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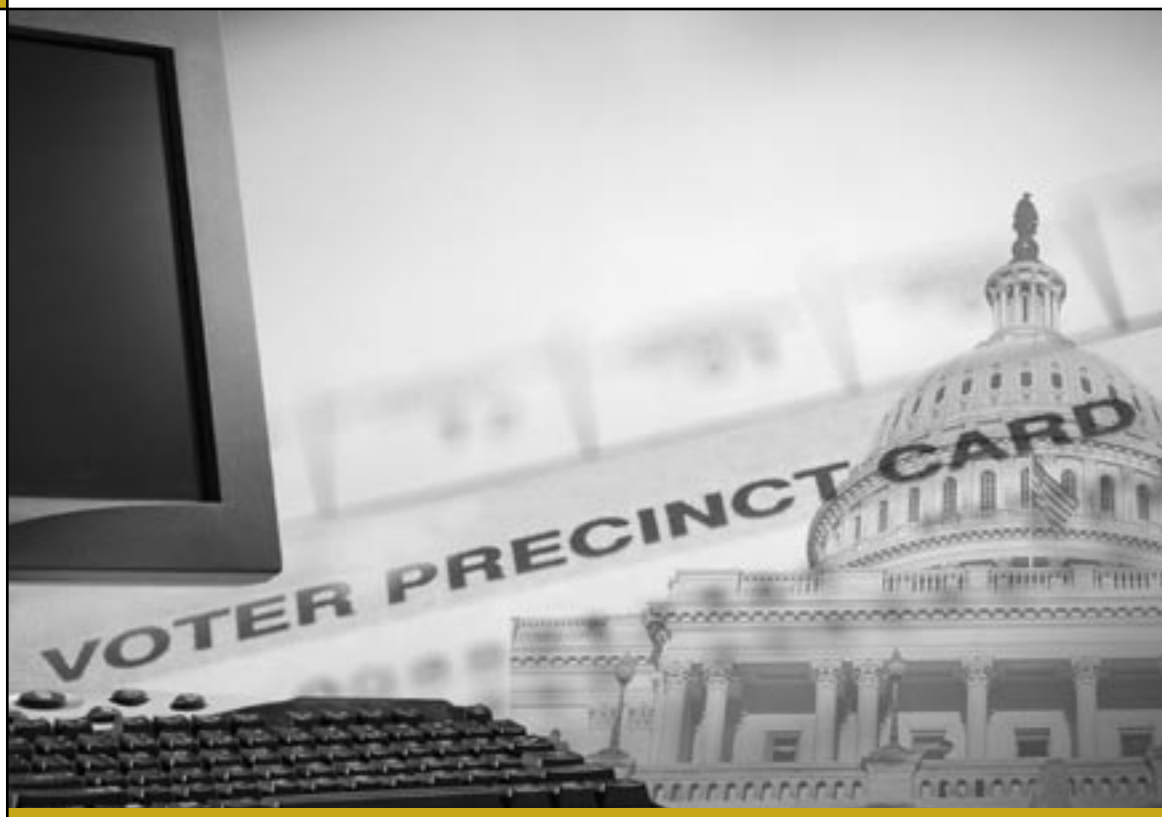
The Next Big Election Challenge: Developing Electronic Data Transaction Standards for Election Administration



R. Michael Alvarez
Professor of Political Science and
Co-Director, Caltech/MIT Voting Technology Project
California Institute of Technology

Thad E. Hall
Assistant Professor
Department of Political Science
University of Utah

IBM Center for
The Business of Government

E-Government Series

E-GOVERNMENT SERIES

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R. Michael Alvarez
Professor of Political Science and
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FOREWORD

July 2005

On behalf of the IBM Center for The Business of Government, we are pleased to present this report, "The Next Big Election Challenge: Developing Electronic Data Transaction Standards for Election Administration," by R. Michael Alvarez and Thad Hall.

This new report continues the Center's interest in meeting the challenge of bringing the nation's election administration systems into the 21st century and taking advantage of the rapid advances in technology over the past decade. In 2002, the Center published "Internet Voting: Bringing Elections to the Desktop" by Robert S. Done. In that report, Professor Done addressed the challenges facing the nation in moving toward electronic voting via the Internet.

In this report, Professors Alvarez and Hall discuss the challenge of moving toward the implementation of a set of electronic transaction standards (ETS) for election administration across the nation. According to the authors of the report, such a standard would allow election management systems to communicate seamlessly and share data to create "a more accurate, cost-effective, and accessible election process and voting experience." Such a standard would enable state and local governments to adopt a modular approach to better integrate election management and voting products, make possible the development of truly integrated voter registration systems, and enhance the ability to conduct consistent and effective post-election audits of elections.

The report highlights an expanded role for the new federal Election Assistance Commission, created by the Help America Vote Act (HAVA), to facilitate the implementation of new electronic transaction standards across the nation. The authors also call upon Congress to strongly encourage states and localities to adopt such new standards.

We trust that this report will be highly informative and useful to election officials across the United States as they face the challenge of improving our election administration systems to meet the needs of 21st century government.

Albert Morales
Managing Partner
IBM Center for The Business of Government
albert.morales@us.ibm.com

Frank Marzolini
Executive, IBM National Election
Modernization Practice
marzolin@us.ibm.com

EXECUTIVE SUMMARY

The world of electronic technology—from e-mail to the Internet—works because of the existence of basic standards of data exchange. In many areas of commerce and government there exist electronic transaction standards (ETS) that facilitate electronic data interchange (EDI). An EDI provides a defined format for the exchange of data for every specific transaction in question. These standards allow for a marketplace full of different products and services that give end users the ability to communicate with other users who also purchase software with the same EDI.

Having an ETS for public elections would improve all aspects of election management. An ETS would allow election management systems to communicate seamlessly and share data to create a more accurate, cost-effective, and accessible election process and voting experience. The lack of such standards has several ramifications. First, it is difficult for a local election official to integrate election management and voting products acquired from different vendors into a single unit, making any sort of "plug and play" or modular approach impossible for election systems. Second, the lack of standards affects the ability of states to develop truly integrated voter registration systems. A complete voter registration system needs to be able to pull data from agencies across state government and to share data across states. Third, the lack of an ETS limits the production of consistent and effective post-election audits of elections.

In three case studies, we examine the problems associated with the lack of an ETS in three policy areas: voter registration, innovation and election administration, and election data and election results. We also examine several ongoing efforts to create uniform standards for exchanging election data. The first is being conducted under the auspices of the Organization for the Advancement of Structured Information Standards (OASIS) and uses an interoperable Election Markup Language that would facilitate data exchange. The second is being developed by the Institute of Electrical and Electronics Engineers (IEEE). Both of these standards-setting activities are open, collaborative efforts that bring together experts from around the world to develop new standards. Regardless of whether either of these two protocols is adopted (or a new protocol is developed and adopted), the move to an ETS will streamline election data transfer. An ETS can encourage innovation in election management by increasing competition and lowering barriers to entry and also can facilitate local and state election officials who want to add new services to expand the franchise to traditionally disenfranchised populations.

A federal approach to comprehensive standards for electronic data transmission can be facilitated by the Election Assistance Commission in the following ways: (1) working with IEEE, OASIS, the National Institute of Standards and Technology, and others to develop a standard ETS for election data; (2) including a requirement for voting systems to have a common electronic-data-exchange component in the revised voting system standards; (3) including a similar requirement in the guidance given to states regarding what makes a statewide voter registration system compliant with the Help America Vote Act (HAVA); and (4) developing a process to encourage states to share voter registration data to improve the maintenance of voter registration rolls. Additionally, the U.S. Congress should consider requiring all states and localities to adopt all federal voting system standards, and making future voting systems standards binding. Finally, the U.S. Congress should strongly encourage all states and localities to adopt these new standards and empower the Election Assistance Commission to issue regulations for voting system standards and standards for voter registration systems.

Introduction and Overview

Today few of us think twice about sending an e-mail across the country or around the world. We routinely open a web browser to see the headlines of newspapers from far-flung locations, to shop across the nation, and to see the pictures of a newborn family member whose parents live thousands of miles from us. We use electronic technologies without thinking twice about them (except when they don't work). Nor do we think about how it is possible to use a Macintosh PowerBook or an IBM ThinkPad to access a Dell e-mail server (running Linux or Microsoft Windows), which itself communicates with e-mail and web servers throughout the world using a multiplicity of different computer hardware and software applications.

What makes all of these electronic transactions work are basic standards of data exchange. What allows all of these different computer hardware platforms, running different operating systems and sometimes proprietary software applications, to communicate together are fundamental protocols like TCP/IP (Transmission Control Protocol/Internet Protocol) and HTTP (Hypertext Transfer Protocol). These two protocols are fundamental building blocks for the development of the transfer of data over the Internet (TCP/IP) and the World Wide Web (HTTP). These basic standards and protocols—and many others like them—allow information to be passed from one computer system to another quickly, efficiently, and with very little error. They let people communicate electronically, allow for e-commerce, and provide the means for many governmental activities, allowing citizens to communicate with their elected officials quickly and effectively, enabling the electronic filing of tax returns, and even allowing the Armed Forces to communicate through highly secure channels.

This report is about the need for similar electronic transaction standards (ETS) in the realm of public elections. All aspects of election management—from managing voter registration to preparing ballots, managing precinct information, and counting and auditing election data—are moving toward complete automation. As this transition occurs, standards are necessary to ensure election data outputs are uniform, so that election management systems can communicate with each other seamlessly and various election management and voting technologies can interface automatically. This seamless communication also will allow election officials to share data—such as voter registration information—that will help produce a more accurate, cost-effective, and accessible election process and voting experience. In Appendix II, we explore the benefits that came to the healthcare industry when ETS protocols were required. This report shows how ETS protocols will improve voting and elections.

We wish to note at the outset that this report and the issue of ETS are distinct from the current controversy in electronic voting surrounding voter verification and voter-verified paper audit trails. ETS in election management is intended to allow election officials to exchange data, like voter registration files, and to allow different voting management systems developed by different vendors to communicate seamlessly. It also allows election data from different states or localities to be aggregated easily as well, which facilitates the reporting of and evaluation of election results. However, because ETS will facilitate the development of "plug and play" software—software solutions that can easily interface with any other software using the same data exchange standard—an ETS in elections could stimulate further the development of voter-verification

Acronyms and Abbreviations

ANSI: As the American National Standards Institute describes itself, ANSI is a private, nonprofit organization—501(c)3—that administers and coordinates the U.S. voluntary standardization and conformity assessment system. It is the official U.S. representative to the International Accreditation Forum (IAF) and the International Organization for Standardization (ISO).

DRE: Direct Recording Electronic voting machine, which is sometimes referred to as a touch-screen voting machine, allows a voter to vote without using a paper ballot. The voter's choices are recorded directly into the memory of the voting machine's computer system.

EAC: The Election Assistance Commission was created by HAVA. It is the federal entity that is now in charge of promoting election reform, distributing federal funds to states, and developing new standards in elections.

