



CITY OF PHILADELPHIA

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Via Electronic Mail at: Lisa.Deeley@phila.gov, Al.Schmidt@phila.gov,
Michael.Quintero.Moore@phila.gov (on behalf of Commissioner Anthony Clark)

February 16, 2019

Chairwoman Deeley, Vice Chair Schmidt, and Commissioner Clark:

A Request for Proposals #B1903107 (the "RFP") for the purchase of voting machines and electronic poll book solutions was issued by the Office of the City Commissioners ("City Commissioners") and the Office of Innovation and Technology ("OIT") on November 30, 2018. On

February 12, 2019, in response to that RFP, I received the scoring and recommendation of the selection committee convened to review the proposals ("Committee"). Pursuant to Section 8(a) of the Regulations Governing the Purchase of Goods and Non-Professional Services Other Than By Awarding of Contracts to the Lowest Responsible Bidder ("Best Value Regulations") promulgated by the Procurement Department, and Section 5.10.3 of the RFP, the Committee recommended that further negotiations commence with the two proposers receiving the highest overall scores for both voting machines and electronic poll books ("Recommended Proposers"), as described in later sections of this letter. The Recommended Proposers are Election Systems & Software, LLC (ExpressVote XL with DS450 Tabulation System) and Dominion Voting Systems Inc. (ImageCast X Kit - Prime BMD with ImageCast Central Kit - G1130) for voting machines, and KNOWiNK, LLC and Tenex Software Solutions for electronic poll books.

Background

In February and April of 2018, the Wolf administration informed Pennsylvania counties that they must have a voter-verifiable paper record voting system selected no later than December 31, 2019, and preferably in place by the November 2019 General Election.¹ The City's current voting machines are classified as "direct recording electronic" voting machines ("DRE"). DREs do not include a paper trail of any kind, and, therefore, will not be compliant with Governor Wolf's mandate. Non-compliance with the Governor's mandate could lead to a decertification of all Philadelphia County votes in local, state, and national elections.

As summarized by the Committee, in order to act on the Governor's mandate, and guided by the U.S. Election Assistance Commission and the Commonwealth's Department of State, the City of Philadelphia ("City") worked over the last year to thoroughly research voting best practices across the country. That research included:

- April 2018: Demonstrations of voting machines and electronic poll books in Harrisburg, PA
- April-September 2018: Requirements discovery and development for Voting Systems and electronic poll books, which included reviewing requirements from other locales, input from the OIT Security Team and City Commissioners, and attendance at a State/Federal sponsored security symposium.
- May 2018: Observation of West Virginia Primary Election
- June 2018: Release of a Request for Information ("RFI") to better understand the election systems market
- August 2018: Observation of St. Louis Primary Election
- November 2018: Best Value RFP for Elections posted on the City's contracting system²
- December 2018: Best Value RFP Responses received from three voting machine vendors and four electronic poll book vendors
- Throughout December 2018 and January 2019, the Committee convened to review the submitted proposals and deliberate, in order to arrive at the recommendation provided to me on February 12, 2019.

¹ <https://www.media.pa.gov/Pages/State-Details.aspx?newsid=276>

² Posted in PHLContracts as B1903107, Best Value RFP – Election Systems

Evaluation Approach: Voting Machines

As described by the Committee, proposers were evaluated based on information provided in their proposal, as well as other information provided by the respective vendors in response to requests from the Committee, as authorized by the RFP and necessary for further evaluation of the proposals.

Both Recommended Proposers for voting machines provide systems that have a voter-verifiable paper trail and are certified by both the Election Assistance Commission and the Pennsylvania Department of State. Furthermore, the security experts at the University of Pittsburgh and the Blue-Ribbon Commission on Pennsylvania's Election Security released a study³, where they recommended that all counties implement "systems using voter-marked paper ballots (either by hand or by machine) before 2020 and preferably for the November 2019 election." Both systems that are certified meet this recommendation. Further, after scoring by the Committee, both Recommended Proposers received scores that were materially indistinguishable. As such, the Committee recommended both systems to the Procurement Commissioner for further negotiations on price and terms.

The Commonwealth of Pennsylvania's Report on both Recommended Proposers for voting machines is attached. Those reports, attached as Exhibits A and B, describe the features and functionality of Election Systems & Software, LLC (ExpressVote XL with DS450 Tabulation System) and Dominion Voting Systems Inc (ImageCast X Kit - Prime BMD with ImageCast Central Kit - G1130) respectively, in more detail.

Evaluation Approach: Electronic Poll Books

As described by the Committee, proposers were evaluated based on information provided in their proposal, as well as other information provided by the respective vendors in response to requests from the Committee, as authorized by the RFP and necessary for further evaluation of the proposals. For electronic poll books, the Committee determined the proposals from KNOWiNK, LLC and Tenex Software Solutions to be substantially similar and recommended both systems for further negotiations on price and terms. Both systems use the same operating platform and have similar features. The Commonwealth of Pennsylvania's Report on both Recommended Proposers for electronic poll books is attached as Exhibits C and D for KNOWiNK, LLC and Tenex Software Solutions respectively. Those reports describe the features and functionality of each electronic poll book solution in more detail.

Current Negotiations and Final Scoring

Following the receipt of the Committee's recommendation, on February 13, 2019, Recommended Proposers were provided with an opportunity to improve their respective offers to the City. Additionally, each Recommended Proposer was asked to respond to a series of clarifying questions regarding their submitted scope of work. Further, the Committee's final scoring calculations for the Cost Proposal⁴ scores

³ https://www.cyber.pitt.edu/sites/default/files/FINAL%20FULL%20PittCyber_PAs_Election_Security_Report.pdf

⁴ The Cost Proposal is based upon the offer received by each proposer on February 14, 2019 and assumes a 10-year purchase price. Pursuant to Section 5 of the Guidelines Governing the Purchase of Goods and Non-professional Services Other Than by Awarding to the Lowest Responsible Bidder ("Best Value Guidelines") issued by the Procurement Department, the Cost Proposal score is calculated in such a way that the lowest price proposal received the maximum price score, and each subsequent proposal received a price score calculated in the following manner: $(\text{Lowest Price} / 2^{\text{nd}} \text{ Lowest Price}) \times \text{maximum point value} = 2^{\text{nd}} \text{ Lowest Price}$. This score is multiplied by the weight of the Price/Cost Effectiveness which is 30% as stated in the RFP.

were re-calculated with the updated offers provided to the City on February 14, 2019. Given this, the Cost Proposal and Total Weighted Scores for the Recommended Proposers were re-calculated.

Based upon these re-calculations, I submit for your consideration the following break-down of the final scores for the Recommended Proposers⁵:

Voting Machines

Vendor Name	Weighted Technical Score (70% of Total Score)	Weighted Cost Proposal Score (30% of Total Score)	Total Weighted Score
Election Systems & Software, LLC ("ES&S")			3.70
Dominion Voting ("Dominion")			3.60

The Technical Scoring is based upon the following criteria and weightings:

Criteria for Voting Machine Solutions	Weight
Ballot Face	15%
Physical Footprint	15%
Delivery	10%
Technical Support & Maintenance	10%
Training & Documentation	10%
Vendor Diversity	10%

Electronic Poll Books

Vendor Name	Weighted Technical Score (70% of Total Score)	Weighted Cost Proposal Score (30% of Total Score)	Total Weighted Score
Tenex Software Solutions ("Tenex")			4.27
KNOWiNK, LLC ("KNOWiNK")			4.16

The Technical Scoring is based upon the following criteria and weightings:

Criteria for Electronic Poll Books	Weight
Technical Qualifications: Usability; Reporting and Audit capabilities	30%
Delivery	10%
Technical Support & Maintenance	10%
Training & Documentation	10%
Vendor Diversity	10%

⁵ Total weighted scores given are based on a scale from 1 to 5, with 5 being a perfect score.

Response to Clarifying Questions

In addition, on February 14, 2019, I received additional information from each of the Recommended Proposers in response to clarifying questions submitted to each proposer regarding their proposed scope of work.

Based upon these responses, I submit for your consideration the following analysis:

Voting Machines

The responses received by the Recommended Proposers do not have a determinative impact on the selection criteria enumerated within the RFP nor the Technical Scores provided by the Committee.

Electronic Polling Books

While the responses received by the Recommended Proposers do not have a determinative impact on any of the selection criteria enumerated within the RFP nor the Technical Scores provided by the Committee, I must note that one vendor, KNOWiNK indicated in their response that they would be willing to accept the City's contract Terms & Conditions without exception. This information separates KNOWiNK from Tenex and could result in an efficient contract execution and may help in moving the overall project forward within the stated project schedule.

Risk Mitigation

In light of the risks posed by the potential decertification of voting results if the City does not implement a voting system that complies with Governor Wolf's mandate, the Board of Elections may take steps to ensure that it has the contractual resources necessary to ensure a successful and timely implementation of the voting machine system. The Board of Elections may, in addition to identifying a primary vendor for voting machines and a primary vendor for electronic poll books, request that the Procurement Commissioner continue negotiations with secondary vendors for both voting machines and electronic poll books, in order to ensure that the Procurement Department has the option of entering into a contract with such secondary vendor, if Procurement is unable to execute a contract with the primary vendor or if the primary vendor is unable to perform its contract. The Board of Elections may direct that such substitution of vendors be limited to, in the first case, the failure of the primary vendor to enter into a contract with the City on terms and conditions substantially similar to those included in the RFP and already agreed to by the vendor(s) in their responses and, in the second case, the occurrence of a default by the vendor in its performance of the City contract.

Recommendation

Based upon the information provided to me by the Committee and the Recommended Proposers, I recommend that the Board of Elections, in exercising its duty under Article III. Section 302 of the Pennsylvania Election Code, vote to preliminarily award a primary contract for the purchase of voting machines and begin contract negotiations with either ES&S or Dominion, and further vote to authorize the Procurement Commissioner to take such steps as may be necessary to ensure the availability of a secondary vendor to implement a voting machine system should the primary vendor be unable to perform, for any reason; and, that they vote to preliminarily award a primary contract for the purchase of electronic poll books to either Tenex or KNOWiNK, and further vote to authorize the Procurement Commissioner to

take such steps as may be necessary to ensure the availability of a secondary vendor for the purchase of electronic polling books should the primary vendor be unable to perform, for any reason.

Pursuant to Section 9(b) of the Best Value Regulations, a final contract award shall not be made until it is determined that the selected proposers meet the eligibility requirements established in Section 17-1404 of The Philadelphia Code relating to campaign contributions to persons serving in or elected to any City elective office. I will notify you once that determination is made.

Should you have questions related to the recommendation or would like to request additional information, please contact my office at 215-686-4750.

Sincerely,



Monique Nesmith-Joyner
Interim Procurement Commissioner

cc: Christine Derenick-Lopez, Chief Administrative Officer
Marcel Pratt, City Solicitor

Enclosures

**COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF STATE**

**REPORT CONCERNING THE EXAMINATION RESULTS OF
ELECTIONS SYSTEMS AND SOFTWARE EVS 6021 WITH DS200
PRECINCT SCANNER, DS450 AND DS850 CENTRAL SCANNERS,
EXPRESSVOTE HW 2.1 MARKER AND TABULATOR,
EXPRESSVOTE XL TABULATOR AND ELECTIONWARE EMS**



Issued By:

A handwritten signature in black ink, appearing to read "Robert Torres", written over a horizontal line.

**Robert Torres
Acting Secretary of the Commonwealth
November 30, 2018**

**EXAMINATION RESULTS OF ELECTION SYSTEMS AND SOFTWARE EVS
6021 WITH DS200 PRECINCT SCANNER, DS450 AND DS850 CENTRAL
SCANNERS, EXPRESSVOTE HW 2.1 MARKER AND TABULATOR
EXPRESSVOTE XL 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 his 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 Commissions, Elections and Legislation (Department) scheduled an examination for June 25, 2018 of EVS 6.0.0.0 (EVS 6000). The system presented for certification in Pennsylvania included the following components - Electionware® (Electionware) election management software used in conjunction with the following components: 1) the ExpressVote XL™ (ExpressVote XL) hybrid paper-based polling place voting device; 2) the ExpressVote® Hardware 2.1 (ExpressVote 2.1) a hybrid paper-based polling place voting device that provides touch screen vote capture that can be configured as a ballot marking device (BMD) or a BMD and tabulation unit; 3) DS200® (DS200) precinct scanner; 4) DS450®(DS450) central scanner; and 5) DS850® high speed central scanner.

The Secretary of the Commonwealth (Secretary) appointed SLI Global Solutions and Center for Civic Design (CCD) as professional consultants to conduct an examination of EVS 6000. The examination process included a public demonstration and functional examination (functional examination), accessibility examination and security testing. The functional and accessibility examinations were performed in Room G24A/B of the Commonwealth Capitol Complex - Finance Building, 613 North Street, Harrisburg, PA 17120. Mike Santos, Senior Test Manager, and Kyle Johnson, Senior Test Engineer, (Functional Examiner) of SLI Global Solutions, conducted the functional examination of the

EVS 6000 pursuant to Section 1105-A(a) of the Election Code, 25 P.S. § 3031.5(a). Whitney Quesenbery, Denis Anson and Colin Macarthur (Accessibility Examiner) representing CCD performed an accessibility examination of the EVS 6000 system. The examinations commenced on June 25, 2018, and lasted approximately four days. Jonathan Marks, Commissioner of the Bureau of Commissions, Elections and Legislation; Kathryn Boockvar, Senior Advisor to the Governor on Election Modernization; Jessica Myers, Deputy Director, Office of Policy; Kathleen Kotula, Executive Deputy Chief Counsel, Office of Chief Counsel; and Sindhu Ramachandran, Voting Systems Analyst, represented the Secretary of the Commonwealth. Steve Pearson, Senior Vice-President of Certification, Benjamin Swartz and TJ Burns, State Certification Managers, represented ES&S. Additional staff members from the Department also attended the examination. The functional examination was open to the public and was videotaped by Department staff. Security testing of the EVS 6000 system was performed at SLI facilities located at 4720 Independence Street, Wheat Ridge, Colorado, prior to the functional examination. Mike Santos, Senior Test Manager, and Jesse Peterson, Security Specialist, at SLI Global Solutions, served as the Security Examiner for the EVS 6000 security testing. The Functional Examiner concluded that the EVS 6000 did not comply with Sections 1107-A(3) and (13) of the Pennsylvania Election Code, 25 P.S. §§ 3031.7(3) & (13), because the ExpressVote XL and ExpressVote 2.1 did not accurately implement the Pennsylvania Method (PA Method) of straight party voting and the general election results did not allow adjudicating two write-in votes from ExpressVote XL ballots. The security testing identified the need to modify the hardening procedures on Electionware for a more secure installation.

