The IEEE VSSC/1622: Voting System Standards

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The IEEE Voting System Standards Committee is developing standards and guidelines for voting systems to create a common data format for election systems. Voting system data will be easier to export and utilize in election processes and by the general public.

Few people think of IEEE when they cast their ballots on Election Day—but they just might when new IEEE standards make their way to voting equipment. The IEEE Voting System Standards Committee project 1622 (VSSC/1622) 1622.2 standard will affect the way election results are reported to the media.

One goal of VSSC/1622 is to improve US voting processes by creating a common data format (CDF) for election data (see Figure 1).

IEEE AND VOTING STANDARDS

In the aftermath of the 2000 elections, IEEE engineers launched an effort to improve Federal Election Commission (FEC) voting system standards. To this end, IEEE formed a Standards Coordinating Committee—SCC 38—to supervise voting-related standards and began work on project 1583 (P1583). P1622, a related project, focused on interchange standards for data flowing through different voting system components. However, neither project achieved a consensus draft, and SCC 38 was discontinued.

The 2002 Help America Vote Act (HAVA) created the Election Assistance Commission (EAC), a federal agency whose goals include developing and promulgating voluntary voting system guidelines (VVSGs) and a federal voting system certification and testing program. A revision to the FEC standards was created in 2005—now known as VVSG 1.0—and an entirely rewritten standard in 2007—VVSG 2.0 (which was ultimately not adopted).

P1622 was re-formed with new officers and members and resumed work, now supported by the National Institute of Standards and Technology. In 2011, P1622 produced its first standard, 1622-2011, which is for an XML-based CDF to assist states in producing blank electronic ballots. Since then, P1622 has worked on several related standards efforts that led to the creation of VSSC/1622, which oversees P1622 and other working groups involved in voting system standards development.

WHY A COMMON DATA FORMAT?

A CDF is analogous to a common language for people to share ideas, products, and services. A language used exclusively by a few people isolates them from the rest of the world.

As the demand for and use of election technology increase, election officials rely on more products that must communicate with one another or share data with a common host to integrate into the election administration process. These products tend to be based on proprietary communications protocols and, as a result, don't interoperate with

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other manufacturers' products. The cost of converting a jurisdiction's entire product line and updating corresponding procedures is often prohibitive; thus, many election officials are limited to the voting systems product line available from their current manufacturer.

ADVANTAGES OF A CDF

Without a CDF for election equipment and associated software and systems, election officials face duplication of effort and a higher risk of error. A CDF also offers the following advantages:

- Devices are easier to use, deploy, and understand. Ultimately, a CDF can make electronic voting devices easier to administer and possibly lead to greater overall trust in them.
- Best-of-breed devices can be built and integrated into existing systems. Manufacturers' support of a CDF results in data format interoperability and lets new manufacturers sell equipment to states or jurisdictions where they were formerly locked out. Small manufacturers can build one-off devices rather than having to build a complete suite of products.
- Election officials can shop for devices that best suit voters' current needs, regardless of manufacturer. They aren't locked in to a single manufacturer's product line because of decisions they made earlier, when these needs might have differed.
- Developers can write applications using a CDF. By special arrangement with IEEE, VSSC voting standards are freely available; new equipment and software developers and integrators can use them to interface with other manufacturers' equipment. This prevents the continual "reinvention of the wheel" that occurs when developers must create their own format for new systems.
- Elections can be audited, analyzed, and archived more easily. Voting devices store data useful for subsequent election audit and analysis, but sometimes pertinent data can't be accessed easily due to proprietary storage formats. With a CDF export format, manufacturers can build in export capability for a class of voting devices.
- Device certification is possible. The EAC certifies *voting systems*—that is, complete systems of devices to run an election. Currently, if a state wants to use a new device in its previously certified voting system, it might "break" certification owing to the changes necessary to achieve interoperability. However, with a CDF, a single device could be certified and added to a voting system without breaking overall certification.