EDI: Electronic data interchange is the exchange of data using ETS.

EML: OASIS defines Election Markup Language as a standard for the structured interchange of data among hardware, software, and service providers who engage in any aspect of providing election or voter services to public or private organizations.

ETS: Electronic transaction standards are a common protocol for exchanging data. The protocol includes common standards for how data will be formatted and for how it will be exchanged across electronic platforms.

HAVA: The Help America Vote Act is federal legislation enacted in 2002 in response to the problems that occurred in Florida in 2000. HAVA created the Election Assistance Commission, required the development of a state plan for election reform, and provided federal funding to states to support these reforms.

HIPAA: The Health Insurance Portability and Accountability Act is a broad healthcare reform package passed by Congress in 1996.

HTTP: HyperText Transfer Protocol is the protocol used on the World Wide Web to define how messages are formatted and transmitted, and the actions web servers and browsers should take in response to various commands.

IEEE: The Institute of Electrical and Electronics Engineers is an international NGO that develops standards for electronic and electrical domains, including computer hardware and software.

LEO: Local Election Officials are the individuals or board who implement elections at the county or city level.

NGO: Non-governmental organization is a more general term for nonprofit and charitable organizations. Political parties and election-related interest groups are considered NGOs.

NIST: The National Institute of Standards and Technology is the federal agency charged with developing standards and measures for everything from what it exactly means for something to weigh "one pound" to the development of usability standards that define when a product is most easily used by specific populations.

OASIS: The Organization for the Advancement of Structured Information Standards, better known as OASIS, is a nonprofit, international consortium of suppliers and users of products and services that support open structured information standards (both de jure and de facto). It provides members with an open forum to discuss market needs and directions, and to recommend guidelines for product interoperability. This work complements that of standards bodies, focusing on making structured information standards easy to adopt and standards-based products practical to use, in real-world, open system applications.

SEO: State Election Officials are the individuals or board who implement elections at the state level.

SERVE: The Secure Electronic Registration and Voting Experiment was intended to allow eligible UOCAVA voters to register and cast votes using the Internet in the 2004 elections. The system was not deployed.

TCP/IP: Transmission Control Protocol/Internet Protocol is a communications protocol that was developed to connect dissimilar systems through a Unix standard. TCP/IP is a routable protocol, because the header prefixed to an IP packet contains not only source and destination addresses of the hosts, but also source and destination addresses of the networks they reside in. Data transmitted using TCP/IP can be sent to multiple networks within an organization or around the globe via the Internet, the world's largest TCP/IP network. (source: http://computing-dictionary.thefreedictionary.com/TCP/IP)

UOCAVA: The Uniformed and Overseas Civilian Absentee Voting Act encourages special voting assistance to military personnel, their dependents, and citizens living overseas.

VSS: Voting system standards are documented agreements containing technical specifications to be used consistently as guidelines to ensure that automated voting systems (both those that use a paper ballot and all electronic systems) are accurate, reliable, and secure.

XML: Extensible Markup Language is a flexible way to create standard information formats and share both the format and the data on the World Wide Web.

systems that offer solutions to the voter-verification problem, both procedural and technical.[1]

Historically, American elections have been a highly decentralized affair. For much of the nation's early history, government officials did not even provide voters with ballots. It was the parties, not the election officials, who printed ballots and did a wide range of the election activities we now attribute to elected or appointed local election officials.[2] As states moved to the Australian ballot—which listed candidates from both parties on a single ballot—election officials gained more control over the elections process. Today, with elections becoming more mechanized and computerized, this area of government has become more complex. The introduction of lever machines, which require maintenance and upkeep, and punch cards, which brought computer technology to elections management, greatly changed the landscape of elections and set the stage for the current world of electronic election management systems.

Over the past three decades, election management has been a part of the transition that governmental units have taken toward e-government. This transition began in the 1960s, when election officials started using electronic vote tabulation equipment. Given the massive media coverage that occurred in 2004 surrounding the use of direct recording electronic (DRE) voting equipment in the election and its possible pitfalls, it would not be unreasonable for someone to think that DREs were the primary component of computer technology in election management. As we will show, nothing could be further from reality.

Today, in most election jurisdictions, much if not all of the election process is being done using e-government solutions. This e-government solution typically begins with a system that contains all candidate and precinct information. The information provides a basis for using computers for ballot design, voter registration data management, precinct and early vote casting, vote tabulation, data reporting, and electronic auditing. The reason for using e-government in elections is simple: It allows local election officials to better manage the elections process and elections information. It also allows election results to be reported faster than before, something that candidates, the media, and the public demand in the current instant news environment.

But election administration is a niche market in the e-government arena. So as state and local election officials have moved into the electronic realm, they have been forced to select systems in a marketplace dominated by a relatively small number of vendors of proprietary systems; in some cases, they have developed their own applications for components of the election administration process. Many private vendors sell systems that require much, and sometimes all, election administration processes to be served exclusively with their proprietary system. One exception is in the case of voter registration applications, which are often today managed with one system while all other election management processes—from ballot design to reporting election outcomes—are managed solely through a second system.

The use of solely proprietary e-government solutions in elections has created a systematic problem in e-government: There is not a common standard or set of standards for sharing election data across these proprietary systems. The problems associated with this lack of electronic data exchange standards manifest themselves in several ways.

First, it makes it difficult for a local election official to integrate various election management and voting products acquired from different vendors into a single unit. For example, an election official would be hard-pressed today to get one vendor's ballot design product to work with a different vendor's electronic voting equipment, or to get one vendor's electronic voting equipment to work with a different vendor's tabulation product. The local official would literally have to get computer programmers from both companies to work together to build a new integration tool that would allow one company's product to "talk" to the other, a costly and difficult process. The lack of a data exchange standard makes virtually impossible any sort of plug and play or modular approach for the development of election administration electronic solutions.

Second, the lack of standards affects the ability of states to develop truly integrated voter registration systems. The Help America Vote Act (HAVA) requires states to develop electronic statewide voter registration databases. Therefore, states are now integrating voter registration data from local election officials (typically counties) into these new databases, a process that is raising the issue of inconsistent data formats for this particular component of election

administration. Also, the statewide voter registration files, once complete, must integrate with other databases, most importantly state department of motor vehicles files, federal Social Security Administration databases, as well as existing election administration databases in each state and county. Some election officials have even talked about setting up mechanisms so that states can share election administration data, for example, so that they can check the authenticity of newly registered voters and verify that they are not currently registered to vote in another state.

Third, the lack of election data transfer standards hinders the capabilities of election administrators and others to produce consistent and effective post-election audits of election practices and procedures. Currently, the quality and consistency of information reported by election administrators is highly variable; it can be exceedingly difficult for third parties interested in auditing election practices and procedures to obtain even rudimentary data from many state and local election officials.[3] By developing a standard format for data exchange, election administrators will be able to provide easily and efficiently a consistent reporting of election administration information that can be used to appropriately audit election practices and procedures.

The need for comprehensive standards for electronic data transmission calls for federal action. The solution to this problem is for the Election Assistance Commission (EAC) to:

- Work with the Institute of Electrical and Electronics Engineers (IEEE), the National Institute of Standards and Technology (NIST), the Organization for the Advancement of Structured Information Standards (OASIS), and others to develop a common ETS for election data.

- Include a requirement for voting systems to have a common electronic data exchange component in the revised voting system standards.

- Include a similar requirement in the guidance given to states regarding what makes a statewide voter registration system compliant with the Help America Vote Act (HAVA).

- Develop a process to encourage states to share voter registration data to improve the maintenance of voter registration rolls.

Additionally, we recommend that the U.S. Congress consider requiring all states and localities to adopt all federal voting system standards and make future voting systems standards binding (not voluntary). States and localities also need to be encouraged to exchange data to improve the quality of the voting experience. When ETS protocols are included in all e-voting systems, states can use the system to improve the quality of their voter registration lists, and local governments can use the technology to innovate and improve their overall service to voters. Finally, the U.S. Congress should strongly encourage all states and localities to adopt these new standards and empower the EAC to issue regulations for voting system standards and standards for voter registration systems.

Standardization creates the potential for a future election model where this interoperability allows election officials to offer a wide array of services to voters, as well as improve election management across jurisdictions. Consider the following examples:

- Local election officials could share or borrow voting equipment from others with confidence that the data exchange from their ballot definition software and vote tabulation software would be compatible with the data exchange in the voting equipment.

- It would allow for registration data to be more easily exchanged and compared between a state and its localities, and among states.

- It would let election officials consider the acquisition of more modular election administration technologies; they would not necessarily be required to purchase a single, end-to-end election administration solution.

- As states move to attempt to add other electronic voting experiences, such as Internet voting for Uniformed and Overseas Civilian Absentee Voting Act (UOCAVA) voters, these new technologies would be able to use a common data exchange protocol to integrate with the existing system.

The creation of standard, interoperable data exchange protocols can also encourage innovation in election management by increasing competition and lowering barriers to entry for firms interested in providing component or modular services rather than complete end-to-end election management systems. It can also facilitate local and state election officials who want to add new services—such as experimentation with Internet voting for military personnel and overseas civilians—that can expand the franchise to traditionally disenfranchised populations.

Standardization often occurs because of political, economic, or social demands. In the case of elections, HAVA and changing socio-demographic trends in the United States are driving the need for standard protocols in election management systems. The move to standards for data exchange in e-government is very similar to shifts in other policy areas. For example, the creation of standard protocols in the area of health insurance and healthcare was driven by a legislative requirement contained in the Health Insurance Portability and Accountability Act (HIPAA); this case is closely analogous to what could occur in election administration. In HIPAA, federal legislation pushed the affected industries to get together and create a standard protocol that addressed federal requirements.

This report begins with an examination of standards in the e-government context, and then considers how the lack of standard integration protocols in the election arena impedes both innovation in this field and effective communications among the various entities involved in election administration. Using three cases—statewide voter registration systems, the Secure Electronic Registration and Voting Experiment (SERVE) Internet voting project, and election data results and reporting—we highlight the difficulties caused by the lack of effective data transfer protocols in this field. We conclude by examining how the future of elections could look with a standard data exchange protocol in place. The report also contains an appendix (see Appendix II), where we illustrate how ETS standards in healthcare are analogous to what is currently occurring in e-voting and the benefits that can accrue from such standards.