Thereafter, ES&S incorporated corrections for the issues identified during the EVS 6000 examination and a performance enhancement fix to a field anomaly noted during the use of the system in a primary election in the State of Kansas, and re-submitted the new release, EVS 6.0.2.1 (EVS 6021), to both the U.S. Election Assistance Commission (EAC) for federal approval and the Department for state certification. The system components remained the same and the only change in the new release was the software enhancements to remediate the identified anomalies. The Functional Examiner performed a follow-up

examination of EVS 6021 on September 25 through 28, 2018, at SLI Global Solutions located in Wheat Ridge, Colorado. Department staff observed the examination via web conference. The examination was videotaped by SLI and the video is on file at the Department. The Security Examiner validated that the hardening procedures were modified for a secure installation. Since the software changes made to the EVS 6021 system were specifically to remediate the identified anomalies in EVS 6000 and did not impact accessibility of the system, it was determined that the results of the accessibility examination conducted as part of the EVS 6000 examination may be utilized for EVS 6021 certification.

II. THE EVS 6021 VOTING SYSTEM

EVS 6021 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 ADA component. The system hardware components include: ExpressVote XL™ Full-Faced Universal Voting System, ExpressVote Universal Voting System hardware 2.1, DS450 High-Throughput Central Tabulator, DS850 High-Speed Central Tabulator and DS200 Precinct-Based Tabulator¹.

The following is a description of the EVS 6021 components summarized from Section 2.0 (System Overview) of the Test Report for Examination of EVS 6021 (Report id - PES-002-FTR-01), prepared by the Functional Examiner and the System Overview document submitted by ES&S as part of the Technical Data Package (TDP).

¹ The EAC certified system 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.

Electionware®

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™

ExpressVote XL 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 (CVR), and tabulation scanning into a single unit. 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 vote summary cards 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 can print the vote summary card once they are ready to cast the vote. Once printed, the ExpressVote XL internally processes the vote summary card for tabulation. The tabulated vote summary card is deposited into a removable, secure card container attached to the ExpressVote XL cart.

ExpressVote® Hardware 2.1

ExpressVote Universal Voting System Hardware 2.1 (ExpressVote HW2.1) is a hybrid paper-based polling place voting device that provides touch screen vote capture and incorporates the printing of the voter's selections as a Cast Vote Record (CVR), and tabulation scanning into a single unit. This system, capable of serving all voters, can operate in either marker or tabulator mode, depending on the configuration that is selected in

Electionware. In marker mode, the voter marks a ballot and prints the vote summary card using the internal thermal printer. The vote summary card is then scanned on DS200 precinct scanner or the central scanners DS450 or DS850. When utilized as a tabulator, the ExpressVote 2.1 provides the capability of tabulating printed vote summary cards. ExpressVote 2.1 incorporates an attached removable, secure container to hold the ballots, allowing the voters to cast the ballots. ExpressVote as a Tabulator uses a Master Media USB device for Poll Open and Poll Close functions.

DS200®

DS200 is a polling place paper-based 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 CVR's to be saved on USB media. DS200 scans and tabulates hand marked paper ballots and ballot cards produced from ExpressVote 2.1. It also has a touch screen for voter communication, an integrated thermal printer for printing reports and internal battery backup.

DS450®

DS450 is a central scanner and tabulator that simultaneously scans the front and back of a hand marked paper ballots and/or vote summary cards from ExpressVote and ExpressVote XL in any of four orientations 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®

DS850 is a central scanner and tabulator that simultaneously scans the front and back of hand marked paper ballots and/or vote summary cards from ExpressVote and ExpressVote XL in any of four orientations 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. DS850 provides higher throughput than DS450.

The following is a listing of the software/firmware components that comprise the entire ES&S 6021 system:

Manufacturer Software/Firmware

The ES&S EVS 6.0.2.1 voting system consists of the following software and firmware components:

Application	Version
Electionware – Client/Server	5.0.2.0
Event Log Service	1.6.0.0
Removable Media Service	1.5.0.0
DS450	3.1.0.0
DS850	3.1.0.0
DS200	2.17.0.0
ExpressVote HW2.1	2.4.3.0
ExpressVote XL	1.0.1.0
Optional Utility: ExpressLink	1.4.0.0
Optional Utility: Toolbox	3.3.0.0

- **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
- **DS200** Precinct scanner and tabulator, Precinct Tabulator firmware
- **ExpressVote HW2.1** Precinct ballot marker and/or Precinct scanner and tabulator, Universal Voting System firmware
- **ExpressVote XL** Precinct ballot marker and/or Precinct scanner and 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.

COTS Software/Firmware

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

Hardware

Below is a listing of the hardware components that comprise the entire ES&S EVS 6.0.2.1 system categorized by system functionality:

Hardware	HW Revision
ExpressVote Universal Voting System	2.1
DS200 Precinct-based Scanner and Tabulator	1.2, 1.3
DS450 Scanner and Tabulator	1.0
DS850 Scanner and Tabulator	1.0
ExpressVote XL Full-Faced Universal Voting System	1.0
ExpressVote Rolling Kiosk	1.0
ExpressVote Voting Booth	N/A
ExpressVote ADA Table	N/A
DS200 Collapsible Ballot Box	1.0
DS200 Plastic Ballot Box	1.2, 1.3, 1.4, 1.5
DS200 Metal Ballot Box	1.0, 1.1, 1.2
DS450 Cart	N/A
DS850 Cart	N/A
Universal Voting Console	1.0

Test Materials

Test support materials utilized during the examination included:

- Thermal receipt paper for the **ExpressVote 2.1 Marking Only**, **ExpressVote 2.1 Marking and Tabulating**, and the **ExpressVote XL**.
- Ballot card stock for processing ballots on the **ExpressVote 2.1 Marking Only**, **ExpressVote 2.1 Marking and Tabulating**, and the **ExpressVote XL**.
- Ballot stock, for printing of ballots to be processed by the **DS200**, **DS450** and **DS850**
- Activation cards
- Smart cards
- USB thumb drives
- Ballot pens
- Printer paper rolls

III. EXAMINATION APPROACH, PROCEDURES AND RESULTS

A. Examination Approach

To ascertain whether EVS 6021 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 initial functional examination of EVS 6000 determined that the system did not comply with Sections 1107-A(3) and (13), 25 P.S. §§ 3031.7(3) & (13). The Examiners also observed that system documentation for validating the installed components and hardening procedures needed to be updated for a secure implementation. After the initial examination for PA state certification in June 2018, EVS 6000 field use in the State of Kansas's primary elections also identified performance anomalies that necessitated remediation. The Examiners then performed a follow-up examination of EVS 6021 to confirm that the anomalies identified in EVS 60000 were corrected and the system complies with all the requirements of the Pennsylvania Election Code. The examination approach followed for EVS 6000 and EVS 6021 is discussed in the below sections.

EVS 6000 Examination Approach

Functional 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 six main areas of test execution: (1) Source Code Review; (2) Documentation Review; (3) System Level Testing; (4) Security/Penetration Testing; (5) Privacy Analysis; and (6) Usability Analysis.

Source Code Review was performed prior to the functional examination to determine if there are any vulnerabilities found that would warrant additional security examination.

Documentation Review was performed to verify that the portions of the Pennsylvania Election Code, which reference documentation detail, are sufficiently met by the ES&S EVS 6000 documentation. The Functional Examiner validated compliance of the system to 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 ITA;
- 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.

System Level Analysis examined the ES&S EVS 6000 voting system in terms of conducting an election. The Functional Examiner created election definitions using Electionware and populated the voting devices (ExpressVote XL - Tabulator, ExpressVote 2.1 - Ballot Marking Device and Tabulator, DS200 – Precinct Scanner, DS450 Central Count Scanner and DS850 Central Count Scanner) with election definitions using transport

media. Votes were captured and ballots were printed and tabulated via ExpressVote XL and ExpressVote 2.1 configured as tabulator. Ballots were marked manually as well as via the ExpressVote 2.1 in marking mode, then tabulated through the polling place DS200 scanner. All ballots (hand marked paper ballots, ExpressVote 2.1 in marking mode, ExpressVote 2.1 in tabulator mode, and ExpressVote XL) created were then tabulated through the DS450 and DS850. Tabulation results for ExpressVote 2.1 in Tabulator mode, ExpressVote XL, DS200, DS450 and DS850 were then processed into Electionware, write-in votes were adjudicated, and reports were generated with results for the election. The results reports were validated against the expected results of the voted ballots.

All components of the EVS 6000 system were exercised to verify that they meet all pertinent requirements of the Pennsylvania Election Code. The test cases were designed to ascertain compliance to 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(3), 25 P.S. § 3031.7(3), requiring an electronic voting system to permit straight party voting, including the "Pennsylvania method" of straight party voting;
- 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 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 prevents 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 prevents 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 for systems that use paper ballots or ballot cards, permits a voter to get a new ballot in the case of a spoiled ballot, and to mark and cancel the 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 (i) a public counter to register how many ballots are submitted to be counted; (iv) will not tabulate an over-vote, with an option to notify a voter of an over-vote if used during voting hours; and (v) generates a printed record that counters are set to zero before voting commences; and
- Parts of 1107-A(17), 25 P.S. § 3031.7(17), requiring an electronic voting system which provides for central-count tabulation to (ii) preclude tabulation of an over-vote; and (iii) indicate that counters are set to zero before processing ballots, either by district or with the capability to generate cumulative reports.

The Functional Examiner 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 his use at public demonstration, even though the requirements were already validated in the documentation review phase by reviewing EAC certification reports.

The Security/Penetration Analysis examined the voting system's compliance with the requirements of the Pennsylvania Election Code by analyzing physical security procedures and impoundment of ballots. Precinct tabulation devices were installed for delivery to the precinct, and the Functional Examiner analyzed the pertinent security procedures performed on each device to ascertain compliance to 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 Examiner also used the security analysis phase of testing to validate

compliance to 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 to Section 1107-A(1) 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 Usability analysis evaluated the compliance of the voting system to Sections 1107-A(14) and (15), 25 P.S. §§ 3031.7(14) & (15). The results from the tests were used by the Functional Examiner to supplement his conclusions from the documentation review phase.

Accessibility Examination

The accessibility examination was designed to provide insight and information on each voting system's usability and accessibility, especially for voters with disabilities and for poll workers responsible for managing the system on Election Day. The Accessibility Examination included a team of three examiners with accessibility, usability and election process experience (collectively referred as "Accessibility Examiner"). The examination process was divided into three parts:

- **Expert review** by the Accessibility Examiner, using scenarios based on personas of people with disabilities from National Institute of Standards and Technology (NIST) and their professional experience.
- **Voters with disabilities** used the system voting a reasonable length PA ballot and completed a questionnaire about their experience. The Accessibility Examiner observed and made notes.
- **Election officials and poll workers** tested the accessibility features to evaluate how they would be activated during an election. They commented on the system based on their experience.

The testing team constructed a typical PA ballot, with a mix of contest types and variation in the number of candidates to be voted for each contest. The Accessibility Examiner conducted an expert review, observed 7 voters with disabilities, and worked with 10 poll workers in a guided review of the systems. Voters alternated between using the ExpressVote/DS200 and ExpressVote XL and some voters tried both systems.

Security Testing

The Security testing provided a means to assess the required security properties of the voting system under examination and 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 used in a live election.

EVS 6021 Examination Approach

EVS 6021 is a release to correct the anomalies noted in EVS 6000 system. The examiners evaluated the changes submitted by ES&S and developed test protocols to validate the modifications to EVS 6000 to ensure that the fixes resolved the identified anomalies and that the modified system maintained compliance with all the Pennsylvania Election Code requirements.

Functional Examination

The Functional Examiner and Department agreed that the test approach must include Source Code Review, System Level Testing and Documentation review. Security/Penetration, Privacy and Usability analysis results were leveraged from the EVS 6000 examination since those aspects of the system remained unaffected by the isolated code changes made to the system.

Source code review was done to determine if there were any vulnerabilities that warranted additional testing. System Level Testing examined EVS 6021 in terms of conducting a general election and closed primary election. The election runs were to (a) test and confirm that the anomalies identified during EVS 6000 examination were remediated and (b) to perform regression testing of all components of the system. The election runs allowed the Functional Examiner to ascertain that compliance with the Election Code requirements determined during the System Level Testing of EVS 6000 is maintained in the new release. The Documentation review was conducted to ensure that the system documentation for EVS 6021 provided accurate validation procedures for verifying installation of correct system components.

Accessibility Examination

The Department of State in consultation with the Accessibility Examiner decided that the findings from EVS 6000 Accessibility Examination could be used for EVS 6021, since there were no hardware changes and the isolated code changes were for performance improvements and fixing the anomalies identified during EVS 6000 Functional Examination.

Security Testing

The Security Examiner evaluated the system changes, specifically the changes to the Electionware hardening scripts to confirm that the script changes would secure the Election Management installation further.

B. Examination Process and Procedures

The examination process and procedures followed for EVS 6000 and EVS 6021 examinations are listed in the below sections. The final determination in this report is based on the combined analysis of the results and conclusions from both examinations.

EVS 6000 Examination

Functional Examination

The public demonstration and functional examination portion commenced on June 25, 2018, at Room G24A/B of the Commonwealth Capitol Complex - Finance Building, 613 North Street, Harrisburg PA 17120. The test execution tasks took approximately two and one-half days. Members of the public were allowed as observers for the examination. The Functional Examiner performed System Level Testing, Security/Penetration Testing and Privacy and Usability Analysis during the examination. Source code and Documentation review were completed prior to the public examination at SLI lab facilities in Wheat Ridge, Colorado.

ES&S supplied all the hardware equipment required for the examination. All software and firmware necessary to perform the examination was received directly from the Voting System Test Laboratories (VSTL) that tested the voting system for EAC certification. The trusted build of the software and firmware for each device being evaluated were installed using the appropriate media for installation. The hash codes for all system components were captured using the process listed in the manufacturer's Technical Data Package (TDP) by the Functional Examiner with assistance from ES&S representative. The Functional Examiner 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.

