government

F O R E W O R D

February 2002

On behalf of The PricewaterhouseCoopers Endowment for The Business of Government, we are pleased to present this report by Robert S. Done, "Internet Voting: Bringing Elections to the Desktop."

This report is the Endowment's 10th publication in its E-Government Series. The Endowment continues to believe that e-government will significantly change the way government—at all levels—interacts with citizens. Several previous Endowment reports (such as "Commerce Comes to Government on the Desktop" by Genie N. L. Stowers and "The Auction Model" by David C. Wyld) have focused on the Government-to-Business (G2B) challenge. Other reports in this series (such as "The Use of the Internet in Government Service Delivery" by Steven Cohen and William Eimicke and "State Web Portals" by Diana Burley Gant, Jon P. Gant, and Craig L. Johnson) have examined the Government-to-Citizen (G2C) interface in which citizens receive government services via the Internet.

In their Endowment report ("Privacy Strategies for Electronic Government"), Janine S. Hiller and France Bélanger make an important distinction between Government-to-Citizen (services) and Government-to-Citizen (political). In this report, Robert Done directly addresses the challenge of government in delivering "political" services (such as voter registration and voting) to citizens over the Internet. While facing clear technological, legal, and social challenges, Professor Done presents a case study of Arizona, where Internet voting was tested in the 2000 Democratic presidential primary election. The case study clearly documents that Internet voting is possible and has the potential to substantially increase voter participation in the years ahead.

We trust that this report will be both helpful and enlightening to the many individuals both inside and outside of government who are working to improve our democratic processes and make it easier for citizens to participate in our nation's political process.

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EXECUTIVE SUMMARY

Internet voter registration and voting could be the most compelling issue facing e-government today and could also reinvigorate democracy like nothing before. The opportunities to improve voter registration, participation, efficiency, and effectiveness are accompanied by complex technical, legal, and social issues. The extent of these opportunities and issues has been difficult to assess in the absence of hard evidence. However, the 2000 Arizona Democratic presidential preference election provides experience and insight into the possibility of Internet voting systems.

Internet voting systems could capitalize on opportunities to improve the voting process. Results of a survey conducted at the University of Arizona suggest that 62 percent of the unregistered voting age population would register to vote on the Internet. The survey data also suggest that Internet voting would increase voter participation by about 42 percent while conserving valuable resources. The 2000 Arizona Democratic presidential preference election survived legal challenge and rebuffed cyber attacks. About 92 percent of the voting age population now has Internet access at some location—an indication that the digital divide is not as wide as it once was.

Overall, the Internet experience in the 2000 Arizona Democratic presidential preference election was successful and yields recommendations for additional research and development in information technology and social science. First, state and local jurisdictions should continue to experiment with Internet voting in local elections of lim-

ited scope such as for school board and city council members. Second, in collaboration with state and local experimentation, the level of research and development to improve Internet transaction security should be increased, especially refinements in encryption and secure Internet transmission. Third, social scientists should study the effect of Internet voting on voter participation and the democratic process. Ultimately, Internet voting systems should be neither accepted nor rejected out of hand. Instead, they should be the focus of vigorous research that can assist policy makers as they consider the role of the Internet in the democratic process.

Introduction*

The government's use of the Internet to communicate is increasing. Hiller and Bélanger (2001) observe that this type of communication is characterized by the intersection of the differing types of relationships and stages of government that exist. Governments can use the Internet to interact with other government agencies, government employees, businesses, and individuals. To these constituents, the government can provide information, exchange communication, provide transactions, and integrate services. Currently, the Internet is used primarily to support the government to business relationship in ways such as providing regulatory information and accepting tax payments. To a lesser extent, the Internet is also used to support the government to individual relationship (e.g., automobile registration). Political participation (i.e., voter registration and voting) is the most important government to individual relationship but has received the least attention. In the political process, the government can and does use the Internet to provide online information about election dates and voter registration, but until recently the use of the Internet to support elections was limited to speculation.

The 2000 Arizona Democratic presidential primary was the first binding political election to include Internet voting. The election began with an extensive education and outreach program for voters. The election also faced legal challenge and claims that Internet voting effectively discriminates against ethnic minorities, but the election was allowed to proceed. Voters were able to cast their ballots from home, work, or wherever they had Internet access.

Voters were also able to cast ballots by mail and at regular polling places.

This unique election provides the opportunity and empirical data needed to examine the benefits and issues of Internet voting, especially in comparison to the 1996 Arizona Democratic presidential preference election. The 2000 election illustrated the use of Internet technology in the voting process, the effect it could have on voter participation, and issues that must be resolved for future Internet elections. As the first of its kind, it is likely to be the focus of future discussions of Internet voting.

* The author would like to thank The PricewaterhouseCoopers Endowment for The Business of Government for its support of this research, and Suzanne Cummins, George Powers, Valorie Hanni Rice, and Christine Salterio for their invaluable assistance.

The 2000 Arizona Democratic Presidential Preference Election

In March 2000, the Arizona Democratic presidential preference election became the first binding political election to include Internet voting. Beyond that critical difference, the 2000 primary election was similar in many ways to the 1996 primary election. Both presidential preference elections were run by the Arizona Democratic Party rather than the Arizona secretary of state. Although the Arizona secretary of state does run presidential preference elections for political parties, the Democratic National Committee rules on election timing precluded the presidential preference elections from being conducted by the Arizona secretary of state. In both primary elections, there was effectively only one candidate. In 1996, Bill Clinton ran unopposed. In 2000, both Al Gore and Bill Bradley campaigned in Arizona, but Bill Bradley withdrew from the election, leaving only one candidate on March 7, the first day of voting. The goal of Internet voting was to increase voter turnout. "The last time we held a primary, only 12,000 out of 880,000 registered Democrats turned out. We need to do something to change that," said then Democratic Party Chair Mark Fleisher (Salkowski, 2000). The similarities between the two elections make Internet voting, the primary difference between them, easier to evaluate.

The educational outreach, legality, process, and technology used in the 2000 Arizona Democratic presidential preference election were reported on during and after the election (e.g., Mohen & Glidden, 2001). The election process began weeks before polls opened with an extensive outreach effort to educate voters, followed by increasing other opportunities to vote (e.g., mail), and providing voters with ample time and support to cast their

2000 Arizona Democratic Presidential Preference Election Milestones

January	Education and outreach begins. Voting Integrity Project files suit.
February	Court declines to prohibit Internet voting.
March	Ballots cast on Internet and paper.

ballots. Concerns about the digital divide resulted in a lawsuit that attempted to preclude Internet voting. Less obvious to voters was the array of hardware, software, and cryptography that were used to ensure the secrecy and security of their votes. The outreach, legal challenge, process, and technology used in the election are detailed in this section.