Standards in the E-Government Context

Over the last decade, there has been a marked increase in research in the study of e-government.[4] This research has examined an array of issues, from examinations of citizens' usage and attitudes toward e-government to barriers in the adoption of e-government. In general, the focus of this research has been on the issues associated with moving to e-government in various jurisdictions or policy areas and citizen use and approval of this technological change. Interestingly, there have been few studies of e-government in the area of election administration, even though state and local governments have been using e-government technologies since the 1960s.[5]

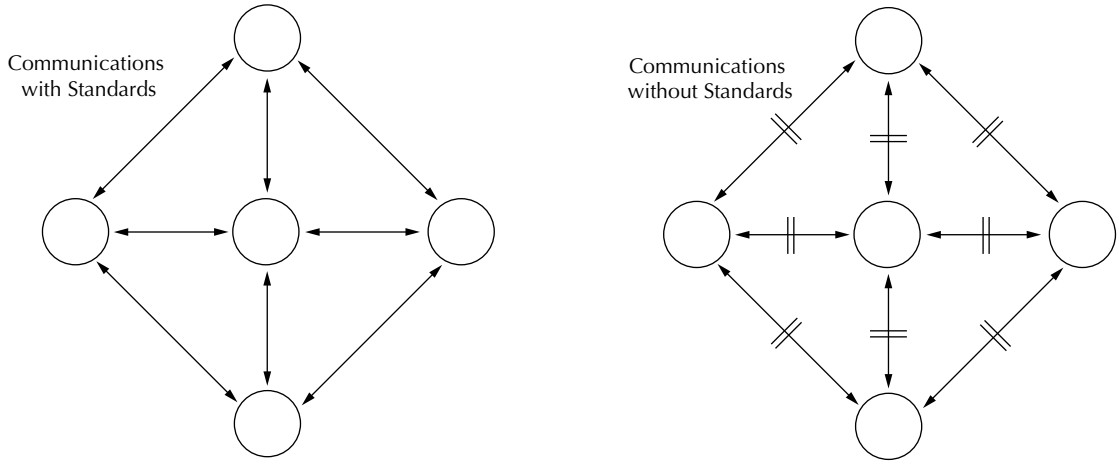
Equally as important, little attention has been paid to the role played by governmental and non-governmental organizations (NGOs) such as the IEEE and OASIS in the establishment of standards and protocols needed to create uniformity across e-government. We generally take e-government standards for granted; we assume that the e-mail recipient can read it and that an Internet connection in Washington, D.C., and Salt Lake City, Utah, are the same as the Internet connection in Pasadena, California. Likewise, when we purchase a computer, we assume that—within certain well-understood limits—we can add software and hardware peripherals to the computer, and they will work. In fact, most computers today work on a plug and play model, where a vast range of items work simply by being plugged into the computer.

We can see the importance of standards when we consider the impact of incompatibility on efficiency and effectiveness. Computers have the capacity to allow organizations to collect and organize vast amounts of information. However, if two organizations have software systems that are not compatible, then the data in one system cannot be easily transferred to or compared with the data in another (see Figure 1). Such problems can be common, especially in proprietary systems. There are many examples of how such incompatibility problems have affected the management of public programs.[6] Typically, one organization has data that a second organization needs, and without a standard data transfer protocol, the only way to share data is to have the data manually re-entered. Too often, the alternative is to not share data at all, resulting in lost productivity and reduced management capacity.

What is required to make this process work smoothly is to have a system that allows for the standard interchange of data between computers without any human intervention. Electronic transaction standards that facilitate electronic data interchange (EDI) are required to achieve this goal. An EDI provides a defined format for the exchange of data for every specific transaction in question. These standards allow for software developers to offer end users an array of different products and services, but with end users knowing that the system they purchase will be able to communicate with others who also purchase software with the same EDI.

In the area of election administration, voluntary standards do exist, with their most important application to date in the area of voting systems. The current voting systems standards (VSS) were adopted by the Federal Election Commission (FEC) in 2002, the first revision of these standards since their initial release in 1990. These standards ensure that voting systems—which include not only the voting technology used in polling places but also the tabulation software used to count ballots and the software used to generate ballots—meet a minimum stan-

Figure 1: Communications with and without Standards



dard. Importantly for our discussion, there are no standards related to electronic data exchange. The standards are open to being updated with improved technical support. Under HAVA, the development of future standards for voting technologies is to be conducted by the new Election Assistance Commission in conjunction with the National Institute of Standards and Technology (NIST).[7]

The role of government in the development of electronic transaction standards, or ETS, and the benefits of such a system can be seen in the healthcare arena, a complex field involving government-to-business interaction. The implementation of federal health policy requires the coordination of federal actors, corporate and not-for-profit healthcare organizations, and information technology solution providers. Without standards, the process of communicating insurance claims or patient health information between the federal government and health providers—or among health providers—was unnecessarily complex, requiring people to convert data from format to format as it went through the system. To bring order to this process, the federal government mandated the development of a standard protocol for all healthcare-related transactions. With a standard protocol, the communications problem that existed in data transmission was eliminated and greater efficiencies were created. In Appendix I, we present a fuller exposition of this case to illustrate how ETS can be developed through government-business partnership.

The Election Context

Elections in the United States have traditionally been run by local governments under a governance system largely embodied by state law. There is not a single set of election procedures and processes in the United States; there are not even 50 sets, or one set per state. Instead, there are several thousands of different ways of running elections in the United States, since local election officials, including both county and city election administrators, maintained their own unique methods of election administration before the 2000 election debacle. The rationale behind this decentralization of election administration is partly constitutional. Article I of the U.S. Constitution allows for a federal role in congressional elections, but typically the federal government has sought to delegate election procedures for federal offices to the states. Therefore, election governance regimes vary broadly across states, and often within states. At the state level, the laws govern every aspect of voting:

- **Who can vote.** For example, in some states, citizens convicted of felony violations can never cast a vote again without going through a rights re-establishment process.

- **When people vote.** Some states allow voting only on Election Day, but others also allow "early voting."

- **Where people vote.** For example, in Oregon, there is no voting at designated polling places; everyone votes through an absentee voting process.

- **How people vote.** Some states, like Georgia, have a single voting system for the entire state, while others, like California, defer such decisions to the county level.

There are similar variations across counties. Counties often have substantial leeway in the manner in which they implement election law, and they historically have been empowered to determine the election management systems that will be used in the county—from voter registration to voting equipment to ballot design and management software. With this control at the county level, in a given state, no two counties may use exactly the same voting equipment, even if two counties have purchased the same type of system from a vendor. Counties often customize these systems so that—even though the systems are produced by the same vendor—they produce output that is not compatible.

The federal government has periodically sought to provide some uniformity in election administration. For example, the Voting Rights Act created more uniform protection of voting rights, and the National Voter Registration Act sought to promote more consistent voter registration procedures across the states. However, until the 2000 presidential election and the passage of HAVA in that election's aftermath, administration of election procedures was largely a matter of county or sub-county administration.

In the area of election administration, the development of standards has been a slow and somewhat controversial process. The first election standards—known as the voting system standards, or VSS—were promulgated in 1990, after NIST completed a feasibility study in this area. The standards were then updated in April 2002, but it is widely recognized that the standards have not remained up to date. As the FEC, which promulgated the 2002 standards, notes:

Players in the Election Administration and Standards Process

As election reform has occurred over the past several decades, the players in election administration have evolved. This evolution has continued with the development of voting system standards and related electronic data transmission standards.

The frontline operators in elections are **local election officials** (LEOs). LEOs are responsible for running elections: They hire the poll workers, select poll sites, generate ballots, maintain and use voter registration rolls, and count and audit ballots. Historically, LEOs have been responsible for the selection of election administration and voting technologies, including voting systems, voter registration systems, and election management software systems.

At the state level, **state election officials** (SEOs) play a key role in election administration, especially since the passage of the Help America Vote Act. Typically, the state election powers are in the hands of the secretary of state, but in some states the lieutenant governor or a state election board holds these powers. Under HAVA, the SEO is responsible for the development of a state election plan, as well as for maintenance of the state's voter registration system. In many states, such as Georgia and Maryland, the state has exercised control over the selection of the voting technology that will be used in the state.

Before the passage of HAVA, the **Federal Election Commission** (FEC) was responsible for providing data, research, and information about election administration to various interested groups. It was also responsible for overseeing the development of the voting system standards (VSS). Under HAVA, these powers have been transferred to the **Election Assistance Commission** (EAC). The EAC is responsible for overseeing the implementation of HAVA, including evaluating state election reform plans, providing funds to states to support HAVA, conducting studies and issuing guidance to facilitate election reform, and overseeing the development of new VSS.

HAVA also formally brings the **National Institute of Standards and Technology** (NIST) into the elections process. NIST is to help in the development of the VSS and to work on supporting other studies on issues such as usability and voting system security. Other independent standards-setting bodies, such as the **IEEE** and **OASIS,** also support the development of standards that are used throughout specific industries, such as the elections management and voting technology industry.

> Standards are not permanent. They must evolve alongside technological advancements. Indeed, it is common practice to review and update technical standards every five years or so. The voting system standards, issued in 1990, are no exception to this rule. Vendors are now using new technology and expanding system functions that are not sufficiently covered by the existing standards.[8]

For example, there are no standards governing Internet voting, even though there have been several trials of Internet voting in the United States. The standards in elections, moreover, have been exacerbated by the decentralized governance structure in the area of voting technology and election administration. Moreover, the voting system standards are voluntary, not mandatory. All states have not adopted the 1990 or 2002 voting system standards, and there is no requirement that states be mandated to adopt them.

What has been the impact of this lack of standards? It has exacerbated many of the recent trials our nation has weathered in election administration. The 2000 presidential election created pressure to overcome the problems that exist in the decentralized nature of American election administration. The Florida election process in 2000 illustrated that there were substantial differences across counties in how administrative procedures were handled; in part, this was the rationale used by the Supreme Court in the *Bush v. Gore* decision that stopped the Florida recount in December 2000. In response to these problems, the federal government acted in 2002 and passed HAVA. This legislation provided for a slightly stronger federal role in election administration, mainly by establishing a new federal entity—the Election Assistance Commission—and by mandating that states work to develop statewide voter registration databases and eliminate inferior voting technologies.

Standardization of Election Management Protocols

One area where there are no election standards is the area of coding standards or electronic data transmission standards. This means that voting systems—even if they complete the same certification standards—do not have to meet specific standards for electronic data transmission or for file coding and formatting. Not surprisingly, the lack of standardization has led to a marketplace dominated by a few vendors who provide end-to-end product solutions. Because these systems are proprietary and typically do not produce a standard output, election officials are often forced to purchase entire election management solutions from a single vendor. It is typically not possible to use the ballot definition software from one vendor with the voting equipment of another vendor and the vote tally and audit software of a third vendor.

Fortunately, there are several efforts to create uniform standards for exchanging election data. Here, we profile two of the most promising. The first is being conducted under the auspices of OASIS and the second by IEEE. Both of these standards-setting activities are open, collaborative efforts that bring together experts from around the world to develop new standards.

The OASIS Election and Voter Services Technical Committee began its efforts in May 2001 to develop an interoperable Election Markup Language (EML) that would facilitate data exchange. Its charge is to:

> develop a standard for the structured interchange of data among hardware, software, and service providers who engage in any aspect of providing election or voter services to public or private organizations. The services performed for such elections include but are not limited to voter roll/membership maintenance (new voter registration, membership and dues collection, change of address tracking, etc.), citizen/membership credentialing, redistricting, requests for absentee/expatriate ballots, election calendaring, logistics management (polling place management), election notification, ballot delivery and tabulation, election results reporting and demographics.[9]

The EML standards have been through four iterations—Version 4.0 was released on January 24, 2005. EML is not updated on a regular schedule, but instead is modified as users and technical experts identify issues with the schema. The EML protocol has been tested in pilot projects in several nations, and edits have been made to EML based on the results of these pilot implementations.