The Functional Examiner created the election definition using Electionware and prepared the precinct tabulation device DS200, polling place vote capture devices ExpressVote XL and Express Vote 2.1 and central scanners DS450 and DS850 using transport media. The polling place was set up using ExpressVote XL, ExpressVote 2.1 Marker, ExpressVote 2.1 Tabulator and DS200. A primary and general election were then run using polling place devices and central scanners. Ballots were tabulated via the polling place tabulation devices and central scanners. Results were then tabulated using Electionware and validated against expected results.

Accessibility Examination

The accessibility examination portion commenced on June 25, 2018, at Room

G24A/B of the Commonwealth Capitol Complex - Finance Building, 613 North Street, Harrisburg, PA 17120. The examination lasted approximately three days followed by a debrief meeting on June 28, 2018 with DOS and CCD to discuss initial findings. The examination included expert review by the Accessibility Examiner, sessions with 3 poll worker groups from Dauphin County, PA, and sessions with 7 voters with disabilities using different assistive devices for voting. The voter sessions each took approximately an hour and the poll worker sessions took approximately 90 minutes each. ES&S supplied the hardware and supplies for the Accessibility Examination. The equipment was prepared for the examination by loading the required election definition using transport media. The Accessibility Examiner prepared voting scenarios for each voting session to allow comparison of results between each session. The scenarios were constructed to provide a structured opportunity to explore how the system works in all interaction modes, using:

- visual touch screen with default settings;
- visual touch screen with text size and contrast changes;
- audio and the tactile keypad;
- audio and the visual touch screen; and
- audio or visual display with the dual switch.

Both the ballot contents and the instructions for marking the ballot were designed to exercise different types of interactions (navigation in ballot, navigation in contest, undervotes, overvotes, straight party). The ballot included both very short contests, and those long enough to potentially fill more than one screen, even at the default text size.

Expert Review by Accessibility Examiner

The Accessibility Examiner used the same ballot and instructions to be used for voter and poll worker review, for their expert review, so they would be familiar with the interaction voters would experience.

Sessions with voters

The voter sessions all took about an hour. They included:

- An opening interview about their previous voting experience and the types of assistive technology they used in both daily life and in voting.
- Orientation to the system with an opportunity for voters to ask questions about any assistive technology available. For example, one participant asked if she would be able to use her own audio to connect directly to her hearing aids.
- Voting a ballot, following instructions given verbally by the Accessibility Examiner. Voters were encouraged to give feedback as they went through the ballot. The Accessibility Examiner and the voters discussed any feedback and questions that occurred during the voting sessions and re-evaluated any findings as necessary.
- A closing interview about their reactions to the experience of using the voting system.

Sessions with poll worker groups

The sessions took 60-90 minutes, depending on how many people were in each group. The session included:

- A brief orientation to the voting system and the access features, similar to the way a poll worker trainer might introduce the system.
- The poll workers each then marked a ballot, tried out the access features if they wanted, and were given an opportunity to read the “During Election Day” instructions provided with the system
- The Accessibility Examiner presented them with 6 scenarios of different access needs and asked them to help set up the system for one of the facilitators acting as the voter in each of the scenarios.

The Accessibility Examiner took notes about aspects of the system that worked well and problems they encountered during all three phases of the examination. The issues were then categorized 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
- **Show stoppers** - problems that could prevent successful independent and private voting, even with good knowledge about how to use the system and accessibility features

The Accessibility Examiner then compiled the findings including categorizations from the examination into a report submitted to the Secretary.

Security Testing

The Security Testing was done at SLI lab facilities in Wheat Ridge, Colorado. The Security Examiner received the hardware devices from ES&S and the software and firmware was obtained from the Voting System Test Lab (VSTL) which tested the system for EAC certification testing. The Examiner installed the Trusted Build prior to the evaluation using the appropriate media for installation. The Security Testing is comprised of a series of test suites which are utilized for verifying that a voting system will correspond to applicable security requirements within the Pennsylvania Election Code. The Security Examiner evaluated each component of the EVS 6000 system and the system as a whole for interactions between components. These test suites covered areas of confidentiality, vote anonymity, integrity, availability, and auditability of the voting systems.

The requirements associated to each area of testing were applied to the EVS 6000 system in the following manner. The Security Examiner did a review of the EAC testing reports of the system and also executed tests for a cross section of VVSG 2005 requirements to reconfirm compliance. The Security Examiner then designed tests that included in depth verification and validation of reports, audit logs and physical access controls for each of the components of the voting system. The physical security examination included security seals, lock/key combinations, measures for collection of voting in the event of an extended power outage, ballot box and system access points. Tests were done to ensure that election results, media used, reports and audit logs were protected from attempts to decrypt, manipulate or corrupt election data. The Security Examiner also created a vulnerability assessment and performed penetration testing of the EVS 6000 system.

ES&S EVS 6021 examination

Functional Examination

The follow-up examination commenced on September 25, 2018, at SLI Global Solutions facility, 4720 Independence Street, Wheat Ridge, Colorado, and was observed by Department staff in a conference room in BCEL, 210 North Office Building, 401 North Street, Harrisburg, Pennsylvania via web conference. ES&S supplied all the hardware equipment required for the examination. All software and firmware necessary to perform the examination was received directly from the VSTL that tested the voting system for EAC certification. The Functional Examiner installed and/or verified the Trusted Build for each system component. A primary and general election were then run using ExpressVote XL, ExpressVote 2.1 (Marker and Tabulator), DS200, DS450 and DS850. Results were then tabulated and validated against expected results. The Functional Examiner performed the Source Code and Documentation Review before the witnessed examination.

Security Testing

The follow-up Security testing verified the changes to the documentation for appropriately hardening the Electionware EMS for secure installation.

C. Examination Results

EVS 60000 Functional Examination

On July 16, 2018, the Functional Examiner issued his draft report for the testing of EVS 6000 with a recommendation that the system was not in compliance with Sections 1107-A(3) and (13) of the Pennsylvania Election Code, 25 P.S. §§ 3031.7(3) & (13). The report noted the following concerns for PA method implementation:

- 1) On the ExpressVote XL, when voting a straight party ballot and the voter modified a straight party contest that was a “vote for no more than N” and has “N” candidates for the selected party, with a write-in candidate, the voter was incorrectly notified that they were attempting to overvote. In fact, following the PA method implementation, the “N” straight party selected candidates should have been deselected and the voter should have been able to proceed with the write-in.
- 2) On the ExpressVote 2.1, in the general election, an issue was encountered when voting a straight party ballot and the voter modified a straight party contest that was a “vote for no more than N” and had less than “N” candidates for the selected party. In this scenario, the ExpressVote 2.1 continuously instantiated the PA method any time when the marks on the ballot were the same candidate selections as the straight party selection, irrespective of whether it was the first time a selection was made in the contest after straight party voting or not.

The Functional Examiner noted that the test results were not as expected for the tests executed to verify compliance to Section 1107-A(3), 25 P.S. § 3031.7(13); since an issue was encountered when a general election ballot was scanned through the ExpressVote XL but scanned at an unexpected orientation such that the implemented image area capture parameters were too tight and that Electionware was unable to parse two write-ins from the ballot image, so those write-ins could not be adjudicated.

The Functional Examiner also noted that the EVS 6000 system TDP needed to be

updated to provide accurate validation procedures for verifying installation of correct system components. The EVS 6000 documentation did not accurately reflect system verification procedures for ExpressVote 2.1.

The Functional Examiner's report indicated successful completion of tests executed to ascertain compliance to all other requirements mandated by the Pennsylvania Election Code. The Examiner report for EVS 6000 (Test Report – PES-002-FTR-01) included details of the test cases, execution and successful completion. The following section is a summary of the results of the examination as set forth in fuller detail in the Examiner's Report.

1. Source Code Review

Source Code Review for EVS 6000 was performed, with a focus on determining whether any vulnerabilities could be found. The Functional Examiner reported that the code review was completed with no identified malicious software, cryptographic software, process control or password management vulnerabilities. The Examiner concluded that no deficiencies were found during source code review.

2. Documentation Review

The Documentation Review testing performed by the Functional Examiner demonstrates that the EVS 6000 meets the relevant requirements of the Pennsylvania Election Code. The Examiner reviewed the "Test Report for EAC 2005 VVSG Certification Testing of ES&S EVS 6.0.0.0 Voting System" (report number ESS-7001-CTR-01).

The review of the EAC test reports by the Functional Examiner 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 has been examined and approved by a federally recognized independent testing authority (ITA), or VSTL as such authorities are now called, as meeting the applicable performance and test standards established by the federal government.

Functional Examiner 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 combination of EAC hardware Non-Operating Environmental Tests, which included bench handling, vibration, low temperature, high temperature, humidity and product safety tests. The system accuracy testing 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).

3. 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), three precincts, and 16 contests (14 partisan contests and 2 referendums - 8 "Vote for One", 1 "Vote for no more than Two", 3 "Vote for no more than Three", 1 "Vote for no more than Four" and 1 "Vote for no more than Fifteen") was run utilizing Electionware, ExpressVote 2.1, ExpressVote XL, DS200, DS450 and DS850. Referendum contests were added to test the generation of non-partisan ballots. The Functional Examiner validated compliance of the system to 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 16 contests (13 partisan contests, 1 non-partisan and 2 retention contests, 9 "Vote for One", 1 "Vote for no more

than Two”, 3 “Vote for no more than Three”, and 1 “Vote for no more than Fifteen”) was run utilizing Electionware, ExpressVote 2.1, ExpressVote XL, DS200, DS450 and DS850. The Functional Examiner examined the compliance of the system to Sections 1101-A and 1107-A(2)-(8), (10)-(11) and (13), 25 P.S. §§ 3031.1, 3031.7(2)-(8), (10)-(11) & (13).

The Functional Examiner included test cases to validate Sections 1107-A(16) and (17), 25 P.S. §§ 3031.7(16) & (17), that mandate voting systems to generate zero proof reports and correctly handle over-votes during the election runs. The remainder of the requirements of 25 P.S. §§ 3031.7(16) and (17) were validated by the Functional Examiner 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, DS450 and DS850. Polls were opened and ballots were marked manually, as well as electronically via the ExpressVote 2.1 in Marking mode, then tabulated through the polling place DS200 scanner. Ballots were marked and tabulated utilizing the polling place ExpressVote 2.1 in Tabulator mode and the ExpressVote XL devices. All ballots (hand marked, ExpressVote 2.1 in Marking mode, ExpressVote 2.1 in Tabulator mode, and ExpressVote XL) created were then tabulated through the DS450 and DS850. Thus, each ballot was tabulated three times.

The Functional Examiner used English 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 6000 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 in marker mode allow voters to use the precinct scanner DS200 for tabulation. ExpressVote 2.1 in tabulator mode and ExpressVote XL create a paper ballot based on a voter’s selections, which is tabulated when the voter 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 Examiner successfully added contests including straight party, parties, choices, precincts, districts, ballot styles, referendum questions and retention contests with appropriate candidates and choices. The ExpressVote 2.1 (marker and tabulator), ExpressVote XL and DS200 components of the EVS 6000 successfully permitted votes for "1 of 1," "N of M," and "Question" contests for a standard and ADA voting session. The Functional Examiner also exercised a straight party vote to confirm that all appropriate candidates were selected. The Functional Examiner thus concluded that the system is in compliance with Section 1107-A(2), 25 P.S. § 3031.7(2).

Each of the applicable components of EVS 6000 allowed the test voter to cast a write-in vote and demonstrated compliance with Section 1107-A(5), 25 P.S. § 3031.7(5).

EVS 6000 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 to Section 1107-A(7), 25 P.S. § 3031.7(7), was demonstrated since DS200 has the capability to indicate overvotes for any office and the voter has the ability to either spoil the ballot or cast the ballot with overvotes if the voter decides to do so. ExpressVote XL and ExpressVote 2.1 (marker and tabulator) did not allow overvotes. The Functional Examiner also noted that the system allowed undervotes, but warned the user about the undervote when configured to do so.

The successful validation of the election results shows that central scanners DS450 and DS850, as well as precinct tabulator DS200, 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).

The EVS 6000 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 or central scanners DS450 or DS850. The Functional Examiner attempted to change votes on 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 ExpressVote and ExpressVote XL allowed changing the selections until the voter decides to print or cast the ballot. The DS200 precinct scanner of EVS 6000 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.

Accuracy requirements of 1107-A(11), 25 P.S. § 3031.7(11), that were ascertained by reviewing EAC test reports were further validated by the successful tabulation and validation of the primary and general elections run by the Functional Examiner.

The Functional Examiner validated via test cases during the primary and general election that the tabulating devices DS200, DS450 and DS850 generated zero proof reports only before ballots were cast, the system rejected all votes for the contest in an overvote situation, and 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 Examiner confirmed that the zero-proof report cannot be generated on demand after a ballot is cast.

Ballots were marked by hand including write-in votes during the general election to examine the system's ability to properly enact the PA method. The DS200, DS450 and DS850 demonstrated compliance to Sections 1107-A(3) and (4), 25 P.S. §§ 3031.7(3) & (4), by appropriately tabulating the votes. The Functional Examiner identified anomalies in the

implementation of the PA Method on ExpressVote 2.1 and Expressvote XL.

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. On the ExpressVote XL and Electionware, an issue was encountered when a ballot was scanned through the XL but scanned at an unexpected orientation such that the implemented image area capture parameters were too tight; consequently, the Electionware was unable to parse two write-in votes from the ballot image, so the votes could not be adjudicated. The Functional Examiner hence concluded that EVS 6000 did not comply to Section 1107-A(13), 25 P.S. § 3031.7(13).

4. Security/Penetration Analysis

The Functional Examiner adopted a strategy to review each pertinent requirement for this test individually and then created test cases to address it in either in a documentation review, a functional test, or both.