Outreach and Education

An extensive educational outreach program was launched two months before the election. The program began in January 2000, with the mailing of a notice printed in both English and Spanish to all registered Democrats in Arizona. The notice announced the upcoming presidential preference election and described how and when voters could participate in the election. Voters were provided guidance on how to vote by mail, vote on the Internet from any location, or vote at a polling place using the Internet or paper ballots. Election information was also promoted in 20 target publications and more than 170 print, television, and radio outlets.

A special outreach effort was directed at African-American, Hispanic, and Native-American communities and those with limited Internet access. The number of polling places was increased by 35 percent over the 1996 Arizona Democratic presidential preference election, and 30 Internet voting sites were identified in communities with limited Internet connectivity. And in cooperation with the Arizona Intertribal Council, special voting sites were established on reservations and off reservations in communities with Native-American populations. Election information was also posted on African-American, Hispanic, and Native-American websites.

Legal Challenge

In January 2000, the Voting Integrity Project filed suit in U.S. District Court to prohibit Internet voting in the 2000 Arizona Democratic presidential preference election. The Voting Integrity Project is a nonprofit organization that monitors election integrity and intervenes in instances of perceived voting impropriety. The focus of the suit was the extent of the digital divide and the disenfranchising effect it would have on ethnic minorities in an Internet election. The suit claimed that white voters are more likely to have Internet access from home than African Americans and Hispanics have from any location. Moreover, African-American and Hispanic voters together were only 40 percent as likely as white voters to have Internet access at home. The U.S. attorney general did not oppose the Internet election, and the court ruled against the Voting Integrity Project.

Election Process

Votes were cast by mail, over the Internet, and at polling places using paper ballots or the Internet. The information that was mailed to all registered Democrats contained an application that could be returned in exchange for a mail-in ballot. All registered Democrats were also mailed a random seven-digit alphanumeric personal identification number (PIN) to validate their eligibility to vote on the Internet. Remote Internet voters were required to affirm their eligibility to vote and were advised of the felonious nature of providing false information. Voters also had the option of voting at polling places (at any polling location within the state) using traditional paper ballots or personal comput-

Voting Alternatives in the 2000 Arizona Democratic Presidential Preference Election

- **Off site**—ballots cast on the Internet from outside the polling site
- **On site**—ballots cast on the Internet from inside the polling site
- **Paper**—ballots cast on paper at the polling site
- **Mail**—ballots cast by mail

ers with Internet access located at polling places. Even unregistered voters were permitted to register at the polling place and then vote on the same day. The same ballot could not be cast both on the Internet and at a polling place because the Internet voting server tracked whether or not an individual ballot had been cast and polling places did not open until off-site Internet voting had stopped.

The initial notices were mailed several weeks before the election to give voters time to consider their voting alternatives and to request a mail-in ballot if desired. Internet voting was open during the four-day period beginning on Tuesday, March 7, at 12:01 a.m. and ending at midnight on Friday, March 10. Polling place voting, for both paper and Internet ballots, was held on Saturday, March 11. Help desk support was available to voters who needed assistance in finding the website, configuring their computers, and navigating the ballot. A variety of observers were invited to monitor the election process, including citizens, the Big Five accounting firm KPMG, and the National Association for the Advancement of Colored People (NAACP), among others. This context of time, support, and oversight was the capstone of the voting process.

Technology

Remote Internet ballots were cast from a wide variety of personal computers and web browsers. Most combinations of computers and browsers proved to be compatible with the voting system, but some older browser versions did not support the security and privacy features required by the voting system. Free distribution of the latest versions of the most

common web browsers permitted Internet voters to upgrade their browsers if necessary. A secure socket layer communication link between the voting server and the remote Internet voting clients was established with digital signatures. Secure socket layer technology is the same type of connection used for most banking and commercial Internet transactions. The voting system was protected by a series of redundant servers and electrical power systems. A network router failed shortly after the polls were opened, but it was repaired in less than one hour.

The highest levels of internal and external security were maintained during the election. Individual votes were protected by personal identification numbers, ballot validity control, and ballot encryption. At a higher level of aggregation, the database tables containing the votes were protected against insider malfeasance by encryption that prevented anyone except KPMG from knowing the content of the cast ballots. The computers that contained the tables were housed in an undisclosed location, and access to the computers was controlled by key card and biometric security systems. Denial of service attacks are a simple but effective means of overloading a server with more Internet traffic than it can handle, causing all communication to stop. Given the relative ease of mounting a denial of service attack, it is not surprising that the election was the target of multiple denial of service attacks. All of these attacks were defeated, and intrusion-detection applications protected against virus and Trojan

Security Measures

- **Voter Identification**—personal identification numbers (PIN) required to vote on the Internet were mailed to voters.
- **Ballot Validation**—ballot validity was authenticated by the Internet voting server.
- **Data Encryption**—data were encrypted to ensure ballot secrecy.
- **Intrusion Protection**—hardware and software were protected against intrusion.
- **Audit Trails**—access to ballot data was automatically documented.

Voting Turnout in the 1996 and 2000 Arizona Democratic Presidential Preference Elections

Ballot Type	1996	2000
Off-site Internet	N/A	35,768
On-site Internet	N/A	4,174
Paper	12,651	14,217
Mail	233	32,748
Total	12,884	86,907

horse attacks to cripple or otherwise manipulate the process or the votes.

The secrecy and security of the election was supported by the database design, cryptography, oversight, and audit trails that were built into the voting process. The database containing the ballots had separate tables for voter identification and ballot content. Once the voting system received a ballot cast by a voter, the system detached the identification from the content and stored this information in separate tables that could not be merged. Both tables were then encrypted, but only the ballot content table was provided to KPMG for decryption and tabulation. Audit trails were used to monitor access to the data, hardware, and software. Audit logs recorded those who voted (but not for whom they voted), who accessed the database server, and versions and changes of the software. Thus, secrecy and security of the votes were protected by a series of technical and procedural checks and balances.

The combination of outreach, legal argument, process, and technology used in the election achieved the goal of the Arizona Democratic Party, which was to increase voter turnout. More votes were cast from off-site Internet locations than any other location. The outreach effort increased voter awareness of different voting options, the window of opportunity, and the number of polling places. The court was not convinced that the extent of the digital divide would substantially impact the election results. Polling places were opened after

remote Internet voting was closed so that any voter who tried unsuccessfully at the last minute to vote on the Internet would still have the opportunity to vote at a polling place the next day. The array of technology used in the election protected the secrecy and security of votes, and hardware malfunctions resulted in less than one hour of downtime in the 96-hour Internet voting period. Thus, the unique nature of the event was matched with an equally unique combination of outreach, legal support, process, and technology that resulted in a successful election.