The focus of the EML design is on developing an ETS that has five key characteristics:

1. It can serve as a multinational standard.

2. It can work across various voting regimes—including proportional representation and single-member districts—and across voting platforms—including Internet and traditional paper-ballot voting.

3. It can work in multilingual settings.

4. It is adaptable to both public and private election settings.

5. It can secure data and data interfaces from corruption and manipulation.

One benefit of the EML protocol is that it builds on the existing HTML language that is used extensively as a language on the World Wide Web. This broad usage base means that a wide array of entities can develop using interfaces that use this protocol. This open-source EML protocol also creates the potential for improved interfaces to be developed that may drive improvements to the election process outside of existing technologies.

In September 2002, the IEEE approved a new project in this area: P1622—A Standard for Voting Equipment Electronic Data Interchange. This project follows the same open standards development process outlined before and recognizes the need for broad input in this effort. The P1622 effort begins by recognizing that "the 'Voting System' is composed of a number of components, the voter registration system, the candidate filing process, the petition system, ballot definition, voting, tabulation, and reporting systems." It then states:

> This standard will develop standard data interchange formats to allow the exchange and interoperability of these various systems. The purpose of P1622 is to reach, as nearly as possible, the ideal state, wherein there exists a common definition of the data utilized within election systems and the election industry. This standard would promote interoperability among functional components, reduce complexity, spur innovation, and provide greater assurance within election systems.[10]

One model for meeting this new standard is the Election Data Exchange (EDX) protocol, which has been developed by Hart InterCivic. EDX is an electronic data transmission standard that uses Extensible Markup Language (XML), a common schema that is an integral part of many systems for communicating information over the Internet in real time. The EDX schema is designed to promote electronic data interchange, or EDI, allowing different election management systems to communicate seamlessly at the state level, expanding the reporting and presentation capabilities that were previously available. EDX is designed to define the majority of the data elements for an election, which includes the voter's name and identification number and records of votes cast. A common data interface makes it simple for one county using one election management system to integrate a voter's registration application with a second vendor's election management system. This type of system also can build auditability into the system through enhanced logging functionalities and makes EDI a standard feature of any election management system.

For an ETS to be successful in elections, it has to be broad and encompass the full complement of election activities and complexities, such as multiple ballot languages. The EDX schema provides a complete data format across both voter registration and election management systems. For example, EDX can support:

- Voter registration records (name, address, etc.)
- Poll book data
- Polling place information
- Closed, open, and mixed primaries
- General elections
- Local elections
- Multiple languages
- Fully customized rotation methods
- Graphical images (language based to allow a specific cast vote record for a language)
- Districts—full definitions with relationships to precincts, contests, and ballot styles
- Precinct—support for both reporting precincts and splits
- Summarized tabulation results
- Itemized cast vote records with related associations to handle over vote resolutions
- Ballot style definitions and associated district, precinct/split, and contest relationships
- Dependent, measure, candidate, and single-party contests
- Tabulated results—summary and detailed

Regardless of whether either of these two protocols are adopted (or a new protocol is developed and adopted), the move to an ETS will streamline data transfer of an array of data—from voter registration records to election results on Election Day. Election administration is a field where the ability to transfer and report data quickly, accurately, and efficiently is critical. Prior to Election Day, state and local election officials need to have data transmitted quickly because of the tight deadlines that often exist for closing out voter registration rolls prior to an election or for getting ballots defined and proofed. On Election Day, everyone from state officials and candidates to news organizations and the general public wants election results to be posted quickly and accurately. An ETS can ensure that these activities can be accomplished with minimal or no manual effort, increasing the transparency of the election process and potentially reducing errors as well.

A single ETS will allow various election management systems—including voter registration and broader election management systems—to communicate effortlessly and will avoid local election officials having to replace their legacy election management systems. Election data will have to be entered only once, into a single system, because the ETS will ensure that data can be read accurately in other election management software solutions. Currently, election officials often are forced to enter a single piece of voter information into multiple systems in order to manage their elections. A single data entry system can reduce data entry errors and free local election officials to use their existing resources more efficiently.

This standards effort fits well within the overall environment created by the Help America Vote Act. HAVA encourages technological innovation, especially in the areas of voting equipment and voter registration systems, and opens possibilities for the development of standard protocols for election technologies. For example, HAVA calls for the maintenance and continual updating of the voluntary voting system standards that currently exist. These standards will determine the attributes that are required for a voting system to be used in the states that adopt the standards. Here it is important to note that voting systems are not just the technologies that are used in the polling place but also include the entire system, from ballot definition to election results auditing. And unlike what has been the case in the past, HAVA requires that the voting system standards be reviewed and updated quadrennially, which should help keep the standards relevant in the voting system adoption process.

The VSS provide a mechanism for the Election Assistance Commission, or EAC, to require that all election management systems have an interoperability component. This would ensure that the technology used at each point in the election management process can produce standard output that can then be read by any other election management software. Although the voting system standards are voluntary, the fact that so many states require voting systems to meet these standards before such equipment can be used in their state should lead to an ETS becoming the industry norm. One key issue would be how to get legacy systems covered under this new standard—something that was mandated under HIPAA in the healthcare example—but it might be possible for the EAC to provide local governments with funds to update their system software to meet the new standard.

The Impact of Standardization: Three Case Studies

Electronic transaction standards in election administration would completely change the way in which election data is handled and create a streamlined, uniform process for its transmission. In the three case studies that follow, we show how the current lack of standardization affects a wide array of different election activities. It not only keeps new participants from easily entering to serve a specific niche in this market, but also hinders efforts to innovate, since novel solutions cannot easily be developed that are compatible with the wide range of data formats that exist in the current marketplace.

Just as in the case of the healthcare industry, an election ETS would allow all participants in elections—from the city and county election officials to the state and federal election entities—to communicate from any election management platform to any other platform, without the need for manual data conversion. This interfacing would allow for improved study of election administration, since data collected in a common file format, with common data elements from across jurisdictions, could be easily aggregated to the state and federal level. Such data would allow for the improvement of election administration and better auditing of election outcomes.

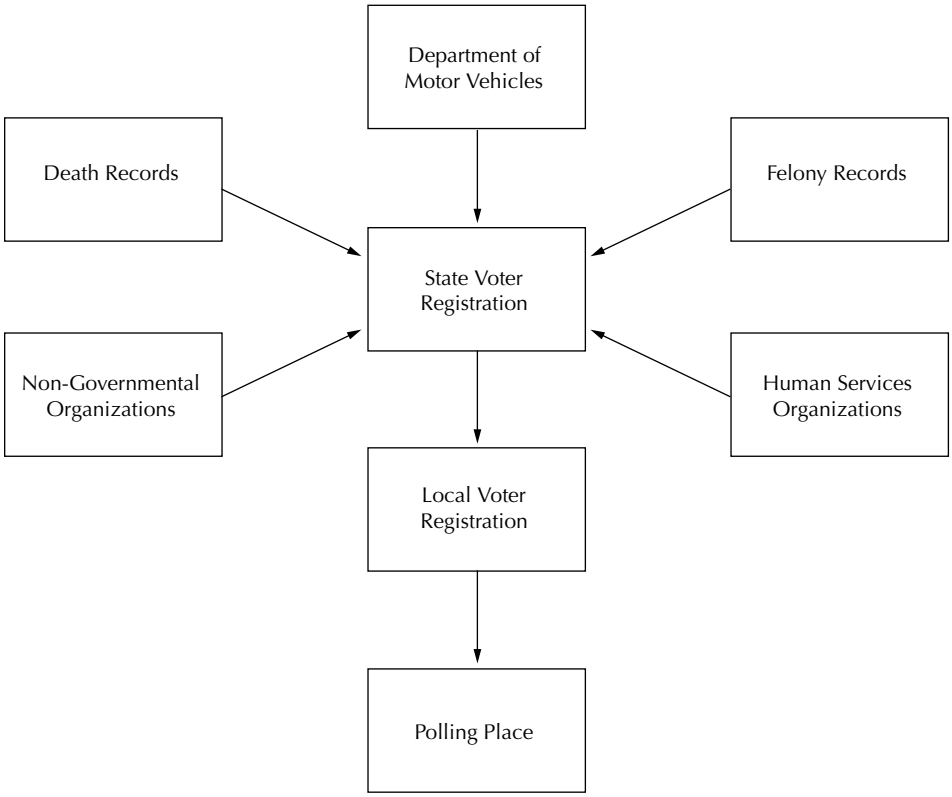
There have been many calls, in the wake of the last two presidential elections, for better reporting of information needed for the detailed auditing of election administration. Therefore, we see the development of standards for the transfer of election data as an important first step toward stronger data reporting, retention, and publication practices by election officials.[11]

Case 1: Voter Registration

In addition to promoting the development of meaningful and modern voting system standards, HAVA requires intra-state uniformity in voter registration by requiring the creation of a statewide voter registration system. According to Section 303, all states with voter registration must have a computerized voter registration system that is centralized at the state level. Section 303 also outlines a set of procedures that requires file maintenance to ensure up-to-date lists. This protocol requires states to link their voter registration system with other state databases, including those governing an individual's felony status (if applicable) and death records. Although not explicitly required, the database also needs to be able to coordinate with the state's department of motor vehicles and the federal Social Security Administration's database; both of these linkages are needed so that information from new registrants can be compared to either of these external databases for verification.

As Figure 2 on page 20 shows, there is a wide array of entities with which a state voter registration system needs to be able to interface in order to keep the voter registration system up-to-date. Without a common protocol, the transmission of data can occur in a couple of ways. First, it can run through a data center, where individuals convert the data from one electronic format to another, which often requires reformatting the data or re-entering parts of the data. Second, the data may have to be completely hand-entered by the election officials in charge of voter registration. This process of reformatting or re-entry introduces opportunities for data entry errors, errors that can result in voters not being listed correctly on the voter rolls at their polling

Figure 2: The Voter Registration Network



place. When this occurs, a voter often has to cast a provisional ballot, which slows polling place operations on Election Day and results in the voter's ballot not being counted.

There are also many legal and social factors that affect the need for data uniformity with voter registration systems across states. For example, mobility impacts election administration, and uniform protocols for voter registration would improve the elections process. Every two years, approximately one-third of the U.S. population moves. Most moves are intra-state moves—often not much farther than three miles—and the concept behind the requirement for statewide voter registration systems is, in part, intended to address the voter re-registration problems associated with short moves. However, on average, 6.87 million people moved to a new state each year in the 1990s, with an additional 1.3 million people moving from abroad to the United States.[12] All of these individuals potentially created a two-part voter registration issue: (1) the need to register to vote in their new state, and (2) the need to un-register to vote in their previous state of residence.[13] This mobility rate means that every presidential election year, up to 27.2 million Americans could be voting in a new state.