Precinct tabulation devices and ballot marking devices were configured for delivery to a polling place from 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 for the ability to be tampered with: the inspection examined ports, outer case and memory devices to confirm that they are all secure and the locks and seals are tamper proof and evident. The Functional Examiner also examined the components of the EVS 6000 system for password management of administrative functions and ensured that the system counter could not be reset by unauthorized persons. In addition, the Functional Examiner also reviewed “ES&S System Security Specification” document for ballot security procedures at the polling place and central location to ensure that the manufacturer recommended the required steps for configuring the EVS 6000 securely for the election. Based on the tests, the Functional Examiner concluded that that the system complies to Section 1107-A(12), 25 P.S. § 3031.7(12).

The Functional Examiner included test cases during the Security/Penetration 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 Examiner validated that the tabulation devices ExpressVote XL, ExpressVote 2.1 (tabulator) and DS200 had a visible public counter and the system prevented authorized and unauthorized users 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) and DS200 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 zeroproof 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 Examiner concluded that EVS 6000 complies with all requirements mandated by 25 P.S. §§ 3031.7(16) and (17).

5. Privacy Analysis

The Functional Examiner reviewed and inspected the privacy aspects of EVS 6000 system to determine compliance with Section 1101-A(1) of the Election Code, 25 P.S. § 3031.7(1). The Functional Examiner 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 Examiner for adequate visual secrecy. The Functional Examiner also verified that no voter data, including stored ballot images are tied back to any specific voter in a manner that would compromise voter secrecy.

6. Usability Analysis

The Functional Examiner determined that EVS 6000 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 his experience of using all the functionalities of the system during the examination.

EVS 60000 Accessibility Examination

The tests included examiner review, sessions with voters and poll workers. A summary of the test details and findings is discussed in this section.

Examiner Review

The Accessibility Examiner conducted a review of the voting system under examination prior to sessions with voters and poll workers. The Accessibility Examination team included both accessibility and usability expertise to ensure background and knowledge of the issues for accessible voting. The Accessibility Examiner had experience working with people with a wide variety of disabilities and their impact on daily life, knowledge of the range and use of assistive technologies that voters with disabilities might rely on for access, experience conducting usability evaluations with voters, and strong knowledge of best practices and design principles for digital technology and voting systems. The expert review by the Accessibility Examiner gave a chance to make sure they understand how the system and accessibility features work and to note anything that could inform preparation for other testing.

Voter Sessions

The following voter population was represented in the test sessions:

- 2 blind from birth
- 1 acquired blindness
- 1 very low vision
- 1 low vision + hard of hearing using a personal assistive device
- 1 cognitive disability
- 1 limited mobility ESL speaker (also a non-voter because not yet a citizen).

Age Ranges: 35 thru 70. All but one (a 70-year old) were in the 35-60 year-old age range.

Counties: Allegheny, Bucks, Cumberland, Dauphin, and Philadelphia

The voters had a range of voting habits. One was a non-voter. One last voted in the 2016 Presidential election. Two last voted in November 2017, and three who voted in the May 2018 Primary.

Poll worker Sessions

Poll workers were invited to come in teams. We had three sessions with poll worker teams of 2, 3, and 5 for a total of 10 people. These poll workers:

- were from Dauphin county
- had between one and twenty-four years of experience and included one election judge
- had limited experience serving voters with disabilities

The examiner compiled the findings from the examiner review, voter sessions and poll worker sessions into positives, annoyances, problem solving, needs assistance and show stoppers.

This section depicts the summarized findings of the most significant issues identified, and the Accessibility Examiner's analysis and recommendations. Attachment B of this document lists these issues in fuller detail and also describes all the observations from the Accessibility Examination.

Automatic selection and deselection and accompanying audio navigation- Some voters using audio ballots were confused by the automatic selection and deselection that is part of the straight party voting. The Accessibility Examiner noted that the audio ballot did not announce all deselections and deselections may not always be visible on screen if the contest has a long list of candidates. The Accessibility Examiner noted that in some cases this issue may lead to voters casting ballots without knowing all their choices. The problem was exacerbated by the inability

of a blind voter to successfully validate the printed ballot on the ballot viewing window on ExpressVote XL. The Accessibility Examiner also noted that the system doesn't allow deselecting all candidates in a contest, if there is an eligible candidate selected by straight party vote. Due to the confusion in selection/deselection, the voters using audio ballot were not able to perceive and understand the system behavior, leading voters into time-consuming problem solving that takes away from their primary task of voting and may lead to requesting assistance. The Accessibility Examiner noted that even though the voting systems must legally comply with the PA method of straight party voting, the interaction should fully inform the voter of what happened including number and names of the candidates being selected/deselected on screen as well as audio ballot.

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 is happening. This may cause the need to ask for assistance. The Accessibility Examiner recommended that all instructions must be reviewed thoroughly and have consistent language without unnecessarily repetitive instruction.

Verification is possible, but challenging – The Accessibility Examiner tested whether verification can be part of the normal course of voting for voters with disabilities and noted the results for both ExpressVote 2.1 and ExpressVote XL.

ExpressVote 2.1 – If configured as marker (without tabulation) the system ejects the ballot after printing and the ballot can be scanned in the DS200 to complete the voting process. This allows voters to review the paper ballot and also makes it possible to use personal devices like magnifiers or text readers to read the paper ballot. The ballot also can be reinserted into the ExpressVote 2.1 for review. The review by reinserting the ballot did not read back the write-in options to the voter. The Accessibility Examiner also suggested that the verification may require the ballots to be moved to a stable surface for review using magnifiers or text readers. The

examiner also noted that removing the ballot from the ExpressVote 2.1 system requires some force and some voters may require assistance.

ExpressVote XL – allows the voter to validate the paper ballot thru a glass window before casting. The Accessibility Examiner noted that this presents a problem for verification for users especially who require personal assistive devices for verification.

Despite these challenges, it is the opinion of the voters and experts that these systems are much more useable and accessible than the current ADA voting systems used in Pennsylvania and allowed most voters to vote independently.

EVS 60000 Security Examination

As mentioned in the Examination Approach section of this document, the Security Examiner defined the Security Testing to be comprised of a series of test suites which are utilized for verifying that a voting system will correspond to applicable security requirements within the Pennsylvania Election Code. The examiner analyzed the test results and summarized any identified deficiencies into 4 major categories documentation, source code, hardware, and functional. The Security Examiner then evaluated the physical security, software hardening and existing system controls in place prior to identifying items that require remediation before the system is certified for use in Pennsylvania. The examiner also provided recommendations on secure implementation and deployment.

EVS 6021 Examination Results

EVS 6021 Functional Examination

As identified in the test approach section of this document the follow-up examination of EVS 6021 included Source Code Review, Documentation Review and System Level Testing.

1. Source Code Review

A Source Code Review for the code modifications for EVS 6021 was performed,

with a focus on determining whether any vulnerabilities could be found. It was concluded that the code review was completed with no malicious software, cryptographic software, process control or password management vulnerabilities being found. The Functional Examiner concluded that no deficiencies were found during source code review.

2. Documentation Review

The Functional Examiner reviewed ES&S submitted documentation for system validation procedures. The Functional Examiner concluded that system documentation was updated to provide accurate procedures for verifying installation of correct system components on the ExpressVote 2.1.

3. System Level Testing

The System Level Testing was divided into two tests, a primary election and general election. The Functional Examiner included test cases to specifically test the PA method anomalies identified during EVS 6000 testing as part of the general election.

A closed primary election consisting of two parties (Republican, Democratic), three precincts, and 16 contests (14 partisan contests and 2 referendums - 8 “Vote for One”, 1 “Vote for no more than Two”, 3 “Vote for no more than Three”, 1 “Vote for no more than Four” and 1 “Vote for no more than Fifteen”) was run utilizing Electionware, ExpressVote 2.1, ExpressVote XL, DS200, DS450 and DS850. Referendum contests were added to test the generation of non-partisan ballots. The Functional Examiner validated compliance of the system to Sections 1101-A and 1107-A(2), (5)-(11) and (13), 25 P.S. §§ 3031.1, 3031.7(2), (5)-(11) & (13). 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 16 contests (13 partisan contests, 1 non-partisan and 2 retention referendum, 9 “Vote for One”, 1 “Vote for no more than Two”, 3 “Vote for no more than Three”, and 1 “Vote for no more than Fifteen”) was run utilizing Electionware, ExpressVote 2.1, ExpressVote XL, DS200, DS450 and DS850.

The Functional Examiner examined the compliance of the system to Sections 1101-A and 1107-A(2)-(8), (10)-(11) and (13), 25 P.S. §§ 3031.1, 3031.7(2)-(8), (10)-(11) & (13).

The Functional Examiner created election definitions and executed appropriate test cases on all components of EVS 6021 to ensure that the modified system satisfies all requirements of the Pennsylvania Election Code. The Functional Examiner used English 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.

Ballots were marked on ExpressVote XL and ExpressVote 2.1 to examine the system's ability to properly effectuate the PA method of straight party voting. The test cases included different voting patterns that selected either a candidate from the same political party, a different political party or a write in when the contest had a full slate of candidates or less than full slate of candidates. The issue found on ExpressVote 2.1 and ExpressVote XL during Examination of EVS 6.0.0.0, were verified to be resolved. The votes were tabulated accurately following the PA method rules. The Functional Examiner concluded that the EVS 6021 complies with Section 1107-A(3), 25 P.S. § 3031.7(3), since the components ExpressVoteXL, ExpressVote 2.1, DS20, DS 450 and DS 850 all handled the PA method test cases done as part of the general election test appropriately.

The issue found during the examination of EVS 6.0.0.0, on the ExpressVote XL and Electionware, when a ballot was scanned through the XL but scanned at an unexpected orientation such that the implemented image area capture parameters were too tight, that Electionware was unable to parse two write-ins from the ballot image, so could not be adjudicated, was verified to be resolved. To validate this, the Functional Examiner imported the scanned ballot data from the EVS 6000 to EVS 6021 Electionware and the write-ins were visible to be adjudicated appropriately.

The Functional Examiner confirmed with appropriate test cases and voting patterns that EVS 6021 maintains compliance to Sections 1101-A and 1107-A(2), (4)-(11) and (16)-

(17), 25 P.S. §§ 3031.1, 3031.7(2), (4)-(11), & (16)-(17), via tests cases in a similar manner as done during the EVS 6021 examination.

The Functional Examiner also noted that the paper ballots will allow statistical recounts as required by Sections 1117-A, 25 P.S. § 3031.17.

EVS 6021 was certified by EAC on November 12, 2018, and hence compiles 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 added to this report as Attachment A.

Additional Security/Penetration Analysis, Privacy and Usability results were not conducted during the EVS 6021 examination since the test cases validated during these tests were not affected by the isolated modification done to the OVI-VC to adequately handle the PA method.

The Functional Examiner identified that the following 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; and
- 25 P.S. § 3031.22.

After all the testing activities, the Examiners and Department concluded that the EVS 6021 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. The conclusion was drawn based on the examination of EVS 6021 in conjunction with the EVS 6000 examination.

D. Observations

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

1. The ExpressVote XL and ExpressVote 2.1 doesn't intuitively allow a voter to deselect all candidates after straight party voting if there is an eligible candidate selected by straight party vote. This will make it difficult for a voter to vote for no candidate in a contest after voting straight party. The system presents the voter with a pop-up message suggesting that the voter cannot deselect all candidates when using the straight party option to mark the ballot. The voter must undo their straight party selection and mark individual contests if they intend to cast a "no vote" in a contest.
2. The system presented for examination had undervote warnings turned on for straight party contest on ExpressVote XL and ExpressVote 2.1. This may make the voter believe that there is a need to make a selection in that contest.
3. ES&S EVS 6021 does not support cumulative voting.
4. The system allows a configuration on ExpressVote 2.1 as tabulator where the voter can proceed to cast a vote without reviewing the paper ballot. If the system is configured to do so, the voter after reviewing the ballot on the ExpressVote 2.1 screen, can cast the ballot. With this configuration, the voter doesn't have the opportunity to verify the paper ballot before casting the vote.

5. The ExpressVote XL can be configured without the vote summary and review screen.

6. The Functional Examiner 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.

7. The configuration of the system complying with the Pennsylvania Election Code requirements including the PA method will require the use of appropriate selections of configurable parameters.

8. The USB devices and other portable media used with the voting system components need to be reformatted or replaced with new media before every Election use. The vendor recommendations only suggest a reformat, but doesn't specify that it needs to be a full reformat.

IV. Conditions for Certification

Given the results of the examination that occurred in June and September 2018, and the findings of the Examiners as set forth in his reports, **the Secretary of the Commonwealth certifies the EVS 6021 subject to the following conditions:**

A. Pennsylvania counties using the EVS 6021 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, and any future revisions or directives. In particular, Pennsylvania counties must adhere to item four (4) of the 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(1) of the Election Code, 25 P.S. § 3031.7(1)).

B. No components of the EVS 6021 shall be connected to any modem or network interface, including the Internet, at any time, except when a standalone local area wired

network configuration 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 6021, including wireless LAN cards, network adapters, etc. must be uninstalled or disabled prior to delivery or upon delivery of the voting equipment to a county board of elections.

C. Because EVS 6021 is a paper-based system, counties using the EVS 6021 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 via a manual count of the voter marked paper ballots exclusively. 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 and any future revisions or directives that may apply to audits of electronic voting systems.

D. All jurisdictions implementing the EVS 6021 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. Counties must ensure that the L&A test cases include all applicable scenarios of PA straight party method identified in Attachment C to the Directive for electronic voting systems published by BCEL on September 11, 2017.

E. EVS 6021 is a paper-based system, and hence, implementation of the system for precinct or central count scanning is scalable. Jurisdictions should calculate the number of voting booths 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 on polling place components when deciding on the number of voting booths. Jurisdictions must also take into consideration that ExpressVote XL and ExpressVote 2.1 as a tabulator requires the ballot bin to be changed or emptied after about 300 ballots. For DS200 ballot box capacities, jurisdictions can refer to DS200 operators guide from ES&S.

F. All jurisdictions implementing the EVS 6021 must implement administrative safeguards and proper chain of custody to facilitate the safety and security of electronic systems pursuant to the Guidance on electronic Voting System Preparation and Security, September 2016.

G. Jurisdictions implementing the EVS 6021 with the Central Count Tabulator 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.

H. All jurisdictions implementing the EVS 6021 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 any password compromise. The passwords and permissions management must at a minimum comply to 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 6021 must configure the polling place components of the voting system to notify voters when they attempt to cast overvotes. The

DS200 tabulation device options must be set to “Query Voter Preference” for overvoted hand marked paper ballot. 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 6021 must work with ES&S to ensure that only the certified system configuration is installed on purchase or anytime 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. A sample format that can be used for the attestation is added Attachment C to this document.