Efficiency and Effectiveness

As older voting systems are replaced with more current technology, issues of efficiency and effectiveness will be important to election officials. The grim picture of Florida election workers interpreting the remnants of chads on punchcard ballots will be especially salient in the search for new equipment. Besides the absence of chads, Internet voting could result in other efficiency and effectiveness improvements. The 2000 Arizona Democratic presidential preference election experienced a dramatic increase in Internet voter participation without the need for additional precinct polling sites and workers to staff them. Moreover, this increased voter participation required no additional voting booths or printed ballots.

The efficiency and effectiveness of the voting technology that election officials adopt will also be important to voters. The number of remote Internet votes as compared to traditional votes cast in the 2000 Arizona Democratic presidential preference election suggests that efficiency and effectiveness are important considerations to voters. The savings in time and reduction of pollution produced by that level of increased voter participation on a national basis would be immense, even if voters spent only one hour and drove only one mile to vote. If just 1 percent of votes actually cast in the 2000 U.S. presidential election had been cast on the Internet, the nation would have saved more than 26,000 hours and thousands of pounds of auto emissions.

Thus, data from the 2000 Arizona Democratic presidential preference election and the follow-up survey suggest that there is indeed ample opportunity to improve the voting process. Survey responses

suggest that 62 percent of the unregistered voting age population would register on the Internet, increasing registered voters to over 90 percent of the voting age population. Similarly impressive increases could be found with Internet voting. At a national level, Internet voting would have resulted in ballots from more than 71 percent of the voting age population in the 2000 U.S. presidential election. Also important are the increases in efficiency and effectiveness that would reduce pollution and the use of natural resources.

Arizona Citizen Attitudes Toward Internet Voting

On November 7, 2000, the Arizona secretary of state and the Maricopa County recorder sponsored an Internet voting pilot demonstration in Phoenix. Voters were allowed to cast mock votes at a polling place on an Internet voting demonstration system and were then surveyed about their experience. Of the 116 respondents, only 3 percent preferred the existing voting system over Internet voting and 85 percent believed the Internet voting system to be at least as secure as the existing system.

In the spring of 2001, a survey conducted at the University of Arizona on Internet voting was sent to a sample of Arizona residents. The survey was mailed to 4,000 Arizona residents randomly selected from driver and identification license records, and completed surveys were returned by 495 respondents. Sampling from driver and identification license records provided better selection than voter registration records would have because the former includes people who are not currently registered to vote. The resulting sample reflected the characteristics of the Arizona and U.S. populations, except that respondents reported somewhat higher levels of education than average. More information on the sample characteristics can be found in the Appendix.

The survey included sections containing items on voter registration, voter participation, computer technology, the 2000 Arizona Democratic presidential preference election, and demographic identifiers. Registered voters were asked to identify their political party affiliation, and those who were not registered voters were asked if they would use the

Internet to register if they could do so. Respondents who voted in the 2000 presidential election were asked what method they used to vote and the candidate for which they voted, and those who did not vote were asked which candidate they would have selected if they had voted. Respondents were asked if current or future computer technology could provide secure and reliable Internet voting. Finally, respondents were also asked if they would have voted on the Internet in the 2000 U.S. presidential election if it had been an option and the method (including the Internet) they would prefer to use in the next presidential election.

The survey contained a section for registered Democrats eligible to vote in the 2000 Arizona Democratic presidential preference election. Respondents were asked if and how they voted in this election. Respondents were also asked about the extent of their Internet access at the time of the election and if they received their voting PIN while the polls were open. A series of questions were directed at those respondents who voted on the Internet during this election. These respondents were asked if they experienced any technical difficulty with their computers or the voting website. They were also asked if they were able to successfully cast their ballot on the Internet. Finally, they were asked if their Internet voting experience was easier, faster, more economical, or made the difference between voting or not as compared to the traditional voting process.

The last part of the survey contained items on demographic identifiers and Internet connectivity.

Respondents were asked to identify their sex, age, ethnicity, education, and range of household income. Respondents were also asked about their access to the Internet at home, school, work, public libraries, or other places (e.g., church, club, etc.). Respondents who did not have access to the Internet at any location were asked if they expected to get access within three, six, or 12 months, or if they ever expected to have Internet access.

Voter Registration

When those respondents who were not currently registered to vote were asked if they would register if able to do so on the Internet, 62 percent indicated that they would register to vote (see Table 1). Equal proportions (62 percent) of men and women would register on the Internet, and age was not a significant predictor of willingness to register on the Internet. A majority of all ethnic groups reported that they would register on the Internet.

White respondents were the most likely to register on the Internet, but they were also the most likely not to register on the Internet. Education increased the likelihood of Internet voter registration, but the majority of respondents in all education and income groups reported that they would register on the Internet.

The survey results suggest that the Internet could dramatically increase voter registration across all sex, age, ethnicity, and education groups. These results undermine the claim that voter registration would effectively benefit only white voters. White respondents were more likely than any other ethnic group not to register on the Internet. In the context of the entire voting age population in the United States, if just half of the 24 percent of the unregistered voting age population actually did register on the Internet, there would be an additional 25 million registered voters.

Table 1: Currently Unregistered Arizona Voters Who Would Use Internet for Voter Registration (percent)

		No	Not Sure	Yes
Total		23.2	14.8	62.0
Gender	Female	28.4	9.5	62.1
	Male	17.6	20.6	61.8
Ethnicity	Native American	0.0	0.0	0.0
	Asian	0.0	42.9	57.1
	Black	0.0	33.3	66.7
	Hispanic	21.7	17.4	60.9
	White	25.0	12.0	63.0
Education	Grade School	33.3	22.2	44.5
	High School/GED	21.8	18.2	60.0
	College	23.4	10.4	66.2
Income	Prefer not to answer	28.6	25.7	45.7
	Less than \$30,000	14.3	25.0	60.7
	\$30,001–\$60,000	18.4	10.5	71.1
	\$60,001–\$90,000	20.0	0.0	80.0
	More than \$90,000	29.4	5.9	64.7

(N = 495)

Voter Participation

About 42 percent of all survey respondents indicated that they would have voted on the Internet in the 2000 U.S. presidential election if it had been an option (see Table 2). What people report that they would do is not always what they actually would do, so it is striking that almost the same percent (41 percent) of all votes in the 2000 Arizona Democratic presidential preference election were cast on the Internet. In addition, the number of traditional paper ballots cast in the 1996 and 2000 Arizona Democratic presidential preference elections was about the same. The survey results revealed that education and income increased somewhat the likelihood of Internet voting and are consistent with findings reported by Solop (2001).

