COMMONWEALTH OF PENNSYLVANIA

DEPARTMENT OF STATE

REPORT CONCERNING THE EXAMINATION RESULTS OF ELECTIONS SYSTEMS AND SOFTWARE EVS 6300 WITH DS200 AND DS300 PRECINCT SCANNER, DS450, DS850, AND DS950 CENTRAL SCANNERS, EXPRESSVOTE HW 2.1 MARKER, EXPRESSVOTE XL MARKER AND TABULATOR, AND ELECTIONWARE EMS

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Leigh M. Chapman

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Acting Secretary of the Commonwealth
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EXAMINATION RESULTS OF ELECTIONS SYSTEMS AND SOFTWARE EVS 6300 WITH DS200 AND DS300 PRECINCT SCANNERS, DS450, DS850, AND DS950 CENTRAL SCANNERS, EXPRESSVOTE HW 2.1 MARKER, EXPRESSVOTE XL MARKER AND TABULATOR, AND ELECTIONWARE EMS

I. INTRODUCTION

Article XI-A of the Pennsylvania Election Code, 25 P.S. §§ 3031.1 *et seq.*, authorizes the use of electronic voting systems. Section 1105-A of the Pennsylvania Election Code, 25 P.S. § 3031.5, requires that the Secretary of the Commonwealth (Secretary) examine all electronic voting systems used in any election in Pennsylvania and that the Secretary make and file a report stating whether, in her opinion, the electronic voting system can be safely used by voters and meets all applicable requirements of the Election Code.

Upon the request of Election Systems and Software (ES&S), the Department of State's Bureau of Election Security and Technology (Department) scheduled an examination of EVS 6.3.0.0 (EVS 6300). The system presented for certification in Pennsylvania included the following components - Electionware® (Electionware) election management software used in conjunction with the following components:

1) ExpressVote XL™ (ExpressVote XL) hybrid paper-based polling place voting device
2) ExpressVote® Hardware 2.1 (ExpressVote 2.1), a paper-based polling place voting device that provides touch screen vote capture that can be configured as a ballot marking device (BMD)
3) DS200® (DS200) precinct scanner
4) DS300® (DS300) precinct scanner
5) DS450® (DS450) central scanner
6) DS850® (DS850) high speed central scanner
7) DS950® (DS950) high speed central scanner

EVS 6300 is an upgraded version of the EVS series of voting systems used by certain

counties in Pennsylvania. EVS 6300 adds a new precinct scanner DS300 and a central scanner DS950 to the system. There are also system performance and reporting enhancements added to the system. ExpressVote 2.1 and ExpressVote XL printed ballots also allow multilingual printing in the EVS 6300 system.

The Secretary of the Commonwealth (Secretary) appointed SLI Global Solutions (SLI) and Center for Civic Design (CCD) as professional consultants to conduct an examination of EVS 6300. The examination process included a Functional Examination, Accessibility Examination and Security Testing.

The Functional Examination commenced on October 17, 2022 and was performed in Room G24A/B of the Commonwealth Capitol Complex - Finance Building, 613 North Street, Harrisburg, PA 17120.

Two SLI Global Solutions employees, Mike Santos, Voting System Test Lab Director, and Chase Lake, Test Engineer (collective, the "Functional Examiners"), conducted the Functional Examination, of the EVS 6300 pursuant to Section 1105-A(a) of the Election Code, 25 P.S. § 303l.5(a). Jesse Peterson, Security Specialist, at SLI Global Solutions, served as the Security Examiner for the EVS 6300 Security Testing. The Functional Examination commenced on October 17, 2022, and completed on October 19, 2022, lasting approximately two and a half days. The examination was videotaped by DOS staff. Sindhu Ramachandran, Chief Division of Election Security and Technology and Matthew Ruch Voting Systems Analyst, represented the Secretary of the Commonwealth. Benjamin Swartz, ES&S's State Certification Manager, represented ES&S. Whitney Quesenbery from CCD conducted the Accessibility Examination of the EVS 6300 via a teleconference on December 16, 2022. The Accessibility Examination was limited to the changes EVS 6300 made to earlier EVS versions previously certified by Secretary of the Commonwealth. Accordingly, with respect to aspects of EVS 6300 that were unchanged relative to the previously certified versions, the results from the Accessibility Examination of the EVS 6021 and 6100 systems also apply to EVS 6300. Following the creation of the trusted build that was used in Pennsylvania for functional testing, an issue was identified in the EAC testing of the system. The issue encountered was polling place tabulators (DS200/DS300) time zone changes were not being retained after a system reboot. This

issue caused all reports (except the configuration report) to show Central Time even though the machine was set for another time zone, and upon reboot the time zone setting was lost and returned to Central Time. The Functional Examiners further reviewed the Root Cause Analysis of the issue and concluded that there was no additional testing required based on the regression testing performed during EAC certification testing. The details of the Functional Examiners' determination are noted in further sections of this report.

II. THE EVS 6300 VOTING SYSTEM

EVS 6300 is a paper-based voting system that provides end-to-end election support; from defining an election to generating final reports. The system is comprised of both precinct and central count tabulators and Universal Voting System and/or Ballot Marking Devices as American with Disabilities Act (ADA) components. The system hardware components include: ExpressVote XL™ Full-Faced Universal Voting System, ExpressVote Universal Voting System hardware 2.1 as BMD, DS450 High-Throughput Central Tabulator, DS850 High-Speed Central Tabulator, DS950 High-Speed Central Tabulator, DS200 Precinct-Based Tabulator, and DS300 Precinct-Based Tabulator[1]. The following is a description of the EVS 6300 components.

Electionware® election management software is an end-to-end election management software application that provides election definition, ballot formation, equipment configuration, result consolidation, adjudication, and report creation. Electionware is composed of five software groups: Define, Design, Deliver, Results and Manage. Electionware can be configured as a Standalone EMS Workstation or as a closed Local Area network with EMS server and client/s.

ExpressVote XL™ is a hybrid paper-based polling place voting device that provides

[1] The EVS 6300 Voting System certified by the federal Election Assistance Commission (EAC) also includes ExpressTouch Electronic Universal Voting System and ExpressVote Universal Voting System hardware 1.0, but those components are not part of the system presented for certification in Pennsylvania. Regional Results module of EVS6300 is also not certified for use in Pennsylvania.

touch screen vote capture that incorporates in a single unit the printing of the voter's selections on a paper ballot and the scanning and tabulation of the voter's ballot. The screen provides a display of the full ballot. This device can serve all voters, including those with special needs, allowing all voters to cast paper ballots autonomously. Voters navigate ballot selections using the touch screen, detachable UVC keypad or ADA support peripherals, such as a sip and puff device. ExpressVote XL guides voters through the ballot selection process with screen prompts, symbols and ballot audio. The voter's ballot selections are then printed on a paper ballot for the voter to review before casting her vote. Once printed, the ExpressVote XL, when configured as a tabulator, internally processes the ballot for tabulation. The ballot is printed, reviewed by the voter, tabulated (if the voter confirms her intention to cast that ballot), and deposited into a removable, secure card container attached to the ExpressVote XL cart.

In the EVS 6300 version, ExpressVote XL can also be configured as a ballot marker only (rather than as a ballot marker and tabulator), in which case the voter marks a ballot and the voter's ballot selections are printed on a paper ballot that is then ejected from the voting device so that it can be carried to a separate scanner/tabulator. The paper ballot must then either be inserted into a DS200 or DS 300 precinct scanner and tabulator, or it must be inserted into a secure ballot box until it can be scanned and tabulated on a DS450, DS850, or DS 950 central scanner.

ExpressVote® Hardware 2.1 (HW2.1) is a paper-based polling place voting device that provides touch screen vote capture and printing of ballot selections on a paper ballot using the internal thermal printer. Voters navigate ballot selections using the touch screen or assistive devices. The ExpressVote Hardware 2.1, capable of serving all voters, can only operate in marker mode in EVS 6300; EVS 6300 does not allow the device to operate in tabulator mode. In marker mode, the voter marks a ballot and prints the paper ballot using the internal thermal printer. The paper ballot must then either be inserted into a DS200 or DS300 precinct scanner and tabulator, or it must be inserted into a secure ballot box until it can be scanned and tabulated on a

DS450, DS850, or DS 950 central scanner.

DS200® is a polling place paper-based system, specifically a digital scanner and tabulator that simultaneously scans the front and back of a hand-marked paper ballot and/or machine-marked paper ballot in any of four orientations to capture a digital image of each ballot and for conversion of voter selection marks to electronic Cast Vote Records (CVRs) to be saved on USB media. DS200 scans and tabulates hand-marked paper ballots and machine-marked paper ballots produced from the ExpressVote 2.1 and ExpressVote XL. It also has a touch screen for voter communication, an integrated thermal printer for printing reports and an internal battery backup.

DS300® is a polling place paper-based voting system, specifically a digital scanner and tabulator that simultaneously scans and tabulates the front and back of a paper ballot and/or vote summary card in any of four orientations for conversion of voter selection marks to electronic Cast Vote Records (CVR) to be saved on USB media. DS300 scans and tabulates hand-marked paper ballots and machine-marked paper ballots produced from the ExpressVote 2.1 and ExpressVoteXL. It also has a touch screen for voter communication, an integrated thermal printer for printing reports and an internal battery backup. DS300 is a newly added precinct scanner to the EVS series of voting systems.

DS450® is a central scanner and tabulator that simultaneously scans the front and back of hand-marked paper ballots and/or machine-marked paper ballots from the ExpressVote 2.1 and ExpressVote XL in any of four orientations to capture a digital image of each ballot and for conversion of voter selection marks to electronic CVR's. It sorts tabulated ballots into discrete output bins without interrupting scanning. The tabulation results can be physically transported using USB drives, or the device may be configured to transmit tabulation results to the results server through a closed network connection.

DS850® is a central scanner and tabulator that simultaneously scans the front and

back of hand-marked paper ballots and/or machine-marked paper ballots from the ExpressVote 2.1 and ExpressVote XL in any of four orientations to capture a digital image of each ballot and for conversion of voter selection marks to electronic CVR's. The tabulation results can be physically transported using USB drives or the device may be configured to transmit tabulation results to the results server through a closed network connection. The DS850 provides higher throughput than the DS450.

DS950® is a central scanner and tabulator that simultaneously scans the front and back of hand-marked paper ballots and/or machine-marked paper ballots from ExpressVote 2.1 and ExpressVote XL in any of four orientations to capture a digital image of each ballot and for conversion of voter selection marks to electronic CVR's. The tabulation results can be physically transported using USB drives or the device may be configured to transmit tabulation results to the results server through a closed network connection. The DS950 provides higher throughput than the DS450.

The following is a listing of the software/firmware components that comprise the entire EVS 6300 system:

A. Manufacturer Software/Firmware

The EVS 6.3.0.0 voting system consists of the following software and firmware components:

Application	Version
Electionware – Client/Server	6.3.0.0
Event Log Service	3.0.0.0
Removable Media Service	3.0.0.0
DS450	4.2.0.0
DS850	4.2.0.0
DS950	4.2.0.0
DS200	3.0.0.0
DS300	3.0.0.0
ExpressVote HW2.1	4.2.1.0
ExpressVote XL	4.2.1.0
Optional Utility: ExpressLink	3.0.0.0

Application	Version
Optional Utility: Toolbox	4.3.0.0

- **Electionware –** Election database creation, media programming and tally/reporting software
- **DS450 –** Central Count scanner and tabulator, Central Tabulator firmware
- **DS850 –** Central Count scanner and tabulator, Central Tabulator firmware
- **DS950 –** Central Count scanner and tabulator, Central Tabulator firmware
- **DS200 –** Precinct scanner and tabulator, Precinct Tabulator firmware
- **DS300 –** Precinct scanner and tabulator, Precinct Tabulator firmware
- **ExpressVote HW2.1 –** Precinct ballot marker, Universal Voting System firmware
- **ExpressVote XL –** Precinct ballot marker with tabulator, using a full-face touchscreen and Universal Voting System firmware.
- **ExpressLink™ –** Standalone application that interfaces with voter registration (e.g. electronic Pollbook) systems and the ExpressVote Activation Card Printer to print the ballot activation code on an ExpressVote and ExpressVote XLcards.
- **Electionware Toolbox –** Set of utilities that can be integrated into the Electionware EMS to enhance the software usability experience and streamline various processes. These add-on utilities include Test Deck and Text to Speech.

B. COTS Software/Firmware

Additional COTS software and firmware included in the system have been defined as part of the EAC system certification scope appended to this report as *Attachment A*.

C. Hardware

Below is a high-level listing of the hardware components that comprise the entire EVS 6.3.0.0 system categorized by system functionality:

Hardware	HW Revision
ExpressVote HW2.1	2.1.0.0, 2.1.2.0
ExpressVote XL	1.0
DS200 Precinct-based Scanner and Tabulator	1.2, 1.3
DS300 Precinct-based Scanner and Tabulator	1.0

Hardware	HW Revision
DS450 Scanner and Tabulator	1.0
DS850 Scanner and Tabulator	1.0
DS950 Scanner and Tabulator	1.0
ExpressVote Rolling Kiosk	1.0
DS200/DS300 Collapsible Ballot Box	1.0, 1.1
DS200/DS300 Plastic Ballot Box	1.2, 1.3, 1.4, 1.5

For a full list of certified hardware including additional ballot boxes refer to EAC certification in Attachment A.

D. Test Materials

Test support materials utilized during the examination included:

- Thermal receipt paper for the ExpressVote XL Tabulator mode and DS200 Precinct Tabulator mode
- Ballot card stock for processing ballots on the ExpressVote HW2.1 BMD mode and ExpressVote XL Tabulator mode
- Ballot stock for printing of ballots to be processed by the DS200, DS300, DS450, DS850 and DS950 scanners
- USB thumb drives
- Pens for marking ballots
- Printer paper rolls

III. EXAMINATION APPROACH, PROCEDURES, AND RESULTS

A. Examination Approach

To ascertain whether EVS 6300 can be safely used by voters at elections in the Commonwealth and meets all the requirements of the Pennsylvania Election Code, the Examiners developed test protocols for the examination. The test protocols separated the

requirements of Article XI-A of the Pennsylvania Election Code, Sections 1101-A to 1122-A, 25 P.S. §§ 3031.1 - 3031.22, into five main areas of test execution:

1) Documentation Review
2) System Level Testing
3) Security/Penetration Analysis
4) Privacy Analysis
5) Usability Analysis

Documentation Review was performed to verify that the EVS 6300 document satisfies the portions of the Pennsylvania Election Code that reference documentation detail. The Functional Examiners validated to the system's compliance with the following sections of the Election Code during the documentation review.

1105-A(a), 25 P.S. § 3031.5(a), requiring that an electronic voting system has been examined and approved by a federally recognized independent testing authority (ITA), or Voting System Test Laboratory (VSTL), as these entities are now referred to;

- 1107-A(11), 25 P.S. § 3031.7(11), requiring an electronic voting system to be suitably designed in terms of usability and durability, and capable of absolute accuracy;
- 1107-A(13), 25 P.S. § 3031.7(13), requiring an electronic voting system to correctly tabulate every vote;
- 1107-A(14), 25 P.S. § 3031.7(14), requiring an electronic voting system to be safely transportable; and
- 1107-A(15), 25 P.S. § 3031.7(15), requiring an electronic voting system to be designed so voters may readily understand how it is operated.

The System Level Testing examined the EVS 6300 voting system with respect to conducting an election. Election definitions were created using Electionware and the voting devices (ExpressVote XL, ExpressVote 2.1, DS200 – Precinct Scanner, DS300 – Precinct Scanner, DS450 Central Count Scanner, DS850 Central Count Scanner, and DS950 Central Count Scanner) were populated with election definitions using transport media. Ballots were marked via the ExpressVote HW2.1 in marker mode. Ballots were marked and

tabulated on ExpressVote XL in tabulator mode. Ballots marked on the ExpressVote 2.1 were tabulated through the ExpressVote XL in Tabulator mode. ExpressVote 2.1 and Express Vote XL ballots were then scanned through the DS200, DS300, DS450, DS850 and DS950 for tabulation. Ballots were marked by hand and were scanned through the DS200, DS300, DS450, DS850 and DS950 for tabulation. This resulted in each hand marked paper ballot being tabulated a total of five times, once on each scanning device. ExpressVote 2.1 ballots were tabulated a total of six times, once on each scanning device and once on the ExpressVote XL device. The ExpressVote XL in Tabulator mode ballots were tabulated a total of six times, once on each scanning device and once on the ExpressVote XL device. Tabulation results for ExpressVote XL, DS200, DS300, DS450, DS850, and DS950 were then processed into Electionware, write-in votes were adjudicated, and reports were generated with results for the election. The ExpressVote 2.1 in marker mode, ExpressVote XL, DS200, DS300, DS450, DS850, and DS950 were all exercised to verify that they met all pertinent requirements of the Pennsylvania Election Code. The results reports were validated against the expected results of the voted ballots. The test cases were designed to ascertain compliance with the following sections of the Election Code:

- 1101-A, 25 P.S. § 3031.1, requiring an electronic voting system to provide for a permanent physical record of all votes cast;
- 1107-A(2), 25 P.S. § 3031.7(2), requiring an electronic voting system to permit voting on both candidates and ballot questions, according to the official ballot;
- 1107-A(4), 25 P.S. § 3031.7(4), requiring an electronic voting system to permit a voter to vote for candidates of all different parties, and for write-in candidates;
- 1107-A(5), 25 P.S. § 3031.7(5), requiring an electronic voting system to permit a voter to enter write-in votes;
- 1107-A(6), 25 P.S. § 3031.7(6), requiring an electronic voting system to permit a voter to cast votes for candidates and ballot questions he or she is entitled to vote for, and prevent a voter from casting votes the voter is not entitled to vote on;
- 1107-A(7), 25 P.S. § 3031.7(7), requiring an electronic voting system to prevent over-votes;

- 1107-A(8), 25 P.S. § 3031.7(8), requiring an electronic voting system to prevent a person from casting more than one vote for a candidate or question, except where this type of cumulative voting is permitted by law;

- 1107-A(9), 25 P.S. § 3031.7(9), requiring an electronic voting system to permit voters to vote in their own parties' primaries, and prevent them from voting in other parties' primaries, while also permitting voters to vote for any nonpartisan nomination or ballot question they are qualified to vote on; and

- 1107-A(10), 25 P.S. § 3031.7(10), requiring an electronic voting system that registers votes electronically to permit voters to change their votes up until taking the final step to register the vote and permits the voter to get a new ballot in the case of a spoiled ballot;

- Parts of 1107-A(16), 25 P.S. § 3031.7(16), requiring an electronic voting system which provides for district-level tabulation to include a public counter to register how many ballots are submitted to be counted (§ 3031.7(16)(i)); not to tabulate any vote if the voter has recorded more than the number of choices allowed in a contest (over-vote), and must notify a voter of an over-vote if used during voting hours (§ 3031.7(16)(iv)); and to generate a printed record indicating that counters are set to zero before voting commences (§ 3031.7(16)(v)); and

- Parts of 1107-A(17), 25 P.S. § 3031.7(17), requiring an electronic voting system which provides for central-count tabulation to preclude tabulation of an over-vote (§ 3031.7(17)(ii)); and indicate that counters are set to zero before processing ballots, either by district or with the capability to generate cumulative reports (§ 3031.7(17)(iii)).