K. ExpressVote 1.0 and ExpressTouch devices are not certified for use in Pennsylvania with EVS 6021. 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 review of the ballot must be agreed upon by a team of at least two reviewers authorized by the election official. The election official can also consult the paper ballot to assist with determinations made during adjudication. In the event of a recount, the voter verified paper ballots must be used for the count.

M. Jurisdictions implementing EVS 6021 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 use certified voting system components. The systems used for ballot definition must be configured securely following conditions outlined in this report and following any Directives and Guidance issued by the Secretary. Any data transfer between the vendor and county must be done using encrypted physical media or 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. 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 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 interaction with straight-party choices.
- The audio ballot instructions on messages on the system must have the specific information for the task or screen before the general, repeated instructions.

P. Jurisdictions must make voters aware that voting straight party is optional via clear instructions on paper, on screen and on audio ballots. This is to ensure that the voter doesn't assume that he/she must make a selection for the straight party contest. The ballot instructions must be approved by the Department and follow any directives and/or guidance issued by the Department.

Q. The ExpressVote XL and ExpressVote 2.1 components of the EVS 6021 system does not allow the voter to deselect all candidates after voting straight party as noted

on Page 36, Observation 1 of this document. Jurisdictions must ensure that the message used in the pop up window to the voter is clear enough to communicate the system behavior to the voters. The message content must be approved by the Department and follow any directives and/or guidance issued by the Department.

R. Jurisdictions implementing ExpressVote XL must ensure that the configuration allows voters to review their vote selections on the screen and on the printed ballot card before it is cast.

S. Jurisdictions implementing the ExpressVote 2.1 as a Tabulator must ensure that the system is implemented in a configuration that allows physical review of the printed paper ballot, before casting the vote. The system **must not** be configured to have the voter validate the selections on the screen and “Autocast” the ballot, thus causing a situation where the voter has not verified what was printed on the paper ballot. The system must be configured to always return the marked ballot card (“Always Return Card” option) to the voter for review before tabulation.

T. Jurisdictions implementing ExpressVoteXL and ExpressVote 2.1 as 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 of 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.

U. The electronic voting system must be physically secured while in transit, storage, or while in use at their respective locations. Unmonitored physical access to devices can lead to compromise, tampering, and/or planned attacks.

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

W. 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 that can be removed by authorized personnel when the port is needed.

X. Jurisdictions using standalone installation of the EMS server on portable devices must protect the laptops to prevent lost or stolen device.

Y. 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 and reported in a timely manner.

Z. Jurisdictions implementing EVS 6021 must ensure that the USB devices and any other removable media used for election activities is maintained with strict chain 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.

AA. Jurisdictions implementing EVS 6021 must work with ES&S to ensure appropriate levels of training for election officials is planned on implementation. Counties must ensure that the trainings adhere to the “Minimum Training Requirements” specified in Attachment D of this document.

BB. Jurisdictions implementing EVS 6021 must include voter and poll worker training as part of the implementation plan. The training must include hands on practice for both voters and poll workers. Specific consideration must be given to voters using assistive devices and also poll worker education to assist voters with disabilities. Refer to Appendix B, listing detailed recommendations for deployment noted by the Accessibility Examiner.

CC. Jurisdictions implementing EVS 6021 must consider the following during

voting booth set up for serving voters requiring assistive devices

- 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.
- For the ExpressVote,2.1 as marker, 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.

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

DD. 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 publicly available social media platform. The videos must be closed captioned for the visually 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. Must be provided in additional languages for any jurisdictions required to meet thresholds in the Voting Rights Act.
- EE. 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;
 - **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;
 - **SOC 2 Reporting** – ES&S shall provide the Secretary with its annual American Institute of Certified Public Accountants (AICPA) Attestation Standard (AT) Sec. 101 Service Organization Control (“SOC”) 2, Type 2 certification (AT Sec. 101 SOC 2, Type 2), or an equivalent certification approved by the Commonwealth. Equivalent certifications include, but are not

limited to: International Organization of Standards (ISO) 2700x certification; certification under the Federal Information Security Management Act (FISMA); and AT Sec. 101 SOC 3 (SysTrust/WebTrust) certification.

FF.ES&S must adhere to the “Source Code and Escrow Items Obligations” specified in Attachment F of this document.

GG. 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.

HH. Jurisdictions implementing the EVS 6021 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. § 3031.5(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.

II. 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 6021. If the vendor or a County Board of Elections makes any changes to the EVS 6021 Voting System subsequent to 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 6021 Voting System in the Commonwealth of Pennsylvania.

V. Recommendations

- A. All jurisdictions implementing EVS 6021 Voting System should 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 implementing EVS 6021 should take appropriate steps to ensure that voter education is part of the implementation plan.
- C. All jurisdictions implementing the EVS 6021 should ensure that precinct election officials and poll workers receive appropriate training and are comfortable using the system.
- D. All jurisdictions considering purchase of the EVS 6021 should review the System Limits as mentioned in the EAC certification scope added as Attachment A to this report.
- E. 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.
- F. 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 6021 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 6021 for use in this Commonwealth.

The ExpressVote XL and ExpressVote 2.1 can accommodate 10-12 voters with disabilities during an election day or 20-60 voters an hour when used as the primary voting system depending on 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 DS 200 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 to a secure box and replace the ballot box.

Attachment A – EAC Certification Scope



**EVS6021_Scope&Ce
rt.pdf**



United States Election Assistance Commission

Certificate of Conformance

ES&S EVS 6.0.2.1



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: 6.0.2.1

Name of VSTL: SLI Compliance

EAC Certification Number: ESSEVS6021

Date Issued: November 12, 2018

Executive Director

Scope of Certification Attached

Manufacturer: Election Systems & Software
System Name: EVS 6.0.2.1
Certificate: ESSEVS6021

Laboratory: SLI Compliance
Standard: VVSG 1.0 (2005)
Date: November 12, 2018



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 6.0.2.1 voting system is a modification of the ES&S EVS 6.0.0.0 voting system, certified on July 2, 2018, which contains limited changes to the Electionware application. The ES&S EVS 6.0.2.1 voting system is composed of software applications, central count location devices and polling place devices with accompanying firmware, and COTS hardware and software.

Electionware®

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™

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

ExpressTouch®

ExpressTouch Electronic Universal Voting System (ExpressTouch) is a DRE voting system which supports electronic vote capture for all individuals at the polling place.

ExpressVote® Hardware 1.0

ExpressVote Universal Voting System Hardware 1.0 (ExpressVote HW1.0) 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 scanners.

ExpressVote® Hardware 2.1

ExpressVote Universal Voting System Hardware 2.1 (ExpressVote HW2.1) 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, and tabulation scanning into a single unit. ExpressVote HW2.1 is capable of operating in either marker or tabulator mode, depending on the configurable mode that is selected in Electionware.

There are two separate versions of the ExpressVote hardware version 2.1: 2.1.0.0 and version 2.1.2.0 (6.4 & 6.8). Please note that all future references to ExpressVote HW 2.1 as used throughout the document refers to both hardware versions.

DS200®

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).

DS450®

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 Cast Vote Records (CVR).

DS850®

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 Cast Vote Records (CVR).

Event Log Service (ELS)

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)

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 ES&S applications such as Electionware can use that information for media validation purposes.

Configurations

Within the scope of the ES&S EVS 6.0.2.1 voting system, three unique configurations are supported, in order to accommodate limitations of components with the ES&S EVS 6.0.2.1 voting system.

Configuration A

ES&S EVS 6.0.2.1: Test Configuration A is comprised of the entire suite of voting system products.

- Electionware
- ExpressVote Marker (HW 1.0)
- ExpressVote Marker/Tabulator (HW 2.1)
- ExpressVote XL
- ExpressTouch
- DS200
- DS450
- DS850

Configuration B

- Electionware
- ExpressVote Marker (HW 1.0)
- ExpressVote Marker/Tabulator (HW 2.1)
- DS200
- DS450
- DS850

Configuration C

- Electionware
- ExpressVote XL

Mark Definition

ES&S' declared level mark recognition for the DS200, DS450 and DS850 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

EVS 6.0.2.1 supports English, Spanish, Chinese (Cantonese), Korean, Japanese, Hindi, Bengali, Vietnamese, Tagalog, Creole, Russian, and French. Configuration C also supports Punjabi and Gujarati.

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	5.0.2.0			
ES&S Event Log Service	1.6.0.0			
Removable Media Service	1.5.0.0			
ExpressVote HW 1.0	1.5.1.0	1.0		Paper-based vote capture and selection device
ExpressVote Previewer (1.0)	1.5.1.0			
ExpressVote HW 2.1	2.4.3.0	2.1.0.0 2.1.2.0		Hybrid paper-based vote capture and selection device and precinct count tabulator
ExpressVote Previewer (2.1)	2.4.3.0			
DS200	2.17.0.0	1.2.1, 1.2.3, 1.3		Precinct Count Tabulator
DS450	3.1.0.0	1.0		Central Count Scanner and Tabulator
DS850	3.1.0.0	1.0		Central Count Scanner and Tabulator
ExpressVote XL	1.0.1.0	1.0		Hybrid full-faced paper-based vote capture and selection device and precinct count tabulator
ExpressTouch	1.0.0.0	1.0		DRE
ExpressVote Rolling Kiosk		1.0	98-00049	Portable Voting Booth
Voting Booth		N/A	98-00051	Stationary Voting Booth
ExpressVote Single Table		N/A	87033	Voting Table for One Unit
ExpressVote Double Table		N/A	87032	Voting Table for Two Units
ADA Table		N/A	87031	Voting Table for One Unit

System Component	Software or Firmware Version	Hardware Version	Model	Comments
DS200 Ballot Box		1.0	98-00009	Collapsible Ballot Box
DS200 Ballot Box		1.2, 1.3, 1.4, 1.5	57521	Plastic ballot box
DS200 Ballot Box		1.0, 1.1, 1.2	76245	Metal ballot box
DS200 Tote Bin		1.0	00074	Tote Bin Ballot Box
DS450 Cart		N/A	3002	
DS850 Cart		N/A	6823	
Universal Voting Console		1.0	98-00077	Detachable ADA support peripheral
Tabletop Easel		N/A	14040	
ExpressTouch Voting Booth		N/A	98-00081	Stationary Voting Booth
SecureSetup	2.0.0.1			Proprietary Hardening Script

COTS Software

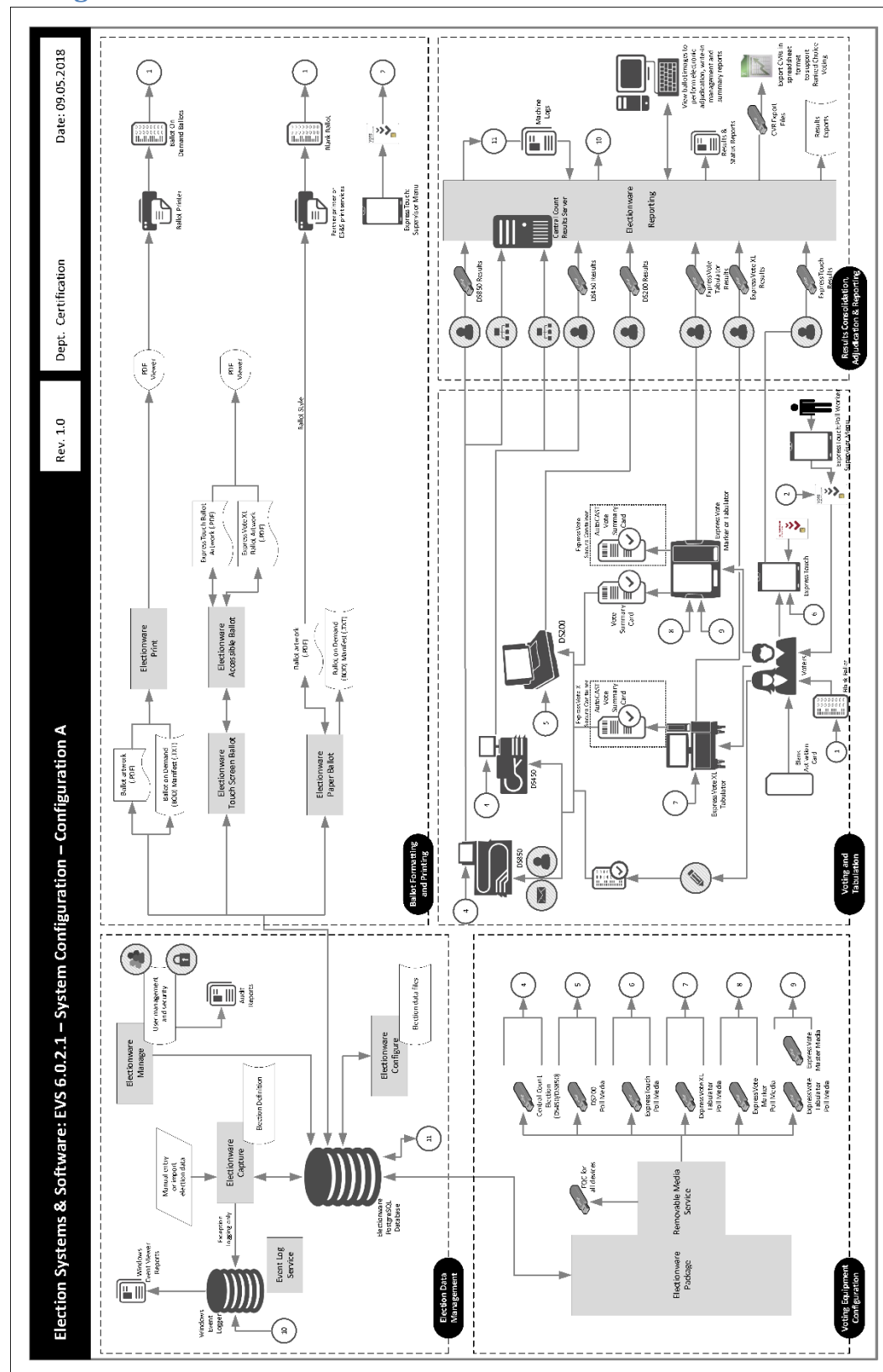
Manufacturer	Application	Version
Microsoft Corporation	Server 2008	R2 w/ SP1 (64-bit)
Microsoft Corporation	Windows 7 Professional	SP1 (64-bit)
Microsoft Corporation	WSUS Microsoft Windows Offline Update Utility	11.1.1
Symantec	Endpoint Protection	14.0.1 (64-bit)
Symantec	Symantec Endpoint Protection Intelligent Updater (File-Based Protection)	20180116-002-core3sds5i64.exe
Symantec	Symantec Endpoint Protection Intelligent Updater (Network-Based Protection)	20180115-040-IPS_IU_SEP_14RU1.exe
Symantec	Symantec Endpoint Protection Intelligent Updater (Behavior-Based Protection)	20180108-003-SONAR_IU_SEP.exe
Cerberus	CerberusFTP Server – Enterprise	9.0.3.1 (64-bit)
Adobe	Acrobat	XI
Microsoft Corporation	Visual C++ Redistributable	vc_redist.x86.exe (32-bit)
RSA Security	RSA BSAFE Crypto-C ME for Windows 32-bit	4.1
OpenSSL	OpenSSL	2.0.12
OpenSSL	OpenSSL	2.0.16
OpenSSL	OpenSSL	1.02d
OpenSSL	OpenSSL	1.02h
OpenSSL	OpenSSL	1.02k