In the 2000 Arizona Democratic presidential preference election, the number of off-site Internet votes was more than two and one-half times the number of paper ballots cast at polling places. In 2000, more than 105 million votes were cast for U.S. presidential candidates. If Internet voting had been available and resulted in the same increased participation as it did in the 2000 Arizona Democratic presidential preference election, then about 71 percent of the voting age population would have voted. This result contradicts speculation (e.g., Internet Policy Institute, 2001; Mohen & Glidden, 2001) that Internet voting would have little effect on voter participation.

Table 2: Would Have Voted on the Internet in 2000 (percent)

		No	Not Sure	Yes
Total		38.3	19.5	42.2
Gender	Female	38.4	19.0	42.6
	Male	38.2	20.0	41.8
Ethnicity	Native American	33.3	33.3	33.3
	Asian	30.8	30.8	38.4
	Black	50.0	16.7	33.3
	Hispanic	36.6	22.0	41.5
	White	38.4	18.8	42.8
Education	Grade School	43.8	31.2	25.0
	High School/GED	43.7	15.2	41.1
	College	35.2	21.3	43.5
Income	Prefer not to answer	45.0	19.5	35.5
	Less than \$30,000	40.0	21.3	38.7
	\$30,001–\$60,000	41.2	18.4	40.4
	\$60,001–\$90,000	29.5	17.9	52.6
	More than \$90,000	22.4	23.9	53.7

(N = 495)

Internet Access

Although the 2000 Arizona Democratic presidential preference survived legal challenge, the extent of the digital divide is crucial to the propriety of Internet voting. Data from the follow-up survey did not support the extent of the digital divide suggested by the Voting Integrity Project. Taken together, 89 percent of African-American and Hispanic respondents had Internet access at some location, as compared to 79 percent of white respondents who reported having Internet access at home. In addition, African-American and Hispanic respondents together were 81 percent as likely as their white counterparts to have Internet access at home. Although a digital divide still exists, it appears to be narrowing with time.

Potential Advantages of Internet Voting

The Internet presents an opportunity for improving democracy and the process by which it is achieved. The registration and participation of voters that is essential to a healthy democracy could be increased with Internet technology. The digital divide between those who do and do not have computers and access to the Internet decreases every day as Internet technology becomes more affordable. Internet voting could also create gains in efficiency and effectiveness for voting technology, democracy, and the voting process. Despite the controversy and delay created by punchcard ballot technology in the 2000 U.S. presidential election, most jurisdictions do not have the resources to replace their punchcard ballot devices or other outdated voting equipment. As a remedy, the Ney-Hoyer bill (H.R. 3295, "Help America Vote Act of 2001," passed the House in December 2001) provides \$2.65 billion over three years for jurisdictions to improve voting equipment, voter registration lists, and poll worker training. Included in the bill is \$400 million to fund the replacement of punchcard voting machines. Internet technology could replace some of the voting machines in use today on a more cost-effective basis than simply replacing them with other poll site voting machines. In this section, each of these opportunities is discussed in more detail.

Easing Voter Registration

In 2001, the National Commission on Federal Election Reform published its report on recommendations to improve the federal election process. The first of 13 recommendations was the development and implementation of a computerized voter registration system that provides access to any jurisdiction within a state and shares information with

other states. Internet voter registration could efficiently and effectively accomplish this and could also increase overall voter registration, especially among young people, who have always had the lowest levels of voter registration. Among registered voters there are millions of record changes each year and a substantial number of duplicate registrations. The opportunity for Internet voter registration to improve these conditions is described below.

Estimates of voter registration are based on the voting age population, which is the number of people in the United States who are at least 18 years of age. Because this population includes many people who are not eligible to vote (e.g., non-citizens, convicted felons, etc.), the percentage of the voting age population who are registered to vote is not accurate. However, it remains the basis for voting analyses and can be considered to yield conservative estimates of voter registration. That is, the true percentage of registered voters should be no less than the estimate and probably higher. In the 2000 U.S. presidential election, approximately 76 percent of the voting age population was registered to vote. Currently, an increase in registered voters equal to just 1 percent of the voting age population would result in over 2 million more registered voters.

The National Voter Registration Act of 1993 (NVRA) was designed to:

- Establish procedures to increase the number of registered voters for elections for federal office;
- Assist all levels of government in increasing voter registration and participation;

- Protect the integrity of the electoral process; and
- Ensure the accuracy and currency of voter registration rolls.

The NVRA also requires the Federal Election Commission (FEC) to maintain a voter registration form that does not require notarization or formal authentication and to report to Congress every two years on the effect of the NVRA. Internet voter registration could help accomplish all four goals of the NVRA by increasing the ease of registering and updating for voters and the efficiency of maintenance and validation for election officials.

The FEC reports to Congress on voter registration and ways to improve the process. From 1995 to 1998, in 43 states and the District of Columbia almost 77 million voter registration transactions were processed (FEC, 1997, 1999). About 59 percent of those transactions were first time or inter-jurisdictional changes, and the remaining 41 percent were intra-jurisdictional changes of name and address. During this time, there were more than 4 million duplicate voter registrations. The FEC also recommends that voter registration be maintained on statewide computer systems with online access by all local jurisdictions. Even if all first-time registrations were manually processed, subsequent updates processed on the Internet could decrease the enormous administrative burden and duplicate registrations currently experienced.

Thus, the Internet could increase voter registration, further the goals of the NVRA, and increase the speed and accuracy of voter registration transactions. Internet voter registration may be especially appealing to 18- to 20-year-old voters, who have had the lowest rates of voter registration since 1971, when the voting age was lowered from 21 to 18 years. Beyond advancing the goals of the NVRA, Internet voter registration would fulfill the FEC's consistent recommendation that voter registration records be maintained on a computer network with access at every jurisdiction office. The flexible nature of the Internet would allow voter registration records to be maintained at the national, state, or local level yet remain available to users at any location who need access to those records.

Increasing Voter Participation

The Internet can create an opportunity to convert increased voter registration into increased voter participation. In 2000, about 50 percent of the voting age population cast ballots in the presidential election, and that number could have been much higher with Internet voting. The close results of the 2000 presidential election illustrate how important individual votes can be (even in an electoral college system), and Internet voting could answer the demand for increased voter participation in future elections. Historically, rates of voter participation are generally stable across gender, age, and ethnicity. Rates of voter participation for various demographic groups and the effect Internet voting could have on voter participation among some of those least likely to vote are reviewed in this section.