Without system interoperability among voter registration systems, it is not possible for the state in which a voter is registering to electronically notify the voter's previous state of residence to remove the voter from the rolls. This notification can be done manually—with a piece of paper sent from one state to another—but this process has relatively high administrative costs. Now consider how this system might look if there was a voter registration ETS and states could use an EDI to transmit this information. When the same voter came in to register in state A, all of the voter's information—sent in the standard file format and with the standard data elements—would be transmitted to state B, the previous place of registration. State A would add the voter to its rolls and state B would be able to remove that voter—and this could be done almost instantaneously.[14]

Because of the inability of states to transmit new voter registrations to the state of previous registration, tens of thousands of voters could be regis-

tered in multiple states and potentially could vote in multiple states. For example, studies by media organizations have found that in the 2000 election, 46,000 people were registered to vote in both Florida and New York. It is estimated that between 400 and 1,000 of these individuals voted in both states. Similarly, 68,000 individuals are registered to vote in both Florida and either Georgia or North Carolina, and it is estimated that 1,650 of them voted twice in 2000 or 2002. An ETS would enable states to overcome this problem and keep voters from being registered twice and voting twice.[15]

Case 2: Innovation and Election Administration

The lack of a common interface is also hindering the development of innovation in elections. One of the problems highlighted by the 2000 election debacle was the plight of overseas and military voters. These voters have a difficult time voting because of an array of issues including ballot transit time: the amount of time it takes for a piece of mail to go from the election official to the voter and return to the election official.

Ballot transit has long been a problem for those who wish to vote from overseas locations, but in recent years efforts have been made to use technology to address this problem. In 2000, the Federal Voting Assistance Program—the component of the Department of Defense in charge of serving the voting needs of uniformed personnel, their dependents, and overseas civilians—initiated an Internet voting project called Voting Over the Internet. This proof-of-concept effort allowed 83 individuals to cast ballots in the 2000 election and showed that Internet voting could be done successfully in a presidential election. Congress subsequently requested that the Department of Defense conduct a second and larger Internet voting trial.

The Secure Electronic Registration and Voting Experiment, or SERVE, was not deployed for use in the 2004 general election. However, the implementation effort for SERVE prior to the project's termination illustrated the problems associated with attempting to add a new technology—an Internet voting system—to the existing election management systems used in counties. As the development team attempted to integrate the SERVE system into the existing technologies used in participating counties, they determined that (1) different companies used different file formats and data transfer protocols, and (2) the same company often used various file transfer protocols across versions of their product or even within the same version of their product. Thus, future attempts to develop innovative, end-to-end voting solutions for particular citizen groups like military personnel and overseas voters will be much easier to develop and implement if election data standards are in place.

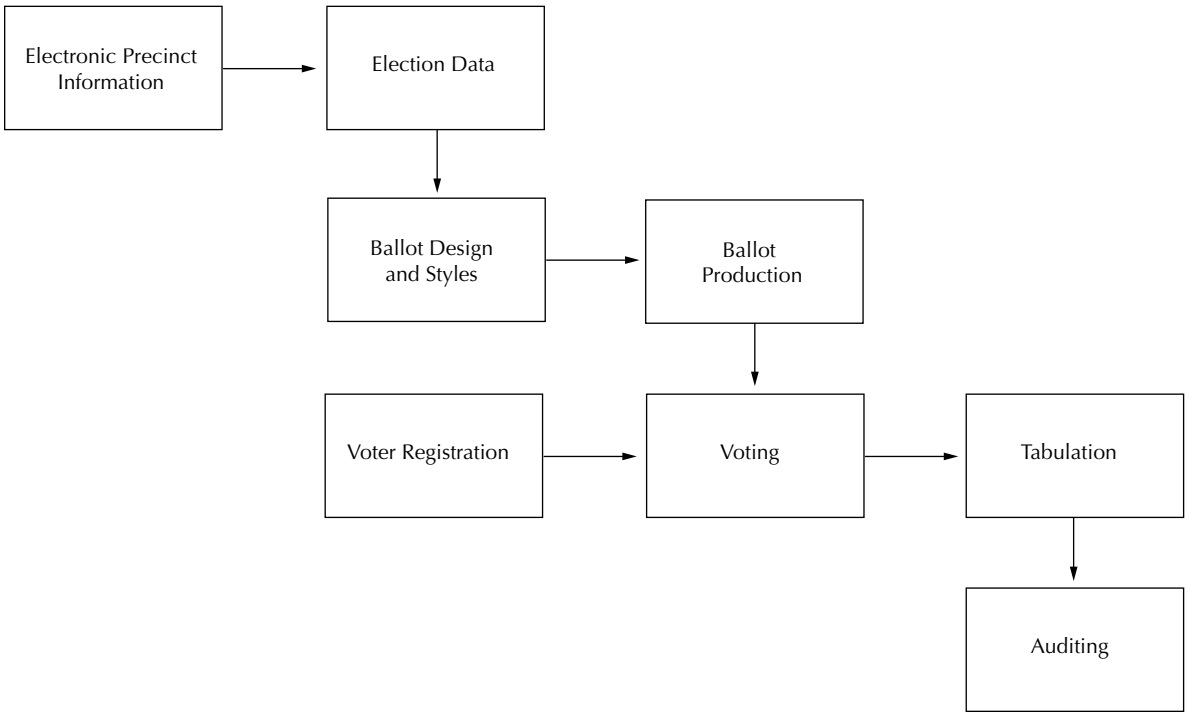
Others have also issued calls for the development of more modular voting systems. In particular, the Caltech/MIT Voting Technology Project in 2001 presented a visionary approach for future voting systems in which voters could use a variety of devices to obtain and manipulate their ballot.[16] This innovative architecture, which they termed "A Modular Voting Architecture" (AMVA), assumes that there are common formats for data exchange between components of election technologies. Thus, for innovative ideas like the AMVA to be viable in the near future, some standards for data interchange between election administration hardware/software platforms is necessary.

Because there is not an electronic transaction standard and common file format for election materials, it is almost impossible to plug and play new innovations onto existing election management platforms. This is a major hurdle that is blocking the development of new e-government solutions for election administration. Figure 3 on page 22 shows the election management processes that localities currently have to manage. This is a multi-stage process that requires the integration of data from multiple sources, with the final output being the ballots and voter data used in polling places on Election Day and the final audited election outcomes. Without a standard means by which to share data across these points in the election process, election officials are not able to use different products or integrate innovations into their current election system, thus significantly inhibiting their ability to produce innovative solutions for their main clients (voters, candidates, and the media).

Case 3: Election Data and Election Results

Election night is a critical time for the Associated Press (AP). They are a primary source of preliminary election results for a large number of media outlets

Figure 3: The Election Management Process



across the country, providing the information you see in the morning paper or on the morning news. The success of this operation is predicated on AP being able to capture data from states and localities across the country and then putting those data into a standard format. This would seem to be an easy task: The state simply e-mails or otherwise transmits a file to the AP, and AP pulls this file into the other state files, creating a single database of election results.

The reality is far from simple. Because of the lack of standards in the capture and transmission of electronic data in elections, the AP cannot simply request a file from each state for the appropriate races and then expect to receive the information in a single file format or even a single data format. Almost every state has election results in a unique file format, and each often uses unique coding schemes even when variables in the results data set are the same. As a result, the AP has to hire programmers that can create unique "data wizards"—small programs that can take the election results from a given state and put those data into a common format. Given the lack of uniformity, almost every state needs its own data wizard program. The data wizards are used in conjunction with the hand-entering of data, because some states lack the ability to transmit election data effectively.

The election night data problems also extend to related work AP does on elections. For example, AP often wants to know whether the votes reported are from absentee voters, early voters, or precinct voters. However, different states use different terms or different coding for the same concept. For example, early voting is called "in-person absentee voting" in several states. In Utah, these early votes are incorporated with the absentee ballots in a precinct, so the state does not collect any information on "early voting."

This case illustrates a second issue associated with the standards-setting process, which is that an ETS also involves the creation of clear definitions of what each part of the data record looks like. Thus, all users of the standard would code the same concept the same way, in the same order, so when these data are aggregated, the result would be consistent and uniform across states. For AP, it would also mean that election data would be easily aggregated for transmission to its customers on election night, without the costly step of having to re-create data wizards and hand-enter data. For other subsequent users of election administration data, like policy makers and researchers, an ETS would allow for easier, more consistent, and highly accurate post-election studies of election practices and procedures.

Conclusions and Recommendations

In many ways, elections have changed little over the past 150 years. Voters assemble at a designated location on a chosen day to select their candidates for office. However, there are growing pressures for this process to change. Voters are demanding that elections be as customer friendly as possible, which manifests itself in demands for more early voting and for no-excuse absentee voting. There is also growing interest in many circles to provide electronic (and possibly Internet) voting services to voters with special needs, such as military personnel and their dependents, and citizens who live overseas. At the same time, the recently passed HAVA legislation—as well as the demands created by partisan politics and the closeness of recent presidential elections—requires that voter registration rolls be as accurate as possible and the voting process as smooth as possible. Accomplishing these dual goals of customer service and the execution of a well-run election requires the smooth communication of data among a broad array of actors.

Over the last several decades, e-government has revolutionized the way in which elections are administered, both in the central election official's office and in polling places. Everything from voter registration to ballot design to vote counting is done using electronic systems. The three case studies illustrate how standards that allow for the easy exchange of election data across software and hardware platforms are an important component of the continual evolution of making the voting process easier and more convenient for citizens. Today, many voters often face long lines when they go to vote on Election Day, and some voters (as many as 4 million to 6 million in the 2000 presidential election) attempt to vote, only to have their votes "lost" due to snafus, mistakes, and errors in the process. Improving the technology of elections can reduce the number of votes lost in future elections—and one aspect of improving the technology will be developing standards for data exchange.

Recommendations

1. The Election Assistance Commission should request that the National Institute of Standards and Technology provide a recommended electronic transaction standard for election data.
2. The Election Assistance Commission, through the voting system standards-setting process, should ensure that all voting systems have a common electronic data exchange component.
3. The Election Assistance Commission should include a similar requirement for an ETS protocol in the guidance given to states regarding what makes a statewide voter registration system compliant with the Help America Vote Act.
4. The Election Assistance Commission should develop a process for encouraging states to share voter registration data to improve the maintenance of voter rolls.
5. The U.S. Congress should strongly encourage all states and localities to adopt all federal voting system standards and should empower a federal government agency like the Election Assistance Commission to develop and issue guidelines for standards for voting systems and voter registration systems.

To achieve the broader goals of a more cost-effective, reliable, and accurate election administration process, standards for data communication are necessary. If standards can be implemented and enforced, this one simple reform should, in the short term, help improve the process of administering elections. Elections could be administered more accurately, because election officials could use the common data formats to better cross-reference elec-

tion data across jurisdictions (for example, election officials would be able to compare voter registration data across counties and states) and against other databases.