The Functional Examiners also used the System Level Testing to further evaluate the design and accuracy aspects of the system as required by Sections 1107-A(11) and (13), 25 P.S. §§ 3031.7(11) & (13), through their use of the system during the testing process, even though the accuracy and design requirements were already validated in the documentation review phase by reviewing EAC certification reports.

The Security Analysis examined the voting system's compliance with the requirements of the Pennsylvania Election Code by analyzing physical security procedures and impoundment of ballots. The examiners also leveraged test results from previous examinations where there were no pertinent changes in this version that require reevaluation. Precinct tabulation devices and BMDs were installed as for use at polling

places on Election Day, and the Functional Examiners analyzed the pertinent security procedures performed on each device to ascertain compliance with Section 1107-A(12), 25 P.S. § 3031.7(12), requiring an electronic voting system to provide acceptable ballot security procedures and impoundment of ballots to prevent tampering with or substitution of any ballots or ballot cards. The Functional Examiners also used the Security Analysis phase of testing to validate compliance with parts of Sections 1107-A(16) and (17), 25 P.S. §§ 3031.7(16) & (17), that relate to system security.

The Privacy Analysis examined the voting system's compliance with Section 1107-A(l) of the Election Code, 25 P.S. § 3031.7(1), requiring that an electronic voting system provide for absolute secrecy of the vote, by analyzing how the polling place devices met the pertinent privacy requirements. The examiner leveraged previous test results from previous EVS voting system examinations where there were no pertinent changes that needed re-evaluation.

The Usability Analysis evaluated the compliance of the voting system with Sections 1107-A(14) and (15), 25 P.S. §§ 3031.7(14) & (15). The results from the tests were used by the Functional Examiners to supplement their conclusions from the documentation review phase. The examiners leveraged previous test results from previous EVS voting system examinations where there were no pertinent changes that needed re-evaluation.

i. Accessibility Examination Approach

The Department worked with the Accessibility Examiner and determined that there was no need to undertake a complete accessibility examination of EVS 6300 because the changes incorporated in EVS 6300 do not alter the voter's experience. The accessibility

examination was limited to examiner review of the ballot marking device screen changes to the EVS 6300 system from the previous certified version of EVS 6110.

ii. Security Testing Approach

The Security Testing provided a means to assess the required security properties of the voting system under examination, and to ascertain compliance with the Pennsylvania Election Code requirements, including 25 P.S. §§ 3031.7(11), (12), (16), & (17). The security tests specifically addressed confidentiality, vote anonymity, integrity, availability, and auditability of the voting systems. The Security Examiner also conducted a vulnerability assessment and penetration testing against systems that were configured and secured in the same manner that would be when used in a live election.

B. Examination Process and Procedures

The examination process and procedures followed for EVS 6300 are listed in this section.

i. Functional Examination Process and Procedures

The Functional Examination commenced on October 17, 2022, in Room G24A/B of the Commonwealth Capitol Complex - Finance Building. The test execution tasks took approximately two and a half days. The Functional Examiners performed System Level Testing by running a closed primary and general election.

ES&S supplied all the hardware equipment required for the examination. All software and firmware necessary to perform the examination were received directly from the VSTL that tested the voting system for EAC certification. The trusted build of the software and firmware for each device being evaluated was installed using the appropriate media. The hash codes for all system components were captured by the Functional Examiners with assistance from the ES&S representative using the process listed in the manufacturer's Technical Data Package (TDP). The Functional Examiners further compared and confirmed that all the captured hash codes matched the hash codes for the EAC-certified system executables before executing the test scripts.

An election definition was created using Electionware, and transport media was prepared to load the election to vote capture and scanning devices. Precinct tabulation devices DS200 and DS300, polling place vote capture devices ExpressVote XL and Express Vote 2.1, and central scanners DS450, DS850 and DS950 were loaded with election definitions using transport media. The polling place was set up using ExpressVote XL, ExpressVote 2.1 Marker, DS200, and DS300. Central Scanners DS450, DS850, and DS950 were prepared to scan ballots. A primary and general election were then run using polling place devices and central scanners. Ballots were marked and tabulated via the polling place tabulation devices and central scanners. Results were then tabulated using Electionware and validated against expected results.

ii. Accessibility Examination Process and Procedures

The Accessibility Examination of EVS 6300 focused on the changes to ExpressVote 2.1 and ExpressVote XL from the previously tested and certified EVS 6110. The Accessibility Examiner reviewed the changes to ExpressVote 2.1 and ExpressVote XL via teleconference on December 16, 2022.

iii. Security Testing Process and Procedures

The Security Testing was done at SLI Lab facilities in Wheat Ridge, Colorado. The Security Examiner utilized results from previous examinations in areas where no changes occurred from previous versions examined. The Security Examiner prepared tests to evaluate voting system security provisions implemented to counter unauthorized access, deletion or modification of data, audit trail data, as well as modification or elimination of security mechanisms. The Security Examiner identified the specific threats that are tested for and the associated risk if a flaw or exception is identified in a voting system.

C. Examination Results

Functional Examination

1. Documentation Review

The Documentation Review testing performed by the Functional Examiners demonstrates that the EVS 6300 meets the relevant requirements of the Pennsylvania Election Code. The Examiner reviewed the EAC certification test reports.

The EAC test reports and the EAC certifications submitted by ES&S satisfy the requirements of Section 1105-A(a) of the Election Code, 25 P.S.§ 3031.5(a), requiring that an electronic voting system must be examined and approved by a federally recognized independent testing authority (ITA), or VSTL as such authorities are now called, and must meet the applicable performance and test standards established by the federal government.

The Functional Examiners concluded that the design requirements of Sections 1107-A(11) and (14) of the Pennsylvania Election Code, 25 P.S. §§ 3031.7(11) & (14), are met by the EAC hardware Non-Operating Environmental Tests, which included bench handling, vibration, low temperature, high temperature, humidity and product safety tests. The system accuracy testing completed during EAC certification testing provided confirmation of system accuracy as required by Section 1107-A(11) of the Pennsylvania Election Code, 25 P.S. § 3031.7(11).

The system summative usability test reports were accepted by the EAC as part of the Federal Certification. This, along with the Functional Examiner's use of the system, demonstrates that the system can be readily learned, and hence satisfied the usability requirement of Section 1107-A(15) of the Pennsylvania Election Code, 25 P.S. § 3031.7(15).

2. System Level Testing

As set forth in the examination approach, System Level Testing was divided into two separate tests, a closed primary election and a general election. The ballots defined had contests with voting variations supported in Pennsylvania.

A closed primary election consisting of two parties (Republican, Democratic), and three precincts, was run utilizing Electionware, ExpressVote 2.1, ExpressVote XL, DS200, DS300, DS450, DS850, and DS950. Referendum contests were added to test the generation of non-partisan ballots. The Republican ballot contained 8 "vote for one" contests, 1 vote for "no more than two" contest, 2 "vote for no more than three" contests, 5 "vote for no more than four" contests, and 1 "vote for no more than fifteen" contest, as well as 2

referendums. The Democratic ballot contained 8 "vote for one" contests, 1 "vote for no more than two" contest, 2 "vote for no more than three" contests, 5 "vote for no more than four" contests, 1 "vote for no more than fifteen" contest, as well as 2 referendums. The non-partisan ballot contained 2 referendum questions. The Functional Examiners validated the system's compliance with Sections 1101-A and 1107-A(2), (5)-(11), 25 P.S. §§ 3031.1, 3031.7(2), (5)-(11). No issues or anomalies were experienced during these tests, and the objective criteria established in the test protocols were met.

A general election consisting of four parties (Republican, Democratic, Green and Libertarian), three precincts (one of which was a split precinct), and 21 contests: 19 contests and 2 retention questions were run utilizing Electionware, ExpressVote 2.1, ExpressVote XL, DS200, DS300, DS450, DS850, and DS950. The contests included 12 "vote for one" contests, 2 "vote for no more than two" contests, 6 "vote for no more than three" contests, and 1 "vote for no more than fifteen" contest.

The Functional Examiners examined the compliance of the system with Sections 1101-A and 1107-A(2),(4), (5), (6), (7), (8), (10)-(11) and (13), 25 P.S. §§ 3031.1, 3031.7(2), (4), (5), (6), (7), (8), (10)-(11) and (13). The Functional Examiners included test cases to validate compliance with Sections 1107-A(16) and (17), 25 P.S. §§ 3031.7(16) & (17), which mandate that voting systems generate zero proof reports and correctly handle over-votes during the election runs. The system's compliance with the remainder of the requirements of 25 P.S. §§ 3031.7(16) and (17) was validated by the Functional Examiners during the Security/Penetration Analysis.

Election definitions for both primary and general elections were created within Electionware, and transport media was created to populate ExpressVote 2.1, ExpressVote XL, DS200, DS300, DS450, DS850, and DS950. Polls were opened and ballots were marked manually and tabulated through the polling place DS200 and DS300 scanners. Ballots were marked utilizing the polling place ExpressVote 2.1 in marker mode. Ballots were also marked and tabulated on the ExpressVote XL device. Ballots from the

ExpressVote 2.1 and ExpressVote XL were then scanned through the polling place DS200 and DS300. All ballots created (hand-marked paper ballots and ExpressVote 2.1 and ExpressVoteXL machine-marked ballots) were then scanned through the DS450, DS850, and DS950. ExpressVote 2.1 ballots were also tabulated on ExpressVote XL. Thus, each ExpressVote XL and ExpressVote 2.1 ballot was tabulated a total of six times, once for each scanning device and once using ExpressVote XL; and each hand marked paper ballot was tabulated a total of five times once on each scanning device.

The Functional Examiners used English, Chinese and Spanish ballots for the test. Reports were generated after closing polls and results were validated against expected results. Each specific hardware and software component was tested for compliance with the required sections of the Election Code.

The EVS 6300 is a paper-based system and paper ballots provide a permanent physical record of each vote cast adhering to Section 1101-A, 25 P.S. § 3031.1. Hand-marked paper ballots and ExpressVote 2.1's machine-marked paper ballots in marker mode allow voters to use the precinct scanners DS200 and DS300 for tabulation. The ExpressVote XL create machine-marked paper ballots based on a voter's selections, which are tabulated after the voter reviews the ballot and affirms that he/she is ready to cast a vote.

The primary and general election definitions were created using Electionware and loaded to polling place devices and central scanners, which provided assurance that the system can perform ballot creation activities. The Functional Examiners successfully added contests, parties, choices, precincts, ballot styles, referendum questions and retention contests with appropriate candidates and choices. The ExpressVote 2.1, ExpressVote XL, DS200, and DS300 components of the EVS 6300 successfully permitted votes for "1 of 1," "N of M," and "Question" contests for a standard and ADA voting session. The Functional Examiners thus concluded that the system is in compliance with Section 1107-A(2), 25 P.S. § 3031.7(2).

EVS 6300 components allowed the test voter to cast votes for any candidate on the ballot, and write-in votes demonstrating compliance with Section 1107-A(4), (5), 25 P.S. § 3031.7(4), (5). EVS 6300 meets the requirements for Section 1107-A(6), 25 P.S. § 3031.7(6), because the test voters cast votes on different ballot styles for candidates and questions and the ExpressVote 2.1 and ExpressVote XL displayed only contests for which the voter was entitled to vote.

The system's compliance with Section 1107-A(7), 25 P.S. § 3031.7(7) was demonstrated by the DS200 and DS300 functionality of indicating over-votes for any office, and the voter's ability to either spoil the ballot or, at the voter's option, cast the ballot with over-votes. The ExpressVote XL and ExpressVote 2.1 did not allow over-votes. The Functional Examiners also noted that the system allowed under-votes but warned the user about the under-vote when configured to do so. The successful validation of the election results demonstrated that central scanners DS450, DS850, and DS950, as well as precinct tabulators DS200 and DS300, include the capability to reject all choices recorded on the ballot for an office or question if the number of choices exceeds the number for which the voter is entitled to vote, adhering to Section 1107-A(8), 25 P.S. § 3031.7(8).

EVS 6300 complies with Section 1107-A(9), 25 P.S. § 3031.7(9), because test voters in the closed primary election were only able to vote for referendum questions and candidates seeking the nomination of their party.

Adherence to Section 1107-A(10), 25 P.S. § 3031.7(10), was demonstrated for both ADA and standard voting sessions. ExpressVote 2.1 and ExpressVote XL allowed the voters to review their ballots before printing for tabulation on DS200 and DS300 or central scanners DS450, DS850, and DS950. The Functional Examiners attempted to change votes on the ExpressVote 2.1 and ExpressVote XL for candidates within the contest, as well as after leaving the contest and then returning to other contests, and while reviewing the summary screen. The tests demonstrated that the ExpressVote and ExpressVote XL allowed changing the selections until the voter decides to print or cast

the ballot. The DS200 and DS300 precinct scanners of EVS 6300 provides the voter with a caution message when the ballot contains potential errors, such as the presence of overvotes or undervotes. The voter is also presented an error report on the screen when the tabulator detects potential errors. The voter can either decide to affirm their intent by casting the ballot, or they can spoil the ballot and fill out another ballot.

The system's compliance with the accuracy requirements of 1107-A(11), 25 P.S. § 3031.7(11), which was ascertained by reviewing EAC test reports, was further validated by the successful tabulation and validation of the primary and general elections run by the Functional Examiners.

The Functional Examiners validated via test cases during the primary and general election that the tabulating devices DS200, DS300, DS450, DS850, and DS950 generated zero-proof reports only before ballots were cast; the system rejected all votes for the contest in an overvote situation; and the system produced a results report when appropriately configured as required under Sections 1107-A(16) and (17), 25 P.S. §§ 3031.7(16) & (17). The Functional Examiners confirmed that a zero-proof report cannot be generated on demand after polls are open and a ballot is cast.

The voting variations used for the examination included write-in votes to ensure that all components of the system will identify the appropriate write-ins and allow the election official to tabulate all cast votes, including write-in votes. Thus, the system demonstrated compliance with Section 1107-A(13), 25 P.S. § 3031.7(13).

3. Security Analysis

The Functional Examiners reviewed each pertinent requirement for this test individually and then created test cases to address the requirements via a documentation review, a functional test, or both. Results from the previous examinations were leveraged when there were no changes that needed evaluation. Precinct tabulation devices and ballot marking devices were configured for delivery to a polling place from a warehouse,

including all seals and locks recommended by the manufacturer. The central scanners were configured for operation in a county office. The devices were inspected to determine if adequate controls can be employed to prevent and detect tampering. The inspection included the examination of ports, examination of the outer case and memory devices to confirm that they are all secure, and examination of the locks and seals to ensure that they are tamper proof and/or tamper evident. The Functional Examiners also examined the components of the EVS 6300 system for password management of administrative functions and ensured that the system counter could not be reset by unauthorized persons. In addition, the Functional Examiners reviewed the ES&S system documentation for ballot security procedures at the polling place and central location to ensure that the manufacturer recommended the required steps for configuring the EVS 6300 securely for the election. Based on the tests, the Functional Examiners concluded that that the system complies with Section 1107-A(12), 25 P.S. § 3031.7(12).