Voting patterns in U.S. presidential elections are largely stable, but do shift occasionally. Slightly more than 50 percent of the voting age population voted in the 2000 election, down from an average of 57.6 percent of the voting age population who voted in the years 1972–1996. In the 1970s, men voted at slightly higher rates than women, but that trend reversed in 1980 and since then women have participated at slightly higher rates than men. Rates of voter participation consistently increase with age, except that in the years 1972–1984 rates of participation were lower for retirement-age voters than for those who were approaching retirement. But since 1988, rates of voter participation have been the highest among those who are 65 and older. Voter participation is weakest among 18- to 20-year-olds, whose participation rate of 37 percent is about half that of those who are 65 and older. A more constant pattern is the ethnic distribution of voter participation, which is led by whites (61 percent), followed by blacks (52 percent), and Hispanics (31 percent). Internet voting could increase levels of voter participation among everyone, especially those in the 18–20 age group.

Internet voting could increase rates of voter participation for those who are or will become part of the voting age population by increasing opportunities to vote, especially from home. According to 2000 census data, almost 54 million households had at least one computer and 81 percent of those also had access to the Internet. Men have slightly more computer and Internet access than women.

Computer and Internet access increases with age until 44, after which it drops sharply. Patterns of computer and Internet access for ethnic groups mirror those of voter participation, with the highest levels of computer and Internet access reported by whites, followed by blacks and Hispanics.

Internet voting could have a balancing effect on voter participation because some of these computer and Internet access trends complement those of voter participation. For example, slightly more women vote than men, but men have slightly more computer and Internet access than women. Similarly, the youngest possible voters have the most computer and Internet access while the oldest voters have the least access. Internet voting would not only increase opportunities to vote from home, but also from school, work, public libraries, Internet cafes, and any other place around the world where the Internet can be accessed.

Increasing voter participation is the most often cited benefit of Internet voting. Because of increasing access to and use of the Internet, many people rely on it for personal and business transactions. The demographic characteristics of the current voting age population suggest that with Internet voting, the lower voter participation of men and young people could be improved because of their higher computer and Internet access. In addition, many of tomorrow's voters are currently exposed to and learning about Internet technology. About 70 percent of children in the 12–17 age group have a computer at home and about 69 percent of those also have Internet access, beyond what access they might have at school or other locations. By the time Internet voting could be possible, this group may not remember life without the Internet.

Improving Efficiency and Effectiveness

While the most obvious and perhaps most desirable benefits that the Internet could provide to the election process are increases in voter registration and voter participation, less obvious increases in efficiency and effectiveness are also desirable. One of the older forms of voting technology, mechanical lever machines, are no longer in production, and individual jurisdictions are considering newer voting technology to replace these machines. At

the national level, increases in the efficiency and effectiveness of the democratic process could result in a more active and inclusive political process that could inspire higher rates of voter participation. The economic costs of elections could also be reduced with Internet voting. In this section, these opportunities for increased efficiency and effectiveness are examined.

Internet voting should not eliminate current voting technology, but rather complement it by improving the efficiency and effectiveness of balloting. Currently, five types of voting technology are used in the United States. The oldest form is the paper ballot, which is often used in smaller communities. Mechanical lever machines do not mark ballots but simply total the votes cast. Punchcard systems provide voters with a ballot in which holes are punched to identify their vote. Optical scanners can be used to tabulate ballots marked by voters. More recently, direct recording electronic systems have been used, which are an electronic version of the mechanical lever machine. Internet voting would be a distributed version of direct recording electronic systems, with a voting booth at every point of Internet access in the world.

Internet voting could increase the efficiency and effectiveness of the democratic process. For example, one reason that potential voters might not vote is that they feel removed from the process by relatively infrequent elections. Internet voting would allow elections to be held more frequently and thus allow voters to maintain a higher baseline level of participation in the process. Internet voting would also require elected officials to be more responsive to their constituents. One reason for this is that more frequent elections would require elected officials to maintain more frequent communication with their constituents, rather than just at election time. Another reason is that incumbents who do not represent the will of their constituents could no longer rely on the difficulty of mounting a recall election to maintain their position.

Internet voting could also reduce the cost of elections to society. As worthwhile as elections are, they represent a significant investment in time, money, and natural resources. Voting may take employees away from their jobs, which not only reduces productivity at the national level but may

also require hourly employees to take time off at their own expense. A national voting holiday, as recommended by the National Commission on Federal Election Reform (2001), might increase voter participation but could result in even more lost productivity and wages than is currently experienced. Internet voting could also reduce the amount of natural resources consumed by elections. For example, the amount of paper used for ballots would be reduced, as would petroleum used to make special trips to polling places.

Thus, the Internet could create a more efficient and effective voting process. The Internet would be an efficient and effective voting technology, and is not far removed from the direct recording electronic voting systems in use today that do not use ballots but simply record votes in an electronic medium. Increased levels of democratic activity made practical by the efficiency and effectiveness of the Internet could lead to higher levels of participation by voters and accountability by elected officials if elections became more commonplace. This would be especially true for referendum elections. The efficiency and effectiveness of Internet voting could also result in increased voter participation while at the same time reducing income losses for employees who must take time off from work to vote and productivity losses for the organizations that employ them.

Clearly, there are numerous opportunities to improve voter registration, participation, efficiency, and effectiveness, and the Internet could deliver improvements in all of these areas. In concert with the recommendations of the National Commission on Federal Election Reform (2001) and the Federal Election Commission (1997, 1999), the Internet would create a computerized voter registration system that might not only increase voter registration but also increase the accuracy of the voter registration rolls. Internet voting could also increase rates of participation among those in the voting age population who have been the least likely to vote. The economies of scale that can be achieved with the Internet could also make the voting process much more efficient and effective. However, while the Internet could yield many benefits to the democratic process, there are three key sets of issues that must be overcome to achieve those benefits.

Key Issues to Be Resolved

The primary challenges facing Internet voting systems come from technical, legal, and social domains. Advances in Internet technology now allow commerce and banking to be securely transacted on the Internet, but even more advanced technologies would be required to maintain the security and secrecy of Internet voting at the client, server, and communication levels. Equally stringent will be the legal tests that Internet voting must pass so that it does not result in discrimination in voter registration or voting. At the societal level, Internet voting would require the integration of a sophisticated information system into a population with widely varying knowledge, skills, abilities, and attitudes toward computers. In this section, each of these challenges to Internet voting is discussed in more detail.

Technological Issues

The function of Internet voting systems requires them to be founded on unprecedented technology. This technology must meet the demands of providing the utmost security and secrecy for voters while remaining a viable voting alternative. Security must be maintained at the individual level (e.g., precluding ineligible voters) and at the systemic level (e.g., precluding computer viruses). To achieve this level of security, advancements will have to be made in areas such as identification and cryptography. In general, the technical issues of Internet voting are in the domains of the client, server, and communication path (Internet Policy Institute, 2001).