To achieve the goal of having ETS protocols that make election data more consistent, more accurate, and easier to transmit, the following recommendations should be implemented.

Recommendation 1: The Election Assistance Commission should request that the National Institute of Standards and Technology provide a recommended electronic transaction standard for election data.
This standard should be similar to the EDX or EML protocols described earlier in this report. These two ongoing standards-setting processes should be used as input to the NIST ETS, similar to the process used for NIST's efforts to update the voting system standards. This somewhat parallel effort would ensure that release of an ETS would be placed on a defined timeline in the event that consensus cannot be reached by the independent standards-setting bodies.

Recommendation 2: The Election Assistance Commission, through the voting system standards-setting process, should ensure that all voting systems have a common electronic data exchange component.
This can be done though revisions to the voting system standards, which are ongoing with the technical support of NIST. The inclusion of an ETS protocol in the system standards will provide vendors with more incentive to incorporate this into their products.

Recommendation 3: The Election Assistance Commission should include a similar requirement for an ETS protocol in the guidance given to states regarding what makes a statewide voter registration system compliant with the Help America Vote Act.
HAVA gives the EAC some control over determining what constitutes a statewide voter registration system, and the EAC should use this to promote an ETS that ensures these systems can communicate easily in a standard format.

Recommendation 4: The Election Assistance Commission should develop a process for encouraging states to share voter registration data to improve the maintenance of voter rolls.
With such a mobile population, state voter rolls can quickly become out of date. For example, voting precincts surrounding colleges and universities often have far more voters on the rolls than are active voters, because students who registered to vote did not change their registration status when they moved. If states could easily transmit data on new registrants to that person's state of previous registration, voter rolls could be much more accurate and the potential for voting fraud reduced. The EAC should publish guidance on best practices for the sharing of voter registration data and consider developing a clearinghouse to facilitate the sharing of new registration information by all 50 states and the District of Columbia to promote the effective maintenance of voter rolls.

Recommendation 5: The U.S. Congress should strongly encourage all states and localities to adopt all federal voting system standards and should empower a federal government agency like the Election Assistance Commission to develop and issue guidelines for standards for voting systems and voter registration systems.
Congress, through its appropriations, can provide states with a strong incentive to adopt these guidelines in exchange for additional resources to improve elections. By allowing a federal government agency like the EAC to issue meaningful guidelines in the area of voting system standards and providing funding to encourage the adoption of these rules, states will have every incentive to use election systems that provide the highest level of benefit to voters and allow for the best possible election administration practices to be implemented.

Data exchange standards may also facilitate other longer-term changes in the election administration process. One important change that might occur is greater competition in the business of voting technologies. If developers of voting technologies can rely on a standard data interface—if they know that election data will have a standard and common format—then they can work to develop specific components for election administration, and thus governments could purchase modular election administration systems. This could spur competition and technological development in this sector of e-government.

Appendix I: Standards and Standards-Setting Processes

So what is a standard? One definition is that "a standard is a deliberate acceptance by a group of people having common interests or background of a quantifiable metric that influences their behavior and activities, permitting a common interchange."[17] Language is a simple example of a standard. Although everyone does not speak the same language, each language has its own set of agreed upon metrics—what letters create what sounds, in what direction they are read—that governs its use. Without these metrics, it would not be possible for us to communicate effectively, because the meaning one person ascribed to a letter or word might not be the same as the meaning ascribed by another.

When we think about standards, it is also important to remember that standards are not the same as regulations. Although some regulations contain standards, not all standards are developed through a legalistic, regulatory framework. Instead, some are developed through non-governmental organizations (NGOs) or are developed by governmental agencies on a voluntary-compliance basis. Moreover, some standards that exist in legal regulations are in fact developed in exactly the same manner as are voluntary standards. The National Institute of Standards and Technology (NIST) has developed a typology of standards that defines the different types of standards and the different development models they employ.

Standards are critical for the promotion of economic development, and have been throughout history. For example, uniform coinage in the ancient world broke down barriers to trade across great distances. A silver Roman coin held the same value in Rome as it did in Greece or northern Africa or Persia, and meant that merchants or average citizens could purchase a certain amount of product for a silver coin, no matter where they might be within the Roman Empire.[18] In more modern times, standardization has driven economic development. For example, the standardization of railroad-track width is credited with transforming the United States. When railroads first began in the United States, different companies had different width, or gauge, of track. A train would travel until it hit a different gauge of track, and the train would have to be unloaded onto anther train that could run along the new gauge. Not only were the unloading and reloading of trains costly, so were having different trains and cars to run on the different gauges. Once the gauge became uniform, people and cargo could move across the country more quickly than ever thought possible. If the Transcontinental Railroad had used different gauges as the railroad was being built, the ride, though faster than the conventional mode of travel to the West, would still have been cumbersome and time-consuming.[19]

The Rise of Standards-Setting Institutions

To overcome the problems associated with the lack of standards, several standards-setting bodies have been created to facilitate the creation and diffusion of uniform protocols. In the area of e-government, three of the more prominent standards-setting organizations are the federally established National Institute of Standards and Technology (NIST); the American National Standards Institute (ANSI), a U.S. NGO, and the Institute of Electrical and Electronics Engineers Standards Association (IEEE-SA), an international NGO. As the history of NIST notes (see "The Origins of NIST and National Standards"), the agency was established in 1901 for just the commercial reasons noted above—to promote

Table A.1: Types of Standards

The NIST has developed a typology of standards. First, it identifies two types of standards—performance and design standards—and then highlights an array of means by which these standards can be developed.

Standard	Description
Performance	Standard used to describe a product's intended function without specifically stating how it might achieve that function. These standards are less restrictive than design standards and encourage innovation.
Design	Standard used to define a product's characteristics or how it is to be built. These standards can be used to test for comparability.
Voluntary consensus	Standards produced by standards developing organizations (SDOs) through a consensus process. Participation in the standards development and compliance with the standards is voluntary, except where government regulatory agencies have adopted or referred to the standards.
Defense	Documents that establish uniform engineering and technical requirements for military-unique or substantially modified commercial processes, procedures, practices, and methods. These standards must be written in performance terms.
Mandatory	Standards that are made compulsory by virtue of a general law or exclusive reference in regulation. These standards are generally published as part of a code, rule, or regulation by a regulatory government body and impose an obligation on specified parties to conform to them.
National Institute of Justice (NIJ)	Standards that determine the technological needs of federal, state, and local criminal justice and public safety agencies. The NIJ sets minimum performance standards for specific devices, tests commercially available equipment against those standards, and disseminates the results to criminal justice and public safety agencies nationally and internationally. Compliance with these standards is voluntary.
Federal	Standards developed and issued by the General Services Administration (GSA) to meet procurement needs of federal government agencies.
De facto	Standards developed through means other than formal standards organizations. These standards are typically open to participation from any interested individuals or organizations.
Consortia	Standards created by groups of like-minded companies that collectively have significant market power to develop a standard outside the formal standards process. These standards provide a complementary vehicle to satisfy the need to create partial-consensus standards in rapidly moving high-technology fields.
Industry	Industry standards come in two forms: company standards and industry standards. Company standards are those developed for use by a single company or organization for its own products. Industry standards are developed by industry standards development groups for use within a particular industry.
International	Standards developed and promulgated by governmental and non-governmental international organizations. These standards may be voluntary or mandatory in nature.

Source: Christine R. DeVaux, National Institute of Standards and Technology, "A Guide to Documentary Standards," December 2001 (http://ts.nist.gov/ts/htdocs/210/ncsci/ir6802.pdf)

The Origins of NIST and National Standards

As NIST notes in its centennial history,

> Chartered by the U.S. Congress on March 3, 1901, [NIST] was the first physical science research laboratory of the federal government, established at about the same time as the nation's first commercial laboratory. At that time, the United States had few, if any, authoritative national standards for any quantities or products. What it had was a patchwork of locally and regionally applied standards, often arbitrary, that were a source of confusion in commerce….
>
> The need for such an organization in the United States was discussed for many years by scientists and engineers. One complained, for example, that he had to contend with eight different "authoritative" values for the U.S. gallon. The growing electrical industry needed measuring instruments and was often involved in litigation because of the lack of standards….
>
> To advance fundamental science, NIST developed increasingly precise instruments, measurement techniques offering greater range than ever before, and wholly new standards such as those for sound, frequency, and radiation.
>
> The need for standards was dramatized in 1904, when more than 1,500 buildings burned down in Baltimore, Md., because of a lack of standard fire-hose couplings. When firefighters from Washington and as far away as New York arrived to help douse the fire, few of their hoses fit the hydrants. NIST had collected more than 600 sizes and variations in fire-hose couplings in a previous investigation and, after the Baltimore fire, participated in the selection of a national standard.

Source: http://www.100.nist.gov/founding.htm

uniformity in a rapidly industrializing America—but its work has had wide-ranging benefits, including improved public safety and quality of life.

Not only was the government moving in this period to develop standards through NIST, but the private sector was doing so as well through professional associations. The IEEE's standards work and the creation of ANSI also occurred in this time period. ANSI was created through the collaborative efforts of a variety of engineering societies, including the forerunner of the IEEE. The goal was to create an organization that could "serve as the national coordinator in the standards development process as well as an impartial organization to approve national consensus standards and halt user confusion on acceptability."[20]

The development of these standards processes has been critical to the advancement of modern society. The transparent, open process that was developed allowed all interests to have a say in the developed standards. Once standards are established in a given area, producers have a common knowledge of the qualities their product should have and buyers have confidence that the product they buy meets a certain minimum set of standards for conformity and performance. In many ways, standards provide the language that is necessary for modern commerce to occur by providing a functional baseline for a given product or service.

American National Standards Institute (ANSI) Process[21]

Throughout its history, ANSI has maintained as its primary goal the enhancement of the global competitiveness of U.S. business and the American quality of life by promoting and facilitating voluntary consensus standards and conformity assessment systems and promoting their integrity. The Institute represents the interests of its nearly 1,000 corporate, organization, government agency, institutional, and international members through its office in New York City and its headquarters in Washington, D.C.

In order to maintain ANSI accreditation, standards developers are required to consistently adhere to a set of requirements or procedures, known as the "ANSI Essential Requirements," that govern the consensus development process. Due process is the key to ensuring that ANSIs are developed in an environment that is equitable, accessible, and responsive to the requirements of various stakeholders. The open and fair ANS process ensures that all interested and affected parties have an opportunity to participate in a standard's development. It also serves and protects the public interest since standards developers accredited by ANSI must meet the Institute's requirements for openness, balance, consensus, and other due process safeguards.