The Functional Examiners included test cases during the Security Analysis phase of the testing to evaluate the security requirements mandated by Sections 1107-A(16) and (17), 25 P.S. §§ 3031.7(16) & (17). The Functional Examiners validated that the tabulation devices ExpressVote XL, ExpressVote 2.1 (tabulator), DS200, and DS300 had a visible public counter and the system prevented authorized and unauthorized users from gaining any access to vote data while polls are open. Tests were completed to determine that USB ports do not allow any data or information to be transferred to the ExpressVote XL, ExpressVote 2.1 (tabulator), DS200, or DS300, and no maintenance, poll worker or administrative modes allow tampering with the tabulating element. The system did not allow polls to be opened without running a zero-proof report, and the content of the report showed that all candidate positions, each question, and the public counter were all set to zero. The functionality of the system to generate the close of polls report was verified and the report contents were analyzed to ensure that it contained the total number of ballots tabulated and total number of votes for each candidate and question on the ballot. Based on the above tests and the test cases executed while running the elections, the Functional Examiners concluded that EVS 6300 complies with all requirements mandated by 25 P.S. §§

3031.7(16) and (17).

4. Privacy Analysis

The Functional Examiners reviewed and inspected the privacy aspects of the EVS 6300 system to determine compliance with Section 1101-A(1) of the Election Code, 25 P.S. § 3031.7(1). Results from previous examination of EVS systems 6300 were leveraged when there were no changes that needed evaluation. The Functional Examiners determined that the components of the system used at the polling place comply with 25 P.S. § 3031.7(1) by review of system documentation and physical inspection. Central scanners were physically examined by the Functional Examiners for adequate visual secrecy.

5. Usability Analysis

The Functional Examiners determined that EVS 6300 demonstrated compliance with the usability requirements of Section 1107-A(14) and (15) of the Election Code, 25 P.S. §§ 3031.7(14) & (15), by reviewing appropriate EAC certification reports and from the Examiners' experience using all the functionalities of the system during the examination.

As noted in the introduction section of this report, the final version of the ES&S EVS 6.3.0.0 voting system that was certified by the EAC contained a minor modification relative to the trusted build version of the ES&S EVS 6.3.0.0 voting system used for testing in PA. This modification was made in response to an issue that was discovered late in the EAC testing process. The issue encountered was precinct scanner (DS200/DS300) time zone changes were not being retained after a system reboot. This issue caused all reports (except the configuration report) to show Central Time even though the machine was set for another time zone, and upon reboot the time zone setting was lost and returned to Central Time. In their review of the Time Zone setting, the ES&S Development Team determined that the code involved with time zone settings was pointed to the wrong directory. The only code modified in EVS 6.3.0.0 was to point the time zone setting to the correct directory. In EVS 6.3.0.0 regression testing, prior to the system's final EAC certification, Pro V & V, the VSTL who tested the system for EAC certification, verified that all reports, for all time

zones, contained the correct time, as had been initially set, after device reboot. After evaluating the Root Cause Analysis provided by ES&S to the EAC, the Functional Examiners made the determination that the modification made to the trusted build version of the ES&S EVS 6.3.0.0 voting system used for testing PA did not give rise to the need for any further Functional or Security testing.

i. Accessibility Examination

The Accessibility Examination was limited to reviewing updates to the voter interface for both the ExpressVote and the ExpressVote XL. The review was conducted through a teleconference. An ES&S representative performed voting sessions on ExpressVote 2.1 and ExpressVoteXL, specifically reviewing the updates between EVS 6100 and EVS 6300. The Accessibility Examiner further issued a report of the findings from her review and suggested fielding options to assist voters with disabilities. These recommendations are included as conditions in this report. In addition, any relevant findings from previous examinations for precinct scanners are applicable to EVS 6300.

Attachment B of this report lists all the findings from EVS 6100 and EVS 6021 accessibility examination for reference.

ii. Security Examination

As mentioned in the Examination Approach section of this document, the the Security Testing was comprised of a series of test suites which are utilized for verifying that a voting system will comply with applicable Pennsylvania security requirements. The Security Examiners analyzed the test results and summarized any identified deficiencies under four major categories: documentation, source code, hardware, and functional. The Security Examiners then evaluated the physical security, software hardening and existing system controls in place. The Examiners also provided recommendations on secure implementation and deployment. The Security Examiners recommended the system for use and suggested the need to implement it utilizing a combination of vendor recommendations and election best practices.

The Functional Examiners also noted that the paper ballots generated by EVS 6300 will allow statistical recounts will allow statistical recounts as required by Section 1117-A, 25 P.S. § 3031.17.

EVS 6300 was certified by the EAC on November 17, 2022, and hence complies with Section 1105-A(a) of the Election Code, 25 P.S.§ 3031.5(a), which requires that a voting system must be examined and approved by a federally recognized independent testing authority (ITA), or VSTL as such authorities are now called. The final EAC certification scope is appended to this report as *Attachment A*.

The Functional Examiners identified that the following provisions within Article XI-A of the Pennsylvania Election Code, Sections 1101-A to 1122-A, 25 P.S. §§ 3031.1 – 3031.22, are not applicable to the current examination, as each deal with non-functional testing aspects of acquisition, and use and maintenance aspects of a voting system:

- 25 P.S. § 3031.2
- 25 P.S. § 3031.3
- 25 P.S. § 3031.4
- 25 P.S. § 3031.6
- 25 P.S. § 3031.8
- 25 P.S. § 3031.9
- 25 P.S. § 3031.10
- 25 P.S. § 3031.11
- 25 P.S. § 3031.12
- 25 P.S. § 3031.13
- 25 P.S. § 3031.14
- 25 P.S. § 3031.15
- 25 P.S. § 3031.16
- 25 P.S. § 3031.18
- 25 P.S. § 3031.19
- 25 P.S. § 3031.20
- 25 P.S. § 3031.21
- 25 P.S. § 3031.22

After the completion of all the testing activities, the Examiners and Department concluded that the EVS 6300 demonstrates compliance with all requirements as delineated

in Article XI-A of the Pennsylvania Election Code, Sections 1101-A to 1122-A, 25 P.S. §§ 3031.1 – 3031.22.

D. Observations

During the examination, and in the review of documentation, the Examiner and/or Department staff made the following observations:

1. EVS 6300 does not support cumulative voting.
2. The ExpressVote XL when used as a Tabulator can be configured so as not to allow the voter to review the marked paper ballot before casting her vote. This is not a permitted configuration in Pennsylvania.
3. The Functional Examiners noted that ExpressVote XL must be configured to print terminal level reports to be compliant with the requirements mandated by 25 P.S. § 3031.7(16) when only one device is used at a polling place.
4. If they are not new, the USB devices and other portable media used with the voting system components need to be reformatted before each election.

IV. CONDITIONS FOR CERTIFICATION

Given the results of the examination of the EVS 6300 examination that occurred in October 2022 and the findings of the Examiners as set forth in his reports, **the Secretary of the Commonwealth certifies the EVS 6300 subject to the following conditions:**

A. Pennsylvania counties using the EVS 6300 must comply with the Directive Concerning the Use, Implementation and Operations of Electronic Voting Systems by the County Boards of Elections issued by the Secretary of the Commonwealth on June 9, 2011 (the "Use Directive"), any subsequent revisions of the Use Directive, and any other applicable directives currently in effect or issued in the future. Specifically, Pennsylvania counties must adhere to item four (4) of the Use Directive when setting up and positioning the ExpressVote 2.1 and ExpressVote XL in the polling place to assure compliance with the constitutional and statutory requirements that secrecy in

voting be preserved *(see* Pa. Const Art. VII § 4; and Section 1107-A(l) of the Election Code, 25 P.S. § 3031.7(1)).

B. No components of the EVS 6300 shall be connected to any modem or network interface, including the Internet, at any time. A standalone local area wired network configuration may be considered, in which all connected devices are certified voting system components. Transmission of unofficial results can be accomplished by writing results to media and moving the media to a different computer that may be connected to a network. Any wireless access points in the district components of EVS 6300, including wireless LAN cards or network adapters, must be uninstalled or disabled prior to shipping to a county board of elections.

C. Regional Results, included in the EAC certified components of EVS6300 is not certified for use in Pennsylvania.

D. Because EVS 6300 is a paper-based system, counties using the EVS 6300 must comply at a minimum with Section 1117-A of the Election Code, 25 P.S. § 3031.17, that requires a "statistical recount of a random sample of ballots after each election using manual, mechanical or electronic devices of a type different than those used for the specific election." This audit must be conducted exclusively via a manual count of the voter marked paper ballots. Counties must include in the sample ballots such samples as may be marked by ADA compliant components. Counties are advised to consult the Directive Concerning the Use, Implementation and Operations of Electronic Voting Systems by the County Boards of Elections issued by the Secretary of the Commonwealth on June 9, 2011, any subsequent revisions of that Directive, and any other directives that may apply to audits of electronic voting systems.

E. All jurisdictions implementing the EVS 6300 need to carry out a full Logic and Accuracy test on each device without fail and maintain evidence of Logic

and Accuracy (L&A) testing in accordance with the statutory requirements for pre-election and post-election testing. The Department does not recommend automated L&A testing and discourages the use of preprinted ballots provided by vendors. All components being used on election day, including any Electronic Poll Books being used, must be part of the L&A testing.

F. EVS 6300 is a paper-based system, and hence, implementation of the system for precinct or central count scanning is scalable. Jurisdictions must calculate the number of voting booths and the number of ballots necessary to accommodate the number of registered voters in a precinct to avoid long lines. Jurisdictions must include the ExpressVote 2.1 or ExpressVote XL as an ADA compliant device in configuring a precinct polling place. Jurisdictions must also take into consideration the ballot box capacities of polling place components when deciding on the number of voting booths. Jurisdictions must also take into consideration that the ExpressVote XL when used as a tabulator, requires the ballot bin to be changed or emptied after about 300 ballots. For DS200 and DS300 ballot box capacities, jurisdictions can refer to the DS200 and DS300 operators guides from ES&S.

G. All jurisdictions implementing the EVS 6300 must implement administrative safeguards and proper chain of custody, and document the same, to facilitate the safety and security of electronic systems pursuant to the Guidance on electronic Voting System Preparation and Security, September 2016, and any subsequent revisions or directives.

H. All jurisdictions implementing the EVS 6300 must ensure that no default passwords are used on any devices and that all passwords are complex and secured. Counties must implement an audit process to review and ensure that no default passwords are used upon equipment install/reinstall and routinely change passwords (at least once prior to preparing for each primary and election) to avoid the possibility of any password compromise. The passwords and permissions

management must at a minimum comply with the password requirements outlined in NIST 800-63. This publication can be accessed at https://pages.nist.gov/800-63-3/sp800-63-3.html.

I. All jurisdictions implementing EVS 6300 must configure the polling place components of the voting system to notify voters when they attempt to overvote. The DS200 and DS300 tabulation device options must be set to "Query Voter Preference" for overvoted hand-marked paper ballots. This is to ensure that the system implementation adheres to the requirement of notifying the voter of overvotes as mandated by 25 P.S. § 3031.7(16).

J. All jurisdictions implementing EVS 6300 must work with ES&S to ensure that only the certified system configuration is installed both on first purchase, as well as any time a system component is replaced or upgraded. Jurisdictions must as part of their user acceptance test verify the implementation to ensure that the components, software, and firmware belong to the certified system. Jurisdictions must also perform a trusted build validation as part of the election preparation activities and post-election canvass activities utilizing the vendor supplied methods of validation and verification of voting system integrity. Any time the system is installed after the first purchase or an upgrade is completed, the vendor and the county must complete the implementation attestation and must make a copy available to the Secretary on request. A sample format that can be used for the attestation is included as *Attachment C* to this document.

K. ExpressVote 1.0 and ExpressTouch devices are not certified for use in Pennsylvania with EVS 6300. These devices were not presented to the Secretary for certification by ES&S.

L. Jurisdictions can make use of the Electionware adjudication functionality to adjudicate write-ins and evaluate questionable ballots, contests, or selections to determine voter intent. Any decisions made during the adjudication process must be agreed upon by a team of at least two reviewers authorized

by the election official following Election Code requirements. The election official must, when necessary, consult the paper ballot to assist with determinations made during adjudication. In the event of a recount, the voter verifiable paper ballots must be used for the count.

M. Jurisdictions implementing EVS 6300 must work with ES&S to ensure that the implemented configuration is capable of operating for a period of at least two hours on backup power as required by the VVSG. If the system components don't include internal battery packs for reliable power, the Uninterruptible Power Supply (UPS) specified in the EAC certified configuration must be purchased and used at the polling places.

N. Jurisdictions using the services of ES&S or a third-party vendor for election preparation activities must work with ES&S or the vendor to ensure that systems used for ballot definition activities are considered part of the voting system, and they must use certified voting system components. The systems used for ballot definition must be configured securely following conditions outlined in this report and following any applicable Directives and Guidance issued by the Secretary. Any data transfer between the vendor and county must be done using encrypted physical media or a secure file transfer process. The file transfer and download must be tracked and audited to make sure that data has not been accessed by unauthorized personnel.

O. ExpressVote XL Condition - Jurisdictions implementing ExpressVote XL must ensure that the configuration allows voters to review their vote selections on the screen and on the marked paper ballot before it is cast.

P. ExpressVote XL Condition - Jurisdictions selecting the ExpressVote XL must implement proper poll closing and vote record transportation procedures so that collection bins containing marked paper ballots are sealed and transported with proper chain of custody to the county office. Poll worker training must include the details of the procedures to ensure that collection bins remain

sealed until delivered to the county office. Collection bins must be opened in the presence of board of election members and must be commingled before canvass and storage, in a manner consistent with the procedure outlined for the canvassing of absentee ballots under Section 1308(g) of the Election Code, 25 P.S. § 3146.8(g).

Q. ExpressVote XL Condition - Jurisdictions implementing ExpressVoteXL as a tabulator must ensure that the system is configured to generate a printed report at the close of polls. The report must at a minimum indicate the total number of voters whose ballots have been tabulated, the total number of votes cast for each candidate whose name appears on the ballot, and the total number of votes cast for, or against, any question appearing on the ballot.

R. Jurisdictions must work with ES&S to thoroughly test and review audio ballot instructions to ensure that the voters using an audio ballot can cast the ballot without requesting assistance. Jurisdictions must consider the following while reviewing the ballot:

- The audio ballot must fully inform the voter what has happened and is occurring, and how to select/deselect their choices;
- The feedback messages must explain to voters what is happening, including the number and names of candidates being deselected;
- The audio ballot must provide feedback on the reason for the changes in any selections; and
- The audio ballot instructions regarding messages on the system must communicate the specific information for the task or screen displayed before the general, repeated instructions.

S. ExpressVote XL Condition - Jurisdictions implementing the ExpressVote XL must ensure that the on-screen instructions for ExpressVote XL include specific voter and poll worker instructions detailing spoiling procedures and cues to protect voter privacy. In addition, poll worker training must:

- Emphasize the need to obscure any view of the marked paper ballot during the process of spoiling the ballot;
- Educate poll workers on the proper steps to be taken when they respond to a voter request for spoiling a marked paper ballot to ensure that the secrecy of the spoiled record is maintained. These steps include ensuring that the voter intends to spoil the ballot, and has read the instructions on the screen and has been informed by the poll worker how to prevent inadvertent view of the marked paper ballot before the poll worker enters inside the privacy curtain;

T. Jurisdictions implementing EVS 6300 must include poll worker training as part of the implementation plan. The training must include hands on practice for poll workers. Poll workers must be provided with instructions on how to offer support to help voters get started with (or re-familiarize themselves with) the key layout of the devices and functions as necessary. Follow-on training for replacement poll workers, and refresher training, must also be considered. Refer to Appendix B, listing detailed recommendations for deployment noted by the Accessibility Examiner.

U. Jurisdictions implementing EVS 6300 must include voter training as part of the implementation plan. The training must include hands-on practice for voters. As part of voter-education and outreach efforts, specific consideration must be given to voters using assistive devices. These voters must be provided with the opportunity to use the system tactile keypad in advance of election day so that the voters will know how to use the system effectively.

V. ExpressVote XL Condition - Jurisdictions implementing ExpressVote XL must configure election administration options in Electionware to set printed ballots to use the largest text size for all elections.

W. ExpressVote 2.1 Condition - Jurisdictions must implement ExpressVote 2.1 by configuring it in such a way to ensure that only one contest is displayed per

screen.

X. Jurisdictions implementing EVS 6300 must consider the following during voting booth set up for serving voters requiring assistive devices:

- A table or stand for voters using the tactile keypad who do not use wheelchairs with trays that can hold the keypad to relieve fatigue and make it easier to use with both hands.
- Voters with disabilities may have assistive technology or personal notes that they need to be placed within reach. They may also need room to place the printed ballot on a flat surface to use personal technology such as magnifiers or text readers to verify it.
- For the ExpressVote 2.1 configured as a marker where the voter has to complete the voting process by scanning the ballot on a precinct scanner, the path to the scanner should be as easy as possible, ideally a straight line with no obstructions. The path should include ample room to turn and maneuver a wheelchair if the machine is positioned with the screen facing the wall. The ADA standards suggest a minimum of 60 x 60 inches for this.

Refer to Appendix B, listing detailed recommendations for deployment noted by the Accessibility Examiner.

Y. The electronic voting system must be physically secured and protected while in transit, storage, and while in use at their respective locations. Unmonitored physical access to devices can lead to compromise, tampering, and/or planned attacks. Pennsylvania counties using the EVS 6300 must comply with the Directive Concerning Access to Electronic Voting Systems, including but not limited to the Imaging of Software and Memory Files, Access to Related Internal Components, and the Consequences to County Boards of Allowing Such Access issued by the Secretary of the Commonwealth on July 8, 2021, any subsequent revisions of the Directive, and any other applicable directives

currently in effect or issued in the future.