The Internet voting client is the platform of hardware and software used by the voter to cast a ballot

Key Technology Concepts

- **Client**—combination of hardware and software used by voters to cast ballots
- **Server**—combination of hardware and software used to receive, decrypt, tally, and archive ballots
- **Communication Path**—route and medium used to link the client with the sever

and may be the most likely point at which a malicious object (e.g., software virus) may enter the voting system. For remote Internet voting, the Internet voting clients are the computer systems at home, work, and other locations that may be accessed by multiple users and have various points of entry (e.g., floppy disk, CD-ROM, or Internet link) for malicious objects such as computer viruses. Remote Internet clients could also include other points of Internet access, such as Internet appliances, WebTV, and cell phones. For kiosk Internet voting, the voting client is the voting terminal or booth that would be located in a public place (e.g., shopping mall) and would require constant monitoring to maintain adequate security. Computer-enabled kiosks are currently used in airports, shopping malls, and other locations to provide customer service. Finally, for poll site Internet voting, the Internet voting client is the voting terminal or booth that would be located in the polling place, similar to a traditional voting booth, and it would provide the least opportunity for the introduction of

a computer virus. These clients could be identical to the kiosks but located at the poll site.

The Internet voting server is the system of hardware and software that receives, decrypts, tallies, and archives the votes. The server is vulnerable to various types of penetration attacks that could corrupt the voting process. One type of penetration attack is the Trojan horse, which spreads like a virus throughout the system and could permanently delete or alter votes. Another type of penetration attack is a remote control program, which can turn the target into a computer zombie that operates normally for legitimate operators but also provides complete access and control to illegitimate operators who, operating from anywhere in the world, could stuff or loot the electronic ballot box. Another type of server-based attack on Internet voting could be mounted with spoof servers, which are impostors designed to lure voters away from authentic Internet voting servers. Votes cast at these spoof servers could be lost forever—or, even worse, modified and passed on to an authentic Internet voting server.

The communication path refers to the route and medium used by the client to send the vote to the server. A secure communication path must maintain encrypted data and an authenticated communication link between the client and the server. With current technology, votes could be encrypted but an authenticated communication link between the client and server cannot be guaranteed. The most likely threat to the communication link is an attempt to simply disrupt the link rather than to alter the communication, a technique referred to as a denial of service attack. This type of attack occurs when the server is overwhelmed with more requests than it can handle and shuts down until the attack is over, thereby disrupting the voting process. Currently, denial of service attacks cannot be defended against without shutting down the communication link and effectively accomplishing the goal of the attacker.

Two important technical issues were illustrated in the 2000 Arizona Democratic presidential preference election. The first is the identification and validation of voters. Voters must have a valid registration and that registration must be verified by the Internet voting system. The challenge here is to pro-

Internet Voting Client Access

- **Remote**—access from any Internet location
- **Kiosk**—access from public places (e.g., shopping centers)
- **Poll Site**—access at traditional polling places using personal computers

vide voters with a unique identifier that can be used in the ballot authentication process. The second issue is to maintain the security and reliability of the Internet voting system so that the voting process is not disrupted or delayed. The security of the system must withstand sabotage from both internal and external forces, and the reliability of the system must be ensured with redundant resources.

In the 2000 Arizona Democratic presidential preference election, voters were mailed a randomly generated seven-digit alphanumeric code to be used when voting from remote Internet locations. With about 2 billion permutations of such a code and additional challenge questions to establish the identity of the voter, the identification of voters was not as much an issue as the communication of that identification to the voters. Some voters did not receive their code during the window of remote Internet voting opportunity. Internet voting server security was maintained with biometric identification and firewalls. The vulnerability proved to be with the reliability of the system when a router failed and redundant equipment did not respond.

Although the technical issues of Internet voting are not likely to be insurmountable, they are significant. Under current technological conditions, remote Internet voting would create the greatest risk to the security and secrecy of votes while kiosk and poll site Internet voting would create less risk with monitoring. Servers may be vulnerable to sophisticated viruses or simplistic denial of service attacks. The communication path, which may be international, could also be compromised. Thus, the technical issues that must be resolved before Internet voting can be implemented in public elections are challenging, but no less so than the legal and social issues.

Legal Issues

Although the initial ruling on Internet voting was favorable, Internet voting must face review by the two agencies primarily responsible for regulating election process and technology in the United States, the Department of Justice and the Federal Election Commission. The Department of Justice enforces the Voting Rights Act, which prohibits voting processes and procedures that discriminate based on race or color. The Federal Election Commission maintains voting system performance and test standards to ensure the technical integrity of elections. Internet voting is a change in the democratic process that both of these agencies must address before it could be implemented in public elections.

The Voting Rights Act

The Voting Rights Act of 1965, together with amendments in 1970 and 1982 and numerous interpretations, consists of three main parts. The first part was designed to enforce the 15th Amendment and contains basic provisions against racial discrimination in voting, the application of dissimilar standards, disqualification by immaterial irregularities on voter registration, and qualification testing. The second part, known as Section 2, specifically prohibits any qualification or process that denies or abridges the right to vote on account of race or color. Finally, the third part, known as Section 5, prohibits changes in voting process or procedure that result in more racial discrimination in voting than currently exists.

Department of Justice

The Department of Justice is responsible for protecting voting rights through the enforcement of the Voting Rights Act. Under Section 2, the Department

Changes in Voting Standards and Processes

Changes in voting standards and processes must be approved by either:

- U.S. attorney general, or
- Federal court in the District of Columbia

of Justice takes legal action on behalf of those whose voting rights are currently being violated on the basis of race or color. Under Section 5, proposed changes in existing voting process or procedure must be reviewed and approved by the Department of Justice before the changes can be implemented. Internet voting would be a change in voting process or procedure that the Department of Justice must review and approve before it could be implemented in public elections.

Federal Election Commission

The Federal Election Commission develops and implements performance and test standards for voting technology and equipment. In 1975, the first report on computerized voting technology was issued. During the 1980s, more standards were developed, and in 1990 the first performance and test standards were issued for computerized voting systems. The performance standards describe the functional and technical requirements for voting systems while the test standards describe the process and criteria for evaluating voting systems. The Federal Election Commission, in collaboration with the National Association of State Election Directors, assists voting jurisdictions in the application of voting system performance and test standards.

The updated voting system performance and test standards include guidelines for Internet voting systems to assure that they are as accurate, reliable, and secure as other voting systems. The new standards, reflecting the issues raised in the Internet Policy Institute (2001) report, address Internet voting at poll sites, supervised remote sites, and unsupervised remote sites. The standards provide guidelines for hardware components (e.g., computer equipment used for poll site as well as supervised and unsupervised remote sites), software

Voting Rights Act

Voting Rights Act prohibits discriminatory:

- Standards
- Processes
- Changes

modules (e.g., encryption, decryption, and security) and communication (e.g., privacy, reliability, and durability). These standards will naturally evolve as Internet technology continues to develop.