COTS Hardware

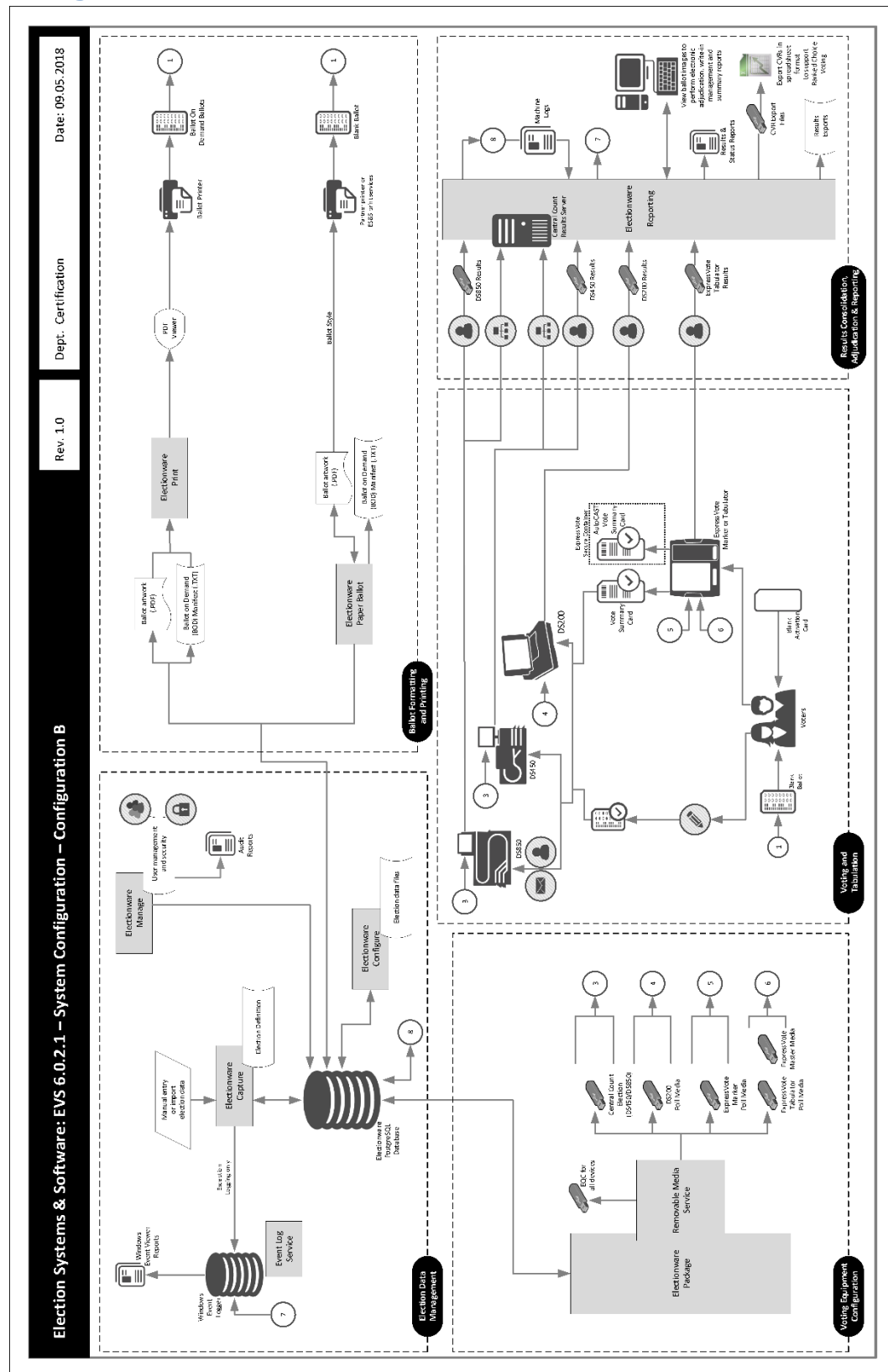
Manufacturer	Hardware	Model/Version
EMS Server		
EMS Client or Standalone Workstation		
Innodisk	USB EDC H2SE (1GB) for ExpressVote 1.0	DEEUH 1-01GI72AC1SB
Innodisk	USB EDC H2SE (16GB) for ExpressVote 2.1	DEEUH 1-16GI72AC1SB
Delkin	USB Flash Drive	512MB, 1 GB, 2 GB, 4 GB, 8 GB
Delkin	Validation USB Flash Drive	16 GB

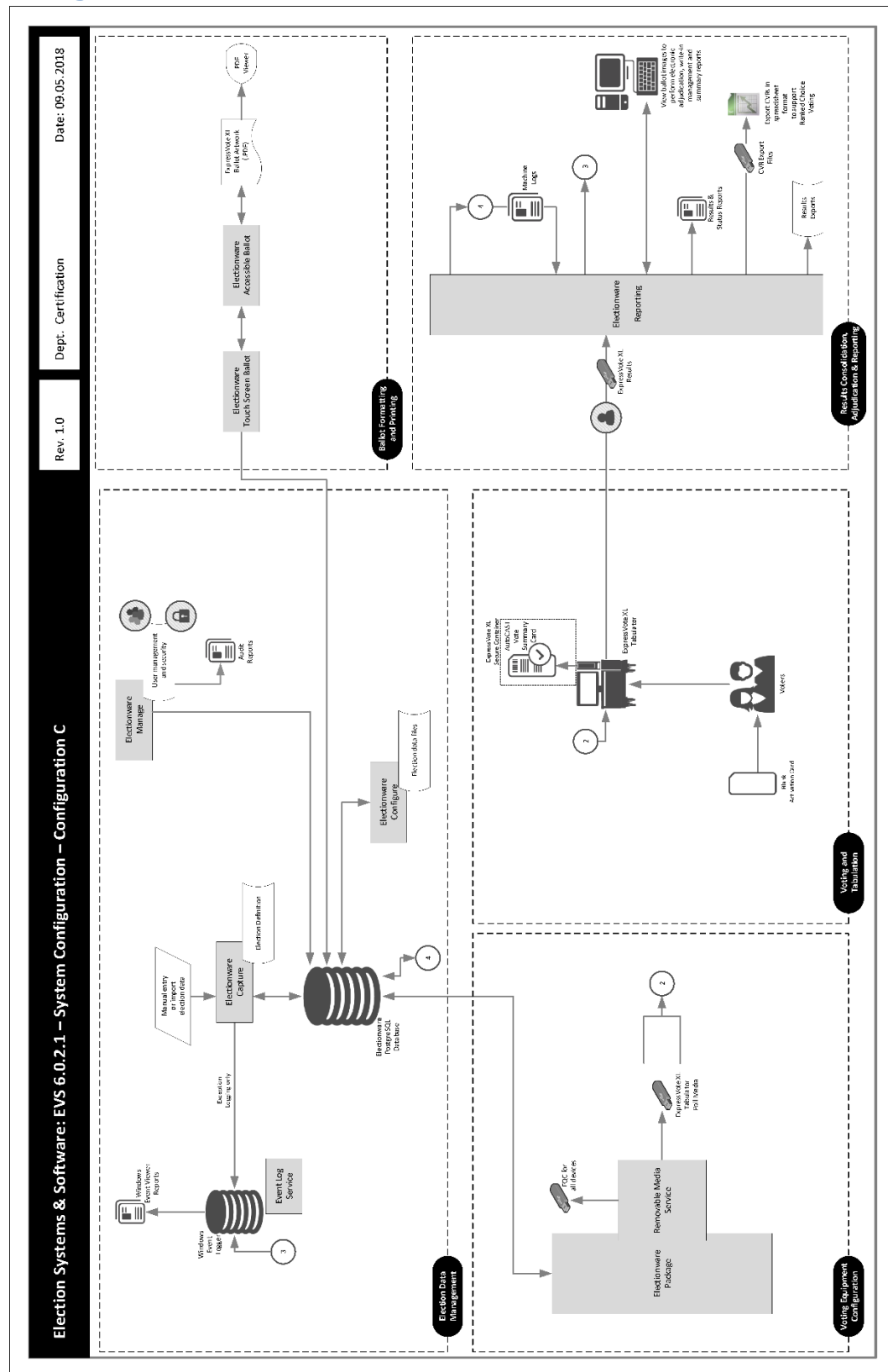
Delkin	USB Embedded 2.0 Module Flash Drive	MY16MGFSY-RA000-D / 16 GB
Delkin	Compact Flash Memory Card	1 GB
Delkin	Compact Flash Memory Card Reader/Writer	6381
Delkin	CFAST Card	2GB, 4GB
Delkin	CFAST Card Reader/Writer	DDREADER-48
CardLogix	Smart Card	CLXSU128kC7/ AED C7
SCM Microsystems	Smart Card Writer	SCR3310
Avid	Headphones	86002
Zebra Technologies	QR code scanner (Integrated)	DS457-SR20009
Symbol	QR Code scanner (External)	DS9208
Dell	DS450 Report Printer	S2810dn
OKI	DS450 and DS850 Report Printer	B431dn/B431d
OKI	DS450 and DS850 Audit Printer	Microline 420
APC	DS450 UPS	Back-UPS Pro 1500
APC	DS850 UPS	Back-UPS RS 1500 or Pro 1500
Tripp Lite	DS450 and DS850 Surge Protector	Spike Cube
Seiko Instruments	Thermal Printer	LTPD-347B
NCR/Nashua	Paper Roll	2320
Fujitsu	Thermal Printer	FTP-62GDSL001/ FTP-63GMCL153

Configuration A



Configuration B





System Limitations

This table depicts the limits the system has been tested and certified to meet.

System Characteristic	Boundary or Limitation	Limiting Component
Max. precincts allowed in an election	9,900	Electionware
Max. ballot styles in an election	15,000	Electionware
Max. candidates allowed per election	10,000	Electionware
Max. contests allowed in an election	10,000	Electionware
Max. number of parties allowed	General election: 75 Primary election: 30	Electionware
Max. District Types/Groups	25	Electionware
Max. districts of a given type	250	Electionware
Max. Contests allowed per ballot style	500	N/A
Max. Reporting Groups in an election	14	Electionware
Max. candidates allowed per contest	230	Electionware
Max. "Vote For" per contest	230	Electionware
Max. ballots per batch	1,500	DS450/DS850

Component Limitations:

Electionware

1. Electionware capacities exceed the boundaries and limitations documented for ES&S voting equipment and election reporting software. For this reason, ballot tabulator limitations define the boundaries and capabilities of Electionware system.
2. Electionware software field limits were calculated using default text sizes 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 limits lower than those listed in the System Overview.
3. The Electionware Export Ballot Images function is limited to 250 districts per export.
4. Electionware is limited to the language special characters listed in the System Overview. Language special characters other than those on this list may not appear properly when viewed on equipment displays or reports.

5. The Straight Party feature must not be used in conjunction with the Single or Multiple Target Cross Endorsement features.
6. The 'MasterFile.txt' and the 'Votes File.txt' do not support results for elections that contain multiple sheets or multiple ExpressVote cards per voter. These files can be produced using the Electionware > Reporting > Tools > Export Results menu option. This menu option is available when the Rules Profile is set to "Illinois".

Paper Ballot Limitations

1. The paper ballot code channel, which is the series of black boxes that appear between the timing track and ballot contents, 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. If Sequence is used as a ballot style ID, it must be unique election-wide and the Split code will always be 1. In this case the practical style limit would be 16,300.
3. The ExpressVote activation card has a limited ballot ID based on the 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.

ExpressVote

1. ExpressVote 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 ES&S ExpressVote are never approached during testing.

ExpressVote XL

1. ExpressVote XL capacities exceed all documented limitations for the ES&S election management, vote tabulation and reporting systems. 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 ES&S ExpressVote XL are never approached during testing.
2. ExpressVote XL 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 does not support Massachusetts Group Vote.
4. ExpressVote XL does not support Universal Primary Contest.
5. ExpressVote XL does not support Multiple Target Cross Endorsement.
6. ExpressVote XL does not support Reviewer or Judges Initials boxes.
7. ExpressVote XL does not support multi-card ballots.
8. In a General election, one ExpressVote XL screen can hold 32 party columns if set up as columns or 16 party rows if set up as rows.
9. ExpressVote XL does not support Team Write-In.

ExpressTouch

1. ExpressTouch capacities exceed all documented limitations for the ES&S election management, vote tabulation and reporting systems. 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. ExpressTouch does not offer open primary support, which is the ability to select a party and vote based on that party.
3. ExpressTouch does not support Massachusetts Group Vote.
4. ExpressTouch does not support Universal Primary Contest.
5. ExpressTouch does not support Multiple Target Cross Endorsement.
6. ExpressTouch does not support Team Write-In.