Z. Jurisdictions must implement processes and procedures involving management, monitoring and verification of seals, locks/keys, and other access methods, before, during and after the election.

AA. Jurisdictions must seal any unused ports on the voting system components using tamper evident seals even if the port is inside a locked compartment. Jurisdictions must work with ES&S and use physical port blocking plugs to close unused ports whenever possible before placing the tamper evident seal. The Department also recommends using port blocking plugs for exposed ports for components of the voting system housed in county office which can be removed by authorized personnel when the port is needed.

BB. Jurisdictions utilizing the standalone installation of the EMS server must take necessary steps to protect the laptops from accidental loss or theft. Suggested mitigations include but are not limited to - cable locks, tamper evident seals, proper password management which utilizes passwords of sufficient strength in each election, as well as locking containers. All standalone Electionware instances should remain in a protected environment protected by sufficient security mitigations to prevent unauthorized access. The chain of custody for the standalone EMS systems must be maintained by the jurisdiction at all times, and periodic auditing of the system's chain of custody procedures are required. Jurisdictions must implement processes to determine exact Electionware system usage by election official for enhanced auditability.

CC. Jurisdictions must implement processes to gather and safekeep system logs for each component of the voting system after each election. Consistent auditing of system logs and reports is vital to maintain system transparency and to ensure that any compromise or malfunction is observed, reported and resolved in a timely manner.

DD. Jurisdictions implementing EVS 6300 must ensure that the USB devices and any other removable media used for election activities are maintained with strict chains of custody. There must be a process to manage the removable media inventory to avoid misplaced and lost media. The devices must be reformatted before use in each election. Appropriate steps must be taken to ensure that the format is a full reformat of the USB devices.

EE. Jurisdictions implementing EVS 6300 must work with ES&S to ensure that appropriate levels of training for election officials are planned and undertaken on implementation. Counties must ensure that training adheres to the "Minimum Training Requirements" specified in *Attachment D* of this document.

FF. Central Scanning configuration condition –Jurisdictions implementing the EVS 6300 with the Central Count Tabulator DS450, DS850, or DS950 as the primary system where votes are counted only at the central counting location using central scanners, must comply with Section 301(a) of Help America Vote Act of 2002. The mandate requires counties using central count paper-based systems to develop voting system specific voter education programs that inform voters of the effect of over voting and instruct voters on how to correct a ballot before it is cast, including instructions on obtaining a replacement ballot. Additionally, the mandate requires that the central count voting system must be designed to preserve voter confidentiality.

GG. ES&S must submit the following system education materials to the Department of State and must consent to the publication and use of the video on any websites hosted by any Pennsylvania counties and the Pennsylvania Secretary of the Commonwealth, or any publicly available social media platform. The videos must be closed captioned for the hearing impaired.

- A video (in an electronic format) for voters that demonstrates how to cast a vote and ballot using the Voting System.

- A video (in an electronic format) for precinct election officials that demonstrates how to setup, operate, and shutdown the Voting System components on an Election Day. The video must demonstrate how to set up and operate the voting system accessible devices for use by voters.
- A "quick reference guide" for precinct election officials to consult on Election Day. The guide must be specific to the purchasing county's setup and use of the Voting System, including accessible options.
- A "quick reference guide" with images that demonstrates to voters how to cast a vote. This must be provided in additional languages for any jurisdictions required to meet language thresholds requirements of the Voting Rights Act.

HH. ES&S must adhere to the following reporting requirements and submit the following to the Secretary:

- Equipment Reporting. Reported field issues or anomalies that occur in Pennsylvania or elsewhere with any piece of equipment deployed in the Commonwealth of Pennsylvania within 3 days of the occurrence;
- Advisory Notices. System advisory notices issued for any piece of equipment deployed in the Commonwealth of Pennsylvania regardless of whether the incident behind the notice occurred in Pennsylvania or elsewhere;
- Ownership, Financing, Employees, Hosting Location. Any changes to information on the Supplier's employees and affiliates, locations, company size and ability to provide technical support simultaneously to several counties in the Commonwealth of Pennsylvania and other jurisdictions that use its Voting System. Additionally, ES&S must provide information on foreign ownership/financing, data hosting, and production for any equipment or ancillary products, including any potential conflict of interest that may have developed for employees and affiliates;
- Security Measures and any updated security testing or risk/vulnerability

assessments conducted by the Supplier or a third-party;

II. ES&S must adhere to the "Source Code and Escrow Items Obligations" specified in *Attachment F* of this document.

JJ. ES&S must work with jurisdictions to ensure that the system is configured to comply with all applicable requirements of the Pennsylvania Election Code delineated in Section Article XI-A of the Pennsylvania Election Code, Sections 1101-A to 1122-A, 25 P.S. §§ 3031.1 – 3031.22.

KK. Jurisdictions implementing the EVS 6300 and ES&S must work together to implement the system under this certification and must comply with the conditions found in this report, and any directives issued by the Secretary of the Commonwealth regarding the use of this System, in accordance with Section 1105-A(a)-(b) of the Election Code, 25 P.S. § 303l.5(a)-(b). ES&S must ensure that future releases of the voting system with enhanced security and accessibility features are presented for approval to the Secretary.

LL. ES&S must work with counties and the Department of State to ensure that the system can integrate with Pennsylvania Department of State's Election Night Reporting (ENR) system. In addition, pursuant to the Directive on Electronic Voting Systems issued by the Secretary of the Commonwealth on August 8, 2006, the Directive Concerning the Use, Implementation and Operation of Electronic Voting Systems by the County Boards of Elections issued on June 9, 2011, and Section 1105-A(d) of the Pennsylvania Election Code, 25 P.S. § 3031.5(d), this certification and approval is valid only for EVS 6300. If the vendor or a County Board of Elections makes any changes to the EVS 6300 Voting System after the date of its examination, it must immediately notify both the Pennsylvania Department of State and the relevant federal testing authority or laboratory, or their successors. Failure to do so may result in the decertification of the EVS 6300 Voting System in the Commonwealth of

Pennsylvania.

MM. ES&S must work with counties and Department of State to ensure that the counties are trained on generating the reports from Electionware required for results certification on audits.

NN. ExpressVote XL Condition - Counties implementing ExpressVote XL, must configure screens to ensure that the screen titles and text on each screen clearly identifies to the voter about what the specific voting step that is being performed, specifically the review screen must tell the voter that they are reviewing their selections.

V. RECOMMENDATIONS

A. All jurisdictions implementing EVS 6300 Voting System should take appropriate steps to ensure that the system is correctly set up pursuant to all the recommendations of the Directive Concerning the Use, Implementation and Operations of Electronic Voting Systems by the County Boards of Elections issued by the Secretary of the Commonwealth on June 9, 2011, and Guidance on Electronic Voting System Preparation and Security, September 2016.

B. All jurisdictions considering purchase of the EVS 6300 should review the System Limits as mentioned in the EAC certification scope added as *Attachment A* to this report.

C. The Secretary recommends that ES&S and counties work with the Department on any changes to their voting equipment including, but not limited to, purchase and upgrades.

D. The Secretary recommends in-house ballot definition activities at a county location whenever possible. If an external vendor location is used, the county should implement oversight measures to ensure that election data, including ballot definition files and audit logs stored on devices outside of the county, are protected from unauthorized access.

VI. CONCLUSION

As a result of the examination, and after consultation with the Department's staff, counsel and the examiners, the Secretary of the Commonwealth concludes that the EVS 6300 can be safely used by voters at elections as provided in the Pennsylvania Election Code and meets all of the requirements set forth in the Election Code, **provided the voting system is implemented under the conditions listed in Section IV of this report.** Accordingly, the Secretary certifies EVS 6300 for use in this Commonwealth.

The ExpressVote XL and ExpressVote 2.1 can accommodate 10-12 voters with disabilities per hour or 20-60 voters per hour when used as the primary voting system, depending on the size of the ballot. DS200 can serve 120-180 voters per hour. The ExpressVote XL and ExpressVote 2.1 ballot box will hold approximately 300 ballots, and DS200 ballot boxes can hold 1250 to 3000, 19-inch ballots depending on the type of ballot box used. After the capacity is reached the poll workers will need to change the ballot box or empty the contents and transfer the ballots to a secure ballot box.

Attachment A – EAC Certification Scope

ESS EVS 6300
Certificate and Scop

United States Election Assistance Commission

Certificate of Conformance

ES&S EVS 6.3.0.0

The voting system identified on this certificate has been evaluated at an accredited voting system testing laboratory for conformance to the *Voluntary Voting System Guidelines Version 1.0 (VVSG 1.0)* . Components evaluated for this certification are detailed in the attached Scope of Certification document. This certificate applies only to the specific version and release of the product in its evaluated configuration. The evaluation has been verified by the EAC in accordance with the provisions of the EAC *Voting System Testing and Certification Program Manual* and the conclusions of the testing laboratory in the test report are consistent with the evidence adduced. This certificate is not an endorsement of the product by any agency of the U.S. Government and no warranty of the product is either expressed or implied.

Product Name: EVS

Model or Version: 6.3.0.0

Name of VSTL: Pro V&V

EAC Certification Number: ESSEVS6300

Date Issued: 11/17/2022

Mark A. Robbins

Interim Executive Director

Scope of Certification Attached

Manufacturer: *Election Systems & Software*
System Name: *EVS 6.3.0.0*
Certificate: *ESSEVS6300*

Laboratory: *Pro V&V*
Standard: *VVSG 1.0*
Date: *11/17/2022*

Scope of Certification

This document describes the scope of the validation and certification of the system defined above. Any use, configuration changes, revision changes, additions or subtractions from the described system are not included in this evaluation.

Significance of EAC Certification

An EAC certification is an official recognition that a voting system (in a specific configuration or configurations) has been tested to and has met an identified set of Federal voting system standards. An EAC certification is **not**:

- An endorsement of a Manufacturer, voting system, or any of the system's components.
- A Federal warranty of the voting system or any of its components.
- A determination that a voting system, when fielded, will be operated in a manner that meets all HAVA requirements.
- A substitute for State or local certification and testing.
- A determination that the system is ready for use in an election.
- A determination that any particular component of a certified system is itself certified for use outside the certified configuration.

Representation of EAC Certification

Manufacturers may not represent or imply that a voting system is certified unless it has received a Certificate of Conformance for that system. Statements regarding EAC certification in brochures, on Web sites, on displays, and in advertising/sales literature must be made solely in reference to specific systems. Any action by a Manufacturer to suggest EAC endorsement of its product or organization is strictly prohibited and may result in a Manufacturer's suspension or other action pursuant to Federal civil and criminal law.

System Overview

The ES&S EVS 6.3.0.0 voting system is a modification of the EVS 6.2.0.0 voting system, certified on December 23, 2021. The EVS 6.3.0.0 voting system contains modifications to Electionware, ExpressVote versions 1.0 and 2.1, ExpressVote XL, ExpressTouch, DS200, and DS950. It also introduces the DS300, a polling place scanner and tabulator. EVS 6.3.0.0 is composed of software applications, central count location devices and polling place devices with accompanying firmware, and COTS hardware and software:

Electionware® election management software is an end-to-end election management software application that provides election definition creation, ballot formation, equipment configuration, result consolidation, adjudication, and report creation. Electionware is composed of five software groups: Define, Design, Deliver, Results, and Manage.

ExpressVote® XL is a hybrid paper-based polling place voting device that provides a full-face touch screen vote capture interface that incorporates the printing of the voter's selections as a cast vote record and tabulation scanning in a single unit.

ExpressTouch® is a DRE voting system which supports electronic vote capture for all individuals at the polling place.

ExpressVote® Hardware 1.0 is a hybrid paper-based polling place voting device that provides touch screen vote capture that incorporates the printing of the voter's selections as a cast vote record to be scanned for tabulation in any one of the ES&S precinct or central tabulators.

ExpressVote® Hardware 2.1 is a hybrid paper-based polling place voting device that provides touch screen vote capture that incorporates the printing of the voter's selections as a cast vote record to be scanned for tabulation in any one of the ES&S precinct or central tabulators. There are two separate versions of ExpressVote HW2.1: version 2.1.0.0 and version 2.1.2.0.

DS200® is a polling place paper-based voting system, specifically a digital scanner and tabulator that simultaneously scans the front and back of a paper ballot and/or vote summary card in any of four orientations for conversion of voter selection marks to electronic cast vote records (CVR).

DS300® is a polling place paper-based voting system, specifically a digital scanner and tabulator that simultaneously scans the front and back of a paper ballot and/or vote summary card in any of four orientations for conversion of voter selection marks to electronic cast vote records.

DS450® is a central scanner and tabulator that simultaneously scans the front and back of a paper ballot and/or vote summary card in any of four orientations for conversion of voter selection marks to electronic CVRs.

DS850® is a central scanner and tabulator that simultaneously scans the front and back of a paper ballot and/or vote summary card in any of four orientations for conversion of voter selection marks to electronic CVRs.

DS950® is a central scanner and tabulator that simultaneously scans the front and back of a paper ballot and/or vote summary card in any of four orientations for conversion of voter selection marks to electronic CVRs.

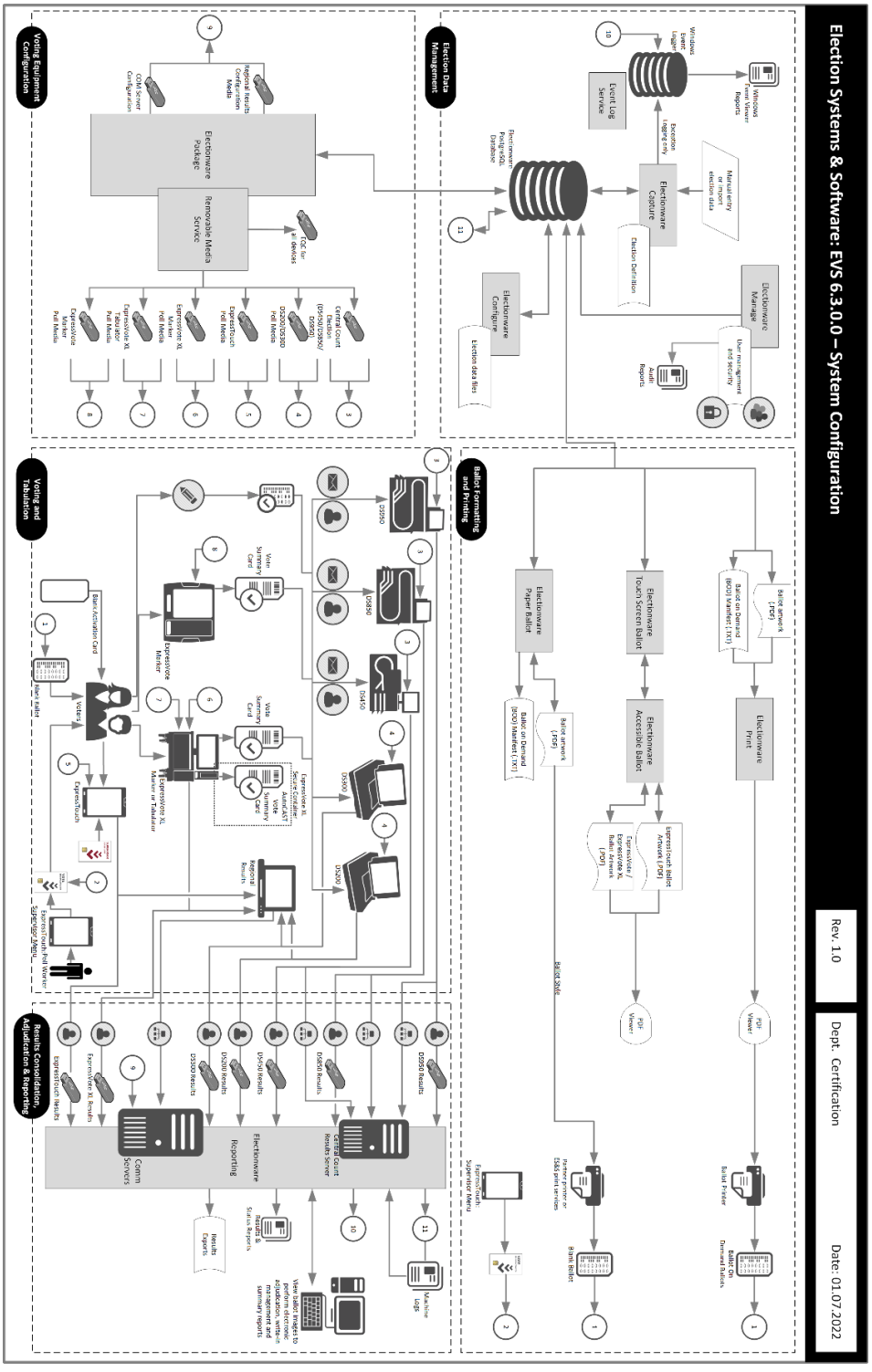
Event Log Service (ELS) monitors and logs users' interactions with the election management system. Events that happen when a connection to the database is not available are logged to the Windows operating system log through the ELS.

Removable Media Service (RMS) is a utility that runs in the background of the Windows operating system. RMS reads specific information from any attached USB devices so that an ES&S application such as Electionware can use that information for media validation purposes.

Electionware® Regional Results (Regional Results) is a standalone application that is deployed at Regional Sending Sites. For more efficient results reporting, the Regional Results software

then securely transmits the encrypted unofficial results collection files over a customer dedicated network.