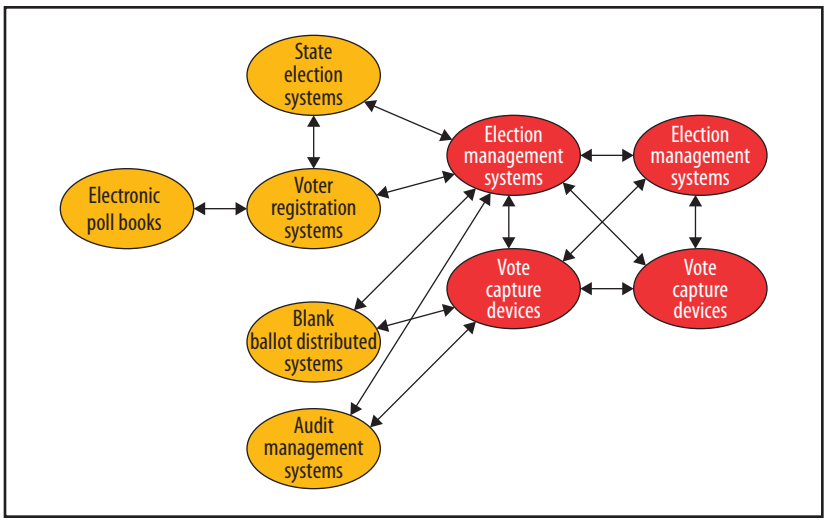

Figure 1. A common data format (CDF) enables interoperability and election transparency.

BUILDING A CDF CAPABILITY

Achieving device-to-device interoperability is complicated and requires the cooperation of many parties. Therefore, the VSSC/1622 strategy focuses on the simpler aspects of a CDF—those that involve the minimum for device-to-device interoperability, lie at the endpoints of voting system interfaces, and have the highest odds of early success.

The initial standard P1622-2011 aimed to produce an XML-based format for exporting blank ballot information from election management systems (EMSs) such that these generically formatted ballots could be made available to overseas military voters and vendors who format ballots for various US states. The current 1622.2 draft, which focuses on election results reporting, addresses EMS exports more broadly, with emphasis on pre-election information, election night results, and highly detailed postelection certified results.

Use case standards

The VSSC's strategy for developing use case standards (or guidelines) ensures a comprehensive, interoperable CDF for election data and equipment. VSSC use case standards include

- summary information about the election application and data,

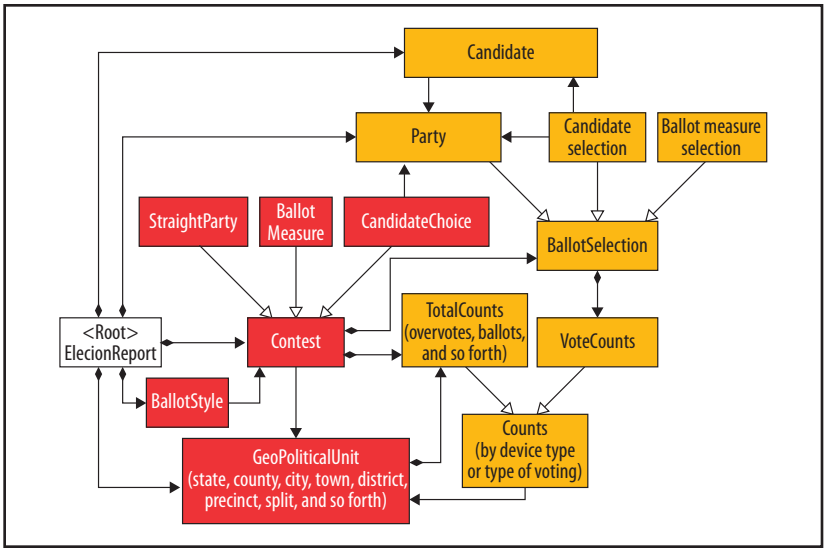

Figure 2. UML model for election results reporting, including class names. Class attributes and multiplicities aren't shown.