Thus, Internet voting will have to face the regulatory challenge of the Department of Justice and the Federal Election Commission. The objective of voting laws enforced by the Department of Justice is to ensure that voters are able to participate in elections without discrimination based on race or color. The objective of the voting system standards developed by the Federal Election Commission is to ensure that all votes are validated and counted. These two agencies, responsive to the complementary needs for elections that are legally and technically viable, are vital in protecting the integrity of the democratic process.

Key Legal Issues

- Does increasing the opportunity to vote for some effectively reduce the opportunity to vote for others?
- Does the digital divide substantially follow ethnic distributions?

Social Issues

Advances in technology and favorable legal rulings would not necessarily make the Internet a socially appropriate addition to the voting process. If protected classes (i.e., ethnic minorities) of the voting age population do not have ready access (e.g., at home) to the Internet, this could be a violation of the Voting Rights Act. A more complicated issue is the prospect of a digital divide that isolates those who are not protected by the Voting Rights Act. One possibility would be to enact special laws that regulate Internet voting, but that solution lacks parsimony. Another possibility would be to increase the number of protected classes under the Voting Rights Act, but that could create more problems than it solves. The solution to this issue is not clear.

Data from the follow-up survey reveal that about 92 percent of the respondents reported having

Internet access at home, school, work, public libraries, or some other location. Since Internet voting from home is likely to be the most convenient voting location, an examination of home Internet access is most relevant. Equal proportions of men and women reported having Internet access at home, and ethnic background was not a strong determinant of Internet access at home. However, those who were younger, more educated, and reported higher incomes were more likely to have Internet access at home than their counterparts. However, age, education, and income are not protected classes under the Voting Rights Act.

Several social aspects of Internet voting must be explored to evaluate the compatibility of Internet voting with society. As with any new information technology system, a wide variety of individuals and government agencies would need to learn how to operate an Internet voting system. One of the most, if not the most, important social impacts of Internet voting is the effect it could have on voter participation. However, if Internet voting had no impact on voter participation or a race-differentiated effect, then it would be ineffective if not illegal. These important social considerations are considered below.

There are a number of individual and organizational factors that can impact the ability of governments to use information technology in general. Dawes, Bloniarz, Kelly, and Fletcher (1999) note that individuals learn and adapt to information systems to varying degrees. They also suggest that more than 80 percent of information systems fail to be implemented or fail to achieve their objectives when they are implemented. One reason for this high failure rate may be that individuals may be inside the organization (e.g., employees) or outside the organization (e.g., clients), but both must interact with information systems to achieve the goals of the organization.

At the organizational level, Dawes et al. (1999) observe that organizations in the Information Age are much more fluid and dynamic than the structured hierarchy that characterized organizations in the Industrial Age. In more contemporary organizations, information technology may be used to enable individuals (both inside and outside the organization) rather than to control them. Although

information systems can permit organizations to rapidly respond to the demands of the environment, the organization must also value needed change. Because of their size, complexity, and inertia, government agencies may face perhaps the most challenge in designing and utilizing information systems.

There are also several social issues specific to Internet voting systems (Internet Policy Institute, 2000). Some of these issues are or can be addressed by law or regulation. For example, access to the Internet for voter registration may fall under the auspices of the National Voter Registration Act. Similarly, the demographics of voter access to the Internet might effectively discriminate against protected classes identified in the Voting Rights Act. Internet voting could also impact the process and administration of elections, currently guided by voting system performance standards. No less important is the impact Internet voting could have on the roles of federal, state, and local government in the election process.

Perhaps more difficult to address are the social issues of Internet voting that are not informed by law or regulation (Internet Policy Institute, 2000). Previous attempts to increase voter participation by lowering barriers to voting have not inspired disaffected voters. But more important than just casting votes is casting informed votes, and the proliferation of dubious information on the Internet could result in misinformed voters. Alternatively, decreasing barriers to voters (however informed) could increase the number of referenda, thus undermining the deliberate and representative nature of the U.S. political system. Furthermore, remote Internet voting could similarly undermine the social cohesion that results from traditional voting.

The development of Internet voting systems will require an investment of years and millions of dollars. Before such an investment is made, the social aspects of Internet voting should be explored to determine how it can generate the highest social return. This return on investment may be weakened

by the challenges of implementing large-scale information systems, monolithic voter apathy, or the relative disenfranchisement of certain voters. Ultimately, while it is almost certain that public Internet voting system technology can be developed, it is much less certain that the effects of such technology will be socially effective or even desirable.

Thus, the technical, legal, and social challenges to Internet voter registration and voting are formidable. New levels of information technology secrecy and security will have to be achieved before Internet voter registration and voting would be possible, but advances in cryptography and secure web transactions suggest that achievement of these new levels is not impossible. Legal structures that are designed to protect against discrimination in voter registration and voting must be applied to the Internet just as they would be applied to any other proposed change in the electoral process. Social structures, which are often difficult if not practically impossible to change, must also adopt or adapt to Internet voter registration and voting to make such an investment worthwhile. The failure of Internet voter registration and voting to meet any one of these challenges will eliminate any possibility of success.

Conclusion and Recommendations

The Internet was successfully used as a voting technology in the 2000 Arizona Democratic presidential preference election. This success was due in part to the considerable effort invested in voter outreach and education, and similar efforts would be important in future elections that include Internet voting. The Internet voting servers experienced no breach of security and only minimal downtime. The original goal of the Internet voting, increasing voter participation, was clearly achieved. More votes were cast on the Internet than any other means and were about three times the total number of votes cast in the 1996 Arizona Democratic presidential preference election.

Based on the results of the 2000 Arizona Democratic presidential preference election and the follow-up survey conducted at the University of Arizona, the future of Internet voting systems appears promising. It seems likely that voter registration and participation would increase on the Internet, and the entire voting process would be more effective and efficient than it currently is. In addition, technical, legal, and social challenges were met and may set a precedent for future online elections. However, these preliminary findings on the success and effectiveness of Internet voting must be followed by additional exploration, such as the research agenda cogently outlined by the Internet Policy Institute (2001) and the following recommendations.

Recommendation 1: State and local jurisdictions should continue to experiment with Internet voting.

The development of Internet voting system technology should be tested in binding political elections whenever possible. The development of this kind of technology should not be undertaken in the social vacuum of a test laboratory. Ideal elections for this kind of testing are local elections of limited scope such as for school board and city council members. Internet voting systems should not be afforded any technological quarter. Rather, the voting should be vetted under real world conditions to determine what improvements, if any, would result in an Internet voting system reliable and secure enough for a national election.