System Diagram



EVS 6.3.0.0 System Overview

Certified System before Modification (If applicable):

EVS 6.2.0.0

Changes addressed by modification

Hardware

New Hardware

- DS300: introduced the new polling place scanner and tabulator.
- DS300 Ballot Box: introduced for use with the DS300 tabulator only.

Hardware Modifications

- ExpressVote XL: added/updated the following components:
  - Added one-way printer roller
  - Updated Paper Path Module (PPM) firmware
- DS450: added/updated the following components:
  - Updated monitor with new video control board
  - Added reverse belt assembly
  - Added output tray stops to allow more room for 19" ballots
- DS950: added/updated the following components:
  - Updated monitor with new video control board
  - Added risk-limiting audit number printer
  - Added cutout with filler plate for future location of imprinter

New Configuration Options

- DS450/DS950 Printer. The Brother printer is a new laser report printer configuration option.
- DS450/DS950 UPS. The CyberPower uninterruptible power supply is a new UPS configuration option.
- DS450/DS950 network cable. The Ethernet network cable is now optional in the certified configuration.
- DS450 Cart. The DS450 is now configured on the Central Count cart.

Software/Firmware Changes

- Customize Write-in Cells
  Added the ability to customize Write-in cells in Electionware Touch Screen Ballot to fit more offices on a page for the ExpressVote XL.
  Impacted products:
  - Electionware
  - ExpressVote XL
- Park the Vote Summary Card

Added the ability to park the vote summary card under glass when the printed card is reinserted into the ExpressVote XL.
Impacted products:
    - Electionware
    - ExpressVote XL
- Reduce Poll worker Intervention
  Implemented an option on the ExpressVote XL to allow the voter to quit the vote session after printing the vote summary card without poll worker intervention:
    - Electionware
    - ExpressVote XL
- Multi-Language Vote Summary Card
  Added configurable options for printing the contest and candidate names in English and the voter's selected language on vote summary cards.
  Impacted products:
    - Electionware
    - ExpressVote HW1.0
    - ExpressVote HW2.1
    - ExpressVote XL
- Team Write-in Contest Type
  Added the ability to enter two write-in names for contests where two candidates use one voting target.
  Impacted products:
    - ExpressVote HW1.0
    - ExpressVote HW2.1
    - ExpressTouch
    - ExpressVote XL
- DS200 Label Change
  Renamed "DS200" labels to "Poll Place Count".
  Impacted products:
    - Electionware
    - Regional Results
- Security
  Implement a Cisco firmware update to address security vulnerabilities on the Cisco RV340 VPN Router.
  Impacted products:
    - Election Management System

<u>DS200</u>

- Operating System
    - Upgraded the DS200 operating system to Linux (Yocto).

<u>DS950</u>

- Risk limiting Audit
    - Implemented DS950 imprinter functionality for risk limiting audits.

Electionware

- System Limit
    - Increased Precinct ID limit from 9900 to 9999.
- Adjudication
    - Enabled adjudication of write-ins on the vote summary card in Ballot Review in the Electionware Reporting module.

ExpressVote XL

- Side by Side Review
    - Introduced the ability to display the full on-screen ballot during voter review when the printed vote summary card is reinserted into the ExpressVote XL, which allows a side-by-side comparison.

Mark Definition

ES&S' declared mark recognition for the DS200, DS300, DS450, DS850 and DS950 is a mark across the oval that is 0.02" long x 0.03" wide at any direction.

Tested Marking Devices:

Bic Grip Roller Pen

Language Capability

System supports English, Spanish, Chinese, Korean, Japanese, Hindi, Bengali, Vietnamese, Tagalog, Creole, Russian, French, Gujarati (not supported by poll place tabulators), Punjabi (not supported by poll place tabulators)

Proprietary Components Included

This section provides information describing the components and revision level of the primary components included in this Certification.

System Component	Software or Firmware Version	Hardware Version	Model	Comments
Electionware	6.3.0.0			Election management software that provides end-to-end election management activities
ES&S Event Log Service (ELS)	3.0.0.0			Logs users' interactions with EMS
Regional Results	1.5.0.0			Standalone application that is deployed at Regional Sending Sites.
Removable Media Service	3.0.0.0			Utility that runs in the background of the Windows operating system

System Component	Software or Firmware Version	Hardware Version	Model	Comments
DS200	3.0.0.0	1.2, 1.3		Precinct count tabulator that scans voter selections from both sides of the ballot simultaneously
DS300	3.0.0.0	1.0		Precinct count tabulator that scans voter selections from both sides of the ballot simultaneously
DS200/DS300 Ballot Box		1.0, 1.1	98-00009	Collapsible ballot box
DS200/DS300 Ballot Box		1.0	98-00110	Collapsible ballot box
DS300 Ballot Box		1.0	57300	DS300 plastic ballot box
DS200/DS300 Ballot Box		1.2, 1.3, 1.4, 1.5	57521	Plastic ballot box
DS200/DS300 Tote Bin		1.0	00074	Tote bin ballot box
DS200/DS300 Ballot Trolley			212516	Ballot Trolley Ballot Box
DS200 Metal Ballot Box		1.0, 1.1, 1.2	76245	Metal Tote Bag
DS200 Ballot Tote Bag			60	Ballot Tote Bag
DS200/DS300 Carrying Case			90282	Soft sided carrying case
DS200/DS300 Carrying Case			98-00045	Hard sided lid/carrying case with wheels and extendable handle
DS200/DS300 Carrying Case			94052	Hard sided carrying case (suitcase)
DS450	4.2.0.0	1.0		Central count scanner and tabulator
DS450 Cart			3002	
DS850	4.2.0.0	1.0		Central count scanner and tabulator
DS850 Cart			6823	
DS950	4.2.0.0	1.0		Central count scanner and tabulator
Central Count Cart			7898	Cart for DS450 and DS950
ExpressVote XL	4.2.1.0	1.0		Hybrid full-face paper-based vote capture and selection device and precinct count tabulator
ExpressTouch	4.2.1.0	1.0		DRE
ExpressVote HW1.0	4.2.1.0	1.0		Hybrid paper-based vote capture and selection device
ExpressVote HW2.1	4.2.1.0	2.1.0.0 2.1.2.0		Hybrid paper-based vote capture and selection device
ExpressVote Rolling Kiosk		1.0	98-00049	Portable Voting Booth
ExpressVote Carrying Case			98-00050	

System Component	Software or Firmware Version	Hardware Version	Model	Comments
Voting Booth			98-00051	Stationary Voting Booth
ExpressVote Ben Franklin Booth			00380, 00381 (adaptor)	Sitting and Standing Voting Booth
ExpressVote Dual Express Cart			41402	Portable Voting Booth
Voting Booth Workstation			87035	Stationary Voting Booth
Quad Express Cart			41404	Portable Voting Booth
MXB ExpressVote Voting Booth			95000	Sitting and Standing Voting Booth
ExpressVote Single Table			87033	Voting Table for One Unit
ExpressVote Double Table			87032	Voting Table for Two Units
ADA Table			87031	Voting Table for One Unit
Universal Voting Console (UVC)		2.0	98-00077	Detachable ADA support peripheral
ExpressVote Audio-Tactile Keypad	1.0.0.0		97-00168	Audio-Tactile Keypad
Tabletop Easel			14040	
ExpressTouch Voting Booth			98-00081	Stationary Voting Booth
ExpressTouch Carrying Case			14041	Soft sided carrying case
SecureSetup	6.3.0.0			Proprietary Hardening Script

COTS Software

Manufacturer	Application	Version
Microsoft Corporation	Windows Server 2016	WIN2016_6300.iso
Microsoft Corporation	Windows 10 Enterprise LTSC	WIN10_6300.iso
Microsoft Corporation	Windows Server 2016 DataComm (ISO)	WIN2016DC_6300.iso
Microsoft Corporation	Windows Updates (Software updates included in the OS image)	Package date: WIN10_6300.iso-01/24/2022 WIN2016_6300.iso-01/20/2022 WIN2016DC_6300.iso-01/20/2022
Microsoft Corporation	Windows Defender Antivirus (Configured within the OS image)	N/A
Dell	TPM Utility	DellTpm2.0_Fw1.3.2.8_V1_64.exe
Cisco	Rommon	ASA 5506-X (1.1.18) ASA 5508-X (1.1.18) ASA FPR-1010 (N/A)
Cisco	ASA Firmware	ASA 5506-X (9.16.1) ASA 5508-X (9.16.1) ASA FPR1010 (9.16.1)
Cisco	RV340 Firmware	1.0.03.26
SolarWinds / Kiwi Syslog Server	Remote Event Log Monitoring	9.6.7
Amyuni	Amyuni PDF Generator	5.5

Manufacturer	Application	Version
Cerberus	Cerberus FTP Server – Professional	12.1 (64-bit)
Sumatra	Sumatra PDF Viewer	3.1.2 (64-bit)
Legion of the Bouncy Castle Inc.	Bouncy Castle FIPS Java API	1.0.2.1
Yubico Login for Windows	Dual Factor Authentication YubiKey USB keys for dual factor authentication (optional)	Yubico-Login-for-Windows- 2.0.3-win64.msi
Progress File Transfer / WS FTP	Secure file transfer	12.7.0

COTS Hardware

Manufacturer	Hardware	Model/Version
Dell	EMS Server	PowerEdge T430, T440, T630, R540
Dell	Regional Results Data Comm Server	PowerEdge T430, T440, T630, R540
Dell	EMS Client or Standalone Workstation	Latitude 5520, 5580 (32GB Ram), OptiPlex 5040, 5050, 7020, XE3
Dell	Trusted Platform Module (TPM) Chip 2.0 (optional)	Security device (optional)
Dell	Regional Results Client	Latitude 5520, 5580
Toshiba	Regional Results Client	Tecra A50-C
Innodisk	USB EDC H2SE (16GB) for ExpressVote 2.1	DEEUH1-16GI72AC1SB
Delkin	2.0 USB Flash Drive (512MB, 1GB, 2GB, 4GB, 8GB)	N/A
Delkin	3.0 USB Flash Drive (4GB, 8GB, 16GB, 32GB)	6206, 6207, 6208, 6209
Delkin	3.0 USB Flash Drive (256GB) data transfer	6210
Delkin	USB Embedded 2.0 Module Flash Drive for ExpressVote HW1.0	MY08TQJ7A-RA000-D (8 GB) MY16TNK7A-RA042-D (16 GB)
Delkin	USB Embedded 2.0 Module Flash Drive for ExpressVote HW2.1	MY16TNK7A-RA042-D (16 GB)
Delkin	Compact Flash Memory Card (1GB)	CE0GTFHHK-FD038-D
Delkin	Compact Flash Memory Card (4GB)	CE04TQSF3-XX000-D
Delkin	Secure CF Card (2GB)	CE02TLQCK-FD000-D
Delkin	CFast Memory Card (4GB)	BE04TRSJG-3N042-D
Delkin	Compact Flash Memory Card Reader/Writer	6381
Delkin	CFAST Card (2GB, 4GB)	380-00006 – 2GB 380-00007 – 4GB
Delkin	CFAST Card Reader/Writer	67417
Delkin USB Flash Drive	BitLocker 32.2 MB (optional)	Storage for security key (Model 10004)
Cisco Firewall	Regional Results Security Firewall	ASA-5506-X, ASA-5508-X, ASA FPR-1010
Cisco Router	Regional Results VPN Router	RV340
D-Link	network switch (1 GB Min)	DSG-1005G
YubiKey USB drive	Multi factor Authentication (optional)	5A series
Lexar	CFAST Card Reader/Writer	LRWCR1TBNA
CardLogix	Smart Card	CLXSU128kC7/ AED C7
SCM Microsystems	Smart Card Writer	SCR3310
Avid	Headphones	86002
Zebra Technologies	QR code scanner (Integrated)	DS457-SR20009, DS457-SR20004ZZWW
Symbol	QR Code scanner (External)	DS9208
Brother	DS450 and DS950 Report Printer	B6400
Dell	DS450 Report Printer	S2810dn
OKI	DS450, DS850, and DS950 Report Printer	B431dn, B431d, B432DN
OKI	DS450 and DS850 Audit Printer	Microline 420

Manufacturer	Hardware	Model/Version
APC	DS450 UPS	Back-UPS Pro 1500, Smart-UPS 1500
APC	DS850 UPS	Back-UPS RS 1500, Pro 1500
CyberPower	DS950 UPS	OR1500PFCLCD
CyberPower	DS450 and DS950 UPS	CP1500PFCLCD
Tripp Lite	DS450 Surge Protector	SPIKECUBE
Seiko Instruments	Thermal Printer	LTPD-347B
NCR/Nashua	Paper Roll	2320
Fujitsu	Thermal Printer	FTP-62GDSL001, FTP-63GMCL153
HP	Ink cartridge for DS450/DS850 ballot number imprinting	87002
HP	Ink cartridge for DS950 ballot number imprinting	HP C6195A
TDS	Ink cartridge for DS200/DS300 ballot stamping	2278
HP	Ink cartridge for DS300 risk-limiting audit number imprinting	370-00538
Pivot	Vote Summary Card Only Suppression Tray	97-00359

System Limitations

This table provides the system limits that have been verified during testing.

System Characteristic	Boundary or Limitation	Limiting Component
Max. precincts allowed in an election	9,999	Electionware
Max. candidates allowed per election	10,000	Electionware
Max. contests allowed in an election	10,000	Electionware
Max. contests allowed per ballot style	500 or # of positions on ballot	N/A
Max. candidates (ballot choices) allowed per contest	230	Electionware
Max. number of parties allowed	General election: 75 Primary election: 30 (including nonpartisan party)	Electionware
Max. 'vote for' per contest	230	Electionware
Ballot formats	All paper ballots used in an election must be the same length. Voteable paper ballots must contain the same number of rows	Ballot scanning equipment
Max. ballot styles	15,000	Electionware
Max. ballots per batch	1,500	DS450/DS850/DS950
Max. precinct types/groups	25 (arbitrary)	Electionware
Max. precincts of a given type	250 (arbitrary)	Electionware
Max. reporting groups	14	Electionware
Max. connections	18 client connections	Electionware

Component Limitations

ExpressVote

1. Capacities exceed all documented limitations for the ES&S election management, vote tabulation and reporting system. For this reason, election management system and

ballot tabulator limitations define the boundaries and capabilities of the ExpressVote system as the maximum capacities of the ExpressVote are never approached during testing.
2. Does not offer open primary support based on the ES&S definition of Open Primary, which is the ability to select a party and vote based on that party.
3. ExpressVote vote summary cards using the high-capacity barcode are limited to 630 or fewer oval positions.
4. Does not support Massachusetts Group Vote.
5. Does not support Universal Primary Contest.
6. Does not support Multiple Target Cross Endorsement.
7. Does not support Judges Initials boxes.
8. ExpressVote does not support 19-inch cards with ballot stubs.

ExpressVote XL

1. Capacities exceed all documented limitations for the ES&S election management, vote tabulation and reporting system. For this reason, election management system and ballot tabulator limitations define the boundaries and capabilities of the ExpressVote XL system as the maximum capacities of the ExpressVote XL are never approached during testing.
2. Does not offer open primary support based on the ES&S definition of Open Primary, which is the ability to select a party and vote based on that party.
3. ExpressVote XL vote summary cards using the high-capacity barcode are limited to 630 or fewer oval positions.
4. Does not support Massachusetts Group Vote.
5. Does not support Universal Primary Contest.
6. Does not support Judges Initials boxes.
7. In a general election, ExpressVote XL screen can hold 32 party columns if set up as columns or 16 party rows if set up as rows.
8. ExpressVote XL does not support 19-inch cards with ballot stubs.
9. ExpressVote XL does not support 17-inch cards with ballot stubs.

ExpressTouch

1. Capacities exceed all documented limitations for the ES&S election management, vote tabulation and reporting system. For this reason, election management system limitations define the boundaries and capabilities of the ExpressTouch system as the maximum capacities of the ES&S ExpressTouch are never approached during testing.
2. Does not offer open primary support based on the ES&S definition of Open Primary, which is the ability to select a party and vote based on that party.
3. Does not support Massachusetts Group Vote.
4. Does not support Universal Primary Contest.
5. Does not support Multiple Target Cross Endorsement.

Electionware

1. Electionware software field limits were calculated based on an average character width for ballot and report elements. Some uses and conditions, such as magnified ballot views or combining elements on printed media or ballot displays, may result in field limits (and associated warnings) lower than those listed.
2. Ballot Images function is limited to 250 districts per export.
3. Supports the language and special characters listed in the System Overview, Attachment 1. Language special characters other than those on this list may not appear properly when viewed on equipment displays or reports.

Electionware Paper Ballot

1. The paper ballot code channel, which is the series of black boxes that appear between the timing track and ballot contests, limits the number of available ballot variations depending on how a jurisdiction uses this code to differentiate ballots. The code can be used to differentiate ballots using three different fields defined as: Sequence (available codes 1-16,300), Type (available codes 1-30), or Split (available codes 1-18).
2. For paper ballots, if Sequence is used as a ballot style ID, it must be unique electionwide and Split code will always be 1. In this case, the practical style limit would be 16,300.
3. The ExpressVote activation card has a ballot ID consisting of three different fields defined as: Sequence (available codes 1-16,300), Type (available codes 1-30), or Split (available codes 1-18).
4. Grid Portrait and Grid Landscape ballot types are New York specific and not for general use.