- the associated stakeholders and system actors,
- a description of the use cases involved in the standard's scope,
- requirements for the application's data elements,
- a data model expressed in UML, and
- schemata and worked examples in XML, JSON, or other formats.

Election data model

A *model* is a format-independent description of a particular application's data, such as event logging or election results reporting. It unambiguously defines the data elements and how they're related without requiring readers to know the technical details of the data format implementation. Using commercial tools, users can generate a data format from the model. If format changes are necessary to support additional requirements, users can revise the model and regenerate the format. If a different format is needed, they can reuse the model and extend it to generate that format.

Figure 2 shows a high-level UML model from the 1622.2 draft. An election report consists of several classes, including candidates, contests, and political parties. There are three primary types of contests—one involving candidates; another, ballot measures; and the third, straight party selections. A contest's ballot selections correspond to these contest types.

Using a commercial tool, members of 1622.2 generated an XML schema from a more detailed version of this model. This required a small amount of hand-tooling but has made it possible for 1622.2 to focus more on the data requirements of election results reporting and less on the specifics of the XML format.

1622.2 ELECTION RESULTS REPORTING

IEEE VSSC members were motivated to develop a standard to reduce complexity in election results collection and publishing, especially on election night when deadlines are tight and many opportunities for error exist. Reporting processes occur over several different timeframes across a state, and the equipment involved and data produced often don't interoperate. In addition, reporting can vary significantly among states, with some states reporting some or all contests centrally and other states reporting by county or city.

Because of these complexities, the 1622.2 group worked with election officials, analysts, and election equipment manufacturers to analyze

- different reporting scenarios and their associated geopolitical geographies,
- existing election devices and how they might operate in the future, and
- typical ways results are studied and used postelection.

The resulting 1622.2 draft standard specifies two data interchange formats—XML and JSON—for reporting and containing data exported from equipment used to manage elections and tabulate results. It allows for reporting on election information known in advance, election night results, and updates and certified results from postelection canvassing. It can be used to report election results from distributed voting places to county or state central offices, and from county or state offices to news media and the general public. The draft is expected to be finalized by fall 2014.

1622.4 ELECTION DATA MODELING

In February 2014, the VSSC approved the creation of several new working groups, one specifically for election data modeling. The 1622.4 working group aims to develop a high-level model of election data and its relationship with election subsystems, such as the voter registration database, EMS, and candidate filing systems (see Figure 3). Other working groups can use this model to develop more specific models for applications such as absentee ballot