DS200

1. The ES&S DS200 configured for an early vote station does not support precinct level results reporting. An election summary report of tabulated vote totals is supported.
2. The DS200 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 at least three 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 Standard (provide definition of how supported)	Yes	Configuration B only
Primary: Open Blanket (provide definition of how supported)	No	
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:		

Feature/Characteristic	Yes/No	Comment
Primary Presidential Delegation Nominations: Displayed delegate slates for each presidential party	No	
Slate & Group Voting: one selection votes the slate.	No	
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:		
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	
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 2 nd 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 2 nd 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.	No	
Ranked Order Voting: A ballot stops being counting when all ranked choices have been eliminated	No	
Ranked Order Voting: A ballot with a skipped rank counts the vote for the next rank.	No	
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.	No	
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	
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	

Feature/Characteristic	Yes/No	Comment
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, ExpressTouch, ExpressVote HW2.1, ExpressVote XL
Central counting device	Yes	DS450 and/or DS850

Baseline Certification Engineering Change Order's (ECO)

There are not any ECO's certified with the voting system.

Attachment B – Accessibility Examination Findings and Recommendations

A) Top problems and Recommendations as listed in the accessibility examiner's report



Top problems.pdf

B) All observations from Accessibility Examination



All
observations.pdf

C) Recommendations for Deployment from Accessibility Examiner report



Recommendations
for deployment.pdf

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. Deselections 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 VWSG 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	<p>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.</p> <ul style="list-style-type: none"> • 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. <p>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.</p> <p>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.</p>	XL	Set up
Keypads	<p>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.</p> <ul style="list-style-type: none"> • On the XL, the jack is on the keypad 	Both	Needs assistance

Function	Observation	System	Severity
	<ul style="list-style-type: none"> On the EV, it is on the front of the device below the screen <p>However, on both systems:</p> <ul style="list-style-type: none"> 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. <p>A blind advocate participant suggested that a raised headset icon would be an easily recognized symbol to solve this problem</p>		
Messages	<p>Some of the participants thought a screen required them to take action when it didn't</p> <ul style="list-style-type: none"> 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	<p>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.</p> <ul style="list-style-type: none"> • 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. <p>However, the EV audio does announce when a multi-select contest is “fully voted,” which participants who heard this message found helpful.</p>	Both	<p>Annoyance</p> <p>Or</p> <p>Problem solving</p>
Display	<p>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.</p>	Both	<p>Annoyance</p> <p>Or</p> <p>Problem solving</p>

Problems

Function	Observation	System	Severity
Display	<p>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.</p>	EV	<p>Potential</p> <p>Show stopper</p>

Function	Observation	System	Severity
Display	<p>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.</p> <ul style="list-style-type: none"> 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	<p>The Home key works in different ways, depending on where the cursor is on the screen.</p> <ul style="list-style-type: none"> 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. <p>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.</p>	Both	Problem-solving
Keypads	<p>There were some concerns about the number of the keys:</p> <ul style="list-style-type: none"> [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)	<p>There is no option to ask the system to spell out a candidate name.</p> <ul style="list-style-type: none"> 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	<p>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.</p> <p>On the full-face ballot, this was visually confusing because it showed a candidate selected in the “wrong” column.</p>	XL	Problem solving
Ballot (Audio)	<p>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.</p> <p>One voter suggested announcing “You selected” <i>before</i> the name of the candidate in these cases.</p>	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: <ul style="list-style-type: none"> Trying to select just one candidate from a group selected by straight party produced inconsistent results, depending on the exact configuration of the candidates. <ul style="list-style-type: none"> If a participant tries to deselect a candidate, it resulted in that candidate being selected and others deselected. If they tried 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. <ul style="list-style-type: none"> 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)	<p>Not being able to clear all selections on a contest with an available straight party option was very confusing.</p> <ul style="list-style-type: none"> 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. <ul style="list-style-type: none"> 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. <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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. <ul style="list-style-type: none"> 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	<p>Voters used to the Danaher Shouptronics expected to find a “Vote” button available to them at any time.</p> <ul style="list-style-type: none"> 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	<p>On the XL, blind participants were not sure what was happening during the printing process.</p> <ul style="list-style-type: none"> 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	<p>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.</p> <ul style="list-style-type: none"> 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	<p>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.</p> <ul style="list-style-type: none"> 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
	<ul style="list-style-type: none"> 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	<p>None of the participants were able to verify their paper ballot on the XL.</p> <ul style="list-style-type: none"> 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



Implementation
attestation.pdf



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				
ExpressVote Previewer (2.1)				
DS200				
DS450				
DS850				
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 6021 system. Any ancillary components like switches, ballot boxes, charging carts sold on this contract are EAC certified components of the EVS 6021 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.
- b) A training session on the Voting System's election management system and/or EPBs 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:
 - i. programming of all voting units and ancillary devices;
 - ii. tabulating results during the unofficial and official canvass;
 - iii. ensuring accuracy and integrity of results;
 - iv. preparing polling places and setting up the system for election day operation;
 - v. Training on accessibility options of the voting system
 - vi. Election day operating procedures;
 - vii. auditing procedures;
 - viii. conducting a recount;
 - ix. preserving records;
 - x. printing, designing, and formatting election reports;
 - xi. troubleshooting common issues;
 - xii. safeguarding and preventing tampering and unauthorized access to all parts of the Voting System; and

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 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 subject to the conditions specified below in Section D(8)(d). 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, EPB software, and/or any Supplier Property placed in escrow from the escrow agent.

**COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF STATE**

**REPORT CONCERNING THE EXAMINATION RESULTS OF
DOMINION VOTING SYSTEMS DEMOCRACY SUITE 5.5A WITH
IMAGECAST® X BALLOT MARKING DEVICE (ICX-BMD),
IMAGECAST PRECINCT OPTICAL SCANNER (ICP), IMAGECAST
CENTRAL STATION (ICC), AND DEMOCRACY SUITE EMS (EMS)**



Issued By:

Kathy Boockvar

**Kathy Boockvar
Acting Secretary of the Commonwealth
January 17, 2019**

EXAMINATION RESULTS OF DOMINION VOTING SYSTEMS DEMOCRACY SUITE 5.5A WITH IMAGECAST® X BALLOT MARKING DEVICE (ICX-BMD), IMAGECAST PRECINCT OPTICAL SCANNER (ICP), IMAGECAST CENTRAL STATION (ICC), AND DEMOCRACY SUITE EMS (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 his opinion, the electronic voting system can be safely used by voters and meets all applicable requirements of the Election Code.

Upon the request of Dominion Voting Systems Inc. (Dominion), the Department of State's Bureau of Commissions, Elections and Legislation (Department) scheduled an examination for October 15, 2018 of the Democracy Suite 5.5 voting system. The voting system presented for certification in Pennsylvania included the Democracy Suite Election Management System (EMS) election management software used in conjunction with the following components: 1) ImageCast® X (ICX) Ballot Marking Device (BMD), a ballot marking device with Commercial Off The Shelf (COTS) printer, HP LaserJet Pro Printer M402dn/HP LaserJet Pro Printer M402dne, for printing marked ballots; 2) ImageCast Precinct Scanner (ICP), a precinct optical scan ballot tabulator that scans, validates and tabulates hand-marked paper ballots and ballots produced on the BMD; and 3) ImageCast Central Station (ICC), a ballot scanning and tabulating system that can be configured with high speed COTS scanners Canon Image Formula DR-G1130 /Canon Image Formula DR-M160-II to tabulate ballots in central office.

The Secretary appointed SLI Global Solutions (SLI) and the Center for Civic Design (CCD) as professional consultants to conduct the examination of Democracy Suite 5.5. The examination process included a public demonstration and functional examination (functional examination), accessibility examination and security testing. The functional and accessibility examinations were performed in Room G24A/B of the Commonwealth Capitol

Complex - Finance Building, 613 North Street, Harrisburg, PA 17120. Mike Santos, Senior Test Manager, and Kyle Johnson, Senior Test Engineer (Functional Examiner), of SLI Global Solutions, conducted the functional examination of the Democracy Suite 5.5 pursuant to Section 1105-A(a) of the Election Code, 25 P.S. § 3031.5(a). Whitney Quesenbery, Denis Anson and Michael Weisman (Accessibility Examiner), representing CCD, performed an accessibility examination of the Democracy Suite 5.5 system. The examinations commenced on October 15, 2018, and lasted approximately four days. Jonathan Marks, Commissioner of the Bureau of Commissions, Elections and Legislation; Kathryn Boockvar, Senior Advisor to the Governor on Election Modernization; Jessica Myers, Deputy Director, Office of Policy; Kathleen Kotula, Executive Deputy Chief Counsel, Office of Chief Counsel; and Sindhu Ramachandran, Voting Systems Analyst, represented the Secretary of the Commonwealth. Jessica Bowers, Director of Certification, and Matt Coffey, Systems Specialist, represented Dominion. Additional staff members from the Department also attended the examination. The functional examination was open to the public and was videotaped by Department staff. Security testing of the Democracy Suite 5.5 system was performed at SLI facilities located at 4720 Independence Street, Wheat Ridge, Colorado, prior to the functional examination. Mike Santos, Senior Test Manager, and Jesse Peterson, Security Specialist, at SLI Global Solutions, served as the Security Examiner for the Democracy Suite 5.5 security testing. The Functional Examiner and Accessibility Examiner concluded that the Democracy Suite 5.5 did not comply with Sections 1107-A(10) and (15), 25 P.S. §§ 3031.7(10) & (15), of the Pennsylvania Election Code because the ICX BMD did not allow the voter to remove all candidate selections in a contest after voting straight party and the screen referenced the process of marking and printing the ballot as “casting” the ballot. Additionally, the Security Examiner noted that the system hardening measures documented in the Technical Data Package (TDP) required additional modifications for a secure implementation.

Thereafter, Dominion incorporated corrections for the issues identified during the Democracy Suite 5.5 examination, and re-submitted the new release, Democracy Suite 5.5A, to both the U.S. Election Assistance Commission (EAC) for federal approval and the

Department for state certification. The system components remained the same and the only change in the new release was the software enhancements to remediate the identified anomalies. The Functional Examiner performed a follow-up examination of Democracy Suite 5.5A on December 5-6, 2018, at SLI Global Solutions located at in Wheat Ridge, Colorado. Department staff observed the examination via web conference. The examination was videotaped by SLI and the video is on file at the Department. The Security Examiner validated that the documentation has been updated to reflect accurate system hardening steps for a secure implementation. Since the software changes made to the Democracy Suite 5.5A system were specifically to remediate the identified anomalies in Democracy Suite 5.5, it was determined that the results of the accessibility examination and security testing conducted as part of the Democracy Suite 5.5 examination may be utilized for Democracy Suite 5.5A certification. The Department discussed the software modifications with the Accessibility Examiner, since both the straight party usability issue and usage of the word “cast” were also part of the Accessibility test findings.

II. The Democracy Suite 5.5A Voting System

Democracy Suite 5.5A components considered for use in Pennsylvania¹ provide a paper-based voting system with 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 BMDs as the ADA component. The system components include: the Election Management System (EMS), the ImageCast Central (ICC) - utilizing two Commercial Off the Shelf (COTS) scanners, the ImageCast Precinct (ICP) optical scanner and the ImageCast X (ICX) (Prime and Classic) ballot marking devices.

The following is a description of the Democracy Suite 5.5A components summarized from Section 2.0 (System Overview) of the Test Report for Examination of Democracy Suite 5.5A, prepared by the Functional Examiner and documentation submitted by

¹ The EAC certified system includes a DRE option for the ICX device which is not considered for certification in Pennsylvania.

Dominion as part of the Technical Data Package (TDP).

Election Management System (EMS)

The Dominion Democracy Suite 5.5A EMS supports elections on the ICX Prime, ICX Classic, ICP and ICC systems. The EMS set of applications are responsible for all pre-voting and post-voting groups of activities in the process of defining and managing elections. EMS software platform consists of end-user (client) and back-end (server) applications. The EMS platform consists of the following major components.

EMS Election Event Designer (EED) - Supports pre-voting activities including election definition together with ballot styling capabilities.

EMS Audio Studio (AS) - End-user helper application used to record audio files for a given election project utilized during the pre-voting phase of the election cycle.

EMS Application Server – Server-side application responsible for executing long running processes, such as rendering ballots, generating audio files and election files, etc.

EMS Results Tally and Reporting (RTR) - Integrates election results acquisition, validation, tabulation, reporting, and publishing capabilities and represents a main post-voting phase end-user application.

EMS File System Service (FSS) - Stand-alone service that runs on client machines, enabling access to low level operating system API for partitioning CF cards, reading raw partition on ICP CF card, etc.

EMS Data Center Manager (DCM) - End-user application used to export election data from election project and import election data into election project.

EMS Election Data Translator (EDT) - End-user application used to export election data from election project and import election data into election project.

EMS Adjudication (ADJ) and EMS Adjudication Service - Server and client components responsible for adjudication, including reporting and generation of adjudicated

result files from ImageCast Central tabulators and adjudication of write-in selections from ImageCast Precinct and Image Cast Central tabulators.

ImageCast Voter Activation (ICVA) - Installed on a workstation or laptop at the polling place, that allows the poll workers to program smart cards for voters. The smart cards are used to activate voting sessions on ImageCast X.

ImageCast X (ICX) Ballot Marking Device (BMD)

The ICX ballot marking platform is used for creation of paper cast vote records. These ballots can be scanned, reviewed, cast and tabulated at the polling location on an ICP or later scanned and tabulated by the ICC at a central location. The ICX consists of two models, ICX Prime and ICX Classic.

2.3 ImageCast Precinct (ICP)

The ICP is a hybrid precinct optical scan ballot counter designed to provide ballot scanning, ballot review and tabulation at a polling place.

2.4 ImageCast Central (ICC) Count Scanner

The ICC is a high-speed, central ballot scan tabulator based on Commercial off the Shelf (COTS) hardware, coupled with the custom-made ballot processing application software. It is used for high speed scanning and counting of paper ballots.

Manufacturer Software/Firmware

The **Dominion Democracy Suite 5.5A** voting system consists of the following software and firmware components:

Application	Version
EMS Election Event Designer (EED)	5.5.12.1
EMS Results Tally and Reporting (RTR)	5.5.12.1
EMS Application Server	5.5.12.1
EMS File System Service (FSS)	5.5.12.1
EMS Audio Studio (AS)	5.5.12.1
EMS Data Center Manager (DCM)	5.5.12.1

Application	Version
EMS Election Data Translator (EDT)	5.5.12.1
ImageCast Voter Activation (ICVA)	5.5.12.1
EMS Adjudication	5.5.8.1
EMS Adjudication Service	5.5.8.1
Smart Card Helper Service	5.5.12.1
ImageCast Precinct	5.5.3-0002
ImageCast Central	5.5.3.0002
ImageCast X	5.5.10.30

COTS Software/Firmware

Additional COTS software and firmware included in the system has been defined as part of the EAC system certification scope that will be added to this report as Attachment A once the final certification is granted for Democracy Suite 5.5A.