DS200

1. Configured for an early vote station does not support precinct level results reporting. An election summary report of tabulated vote totals is supported.
2. Storage limitation for write-in ballot images is 3,600 images. Each ballot image includes a single ballot face, or one side of one page.
3. Write-in image review requires a minimum 1GB of onboard RAM.
4. To successfully use the write-in report, ballots must span three or more vertical columns. If the column is greater than 1/3 of the ballot width (two columns or less), the write-in image will be too wide to print on the tabulator report tape.

DS300

1. Configured for an early vote station does not support precinct level results reporting. An election summary report of tabulated vote totals is supported.
2. Storage limitation for write-in ballot images is 3,600 images. Each ballot image includes a single ballot face, or one side of one page.

3. To successfully use the write-in report, ballots must span three or more vertical columns. If the column is greater than 1/3 of the ballot width (two columns or less), the write-in image will be too wide to print on the tabulator report tape.

Functionality

VVSG 1.0 Supported Functionality Declaration

Feature/Characteristic	Yes/No	Comment
Voter Verified Paper Audit Trails		
VVPAT	No	
Accessibility		
Forward Approach	Yes	
Parallel (Side) Approach	Yes	
Closed Primary		
Primary: Closed	Yes	
Open Primary		
Primary: Open	Yes	ExpressVote, ExpressVote XL and ExpressTouch do not offer open primary support based on the ES&S definition of Open Primary, which is the ability to select a party and vote based on that party.
Partisan & Non-Partisan:		
Partisan & Non-Partisan: Vote for 1 of N race	Yes	
Partisan & Non-Partisan: Multi-member ("vote for N of M") board races	Yes	
Partisan & Non-Partisan: "vote for 1" race with a single candidate and write-in voting	Yes	
Partisan & Non-Partisan "vote for 1" race with no declared candidates and write-in voting	Yes	
Write-In Voting:		
Write-in Voting: System default is a voting position identified for write-ins.	Yes	
Write-in Voting: Without selecting a write in position.	Yes	
Write-in: With No Declared Candidates	Yes	
Write-in: Identification of write-ins for resolution at central count	Yes	
Primary Presidential Delegation Nominations & Slates:		
Primary Presidential Delegation Nominations: Displayed delegate slates for each presidential party	Yes	
Slate & Group Voting: one selection votes the slate.	Yes	
Ballot Rotation:		
Rotation of Names within an Office; define all supported rotation methods for location on the ballot and vote tabulation/reporting	Yes	
Straight Party Voting:		

Feature/Characteristic	Yes/No	Comment
Straight Party: A single selection for partisan races in a general election	Yes	
Straight Party: Vote for each candidate individually	Yes	
Straight Party: Modify straight party selections with crossover votes	Yes	
Straight Party: A race without a candidate for one party	Yes	
Straight Party: "N of M race (where "N">1)	Yes	
Straight Party: Excludes a partisan contest from the straight party selection	Yes	
Cross-Party Endorsement:		
Cross party endorsements, multiple parties endorse one candidate.	Yes	ExpressVote and ExpressTouch do not support Multiple Target Cross Endorsement.
Split Precincts:		
Split Precincts: Multiple ballot styles	Yes	
Split Precincts: P & M system support splits with correct contests and ballot identification of each split	Yes	
Split Precincts: DRE matches voter to all applicable races.	Yes	
Split Precincts: Reporting of voter counts (# of voters) to the precinct split level; Reporting of vote totals is to the precinct level	Yes	It is possible to list the number of voters.
Vote N of M:		
Vote for N of M: Counts each selected candidate, if the maximum is not exceeded.	Yes	
Vote for N of M: Invalidates all candidates in an overvote (paper)	Yes	
Recall Issues, with options:		
Recall Issues with Options: Simple Yes/No with separate race/election. (Vote Yes or No Question)	No	
Recall Issues with Options: Retain is the first option, Replacement candidate for the second or more options (Vote 1 of M)	No	
Recall Issues with Options: Two contests with access to a second contest conditional upon a specific vote in contest one. (Must vote Yes to vote in 2nd contest.)	No	
Recall Issues with Options: Two contests with access to a second contest conditional upon any vote in contest one. (Must vote Yes to vote in 2nd contest.)	No	
Cumulative Voting		
Cumulative Voting: Voters are permitted to cast, as many votes as there are seats to be filled for one or more candidates. Voters are not limited to giving only one vote to a candidate. Instead, they can put multiple votes on one or more candidate.	No	
Ranked Order Voting		

Feature/Characteristic	Yes/No	Comment
Ranked Order Voting: Voters can write in a ranked vote.	Yes	Ballots can be formatted for Ranked Order Voting and the system supports export of CVR data for processing of Ranked Order Voting Rounds
Ranked Order Voting: A ballot stops being counted when all ranked choices have been eliminated	Yes	Ballots can be formatted for Ranked Order Voting and the system supports export of CVR data for processing of Ranked Order Voting Rounds
Ranked Order Voting: A ballot with a skipped rank counts the vote for the next rank.	Yes	Ballots can be formatted for Ranked Order Voting and the system supports export of CVR data for processing of Ranked Order Voting Rounds
Ranked Order Voting: Voters rank candidates in a contest in order of choice. A candidate receiving a majority of the first choice votes wins. If no candidate receives a majority of first choice votes, the last place candidate is deleted, each ballot cast for the deleted candidate counts for the second choice candidate listed on the ballot. The process of eliminating the last place candidate and recounting the ballots continues until one candidate receives a majority of the vote	No	
Ranked Order Voting: A ballot with two choices ranked the same, stops being counted at the point of two similarly ranked choices.	Yes	Ballots can be formatted for Ranked Order Voting and the system supports export of CVR data for processing of Ranked Order Voting Rounds
Ranked Order Voting: The total number of votes for two or more candidates with the least votes is less than the votes of the candidate with the next highest number of votes, the candidates with the least votes are eliminated simultaneously and their votes transferred to the next-ranked continuing candidate.	No	
Provisional or Challenged Ballots		
Provisional/Challenged Ballots: A voted provisional ballots is identified but not included in the tabulation, but can be added in the central count.	Yes	
Provisional/Challenged Ballots: A voted provisional ballots is included in the tabulation, but is identified and can be subtracted in the central count	Yes	
Provisional/Challenged Ballots: Provisional ballots maintain the secrecy of the ballot.	Yes	
Overvotes (must support for specific type of voting system)		
Overvotes: P & M: Overvote invalidates the vote. Define how overvotes are counted.	Yes	
Overvotes: DRE: Prevented from or requires correction of overvoting.	Yes	

Feature/Characteristic	Yes/No	Comment
Overvotes: If a system does not prevent overvotes, it must count them. Define how overvotes are counted.	Yes	
Overvotes: DRE systems that provide a method to data enter absentee votes must account for overvotes.	Yes	
Undervotes		
Undervotes: System counts undervotes cast for accounting purposes	Yes	
Blank Ballots		
Totally Blank Ballots: Any blank ballot alert is tested.	Yes	
Totally Blank Ballots: If blank ballots are not immediately processed, there must be a provision to recognize and accept them	Yes	
Totally Blank Ballots: If operators can access a blank ballot, there must be a provision for resolution.	Yes	
Networking		
Wide Area Network – Use of Modems	No	
Wide Area Network – Use of Wireless	No	
Local Area Network – Use of TCP/IP	No	
Local Area Network – Use of Infrared	No	
Local Area Network – Use of Wireless	No	
FIPS 140-2 validated cryptographic module	Yes	
Used as (if applicable):		
Precinct counting device	Yes	DS200, DS300, ExpressTouch, ExpressVote XL
Central counting device	Yes	DS450, DS850, DS950

Baseline Certification Engineering Change Orders (ECO)

This table depicts the ECOs certified with the voting system:

Change ID	Date	Component	Description	Inclusion
ECO 1141	06/08/22	Windows 10, Windows Server 2016	This ECO addresses the Critical Vulnerability CVE-2021-34527, also known as PrintNightmare, in the Windows Operating System. It also updates antivirus definitions for the applicable EVS systems.	De minimis

Attachment B – Accessibility Examination Findings and Recommendations from EVS 6100

A) EVS 6100 Accessibility Examination all findings

Accessibility Examination EVS6100

B) Top problems and Recommendations as listed in the Accessibility Examiner's report

Top problems.pdf

C) All observations from Accessibility Examination

All observations.pdf

D) Recommendations for Deployment from Accessibility Examiner report

Recommendations for deployment.pdf

All observations

The issues reported here also showed up in the feedback questionnaire responses: voters who had problems rated that aspect of the voting system lower on the satisfaction scale. For example, issues learning the tactile keys was mirrored in lower ratings for how easy the instructions are to follow. Lower ratings were usually accompanied by an explanation, included in this list.

These issues are a combination of statements and questions made by the voters and observations of voter behavior.

Severity scale

In both the expert review and observations of voters with disabilities, we took notes about aspects of the system that worked well and problems they encountered. We categorized these issues based on their impact on a voter's ability to vote independently and privately.

- **Positives** – things that voters mentioned as meeting or exceeding their expectations
- **Annoyances** – things voters mentioned as problems, but which did not significantly slow their progress in marking their ballot
- **Problem solving** – instances where voters had to pause to figure out how to complete an action or task, but were able to do so on their own, by exploring the system or relying on past experience with technology
- **Needs assistance** - problems that could only be solved with help, such as instructions or assistance from a poll worker
- **Likely to prevent independent voting for voters with some disabilities** - problems that could prevent successful independent and private voting, even with good knowledge about how to use the system and accessibility features

Positives

Function	Observation	System	Severity
Tactile keypad	More technology-savvy blind voters had few problems with the keypad layouts. P7, who had never used a voting system before immediately knew how to use the arrow keys and adjusted the speech rate to ~150 wpm. Although they could use both keypads, they preferred the layout and button feel of the ExpressVote, saying that having all the voice controls on the right was easier to understand, remember, and use.	Both	Positives
Audio	Voters said the undervote message for each contest is informative and helpful, without feeling coercive.	Both	Positives
Audio	Voters appreciated the announcement of when a contest is fully voted.	Both	Positives
Audio	The voice is very clear and easy to understand at normal speed and when accelerated or slowed.	Both	Positives
Messages	Language on undervote screen is improved over earlier version. No longer seems coercive. Informs of undervote, but also says to use the right arrow to move on.	Both	Positives
Review	When using the review screen, if the voter needs to return to a contest to correct a vote, on return, the focus is on the contest where it left, rather than at the top of the ballot, though it reads the top of ballot instructions. This makes navigation more efficient.	Both	Positives
Write-In	Voters can exit the write-in process using the Right arrow to hear the letters entered, then reenter the write-in process. This preserves the letters entered, and reads them aloud to the voter, so corrections can be made.	Both	Positives

Function	Observation	System	Severity
Write-in	P7 quickly mastered the write-in process, and clearly understood the process, though she indicated that she had never used this type of device before. She likened the input to her Amazon Fire TV remote. This illustrates the importance of using modes of operation that are common in everyday life when designing voting machines.	Both	Positives
Write-in	P2, a voter with low vision was able to correct a write-in using the touch-screen independently and without prompting.	XL	Positives
Text size	P2 indicated that the text size of the assisted voter interface was large enough for him	XL	Positives

Problems

Function	Observation	System	Severity
Orient and navigate	Visual indication of machine focus on the EV (when navigating contest) is faint. Voters in front of the screen had trouble seeing the dotted outline. When voters lost track of where they were, or entered top-of-screen navigation, they had to experiment to find their place.	EV	Problem Solving
Orient and navigate	On the XL in large text/assistive mode, the contest titles are centered on the large screen, the names are along the left edge, and the next button is at the lower right. This made it hard for a low-vision voter to find the title and buttons. P2 suggested that they should be all aligned the same way "I would center these more."	XL	Problem Solving

Function	Observation	System	Severity
Orient and navigate	The visual labels on the XL keypad are slightly raised black text on a black background. Most voters did not notice them until they were pointed out. (The EV keypad has white labels on a dark grey background and did not have this problem).	XL	Problem Solving
Orient and navigate	In the review screen, audio instructions say to hear the contests by pressing the "up AND down" arrows. Because many computer commands require multiple keys be pressed at once, this was confusing. Should say "Press the Up OR Down" to navigate	Both	Problem Solving
Orient and navigate	On the review screen, many voters did not discover that they could go directly back to a contest by touching it or pressing ENTER when it was highlighted. Instead they simply went “back” until they reached the contest and then navigated though all contests to return to the review screen.	XL	Problem Solving
Orient and navigate	On the XL keypad, one voter with mild cognitive issues was noticeably confused by the navigation keys. Several times, she used the left arrow (back) key instead of the down arrow (next item) key.	XL	Problem Solving
Orient and navigate	On the XL, the “next” buttons on the contest screens are blue with right arrows, but green on the dialogs with no arrows. The audio says to use the green button. One participant repeatedly tried to use the green square select button on the keypad.	XL	Problem Solving
Orient and navigate	On the review screen, which occupied two screens on the EV, voters expected the down-arrow to scroll to the next screen of information, which it does not.	EV	Problem solving
Write in	Depending on how the voter chose to navigate and which input method being used, some had comments about their preferences, for example whether the alphabet starts over with each letter or maintained position in the alphabet or the order of special keys, backspace and space.	Both	Annoyances

Function	Observation	System	Severity
Write-in	In the write-in process, the up or down arrows must be pressed and released for each letter change. P6 commented that it would be helpful to be able to hold the up or down arrow down to move quickly through the alphabet and that the keys were stiff and physically taxing to use	XL / Both	Annoyance
Write-in	P6, a voter with a mild cognitive disability had significant problems using the keypad to enter a write-in, using the tactile keys visually. She repeatedly used the left arrow key to try to move horizontally through the letters, cancelling her input. She persisted through at least 4 attempts before successfully entering a write-in	XL / Both	Problem solving
Write-in	In the beginning, P6 used the down arrow exclusively to move between letters, using the wrap-around feature to return to the earlier letters. Only later, with experience, did she start to use the up-arrow.	XL / Both	Problem solving
Write-in	On the write-in screen, there is no way to review he letters that have been entered. If the voter is distracted, they may need a cue to remind where they are in the process. The only solution found is to exit the write-in process, using the right-arrow to accept the entry, to hear the letters entered, then reenter the write-in process. This preserves the letters entered, and reads them aloud to the voter, so corrections can be made. There is no indication in the instructions or on-screen that this option is available.	Both	Problem solving
Write-in	When pressing the left arrow from the write-in screen, all input is canceled without warning. A warning screen would avoid this mistake.	Both	May prevent successful voting

Function	Observation	System	Severity
Review navigation	Of our test voters, only one discovered that selecting a contest on the review screen would take the voter directly to that contest. All of the other voters use the Left arrow to scroll back through the ballot. This was easy in our short ballot, but would be a problem on long ones The instructions indicate that selecting the contest will navigate there, but voters did not remember it. This behavior was observed in sighted voters as well as those with low-vision or blindness.	Both	Problem Solving/Needs Assistance
Review navigation	Audio feedback reads the full text of the referendum back to voter on the review screen, though the visual ballot only has the title. There does not appear to be a way to skip this reading but still hear who you voted for.	Both	Problem Solving
Review > Print	On the XL, there is a final undervote message displayed when leaving the review screen. It says "continue and cast". It should say "Continue and Print" since it does not cast, but does print the ballot. Cast is an additional step.	XL	Problem Solving
Ballot marking	On the screen, candidate blocks include a small box in the upper-right corner that looked like an interactive checkbox. Some voters believed that they had to touch this box, and had trouble positioning their finger precisely, especially near the right side bezel. The visual check is important so that color is not the only indicator that a candidate is selected, but the display design is confusing.	Both	Problem Solving
Keypad	Although they could use it, voters found the XL keypad annoying, “big and clunky,” cluttered, and not as responsive as that of the EV. One said “All these buttons are a tactile nightmare’ even though the EV has the same buttons	XL	Annoyances

Function	Observation	System	Severity
Audio	Several voters commented about the amount of information provided all at once, without pauses to locate each key being described when using assisted voting. This "fire-hose" of information could result in listening fatigue, so that important information is missed. This was especially true on the initial orientation to the keypad	Both	Annoyances
Audio	Although the system knows immediately if the voter activates either the tactile keypad or the dual-switch, the auditory instructions always provide instructions for both, contributing to the listening fatigue	XL Both?	Annoyances
Audio	Pressing a button (for volume or speech rate) during the orientation to the keyboard restarted the instructions. “Darn, I pushed it and it took me all the way back here!”	Both	Annoyances
Audio	"There should be a way to spell candidate's names in the main ballot, so that names like Schmidt and Schmitt can be differentiated." This is common behavior in screen readers, and expected by blind voters.	Both	Annoyances
Audio	On first use of the keypad, the auditory instructions say to "Press continue to use assisted voting." It does not say that Continue is the right arrow key, and this instruction comes before the orientation to the keypad. Throughout the interface, the auditory instructions say to use the right arrow. Why not here?	XL	Problem Solving
Audio	Voters repeatedly listened through instructions on using dual switch input, although it was not needed. Voters tend not to interrupt verbal instruction, especially in a new system where they are worried about missing information.	XL	Problem Solving
Text size	On the EV screen, the default text is very small, and difficult to read as the letters are fuzzy.	EV	Annoyances

Function	Observation	System	Severity
Settings	When using the EV, P3 used the touch-screen, but had to move closer to read the small print. When asked if she would like to use large-print, she declined, but when shown the large print, said that it would be better. This demonstrates the tendency to assume that the "default" is the "right way" to interact rather than expecting the technology to adapt to their needs.	EV	Needs assistance
Touch	The screen of the XL did not respond to either the stylus provided by the vendor nor to an iPad stylus. Both of these worked on the EV without difficulty. This required the use of a knuckle to make selections on screen for low-hand-function voting, which will not be available to all voters. For example, many mouth-stick users have stylus tips which will not activate the XL.	XL	Needs assistance
Touch	The screen responds to brief touches (click equivalent), but does not respond to longer touches. This can make use difficult for voters with severe tremor or motor control issues who used sustained press to make selections.	Both	Problem solving
Floor space	XL lacks adequate knee space for person in wheelchair to get close. P6 was able to lean forward to use the machine, but a voter with a spinal cord injury would lack the trunk strength to do this. This lack of knee space could require such a voter to use the keypad, even if the touch-screen was preferable	XL	Problem solving

Top problems

The examination identified three problems that could reduce the ability of people with disabilities to vote independently and privately.

