

## Voting for Standards and Standards for Voting

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The election season is upon us again. Candidates for President of the United States are coming out of the woodwork. The United Kingdom recently elected its 56<sup>th</sup> Parliament. And the IEEE's annual election ballot has been finalized (the author is a candidate for President-elect).

As with so many aspects of life, standards play an important role in voting. Standards exist and new ones are emerging in areas such as voting systems, voting equipment, and testing of voting equipment. Some of these standards are rules and regulations that govern the voting process. Others are technical in nature.

Before going into more detail about some of these standards, let's briefly look back at the notorious situation that occurred in the 2000 U.S. Presidential election. The outcome of the election was complicated by punch-card ballots that were not completely determinate. Small rectangular bits of the cards, known as chads, were not fully detached from the ballot cards, resulting in the cards not being read by the tabulating machines.

"Hanging chads," meaning the chad was still attached at one corner, became a household word overnight. Other new terms then sprung up to describe the specific ways that chads were not completely detached from a card. "Swinging chads" are still attached at two corners. "Tri chads" are attached at three corners. "Dimpled chads" have indents in them with no hole punched through. And "pregnant chads" have a hole in them, but they're still attached at four corners.

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The chad issues with punch-card ballots and their tabulating machines prompted legislators to take another look at improving the entire voting process. In 2002, the U.S. Congress passed the Help America Vote Act (HAVA), which was intended to cause sweeping reforms. Included in HAVA was a call for minimum, mandatory standards that U.S. states would have to follow. HAVA also provided funding to help them meet those standards.

### **Standards for Voting Systems**

The term "voting systems" means not only voting machines, but also includes logistical aspects of voting, such as what the voter sees before casting a ballot, how voter lists are maintained, provisional ballots, and citizen voters who are out of the country. Some of the provisions included in HAVA:

require a means to allow a person to double-check his or her votes and be able to change the votes before casting the ballot. The person shall be able to verify the votes privately and independently, and shall receive a replacement ballot if necessary.

- Help cities and towns discover and prevent voting for two or more candidates for a single office on a single ballot. A voter who accidentally or intentionally does this shall be notified and given an opportunity to correct it.
- Instruct the U.S. Election Assistance Commission (EAC) to provide for testing and certification of voting-system hardware and software.
- Demand states to set standards to ensure their voter lists are secure to prevent hacking and other irregularities. States must adhere to a minimum federal standard for list accuracy.
- Dictate that a provisional ballot must be provided to a person whose name is not on the voter list, even though the person claims to be eligible to vote in his or her local jurisdiction.
- Require the National Institute of Standards and Technology (NIST) to recommend areas where additional research is needed.

The EAC and NIST developed the [Voluntary Voting System Guidelines \(VVSG\)](#), which consists of two volumes. Interestingly, the guidelines were formulated in the same way as many electronic design standards are created, with rounds of public comment and each comment being addressed by the EAC. The guidelines use the standard nomenclature of “shall,” “shall not,” “should,” and “may.” As indicated by its name, the VVSG is voluntary in order to address the diversity of voting equipment, states, and municipalities. It builds on standards from numerous standards organizations, such as IEEE, ISO/IEC, EIA, and ANSI.

### **Standards for Voting Equipment**

The first volume of the VVSG is called “Voting System Performance Guidelines.” It deals with the hardware, software, and other aspects of voting machines. The major sections of Volume 1 include:

- *Functional Requirements*, which ensure things like accuracy, security, auditability, error recovery, ballot production, and reporting.
- *Usability and Accessibility Requirements*, which address the need for “user-friendly” voting across a broadly differing population and the principal requirement of privacy.
- *Hardware Requirements*, covering everything from displays, printers, and computers to shelter, electrical supplies, and RF immunity.
- *Software Requirements*, including design and coding standards, configuration, and even programming-language constructs.
- *Telecommunications Requirements*, which involve components such as routers, modems, and cables; telecom providers; data transmission; and design and maintenance.
- *Security Requirements*, which addresses the complex interaction of hardware, software, communication, and human behavior.
- *Quality Assurance and Configuration Management*, which ensures compliance to the VVSG itself.

### **Standards for Voting-Equipment Testing**

second volume of the VVSG, called “National Certification Testing Guidelines,” deals with the testing of voting equipment. It defines the requirements for a voting system to be in compliance with Volume 1 of the VVSG. An accredited test laboratory uses Volume 2 to prove compliance so that the voting system can receive national certification. The major sections of Volume 2 include:

- *Quality and Configuration Management Manual*, which details the documentation required from a manufacturer to show VVSG compliance.
- *Technical Data Package*, which must be supplied by the manufacturer prior to certification testing. It contains design specifications, operating instructions, and standards compliance for both hardware and software.
- *Functionality Testing*, which describes the tests that the voting system will undergo at the certified test lab to ensure the overall system functions properly.
- *Hardware Testing*, to provide details about how the equipment supplied by the manufacturer will be tested for environmental conditions such as temperature, humidity, and vibration.
- *Software Testing*, to provide details about how the software components of the voting system will be tested, including documentation review and source code review.
- *System Integration Testing*, which describes tests for the system’s internal and external interfaces as well as security testing and other audits.

### **The Future of Voting Standards**

As technology advances, so too will the voting methods for citizens, as will the voting equipment. In early 2015, NIST held a symposium on the future of voting systems. It was but one venue that can help NIST continue its work in recommending voting standards. Voting standards are, of course, not a U.S.-only issue. All over the world, organizations such as the United Nations, the Council of Europe, and the African Union have been addressing electoral standards.

Though advanced electronic voting systems will be deployed in some locations, punch-card ballots and other traditional systems will still be in play. In the not-too-distant future, voting may be done over the Internet or via smart mobile devices. Interoperability between the different systems may be addressed by new standards such as IEEE 1622, which is a project underway to create a common interchange format.

Voting machines, voting systems, and voting standards will continue to evolve, while the popular saying “vote early and vote often” lives on.

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