The hallmarks of the American National Standards process include:

- Consensus on a proposed standard by a group or "consensus body" that includes representatives from materially affected and interested parties
- Broad-based public review and comment on draft standards
- Consideration of and response to comments submitted by voting members of the relevant consensus body and by public review commentators
- Incorporation of approved changes into a draft standard
- Right to appeal by any participant that believes that due process principles were not sufficiently respected during the standards development in accordance with the ANSI-accredited procedures of the standards developer

The ANSI process serves all standardization efforts in the United States by providing and promoting a process that withstands scrutiny while protecting the rights and interests of every participant. In essence, ANSI standards quicken the market acceptance of products while making clear how to improve the safety of those products for the protection of consumers.

Appendix II: Standards in E-Government Networks—The Case of HIPAA

A key example of the role that the federal government can play in developing ETS for software and e-government systems in a given policy area is the requirements under the Health Insurance Portability and Accountability Act of 1996 (HIPAA). HIPAA is generally considered to be one of the most sweeping changes to federal healthcare policy since the passage of Medicare in 1965. Although the initial media coverage of this legislation focused on the portability aspects—the ability of individuals to move their health coverage to a new job by requiring certificates of creditable coverage and by imposing restrictions on pre-existing condition exclusions—one of the most far-reaching provisions has to do with requirements for data exchange. Under HIPAA, all covered healthcare-related organizations, as well as entities that exchange data with a HIPAA-covered organization, are required to use a common data exchange format.

A review of the world before the existence of HIPAA explains why ETS requirements are so important. In the pre-HIPAA world, there were no standards regarding how healthcare organizations were to store, process, communicate, or secure data. This lack of standardization led to the development and deployment of more than 450 different electronic insurance claim formats, with many vendors offering multiple—and often incompatible—formats. Even if software came from the same vendor, management and clinical information software often differed across entities, and the lack of a standard data format was a costly and complex barrier. Without a standard protocol for formatting electronic data, data transactions were difficult and the transaction costs associated with making such transactions work were very high.[22]

The lack of a standard data format was seen as a critical factor in the high overhead costs associated with healthcare. As a report by the Midwest Center for HIPAA Education (MCHE) notes:

> A considerable portion of every healthcare dollar is spent on administrative overhead. In healthcare, this overhead includes many tasks, such as:
>
> - Filing a claim for payment
> - Enrolling an individual in a health plan
> - Paying healthcare premiums
> - Checking insurance eligibility for a particular treatment
> - Requesting authorization for services
> - Responding to requests for additional information to support a claim
> - Coordinating the processing of a claim across different insurance companies
> - Notifying the provider about the payment of a claim
>
> Today, these processes involve numerous paper forms and telephone calls, non-standard electronic commerce, and many delays in communicating information among different locations. This situation creates difficulties and costs for healthcare providers, health plans, and consumers.[23]

Software solution providers have issued numerous white papers touting the benefits of the move in HIPAA to electronic data interchange, or EDI. As one of these papers noted, the healthcare industry requires several hundred thousand medical service providers—many of which are five-person or smaller physician practices—and medical suppliers, hospitals, insurance providers, and others to be able to communicate in a common language.[24]

An EDI overcomes these problems by allowing data transfers to be done with very low cost, because the data exchange occurs instantaneously and without human intervention. Without an EDI, humans must fill the communication gap that exists between incompatible computers. The benefits of the HIPAA ETS requirement are numerous. Some of the more obvious ones are:

- Reduced administrative costs
- Instantaneous transmission of claims and other data
- Improved accuracy in information transmission
- Integration of provider transactions into an entity's overall administrative framework
- Increased security, as fewer individuals have to handle the data when it is transferred

EDI in healthcare has the potential to move this industry toward the model used in retail, where Internet-based networks are being used to bring all aspects of the industry under a single communications protocol that allows data to flow freely across vendors and organizations.[25]

There are other, less obvious benefits as well. The MCHE notes that ETS can facilitate corporate synergies among software development and systems implementation firms, as well as among healthcare firms. Companies now have incentives to cooperate in the development of new products, since they have to use a common ETS. Likewise, EDI features provide companies with incentives to share appropriate data to improve healthcare outcomes, in addition to improving claims processing and benefits delivery. Because a standard set of codes will be used for the processing of health information, the reliability of this data will be increased across providers. No longer will a given illness, procedure, or treatment be coded and labeled differently by different healthcare claims payers or providers.[26]

The actual ETS were issued in 2003, after an extensive rule-making process that began in 1998 and extended through the issuance of a proposed rule in 2002.[27] There were more than 17,000 comments received on the initial proposed rule, and 300 received for the final rule. The process for developing this rule was included in Sections 1171 through 1179 of HIPAA.[28] Specifically, the Act requires

> that any standard adopted by the Secretary of Health and Human Services be a standard that has been developed, adopted, or modified by a standard setting organization (SSO). The Secretary may adopt a different standard if the standard will substantially reduce administrative costs to providers and health plans compared to the alternatives.… The Act also sets forth consultation requirements that must be met before the Secretary may adopt standards. In the case of a standard that is developed, adopted, or modified by an SSO, the SSO must consult with the following Data Content Committees (DCCs) in the course of the development, adoption, or modification of the standard: the National Uniform Billing Committee (NUBC), the National Uniform Claim Committee (NUCC), the Workgroup for Electronic Data Interchange (WEDI), and the American Dental Association (ADA). In the case of any other standard, the Secretary is required to consult with each of the above-named groups before adopting the standard … [as well as] with the National Committee on Vital and Health Statistics (NCVHS).[29]

So while the ETS under HIPAA are being promulgated through a regulatory process, they are to be developed using a consultative process that is the hallmark of the standards-setting process in the United States.

The final rule has several components. First, it requires all health plans, healthcare clearinghouses, and healthcare providers that transmit transactions electronically to follow the developed ETS. Second,

it requires covered organizations to be able to pay providers, authorize services, certify referrals, and coordinate benefits using the ETS protocol. Third, the ETS creates a standard format for determining eligibility for insurance coverage and claim status, as well as requesting authorizations for services or specialist referrals. All covered entities will use common codes for all transactions, including reporting diagnoses and procedures. Fourth, employers will have a standard electronic format for enrolling or removing employees from insurance coverage, as well as for making premium payments. Finally, it creates a process for keeping the standards up-to-date, using the traditional standards-setting process.[30] This rule is designed to create a comprehensive set of electronic transaction standards and a process for keeping them current. The entire process is designed to be open and participatory, but at the same time using a regulatory framework to push the standards-setting process to a conclusion that is binding on all covered parties.

The development of ETS is just one aspect of the standardization of healthcare data under HIPAA. HIPAA also requires the study of issues associated with the adoption of uniform data standards for patient medical record information and the electronic transmission of these data. As an analysis by PricewaterhouseCoopers noted, the lack of standardization in this area can lead to an array of medical errors, including misdiagnoses, incorrect diagnoses, treatment choices that lead to drug interactions and allergic reactions, and high morbidity rates.[31] It is estimated that medical errors cause 98,000 deaths per year in the United States, making it the fourth leading cause of death. Incredibly, 7,000 of these deaths are associated with providing patients with drug-related medical errors.

Clearly, standardization of data and data transmission has the prospect of improving the lives of all Americans who receive medical care. It can also decrease administrative costs by allowing EDI systems to communicate easily—from the smallest practice group to the largest health insurance payer—and having these systems integrate with other aspects of the business of healthcare. Since healthcare is one of the largest and most complex components of the U.S. economy, the fact that it is possible to standardize electronic transactions across the several hundred thousand entities that are a part of this industry suggests that ETS can be adopted in any industry, including the elections industry.

Appendix III: Summary of the Help America Vote Act of 2002 (HAVA)

The Help America Vote Act was passed in 2002 in response to the election debacle in Florida in 2000.[32] The Act has nine parts, as summarized below.

Title I: Replacement of Punch Card and Lever Voting Machines

This section provides funding to states that used either punch cards or lever voting machines in November 2000 to replace these systems with new voting technologies that meet the requirements of HAVA.

Title II: Establishment of the Election Assistance Commission (EAC)

Title II has two parts. The first part establishes several key institutions for promoting election assistance, and the second calls for the development of guidance and the commissioning of studies related to election reform.

Institutions

The EAC is established as an independent entity that will serve as a national clearinghouse and resource for the compilation of information and the review of procedures with respect to the administration of federal elections. This section also established three boards:

- The Election Assistance Commission Standards Board and the Election Assistance Commission Board of Advisors are to review the voluntary voting system guidelines, the voluntary election administration guidance, and the best practices guidance for facilitating military and overseas voting.
- The EAC is to establish the Technical Guidelines Development Committee to assist the executive director of the Commission in the development of the voluntary voting system guidelines.

Guidance and Studies

The Commission is to provide for the testing, certification, decertification, and recertification of voting system hardware and software by accredited laboratories. HAVA gives states the option of providing for testing, certification, decertification, or recertification of its voting system hardware and software by the laboratories accredited by the Commission. The National Institute of Standards and Technology is tasked with providing a list of independent, non-federal laboratories that can be accredited to carry out such testing, certification, decertification, and recertification. NIST is also asked to monitor and review accredited laboratory performance on an ongoing basis.

The EAC is directed to conduct periodic studies regarding certain election administration issues, including (1) best practices for facilitating voting by absent uniformed services voters and overseas voters; (2) how human factor research can be applied to voting products and systems design to ensure usability and accuracy of voting products and systems; (3) the impact on voters of new requirements governing voter registration by mail; (4) the feasibility and advisability of using Social Security identification numbers or other information compiled by the Social Security Administration to establish voter registration or other election law eligibility or identification requirements; (5) the issues and challenges of incorporating communications and Internet technologies in the federal, state, and local electoral process; and (6) the feasibility and advis-

ability of having the Postal Service waive or reduce the amount of postage applicable to absentee ballots used in federal general elections. The EAC can also make grants for research and development to improve the quality, reliability, accuracy, accessibility, affordability, and security of voting equipment, election systems, and voting technology.

States are required to file a plan for implementation of certain mandatory, uniform, nondiscriminatory administrative complaint procedures, and have such procedures in place. Once these plans are in place, states are eligible to receive payments that can be used to obtain new voting equipment or for other activities to improve the administration of elections for federal office. Separate funds from the Department of Health and Human Services (HHS) are for ensuring that polling places for individuals with disabilities are accessible. In a related matter, HHS also pays the protection and advocacy system of each state to ensure full participation in the electoral process for individuals with disabilities.

Title III: Uniform, Nondiscriminatory Election Technology and Administration Requirements

Voting systems used in *federal elections* must maintain voter privacy and ballot confidentiality. They also must (1) permit voters to verify their votes before the ballot is cast and counted; (2) allow voters to correct any error before the ballot is cast and counted; and (3) notify voters if they select more than one candidate for an office if it has the effect of casting multiple votes for the office. States can create a voter education program if their voting technology does not allow for each of these provisions. Voting systems are also required to (1) produce a record with an audit capacity for such systems; (2) be accessible for individuals with disabilities; (3) provide alternative language accessibility pursuant to the Voting Rights Act; (4) comply with established error rate standards; and (5) operate according to a uniform definition of what constitutes a vote.