1. Automatic selection and deselection

What happened

- Voters were confused by the automatic selection and deselection that is part of straight party voting.
    - When you make a manual selection to override your straight party, all the straight party choices are deselected automatically. The XL does not completely announce the deselections. Deselects may not be visible onscreen, if happen on a screen.
    - If you want to vote for no one, you cannot deselect all candidates if there's an eligible candidate selected by straight party vote.
    - Touching a straight party candidate (for emphasis or deselection), deselected the other candidates.
- In some cases, this led voters to cast a ballot without knowing all of the candidates that had been selected. This problem is exacerbated by the inability of any of our voters or poll-workers to successfully validate the printed ballot on the XL.
- Voters marking choices manually, with no straight party selection, were *always* clear what was selected and deselected.

Why this is a problem

The system relies on voters both perceiving the change in selections and understanding why those changes happened.

The effect is that the voting system appears to act in inconsistent ways, forcing voters into time-consuming problem-solving that takes them away from their primary task of voting.

Depending on how easily they can use the technology or how confused they are about what is happening, some voters would have to ask for assistance. This is not only a failure to vote independently, but identifying and solving the problem requires revealing their votes to a poll worker or assistant.

This problem affected voters with a variety of disabilities.

Type of disability	Impact of the problem
Cognitive	Seemingly unpredictable and inconsistent machine response can be confusing and frustrating.
Low vision	Changes to selections may be made out of their view because they are made off-screen or because they are not focused on the part of the screen where the change happens.
Low literacy	Voters with low digital or reading literacy also have a narrow range of focus and can miss cues on different parts of the screen
Blind or very low vision	Because the audio does not announce the deselections, changes to candidates higher on the list are not identified unless the voter cycles back through the list. If they don't cycle back, they may never notice the problem.

Recommendations

Legally, the machines must comply with the Pennsylvania Method, but that interaction should happen in ways that fully inform the voter of what has happened, and how to express their preferences.

- Put voters in control and do not allow the system to make any automatic selections or deselections after straight-party voting selections are applied..
- Improve the feedback messages to tell voters what is happening – including number and names of the candidates being deselected.

- Provide feedback on the reason for the changes in selections and the interaction with straight-party choices.

2. Inconsistency in navigation

In both the visual and audio navigation, there were enough small problems of inconsistency or poor instructions to create a cumulative effect. This issue is most serious for voters using the audio ballot without the visual display.

Every participant had at least one problem, despite relatively high election knowledge and digital experience, suggesting that the issue would be more severe for voters without these personal resources to help them understand what it happening.

What happened

Small inconsistencies in the navigation patterns or the audio instructions forced participants to stop and figure out what was wrong or how to do something.

Many of these small issues caused them to need to ask for assistance – easy to do in the examination, but much harder in a polling place.

In some cases, their attempts to guess at a solution caused even more problems.

Example: reviewing and correcting a write-in

An example of this cascading of problems occurred when blind voters tried to write in the name of a candidate. Throughout the system, voters can push the left arrow key to review their previous selection. As a result, two voters used the left arrow to try to review what they'd typed in a write-in. When they pushed the key, they exited the write-in screen and lost the characters they had typed.

This problem was compounded by other challenges of using the tactile keypad for write-ins:

- Using the tactile keypad to enter text is a slow process requiring voters to scan through the alphabet one letter at a time to spell a name.
- When they were not sure of the letters that had been selected, or wanted to check their spelling, they could not find a way to do this.
- All of the participants knew that a misspelled write-in would not be counted, but could not figure out how to review what was typed.
- If they had not listened carefully to the full instructions or had not cycled through all 26 letters, they did not know that there was a backspace key.

Example: Overvote messages

Throughout the system, voters can push the right and up/down arrows to proceed forward. But when the user attempts a selection that would result in an overvote, the error message is shown on a new screen, without audio notification of the change of context. The only way to move forward after the message is using the *left* arrow.

The problem was hardest on people using the audio ballot:

- The instructions on the error message include general instructions for navigating within the contest, so it's not clear that the user must use the left (back) arrow to return to the contest.
- These instructions included using the up and down arrows to move through the contest.
- When voters tried using the arrows immediately a message announced that the up and down arrows did not work here, but then repeated the instructions to use the arrows to deselect a candidate before selecting a new one.

Example: Button labeling

Buttons for different actions in different screens sometimes have the same labels.

- On the XL, the “Cast” button on the review screen prints the ballot for review. The “Cast” button on subsequent screens actually casts ballot into the built-in box.
- The audio narration often doesn’t use the same words as the on-screen buttons. On the XL, it says “print” your ballot instead of “casting it.”

Why this is a problem

People who use assistive technology rely on quickly learning patterns for basic navigation. An example is this comment from a voter: “If it is true to what it did before, I should be able to push the arrow to move to the next issue.”

Breaking these patterns is a usability problem that is amplified for voters using the audio ballot or with cognitive limitations. In both cases, they have fewer resources to perceive and solve the problem.

These problems often happen in the middle of the ballot where assistance could also violate privacy.

Recommendations

Many of these problems were relatively easy to find during the expert review, and confirmed through observing voters.

- Examine all audio instructions on messages to be sure critical information is in an order that puts specific information for the current task or screen before general, repeated instructions.
- No destructive action should ever take place without explicit confirmation from the voter. In the example above, the system could save write-in entry until the voter leaves that contest so that moving back to the contest using the left-arrow is not destructive. It could also warn voters when partially completed write-in entries will be discarded.

Review the visual interface to make sure buttons that do similar things have the same label. Also use key words like “cast” and “print” consistently throughout the system. Better usability testing with voters with a range of

disabilities during system development would have prevented many of these problems.

3. Verification is possible, but challenging

The move to voting systems with paper ballots provides voters with an opportunity to verify their ballot. We wanted to know whether verification can be part of the normal course of voting for voters with disabilities on systems being examined.

What happened

In this examination, we tested systems with two different models for paper handling and verification.

Model 1. Voters can handle the printed ballot

In this model, tested on the ExpressVote, the system ejects the ballot after printing, so it can be cast in the ES&S scanner. This method requires voters to handle the ballot, but also makes it possible for voters to use personal technology such as magnifiers or text readers to read the paper ballot.

- All our participants were able to verify the ballot if they wanted to.
- 2 blind voters tried using personal text readers and were generally successful, though one with more difficulty.
- Voters with vision were able to read the small text with difficulty.

The ballot can be read back to the screen by reinserting it and reviewing (but not changing) selections.

- Some participants tried reviewing their ballots this way and were happy with it.
- 1 blind voter, who had struggled to enter a write-in and wanted to confirm what was on the ballot, found that the actual text of the write-in is not included in the review because it is not encoded in the paper ballot barcodes.

Although we were not able to test with voters with limited dexterity, we believe:

- Most would be able to move the ballot to a stable surface for examination
- The ballot requires some force to remove it from the system. We did not test the amount of force required, but some voters might require assistance.

Model 2. The ballot is presented behind glass

In this model, tested on the ExpressVote XL, the system prints the ballot, displays it under a glass panel, and then casts the ballot by automatically depositing the paper ballot in a container while it records the vote electronically. This means that voters do not have to handle the ballot, but also makes it impossible for voters to use personal technology such as magnifiers or text readers to read the paper ballot.

Some of the participants were surprised that they did not get the ballot back when they pressed "cast." As the ballot went into the XL ballot box, one voter said, "It didn't come out!"

- None of the participants could verify the ballot in the glass cage:
  - Blind voters had no access to the ballot to use personal technology
  - Low vision voters could not position the ballot so they could read the small text
  - Other voters had problems reading the ballot because of glare and because the sides of the ballot were obscured by the cage.
- Although it is possible to have the ballot ejected to handle it while verifying, the procedure is unclear and it requires voters to tell the system they want to "Quit" and call a poll worker.

Why this is a problem

The purpose of accessible voting options is to give people with disabilities the same opportunity to mark, verify and cast their ballot as other voters.

Recommendations

- Require the paper ballot to include an encoding of write-in text so it can be read back when the ballot is reinserted.
- Change the process for ejecting a ballot on the XL (or the auto-cast option on the ExpressVote) so that it can be done independently by the voter.
- Ensure that the systems with an auto-cast capability are set up so that they can work for people with no use of their hands.

All observations

Positives

Function	Observation	System	Severity
Keypads	The layout of the primary navigation keys was familiar to all participants who use tactile controls.	Both	Positives
Audio	The audio running when the voter approaches the system tells them how and where to insert the ballot making it possible for them to start the voting session independently. This included (on the Express Vote) giving instructions to correct the orientation of the ballot	EV	Positives
Audio	Several participants said the synthesized voices are clear and easy to hear, with enough volume.	Both	Positives
Audio	The range of speech speeds provided was adequate, though some of our voters indicated that they would prefer faster speech.	Both	Positives
Display	Blind voters liked the option to hide the visual display or not at any time. (This feature is not available on the XL.)	EV	Positive
Display	The XL screen can be physically adjusted to change the angle of the screen to make it easier to reach or remove glare.	XL	Positive
Audio / Display	One voter favorably compared the option for simultaneous, synchronized audio and visual display to the system she currently uses, where this is not an option. Note: Synchronized audio and video is required in VVSG 1.0+	Both	Positive

Function	Observation	System	Severity
Audio messages	Some of the messages were helpful and elicited comments. For example, after checking a vote by going from the review screen to the contest and then back to the review screen, one participant liked that the audio confirmed what screen it was on.	EV	Positives
Navigation	The “out-and-back” navigation from the review screen to a contest and back was helpful and made it easy to quickly correct a selection.	Both	Positives
Messages	A blind participant liked the message about not having seen all of the candidates in a contest, so that she didn’t miss anyone.	EV	Positives

Ambiguous issues

Function	Observation	System	Severity
Keypads	The XL keypad is used by poll workers to activate the ballot. Even though ballot activation buttons appear on screen, the poll worker has to use the keypad to continue. • The advantage is that every XL system will have a tactile keypad available and working, • The disadvantage is that this means it can be difficult to handle while giving it to a voter. A longer cord would make it easier to hand the keypad to a voter without having to pass it under the screen and around the support structure. There should be easy to reach racks to place the keypad in between uses, rather than balancing it on the top of the base of the machine.	XL	Set up
Keypads	Both systems have an audio jack that is positioned so a voter can easily plug in their own headset and can be found by feel. • On the XL, the jack is on the keypad	Both	Needs assistance

Function	Observation	System	Severity
	• On the EV, it is on the front of the device below the screen However, on both systems: • The labels are black text on a white strip and not tactilely discernable. • The jacks can easily be confused with the similarly labeled jack for the dual switch or other personal technology. A blind advocate participant suggested that a raised headset icon would be an easily recognized symbol to solve this problem		
Messages	Some of the participants thought a screen required them to take action when it didn't • Selecting a party. One poll worker asked if it was possible to vote without a straight party when they reached the straight party screen • The undervote warning screen led several voters to believe that they were forced to vote the full count. They did not listen long enough to know that they could go forward from that screen. • Trying to not vote for anyone, a participant tried putting in a blank write-in. They felt the process seems to be forcing a vote, commenting, "I guess you have to put something."	Both	Problem solving
Keypads	On the XL, voters felt that the keypad was "busy," containing too many keys. While the Braille labels were easily read their positioning was not always clearly related to the controls.	XL	Annoyance
Keypads	On the XL, the buttons may trigger twice, making them too "responsive." Voters with a mild tremor might, for example, move back two contests, not just one. A small latency in the key response coding would prevent this.	XL	Annoyance

Function	Observation	System	Severity
Messages	Both systems gave users a message if they had undervoted as they left a contest. This is a generic message which inserts the name of the contest, but not how many candidates can be or have already been selected. • The message itself was initially confusing, but then easily understood. • Once the message was understood, it quickly became mildly annoying. • The same message is repeated as the voter leaves the review screen. Some of the participants took this as a strong nudge to fully vote in every contest. However, the EV audio does announce when a multi-select contest is "fully voted," which participants who heard this message found helpful.	Both	Annoyance Or Problem solving
Display	We have not done a detailed analysis, but we noticed several places where button labels were not consistent between the two systems. This is not a problem for a voter using just one system, but adds to the complexity of creating voter education and poll worker materials across the state, or for voters who move between counties using different systems.	Both	Annoyance Or Problem solving

Problems

Function	Observation	System	Severity
Display	The EV screen cannot be physically adjusted to change the angle of the screen to make it easier to reach or remove glare. There is a stand on the back of the device, but it is not adjustable.	EV	Potential Show stopper

Function	Observation	System	Severity
Display	The visual cues for the location of the cursor (the indication of what's currently selected) are difficult to interpret, especially for people with low vision. • On the XL, the dotted-line perimeter was not visible at all for participants with low vision and difficult to see for others. • On the EV, using the same background color for the cursor location and selected candidates was confusing. Voters thought the item with focus was selected and would try to deselect it, resulting in the candidate being selected.	Both	Potential Show stopper
Keypads	The labels on the XL tactile keypad are black on black making them almost impossible for anyone to read.	XL	Need assistance
Display	On the XL, the transition between screens was very subtle and participants often changed screens without noticing. Having the contest title in the center of the screen and the contests at the far left added to the problem. A low-vision users said, "I saw some shaded areas here (on the left) but thought that these were from the previous vote. I thought the middle was where I was voting now." (The shaded area is actually the current contest."	XL	Problem solving
Display	In several places, the button labels are inconsistent within a system, especially error messages. These small inconsistencies are magnified for a voter who cannot see the screen, where the position of the button or any icons on them are additional cues.	Both	Annoyance or Problem solving
Keypads	Some of the Braille labels on the EV tactile keypad are abbreviated, making them difficult to	EV	Need assistance

Function	Observation	System	Severity
	understand: “TPO” for Tempo, the label on volume, and “PS” for pause		
Keypads	One participant (P5) was concerned that the controls on the EV tactile keypad are too small for some blind users with limited feeling in their fingers, for example from diabetic-related blindness.	EV	Need assistance
Keypads	Using the XL, a low vision voter tried to follow instructions to press the “square” button. Unfortunately, there are two, and he ended up in the keypad tutorial rather than having pressed select.	XL	Needs assistance or Problem solving
Keypads	The Home key works in different ways, depending on where the cursor is on the screen. • From the list of selections, it goes back to the contest header to begin reading again from the top of the page. • From the contest header, it goes back to the first (straight-party) contest. For the blind voter (the intended user of this button), there is no clear indication of where the cursor is currently located, so it is not possible to predict the action.	Both	Problem-solving
Keypads	There were some concerns about the number of the keys: • [P3] Thought the XL pad has too many keys • [P6] thought the EV pad had too many keys and was too small	Both	Annoyances
Keypads	The “Repeat” key only repeats the last action or audio instruction. Several participants wanted to use this to go back to the top of the contest.	Both	Annoyance
Keypads	There is a key to blank the screen on the [EV] but not the [XL].	EV	Annoyance

Function	Observation	System	Severity
Keypads	The Home button on the EV is used like the Info on the XL, so the label is not helpful.	EV	Annoyance
Keypads	Audio instructions are on the initial screen. If the voter decides that they would like audio after they get to the ballot, the audio is silent until the voter changes selections.	EV	Annoyance
Keypads	There is no feedback when the volume or tempo buttons are pressed. A sound or confirmation (such as “volume up” or “tempo faster”) would be helpful. On the XL, the volume keys announce “Volume up/down.”	EV	Annoyance
Keypads	When the audio is paused, a participant was confused when the audio did not begin again when she navigated to a new contest. “If I move to another candidate or contest, it should start speaking again without having to press Pause again (to restart it)”	EV	Annoyance
Keypads (Audio)	The audio includes instructions for the dual switch and sip-and-puff, even if no device is plugged into the jack. An ideal system would detect input device and adjust the audio to the combination of controls.	Both	Annoyance
Keypads (Audio)	The audio reads all instructions for using the keypads even if the voter is using the touch screen. An ideal system would detect this and adjust the audio to the combination of controls to avoid the lengthy instructions that are not needed.	Both	Annoyance
Ballot Text size	On the XL, selecting “Large Text” changes the screen to a contest-by-contest display, but does not make the text size very much larger. This forces low vision users who simply need slightly larger text into using the audio ballot.	XL	Showstopper