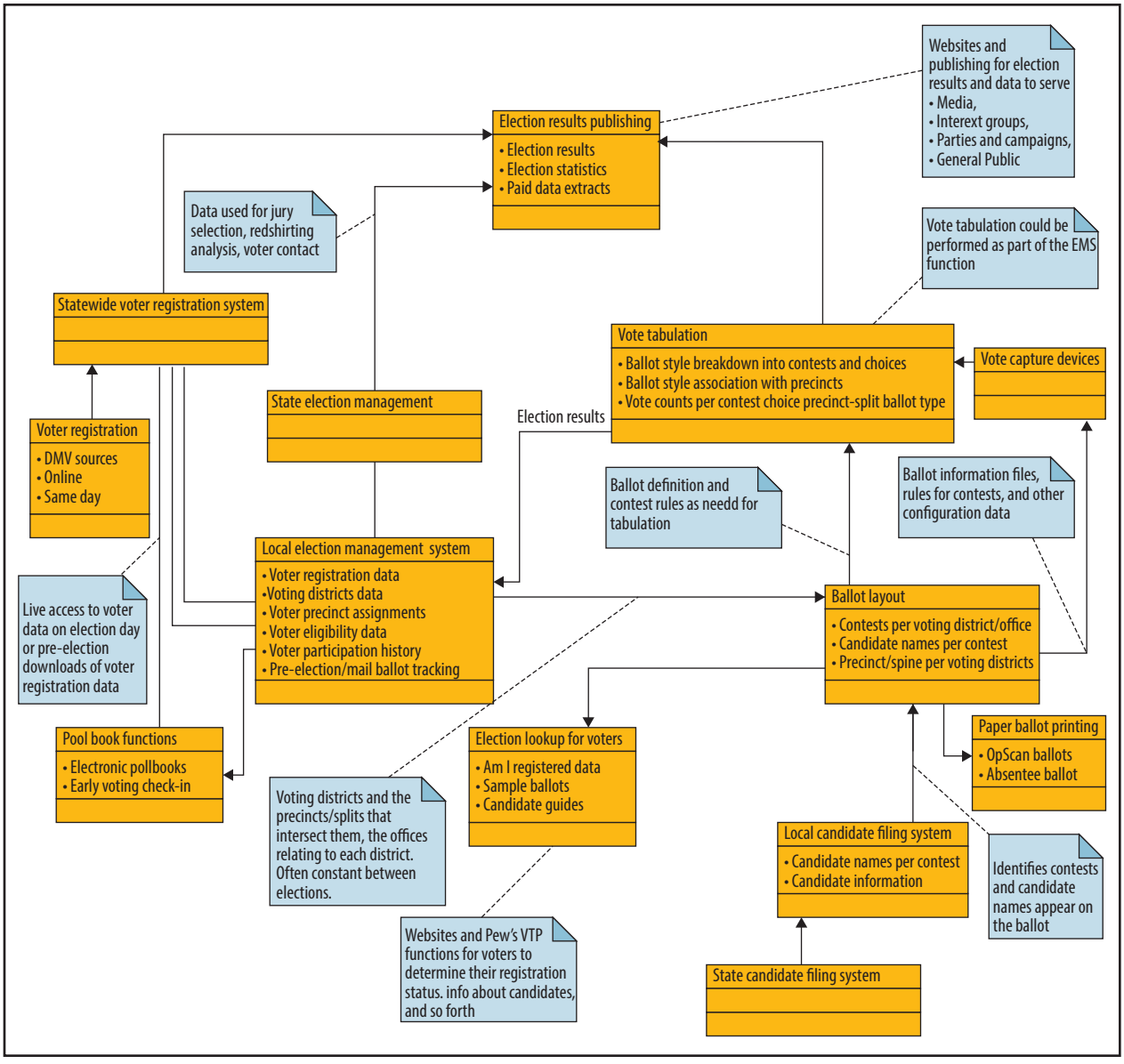

Figure 3. The 1622.4 working group's common election subsystems UML model. Other working groups can use this model to develop more specific models for applications, such as absentee ballot distribution or electronic pollbooks, and to generate data formats.

distribution or electronic pollbooks and to generate data formats from these more specific models.

The 1622.4 working group addresses a significant issue in the election world: many states purchased new voting equipment from funds authorized by the 2002 HAVA, and these systems are nearing the end of their lifespans. As technology evolves, new voting system designs will differ from previous models. It makes sense to develop flexible data models that adapt to new equipment designs as opposed to working solely on XML or other schemata tied to a specific device implementation.

OTHER WORK UNDERWAY

VSSC/1622 is also working on

- a glossary including all terms used in the standards and commonplace in US elections;
- an election event-logging standard (P1622-3), scheduled for review in winter 2014; and
- several new working groups, including one to create formal mathematical definitions and vote-tallying algorithms for contest rules.

The latter are significant for jurisdictions like some in California and

Minnesota, for example, that conduct instant runoff voting.

VSSC/1622 welcomes new participants with appropriate backgrounds and the ability to participate; visit http://grouper.ieee.org/groups/1622.

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