Provisional ballots must be provided to individuals who declare that they are registered to vote in a jurisdiction but are not on the official list of registered voters or are otherwise alleged to be ineligible. These individuals are permitted to cast a provisional ballot, which is to be promptly verified and counted if it is determined to be valid under state law. A voter must also be able to learn if the vote was counted and, if the vote was not counted, why it was not counted. States that do not require voter registration for federal elections are exempt from this provision.

States must create a single, uniform, official, centralized, interactive computerized *statewide voter registration list*. State or local election officials must perform list maintenance on a regular basis and ensure that the database is well secured. The voter registration information must include either a driver's license number or the last four digits of a Social Security number. Voters who register by mail must present valid photo identification when voting in person or by mail.

Title IV: Enforcement

The U.S. Attorney General can take action against any state or jurisdiction to compel implementation of the uniform and nondiscriminatory election technology and administration requirements of Title III. States receiving payment under HAVA must have a state-based administrative complaint procedure with respect to violations of title III. States not receiving payments under HAVA must either certify they meet complaint-procedure requirements or submit a plan to the Attorney General describing steps to be taken to meet Title III requirements.

Title V: Help America Vote College Program

The EAC is to develop a *Help America Vote College Program* to encourage college students to serve as nonpartisan poll workers or assistants, and to encourage state and local governments to use the services of the students participating in the program.

Title VI: Help America Vote Foundation

Establish the *Help America Vote Foundation* to (1) mobilize secondary school students to serve as poll workers or assistants; (2) place secondary school students as poll workers in polling places; and (3) establish cooperative efforts to further the purpose of the foundation.

Title VII: Voting Rights of Military Members and Overseas Citizens

The Secretary of Defense is to prescribe procedures to provide the time and resources for voting assistance officers to perform voting assistance duties during the period in advance of a general election. The Department of Defense (DoD) is also to implement measures to ensure that a postmark or other official proof–of-mailing date is provided on each absentee ballot collected at any overseas location or vessel at sea under DoD control. The DoD is also to engage in informational campaigns for the people covered by the Uniformed and Overseas Civilian Absentee Voting Act (UOCAVA). Each state must designate a single office responsible for providing information on registration and absentee ballot procedures for all voters in the state and report to the EAC the combined number of absentee ballots transmitted to and returned by absent uniformed services voters and overseas voters.

Titles VIII and IX: Miscellaneous

The last two sections of HAVA cover miscellaneous information and transfer-of-duty provisions.

Endnotes

1. We will discuss in more detail how an ETS could facilitate development of modular voting systems that would allow for possibly more accessible and secure voting architectures, like the modular voting system outlined by the Caltech/MIT Voting Technology Project in its 2001 report (http://vote.caltech.edu/reports/2001report), or systems of cryptographic verification like David Chaum's (http://www.vreceipt.com).

2. See Richard Franklin Bensel, *The American Ballot Box in the Mid-Nineteenth Century,* New York, Cambridge University Press, 2004.

3. See R. Michael Alvarez, Stephen Ansolabehere, and Charles Stewart III, "Studying Elections: Data Quality and Pitfalls in Measuring the Effects of Voting Technologies," *Policy Studies Journal,* 33(1), 15–24, 2005.

4. See, for example, Jane Fountain, *Building the Virtual State: Information Technology and Institutional Change,* (Washington, D.C., Brookings Institution Press, 2001); and Mark A. Abramson and Therese L. Morin, eds., *E-Government 2003,* (Lanham, Md., Rowman & Littlefield Publishers, Inc., 2003).

5. There are few works in this area, with the exception of R. Michael Alvarez and Thad E. Hall, *Point, Click, and Vote: The Future of Internet Voting* (Washington, D.C., Brookings Institution Press, 2004); Donald Moynihan, "Building Secure Elections: E-voting, Security and Systems Theory," *Public Administration Review* 64(5): 515–528, 2004.

6. The Government Accountability Office has issued a large number of reports on the impact of data incompatibility on public management. For one example, see Bureau Of Indian Affairs Schools: New Facilities Management Information System Promising, but Improved Data Accuracy Needed, (July 2003) available at http://www.gao.gov/new.items/d03692.pdf (last accessed January 28, 2005).

7. The current standards can be found at http://www.eac.gov/election_resources/vss.html. Information on the NIST role in the future development of voting system standards can be found at http://vote.nist.gov. As we finalize this report, our understanding is that a series of revisions to the current VSS have recently been provided to the EAC and that they should be soon entering a period of public comment. However, there is no indication at this point that the EAC or NIST is considering data exchange standards of the sort we recommend in this report.

8. Federal Election Commission, "Frequently Asked Questions About Voting System Standards," available at http://www.fec.gov/pages/faqsvss.htm (last accessed January 28, 2005).

9. Information on the EML process can be found at http://xml.coverpages.org/eml.html (last accessed April 22, 2005).

10. IEEE: Voting Systems Electronic Data Interchange, Project 1622, available at http://grouper.ieee.org/groups/scc38/1622/index.htm (last accessed January 28, 2005).

11. For example, the Caltech/MIT Voting Technology Project issued a series of detailed recommendations for election data reporting (http://vote.caltech.edu/Reports/auditing_elections_final.pdf). The Election Assistance Commission has worked to implement many of these recommendations during and after the 2004 presidential election.

12. These data are the median figure for the years 1990–1991 to 1999–2000. See "Annual Geographical Mobility Rates, By Type of Movement: 1947–2003," United States Census, available at http://www.census.gov/population/socdemo/migration/tab-a-1.pdf (last accessed January 28, 2005).

13. U.S. citizens living overseas are allowed to maintain their previous residence for voting purposes.

14. State B might want to have a person verify the removal for quality control purposes.

15. Bill Gillford, "People Who Vote Twice," *Slate Magazine,* October 28, 2004, accessible at www.slate.com. It is of course possible that states might allow citizens to be

registered in their state—even if they are also registered in another state—for the purpose of voting only on state and local issues.

16. See "Voting: What Is, What Could Be," available at http://vote.caltech.edu/Reports/2001report.html (last accessed January 28, 2005).

17. Carl Cargill, Information Technology Standardization: Theory, Process, and Organization (Bedford, Mass.: Digital Press, 1989, 13).

18. Cargill, 13–14.

19. Cargill, 15.

20. ANSI—an Historical Overview, available at http://www.ansi.org/about_ansi/introduction/history.aspx?menuid=1 (last accessed January 28, 2005).

21. American National Standards Institute, available at http://www.ansi.org/about_ansi/introduction/introduction.aspx?menuid=1 (last accessed January 28, 2005).

22. New Hampshire Hospital Association, "An Introduction to HIPAA," available at http://www.h2e-online.org/pubs/HipaaIntro.ppt (last accessed January 28, 2005).

23. Midwest Center for HIPAA Education, "The Health Insurance Portability and Accountability Act (HIPAA): Electronic Transaction Standards," available at http://www.mche.us.com/hipaa_edi.shtml (last accessed January 28, 2005).

24. IPNet, "HIPAA: The Changing Face of Healthcare Transactions: An IPNet Solutions White Paper," available at http://www.ipnetsolutions.com/download/pdf/wp_healthcare.pdf (last accessed January 28, 2005).

25. IPNet HIPAA: The Changing Face of Healthcare Transactions.

26. GAO, "HIPAA Standards: Dual Code Sets Are Acceptable for Reporting Medical Procedures," GAO-02-796, (August 2002), available at http://www.gao.gov/new.items/d02796.pdf (last accessed January 28, 2005).

27. "Health Insurance Reform: Modifications to Electronic Data Transaction Standards and Code Sets," 68 Fed. Reg. 8381, 2003 (to be codified at 45 CFR Part 162), available at http://www.cms.hhs.gov/providerupdate/regs/cms0003f_cms0005f.pdf (last accessed January 28, 2005).

28. "Health Insurance Reform: Modifications to Electronic Data Transaction Standards and Code Sets."

29. "Health Insurance Reform: Modifications to Electronic Data Transaction Standards and Code Sets," 8381.

30. "HHS Announces Electronic Standards To Simplify Health Care Transactions," U.S. Department of Health and Human Services, HCFA Press Office, available at http://www.hhs.gov/news/press/2000pres/20000811.html (last accessed January 28, 2005).

31. Available at http://www.ehcca.com/presentations/HIPAA4/3_07.pdf (last accessed February 3, 2005).

32. The complete text of HAVA, as well as other relevant information about HAVA, is available from http://www.fec.gov/hava/hava.htm.

ABOUT THE AUTHORS

R. Michael Alvarez is a Professor of Political Science at the California Institute of Technology in Pasadena, California. He is currently co-director of the Caltech/MIT Voting Technology Project.

In his academic career, Dr. Alvarez has published three books: two on electoral politics and public opinion, and one on Internet voting. He is currently collaborating with Thad E. Hall on a book on the e-voting controversy, which will be published by Princeton University Press in 2006. The author of scores of research papers and monographs, Alvarez focuses on the electoral process, voting behavior, and public opinion.

Alvarez has received research grants for his work from a variety of sources, including the National Science Foundation and a number of private foundations. He has received numerous awards for his research and professional work, most recently being named as one of the "Scientific American 50" for his work on voting technology in 2004.

Alvarez received his B.A. in political science from Carleton College in 1986 and his Ph.D. in political science from Duke University in 1992.

Thad E. Hall is an Assistant Professor of Political Science at the University of Utah in Salt Lake City, Utah, and a research fellow with the University's Center on Public Policy and Administration.

In his academic career, Dr. Hall has published an Internet voting book with Michael Alvarez and a book on policy making in Congress. His book with Alvarez on the e-voting controversy will be published by Princeton University Press in 2006. Hall has also published numerous research papers and articles, most of them focusing on the electoral process or the public policy process.

Hall has received research grants for his work from several sources, including the Carnegie Corporation of New York. He has been involved with an array of election reform related activities, including testifying before the U.S. Senate Judiciary Committee, serving on the professional staff of the National Commission on Federal Election Reform, and collaborating with the Caltech/MIT Voting Technology Project.

Hall received his B.A. in political science from Oglethorpe University in 1990, his M.P.A. from Georgia State University in 1993, and his Ph.D. in political science from the University of Georgia in 2002.

KEY CONTACT INFORMATION

To contact the authors:

Dr. R. Michael Alvarez
Professor of Political Science and
Co-Director, Caltech/MIT Voting Technology Project
California Institute of Technology
Pasadena, CA 91125
phone: (626) 395-4089
fax: (626) 405-9841

e-mail: rma@hss.caltech.edu

Dr. Thad E. Hall
Assistant Professor
Department of Political Science
University of Utah
260 S. Central Campus Dr., Room 252
Salt Lake City, UT 84112-9152
phone: (801) 585-7344
fax: (801) 587-7861

e-mail: thad.hall@poli-sci.utah.edu

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For additional information, contact:
Mark A. Abramson
Executive Director
IBM Center for The Business of Government
1301 K Street, NW
Fourth Floor, West Tower
Washington, DC 20005
(202) 515-4504, fax: (202) 515-4375

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