Function	Observation	System	Severity
	One participant with very low vision put his face so close to the screen that he accidentally made selections with his nose.		
Ballot Layout	Reading the judicial retention instructions and the referendum question, the line length is so long that participants had to swivel their head to visually track across a line of text.	XL	Annoyance
Ballot Layout	The layout of the contest on the very wide screen meant that the title of the contest (centered on the screen) and the number of selections was very far from the list of candidates(on the left margin).	XL	Annoyance
Ballot (Audio)	The audio on the XL does not announce the party of each candidate. This made it impossible to complete tasks based on party, including confirming straight party selections. "I'd assume that is the Democrat because I picked them for straight party." [P3]	XL	Show stopper
Ballot (Audio)	If a voter attempted to make too many selections on a vote-for-N-of-M contest (overvote), a message informs them of the problem. It was not clear to blind voters that they were on a separate message screen. The audio on the overvote message includes the general instructions for using the arrow keys, even though these keys are not active on the message. The message about how to return to the contest screen comes after the general instructions, where voters missed it They needed either extensive problems solving or support to get back to the contest.	XL Both?	Needs assistance
Ballot (Audio)	In the audio announcement of each contest, the information about how many can be selected is easy to miss, and the information about how many candidates have already been selected is	Both	Problem solving

Function	Observation	System	Severity
	either missing, or placed at the end of the standard instructions where none of the participants heard it. This is especially important if a straight party option was selected. Changing the order of the instructions would make it easier for blind voters to keep track of their progress		
Ballot (Audio)	After returning to the contest from the overvote message, participants were confused that the last candidate was not selected and had to puzzle their way through the problem	Both	Problem solving
Ballot (Audio)	There is no option to ask the system to spell out a candidate name. • This is not normally a problem, but could make it difficult to distinguish candidates with very similar-sounding names (Smith and Schmidt, for example). • This capability is a standard feature of screen readers, so voters who use that technology may expect it.	Both	Annoyance
Ballot	A candidate endorsed by both parties was only visually identified as being from one of them. The straight party logic, however, selected here for each of the two parties. On the full-face ballot, this was visually confusing because it showed a candidate selected in the "wrong" column.	XL	Problem solving
Ballot (Audio)	Listening to the list of candidates, participants often skipped to the next one as soon as they heard the name, sometimes missing the announcement that the candidate was selected. One voter suggested announcing "You selected" *before* the name of the candidate in these cases.	Both	Annoyance

Function	Observation	System	Severity
Ballot (Audio)	When the voter has reached the last choice, the audio announces this, but pressing the down-arrow does nothing. A participant suggested that it should repeat "Last choice" or "You have heard all of the choices."	XL	Annoyance
Ballot (Straight Party)	Several participants, including poll workers, hesitated at the screen for straight party, wondering if you had to select a party to continue. Better instructions or an option for "No straight party selection" would be helpful	EV XL (large)	Problem solving
Ballot (Straight Party)	The interaction with changing straight party selections was confusing in several ways: • Trying to select just one candidate from a group selected by straight party produced inconsistent results, depending on the exact configuration of the candidates. o If a participant tries to deselect a candidate, it resulted in that candidate being selected and others deselected. o If they tied to select a candidate from another party, all of the straight party selections were deselected, even if the new selection was within the number of options available. • Participants using the audio ballot did not always notice when candidates were deselected, especially if they were higher in the list when the deselection occurred. o When multiple candidates were deselected by this process, only the first was announced on the XL. • Participants using the audio ballot were surprised to hear that other candidates were deselected and only found that out when	Both	Problem solving Or Needs assistance

Function	Observation	System	Severity
	they reviewed the contest or were told they overvoted.		
Ballot (Straight Party)	Not being able to clear all selections on a contest with an available straight party option was very confusing. • One participant described it as having candidates "popping up" and was unable to figure out why this was so. • One participant did not understand why she was not able to deselect a candidate, not understanding that it was related to her straight party selection. • 2 participants created a write-in for "None" as a way of being able to clear all candidates and vote for no one. • When participants deselected all the straight party options, the resulting alert message was very confusing. Several participants did not figure out that the problem was related to straight party voting. o None of the participants wanted to go back, change their straight party choice and recreate their selections to vote for no one, as the message suggested. • On the XL, this would be a show-stopper for someone using the audio ballot because party affiliations were not read out. o One voter described her current voting machine as having a clear way to vote for none on each contest.	Both	Needs assistance Or Show stopper
Write-in	When trying to enter a write-in, participants paused and had to figure out how to actually select the write-in choice to enter a name, in many cases needing assistance. On the EV, the audio narration does not explain that you must push the select key to enter a write-in.	Both	Needs assistance

Function	Observation	System	Severity
Write-in	One participant did not see where the candidate name was written on the contest screen.	XL	Needs assistance
Write-in (Audio)	Using the tactile keypad and audio, it was not clear how to correct a misspelling because participants did not realize that there were keys for space, backspace and so on. The initial audio instructions don't mention the backspace and space keys.	Both	Needs assistance
Write-in (Audio)	The Info (XL) or Home (EV) button makes the system read what's been entered, but no participants found this even though they wanted it.	Both	Needs assistance
Write-in (Audio + Visual)	When returning to the write-in screen with an entry already made, there is no indication of where the cursor is placed, that is, where the next character will be entered.	Both	Needs assistance
Write-in (Audio)	Participants struggled to find the "Space" button (located after punctuation and backspace buttons in the scanning sequence).	Both	Problem solving
Write-in	On the ExpressVote, the buttons for leaving the write-in are visually opposite to the location of the keys on the keypads: • Accept: left on screen, right on keys • Cancel: right on screen, left on keys	EV	Annoyance
Write-in (Audio)	Participants struggled to find the backspace button to erase a letter. One tried using the left arrow, which took her back to the contest, and destroyed all the text she had already typed.	Both	Problem solving or Show stopper
Review screen	The judicial retention and ballot measures had uninformative headings: • The judicial retention contest did not list the name of the judge to be retained. • The ballot measure did not have a short identifier or title, nor show the full text.	Both	Problem solving

Function	Observation	System	Severity
Review screen	A participant with a cognitive disability was initially confused by the review screen. She had never seen something like this. But after looking at it, was able to explain it reasonably well.	XL	Problem solving
Review screen	Using the audio ballot, a participant went back to the contest to check who she had voted for in a contest, even though it was displayed (and read) on the review screen itself.	EV	Annoyance
Review screen	When voter returns to ballot measure from the review screen to change or confirm a vote, they are always returned to the top measure of the review screen, and have to "down arrow" through the ballot to get back to where they were. Participants assumed they would be returned to the ballot measure they had departed from.	XL	Annoyance
Review screen	Participants were surprised to get a message about undervoted contests after completing the review screen. For some, it made it feel that they were required to completely vote all contests.	Both	Annoyance Or Problem solving
Print, verify, cast	If you eject the ballot and then reinsert it to verify what has been printed, the content of the write-in is lost, because the text entered is not encoded in a barcode, and the system is not reading the text through OCR. • This means that it is not possible for a blind or low-vision voter to completely verify their ballot using just the voting system. • Two participants tried reading the ballot using personal technology. The one who used this technology found it easy. The other struggled, but was successful.	Both	Show stopper

Function	Observation	System	Severity
Print, verify, cast	Voters used to the Danaher Shouptronics expected to find a "Vote" button available to them at any time. • Using the XL in full-face mode means that there is no navigation between screens, so that there is a button to print and cast the ballot always available. • This is an issue that will require voter education.	EV	Problem solving
Print, verify, cast	On the XL, blind participants were not sure what was happening during the printing process. • They understood that something would print. • They heard the printer. • But they did not know where the ballot was or what to do next.	XL	Problem solving
Print, verify, cast	On the XL, it was not clear how to get to the print button. At this point in the process, participants wanted clarity and accuracy. • One participant thought the down arrow should get to the print button, but the correct control is the right arrow.	XL	Problem solving or Needs assistance
Print, verify, cast	On the XL, it was not clear how participants could get their ballot back so they could verify it. This concern was raised even when the XL was the first or only system they used, so it is not simply a comparison to the EV. • The process to review the printed ballot requires that the ballot be "cancelled" to eject it from the machine. It can then be read back in after verification, but there is no audio (or onscreen) description of this process. • One participant thought "Quit" was how to say she was done voting.	XL	Problem solving or Needs assistance Or Show stopper

Function	Observation	System	Severity
	• Another could not figure it out, and ended up casting their ballot without verifying. • There is no indication in the audio that this is an option for blind or low vision voters who don't want to "cancel" their ballot, but just review it manually.		
Print, verify, cast	None of the participants were able to verify their paper ballot on the XL. • The ballot is partially obscured by the cover. • The ballot is behind glass making it harder to see. • The text is too small. • Several participants never saw the ballot to verify.	XL	Show stopper
Print, verify, cast	On the ExpressVote, most participants simply followed the instructions to complete the printing and verifying process, but a few were confused because it wasn't clear that the ballot would be returned to them.	EV	Problem solving
Scanner	There are no audio instructions to help a blind or low-vision voter insert and cast their ballot	DS200	Needs assistance
Scanner	There is no way for a blind or low vision voter to read any of the messages on the scanner. This is a low-frequency problem when using the EV because there are no overvotes possible on the ballot, and the scanner was programmed to ignore undervotes. However, it is possible to cast a blank ballot.	DS200	Needs assistance
Scanner	There is no audio equivalent to the final screen to communicate that the ballot has been cast. Blind participants heard the ballot drop into the box, but in a noisy polling place or when there is a pile of ballots already in the box this sound would not be available.	DS200	Needs assistance

Recommendations for deployment

The participants – and examiners – saw the systems being tested for the first time during the examination. Many voters will also try using a new system for the first time in the voting booth, so our test was realistic for Pennsylvania voters.

The problems we encountered also suggest ideas for how election officials can support voters and poll workers as they introduce the new system and design their processes and procedures.

The recommendations here are based on observations of how both poll workers and voters used the system and direct suggestions they made.

Advance training and hands-on practice

The need for an introduction and a chance to try out the system before Election Day was the strongest recommendation from every poll worker participant. As an election judge said, when we asked what he would tell his poll workers, "Go to the training!"

Poll workers felt strongly that any new system – particularly these digital interfaces – would be intimidating to voters and fellow poll workers who were not used to computers. They recommended:

- Longer training sessions for poll workers to give them more time to familiarize themselves with a new system.
- Opportunities for hands-on experience, including scenarios for different situations they might have to handle.
- An aggressive voter education program to give voters a chance to try out the new system.
- Outreach to voters with disabilities, including those who regularly vote with assistance to let them know about the capabilities of a new system that might help them.

- Instructions or a practice system in the polling place, especially in districts with many older people.

Training to support voters with disabilities

Poll workers may not be familiar with how to help people with disabilities. Most of the poll worker participants said that they had no blind or disabled voters in their polling places, although one pointed out that the features on these systems might enable their “assisted voters” to try voting independently.

In addition to a good training module on ways to help voters with disabilities, the training should focus on how to give instructions before and during a voting session to avoid compromising the privacy. For example:

- A “what if” troubleshooting guide could include specific questions to ask and prompts that poll workers can use to help a voter with problem solving without looking at the screen.
- Give poll workers guidance on where to stand while supporting voters. For example, standing behind the ExpressVote and facing the voter would make it clear that they are not looking at the screen.
- Using the procedures for initiating a voting session, including the screens to select a language or acknowledge that assistive technology has been activated, to make sure that the voter has found the basic navigation keys on the keypad. On the ExpressVote, there is a screen with a diagram of the keys that the poll worker can review with the voter (reading the instructions to be sure they are consistent and accurate).

Poll worker procedures

Poll workers procedures can also help bridge any information gaps for voters, with instructions embedded in the voting process.

- Tell voters how to insert their ballot: identify the corner notch and the location of the slot, and tell them the ballot is inserted directly into the machine, not just slid forward.
- Remind voters to check both the review screen and their paper ballot before casting.
- Tell voters that if they make a mistake, they can get a new ballot.
- Instruct voters to insert their ballot with the corner notch on the bottom right so others can't see their selections. The ballot can be inserted into the scanner in any orientation.

Support for voters using the tactile keypad or dual switch and audio ballot might include:

- A keypad they can try out before entering the voting booth.
- Instructions for how to use the keypad in both Braille and large print. The illustration on the ExpressVote help screen could be the basis for these instructions.

As a voter approaches the voting station, poll workers can help voters adjust the voting system or attach personal assistive technology:

- Help voters get positioned at the voting system so they can reach all controls. The XL screen can be adjusted to change its angle for a closer approach, adapting to standing or sitting postures, and avoiding glare.
- Provide assistance plugging in personal headsets or switches with verbal instructions or by doing it for the voter.
    - A voter with a disability is likely to know how to plug in their personal headset or switch, but they will not know the location of the jacks on the machine.

- Make sure voters are oriented and know where all parts of the voting system are, including the privacy shields. The ExpressVote includes a dedicated key on the tactile keypad to blank the screen.
- Remind voters how to cast their ballot and how to know when they are done.

Voting booth setup

Voters with disabilities may have assistive technology or personal notes that they need to place within reach. They may also need room to place the printed ballot on a flat surface to use personal technology such as magnifiers or text readers to verify it.

- work well with the printed ballot layout

For the ExpressVote, the path to the scanner should be as easy as possible, ideally a straight line with no obstructions. The path should include ample room to turn a wheelchair if the machine is positioned with the screen facing the wall. The ADA standards suggest a minimum of 60x60 inches for this.

Attachment C – Implementation Attestation

EVS 6300
Implementaton Atte

Voting System Implementation Attestation

System Name: _____

County: _____

Date Installed/Upgraded: _____

The below hardware/software was installed and verified on the system implemented:

System Component	Software or Firmware Version	Hardware Version	Model	Comments
Electionware				(Please specify the implementation, single device (desktop/laptop), Client/server
ES&S Event Log Service				
Removable Media Service				
ExpressVote HW 2.1				
DS200				
DS300				
DS450				
DS850				
DS950				
ExpressVote XL				

ExpressLink				
Toolbox				

Further to the key hardware/software components listed above, any of the COTS software installed on the voting system adheres to the EAC certificate of conformance for the EVS 6300 system. Any ancillary components like switches, ballot boxes, charging carts sold on this contract are EAC certified components of the EVS 6300 electronic voting system. (Attach a list of items sold on this contract.)

ES&S also has validated that the systems have been installed and hardened following the EAC certified system hardening instructions and no software other than the voting system software has been installed on any of the components.

Vendor Representative Signature: _____

Vendor Representative Name: _____ **Title:** _____

Telephone: _____ **Email:** _____

County Representative Signature: _____

County Representative Name: _____ **Title:** _____

Attachment D – Minimum Training Requirements

ES&S must provide training and training materials, as set forth below, prior to the first use of the voting system in a primary or general election:

A) A demonstration of and training on the setup and operation of the Voting System to the purchasing county's board of elections' members and staff and the county's precinct election officials. Periodic re-training, and training of new personnel, should be considered as part of the training program.

B) A training session on the Voting System's election management system for the purchasing county's board of elections' members and no less than two and no more than six staff members chosen by the board of elections. The training sessions must afford the board members and its staff the opportunity to learn how to setup and program an election, and if applicable design and layout ballots independently of the Supplier's assistance and support.

C) A training session on the following subjects for the purchasing county's board of elections' members and no less than two and no more than six staff members chosen by the board of elections; programming of all voting units and ancillary devices:

1) tabulating results during the unofficial and official canvass;
2) ensuring accuracy and integrity of results;
3) preparing polling places and setting up the system for election day operation;
4) training on accessibility options of the voting system;
5) election day operating procedures;
6) auditing procedures;
7) conducting a recount;
8) preserving records;
9) printing, designing, and formatting election reports;
10) troubleshooting common issues;

11) safeguarding and preventing tampering and unauthorized access to all parts of the Voting System; and

12) Post-election care, maintenance, and storage of all components, including electronic media.

D) Any and all system manuals necessary to allow a purchasing county to operate the Voting System independently of the Supplier's assistance and support.

E) Training materials for a purchasing county board of elections to use when training its precinct election officials on how to setup, operate, and close down the Voting System on Election Day.

Attachment E – Source Code Escrow Obligations for ES&S

The Supplier must maintain an escrow agreement covering all source codes of the Voting System and/or EPB for a period of ten (10) years from the date of delivery to and acceptance by a purchasing county board of elections. The Pennsylvania Secretary of the Commonwealth shall have the right to access the source codes in escrow. The Supplier must pay all costs associated with 1) placing the codes in escrow; and 2) verifying that the Supplier has placed the codes in escrow (note: the escrow agent conducts this verification and charges a separate fee for this service).

A) Source code. Simultaneously with delivery of the Voting System and/or EPB software to purchasing Members, the Supplier shall deliver a true, accurate and complete copy of all source codes relating to the software to an escrow agent.

B) Escrow. To the extent that Voting System and/or EPB software and/or any perpetually-licensed software include application software or other materials generally licensed by the Supplier, Supplier agrees to place in escrow with an escrow agent copies of the most current version of the source code for the applicable software that is included as a part of the Services, including all updates, improvements, and enhancements thereof from time to time developed by Supplier.

C) Escrow agreement. An escrow agreement must be executed by the parties, with terms acceptable to the Commonwealth prior to deposit of any source code into escrow.

D) Obtaining source code. Supplier agrees that upon the occurrence of any event or circumstance which demonstrates with reasonable certainty the inability or unwillingness of Supplier to fulfill its obligations to Commonwealth under this Contract, Commonwealth shall be able to obtain the source code of the then-current source codes related to Voting Systems software, and/or any Supplier Property placed in escrow from the escrow agent.