Recommendation 2: In concert with state and local experimentation, the level of research and development to improve Internet transaction security should be increased.

The experience of the 2000 Arizona Democratic presidential preference election illustrates the importance of robust Internet voting technology. Resistant to security threats, the Internet voting system used in that election was disabled, if only temporarily, by an internal hardware malfunction. Additional research by information technology experts in academia and industry is needed to develop Internet voting servers that are secure

while accommodating as many different voting clients as possible. Refinements in encryption and secure Internet transmission are also needed to communicate the ballot intact without revealing the identity of the voter.

Recommendation 3: Social scientists should study the effect of Internet voting.

Voter Participation

Social science must study the individual and social effects of an Internet voting system. The voting age population consists of individuals, and research must continue to study the effect of an Internet voting system on voter registration and participation. Individual characteristics such as age, income, education, attitudes toward computers, and access to the Internet can contribute to the likelihood of registering and voting on the Internet. Research must determine whether an Internet voting system will increase voter registration and participation or if it would decrease, perhaps through increased suspicion by voters.

Democratic Process

Social science research must also study the societal effects of Internet voting systems. Currently, the white voting age population does have more Internet access than most other ethnic minorities, so the effect of the digital divide on social equality in the political process remains a critical research topic. The economies of scale created by an Internet voting system have direct implications for democracy. Social and political scientists must consider the effect that cost-effective elections will have on the frequency of elections. Similarly, research must address the changing role of federal, state, and local governments in a centralized voting structure.

Ultimately, these issues can be resolved, and Internet voter registration and voting may prove to be the catalyst that includes the isolated, inspires the disaffected, and motivates the apathetic people in the voting age population who do not currently participate in the democratic process. It may also be the agent that drives the accountability of elected officials to levels that eliminate and preclude those who do not represent their constituency. Internet voting systems should be neither accepted nor rejected out of hand. Instead,

the opportunities and challenges they present should be the focus of vigorous research that can assist policy makers as they consider the role of the Internet in the democratic process.

Appendix: Research Methodology

This study relied in part on a survey research methodology. The survey was mailed to 4,000 people randomly selected from the best database available of Arizona residents. The survey contained items on voter registration, voter participation, Internet voting, and demographic characteristics. Completed surveys were returned by 495 respondents who generally characterized—but reported higher education and income than—the Arizona and U.S. populations.

Sampling

A database of 5.6 million driver and identification licenses from the Arizona Department of Transportation, Motor Vehicle Division, provided the basis for the sample. This source of records was selected over voter registration files because the latter does not reflect those who are not registered to vote but who might in the future. Moreover, the license database is likely to provide the most robust representation of Arizona residents that can be obtained because of the ubiquitous requirement for government-issued identification for transactions such as cashing checks and purchasing tobacco and alcohol. The complete database was transferred to the University of Arizona mainframe computer, and a random sample of 4,000 Arizona residents at least 18 years of age was selected to receive the survey.

Survey

The survey was printed on University of Arizona letterhead and included a cover letter that described the purpose of the study as one on voting and computer technology. The survey instrument measured a variety of variables on voter registration

status, voter participation, and likelihood to vote on the Internet. A special section for those who were eligible to vote in the 2000 Arizona Democratic presidential preference election contained items on voting behavior during that election. The final part contained items measuring demographic characteristics. The survey and a postage paid business reply envelope were mailed to the 4,000 randomly selected residents, and the completed surveys were coded and subjected to statistical analyses.

Sample

Completed surveys were returned by 495 respondents that generally represent the voting age population in Arizona and the United States. The sample consisted of 53 percent women and 47 percent men, as compared to 51 percent women and 49 percent men in Arizona and the United States. The age of the respondents ranged from 18 to 94 years, with a median age of 51 years. The median age of the Arizona and U.S. populations are 34 and 35 respectively, but this includes those who are under 18 years old. About 87 percent of the respondents reported being of white ethnicity, more than the 75 percent white composition of Arizona and the United States. However, about 23 percent of the respondents considered themselves to be multi-ethnic, considerably more than the approximately 3 percent of the Arizona and U.S. populations who consider themselves to be multi-ethnic. About 31 percent of the respondents reported having completed a high school education, slightly more than the 26 percent of the Arizona population and 30 percent of the U.S. population. More than 65 percent of the respondents reported having at least a

bachelor's degree, which is considerably more than the 20 percent of the Arizona and U.S. populations. About 21 percent of the respondents reported household incomes of less than \$30,000, somewhat less than the 53 percent and 50 percent of the Arizona and U.S. populations reporting similar incomes. About 32 percent of the respondents were registered Democrats and 46 percent were registered Republicans, as compared to the 38 percent of registered Democrats and 43 percent of registered Republicans in Arizona. Thus, the respondents in this study were generally characteristic of the Arizona and U.S. populations, but reported somewhat higher levels of education.

Bibliography

Dawes, S. S., P. A. Bloniarz, K. L. Kelly, and P. D. Fletcher. (1999). *Some Assembly Required: Building a digital government for the 21st century*. Albany, N.Y.: University at Albany, SUNY, Center for Technology in Government.

Federal Election Commission. (1997). *The Impact of the National Voter Registration Act of 1993 on the Administration of Federal Elections*. Washington, D.C.: Author.

Federal Election Commission. (1999). *The Impact of the National Voter Registration Act on the Administration of Elections for Federal Office 1997-1998*. Washington, D.C.: Author.

Hiller, J. S., and F. Bélanger. (2001). *Privacy Strategies for Electronic Government*. Arlington, Va.: The PricewaterhouseCoopers Endowment for The Business of Government.

Internet Policy Institute. (2001). *Report on the National Workshop on Internet Voting: Issues and research agenda*. Washington, D.C.: Author.

Mohen, J., and J. Glidden. (2001). "The Case for Internet Voting." *Communications of the ACM* 44: 72, 74-85.

National Commission on Federal Election Reform. (2001). *To Assure Pride and Confidence in the Electoral Process*. New York: The Century Foundation.

National Voter Registration Act, 42 U.S.C. § 1973 et seq.

Phillips, D. M., and H. A. Von Spakovsky. (2001). "Gauging the Risks of Internet Elections." *Communications of the ACM* 44: 73-85.

Salkowski, J. (2000, March 5). "Local Hispanic Leaders Assail Internet Vote." *The Arizona Daily Star*, p. A1.

Solop, F. I. (2001). "Digital Democracy Comes of Age: Internet voting and the 2000 Arizona Democratic primary election." *PS: Political Science and Politics* 34: 289-293.

Voting Rights Act, 42 U.S.C. § 1971 et seq.

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