III. EXAMINATION APPROACH, PROCEDURES AND RESULTS

A. Examination Approach

To ascertain whether Democracy Suite 5.5A 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 initial functional examination of Democracy Suite 5.5 held October 15 through 19, 2018, determined that the system did not comply with Sections 1107-A(10) and (15), 25 P.S. §§ 3031.7 (10) & (15). The Examiners observed the following issues:

1. The ICX-BMD did not allow a voter to deselect all choices in a contest after voting straight party when the voter attempted to do so. Instead, a warning message that required no user acknowledgment displayed above the contest indicating that their “implicit” straight party selections would remain in effect. The screen presented to the voter had all the selections deselected and when the voter printed the ballot, the paper ballot indicated votes for the candidates chosen by the straight party option.

The warning message wording did not clearly indicate the intent. Also, the message displayed was not intuitive enough for a voter to notice it and there was no acknowledgment action required of the voter indicating that the message was seen.

2. The ICX-BMD final screen presented to the voter indicated that the voter was about to cast their ballot, even though the voter was only printing the ballot which needs to be further scanned by the ICP or ICC.

Dominion remediated the software issues and the Examiners then performed a follow-up examination of Democracy Suite 5.5A to confirm that the anomalies identified in Democracy Suite 5.5 were corrected and the system complies with all the requirements of the Pennsylvania Election Code. The examination approach followed for Democracy Suite 5.5 and Democracy Suite 5.5A is discussed in the below sections.

Democracy Suite 5.5 Examination Approach

Functional 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 six main areas of test execution: (1) Source Code Review; (2) Documentation Review; (3) System Level Testing; (4) Security/Penetration Testing; (5) Privacy Analysis; and (6) Usability Analysis.

Source Code Review was performed prior to the functional examination to determine if there were any vulnerabilities found that would warrant additional security examination.

Documentation Review was performed to verify that the portions of the Pennsylvania Election Code, which reference documentation detail, are sufficiently met by the Dominion Democracy Suite 5.5 documentation. The Functional Examiner validated compliance of the system to 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 ITA;
- 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.

System Level Analysis examined the Dominion Democracy Suite 5.5 voting system by conducting an election starting with creating an election definition using EMS and then creating the election media needed to populate the voting devices (the ICX - Classic and Prime with COTS printer HP LaserJet Pro Printer M402dn, ICP, ICC with COTS scanners - Canon DR-G1130 and Canon DR-M160-II). Ballots were marked, manually as well as via both models (Classic and Prime) of the ICX ballot marking device, and tabulated through the ICP and ICC (both COTS scanners). The results reports were validated against the expected results of the voted ballots. All components of the Democracy Suite 5.5 system were exercised to verify that they met all pertinent requirements of the Pennsylvania Election Code. 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(3), 25 P.S. § 3031.7(3), requiring an electronic voting system to permit straight party voting, including the "Pennsylvania method" of straight party voting;
- 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 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 prevents 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 prevents 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 for systems that use paper ballots or ballot cards, permits a voter to get a new ballot in the case of a spoiled ballot, and to mark and cancel the 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 (i) a public counter to register how many ballots are submitted to be counted; (iv) will not tabulate an over-vote, with an option to notify a voter of an over-vote if used during voting hours; and (v) generates a printed record that counters are set to zero before voting commences; and
- Parts of 1107-A(17), 25 P.S. § 3031.7(17), requiring an electronic voting system which provides for central-count tabulation to (ii) preclude tabulation of an over-vote; and (iii) indicate that counters are set to zero before processing ballots, either by district or with the capability to generate cumulative reports.

The Functional Examiner 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 his use at public demonstration, in addition to the requirements being validated in the documentation review phase by reviewing EAC certification reports.

The Security/Penetration Analysis examined the voting system's compliance with the requirements of the Pennsylvania Election Code by analyzing physical security procedures and impoundment of ballots. Precinct tabulation devices were installed for delivery to the precinct, and the Functional Examiner 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 Examiner 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 relates to system security.

The Privacy Analysis examined the voting system's compliance with Section 1107-A(1) 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 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 Examiner to supplement his conclusions from the documentation review phase.

Accessibility Examination

The accessibility examination was designed to provide insights about each voting system's usability and accessibility especially for voters with disabilities, as well as how effectively the system could be deployed by poll workers and voters. The Accessibility Examination included a team of three examiners with accessibility, usability and election process experience, collectively referred as Accessibility Examiner. The examination process was divided into three parts:

- **Expert review** by the Accessibility Examiner, using scenarios based on personas of people with disabilities from National Institute of Standards and Technology (NIST) and their professional experience.
- **Voters with disabilities used** the system voting a reasonable length PA ballot and completed a questionnaire about their experience. The Accessibility Examiner observed and made notes.

- **Election officials and poll workers tested the accessibility features** to evaluate how they would be activated during an election. They commented on the system based on their experience.

The testing team determined the test ballot parameters and constructed a typical PA ballot, with a mix of contest types and variation in the number of candidates to be voted for each contest. The ballot contained 14 contests: 1 straight party contest, 1 vote for a pair (President/Vice President), 7 vote for one, 2 vote for not more than three, 1 vote for not more than five, 1 referendum contest and 1 retention contest. The facilitator instructed voters on the vote selections to be made, so that results could be compared between each session and different examinations.

Security Testing

The Security testing provided a means to assess the required security properties of the voting system under examination and ascertain compliance with PA Election Code requirements, including 25 P.S. §§ 3031.7(11), (12), (16) and (17). The security tests were based on the PA Voting System Security Standard, published as Attachment E to the Directive for Electronic Voting Systems. The Security Examiner conducted tests that covered the following areas of testing - documentation review, design, software security, network capabilities, audit logging, physical security and penetration testing.

Democracy Suite 5.5A Examination Approach

Democracy Suite 5.5A is a release to correct the anomalies noted in Democracy Suite 5.5 system. The examiners evaluated the changes submitted by Dominion and developed test protocols to validate the modifications to Democracy Suite 5.5 to ensure that the fixes

resolved the identified anomalies and that the modified system maintained compliance with all the PA Election Code requirements.

Functional Examination

The Functional Examiner and Department agreed that the test approach must include Documentation Review, Source Code Review, System Level Testing and Usability Analysis. Security/Penetration and Privacy analysis results were leveraged from Democracy Suite 5.5 examination since those aspects of the system remained unaffected by the isolated code changes made to the system.

Documentation review was performed to verify that the portions of the Pennsylvania Election Code, which reference documentation detail, are sufficiently met by the Dominion Democracy Suite 5.5A documentation. Source code review was done to determine if there were any vulnerabilities that warranted additional testing and the review focused on source code modifications for the Democracy Suite 5.5A release. System Level Testing examined Democracy Suite 5.5A by conducting a general election and closed primary election. The election runs were to (a) test and confirm that the anomalies identified during Democracy Suite 5.5 examination were remediated, and (b) to perform regression testing of all components of the system. The election runs allowed the Functional Examiner to ascertain that the compliance with the Election Code requirements determined during the System Level Testing of Democracy Suite 5.5 is maintained in the new release. Usability analysis was performed to verify that the usability concerns identified during the examination of Dominion Democracy Suite 5.5 is remediated in the new release.

Security Testing

The Department of State in consultation with the Security Examiner decided that the test approach must include only validating the documentation updates to ensure secure

implementation of the system components, since the isolated code changes did not affect the security aspects of the system.

Accessibility Examination

The Department of State, in consultation with the Accessibility Examiner, decided that the findings from Democracy Suite 5.5 Accessibility Examination can be used for Democracy Suite 5.5A, since there were no hardware changes and the isolated code changes were for correcting the anomalies identified during Democracy Suite 5.5. The Department discussed the software changes done for the ICX with the Accessibility Examiner, since Accessibility testing also reported the same usability concerns identified during Functional Examination.

B. Examination Process and Procedures

The examination process and procedures followed for the Democracy Suite 5.5 and Democracy Suite 5.5A examinations are listed in the sections below. The final determination in this report is based on the combined analysis of the results and conclusions from both examinations.

Democracy Suite 5.5 Examination

Functional Examination

The public demonstration and functional examination portion commenced on October 15, 2018, at Room G24A/B of the Commonwealth Capitol Complex - Finance Building, 613 North Street, Harrisburg, PA 17120. The test execution tasks took approximately four days. Members of the public were allowed as observers for the examination. The Functional Examiner performed System Level Testing, Security/Penetration Testing and Privacy and Usability Analysis during the examination. Source code and Documentation review were completed prior to the public examination at SLI lab facilities in Wheat Ridge, Colorado.

Dominion supplied all the hardware equipment required for the examination. All

software and firmware necessary to perform the examination was received directly from the Voting System Test Laboratories (VSTL) that tested the voting system for EAC certification. The trusted build of the software and firmware for each device being evaluated were installed using the appropriate media for installation. The hash codes for all system components were captured using the process listed in the manufacturer's Technical Data Package (TDP) by the Functional Examiner with assistance from Dominion representative. The Functional Examiner 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.

The Functional Examiner created the election definition using EMS – EED and transport media was created to populate the devices under examination with the election. The polling place was set up using ICP and ICX - BMD (Classic and Prime). A primary and general election were then run using polling place devices and central scanners. Ballots were tabulated at the polling place using ICP and ICC using scanners Canon imageFormula DR-G1130 and Canon imageFormula DR-M160II. Results were then tabulated using EMS and validated against expected results.

Accessibility Examination

The accessibility examination portion commenced on October 15, 2018, at Room G24A/B of the Commonwealth Capitol Complex - Finance Building. The examination lasted approximately three days followed by a debrief meeting on October 18, 2018, with DOS and CCD to discuss initial findings. The examination included expert review by the Accessibility Examiner, sessions with four poll worker groups, and sessions with six voters with disabilities using different accessible devices for voting. The voter sessions each took approximately an hour. The poll worker sessions took approximately one hour to 90 minutes each. Dominion supplied the hardware and supplies for the Accessibility Examination. The equipment was prepared for the examination by loading the required election definition using transport media. This test examined the Dominion Voting ImageCast X (ICX) touch screen ballot marking device with COTS printer HP LaserJet Pro Printer M402dne and the

ImageCast Precinct Optical Scanner (ICP).

The typical accessible voting experience involves the voter making selections on the ICX to mark their ballot, printing their ballot using a separate printer, and then scanning their printed ballot on the ICP to cast the ballot. The Accessibility Examiner identified the accessibility features of each component as listed below:

ICX accessibility features:

- ADA compliant voting booth
- Touch screen, in portrait orientation
- Audio ballot with two voices: a prerendered, tactile keypad instructions voice and a ballot content, text-to-speech voice
- Tactile key pad with different-shaped, braille encoded buttons
- Binary input/Dual switch jack (on tactile key pad)
- Audio output jack
- Dual switch “jelly bean” buttons
- Sip-and-puff device, mountable to the table with adjustable arm
- Voter settings:
 - Language choice
 - Audio volume and tempo changes
 - Text Size (default, “Big”)
 - Screen contrast options: color, white background with black text, and black background with white text
 - Screen blank, while using the audio only

ICP scanner features

The ICP scanner had no notable accessibility features.

The machine features listed above are not exhaustive. For more information about the Dominion Democracy Suite 5.5 system, refer to the vendor provided technical specifications.

The Accessibility Examiner prepared voting scenarios for each voting session to

allow comparison of results between each session. Both the ballot contents and the instructions for marking the ballot were designed to exercise different types of interactions (navigation in ballot, navigation in contest, undervotes, overvotes, straight party, navigation within the review/summary screen, making changes to a contest from the review/summary screen). The ballot included both very short contests, and those long enough to potentially fill more than one screen, even at the default text size.

The Accessibility Examination does not produce a typical voting session, but it provides a structured opportunity to explore how the voting system works in all interaction modes including:

- Visual display mode with default settings and use of enhanced options for text size, brightness, and contrast
- Audio format with options for volume and tempo
- Touch input and navigation on the display screen
- Input and navigation using a tactile keypad
- Input and navigation using a dual switch

Expert Review by Accessibility Examiner

The Accessibility Examiner used the same ballot and instructions to be used for voter and poll worker review, for their expert review, so they would be familiar with the interaction voters would experience.

Sessions with voters

Each voter session took about an hour. They included:

- An opening interview about their previous voting experience and the types of assistive technologies they use in daily life and in voting.
- A very basic orientation to the system with opportunities for voters to ask questions about any assistive technologies available.

- Set-up of the machine using the provided assistive access features based on the needs of the individual voter. Where a blind voter would typically use the provided or personal headset to listen to the audio instructions, the tests used an external speaker so that the testers could inquire about the voters understanding of the instructions.
- Voting a ballot following facilitator-guided voting instructions, and facilitator help only where necessary. Voters were encouraged to give feedback about their experiences, both positive and negative, as they went through the ballot. The Accessibility Examiner and the voters discussed any feedback and questions that occurred during the voting sessions and re-evaluated any findings as necessary.
- A closing interview including a questionnaire about their voting experience and reactions to the system.

Sessions with poll worker groups

Each poll worker session took approximately an hour and a half, depending on the group size and provided the most activity variability. Each session included:

- A brief orientation to the voting systems and the accessibility features, similar to a poll worker training.
- An opportunity for the poll workers to review vendor-provided instructions before trying the system. They marked ballots and experimented with the accessibility features.
- An opportunity for the poll workers to interact with two to three different access-needs scenarios, depending on the size of the group and available time. Each scenario involved an examiner role-playing as a voter with an unspecified disability. In some scenarios, the voter didn't immediately identify their disability. Since this was not intended to test the poll-worker's ability to determine appropriate accommodations, each simulated voter provided information about the accommodations they needed in

general language. This sometimes required the poll worker to ask the voter what additional assistance she or he might need. Then the poll worker activated the necessary accessibility features for the voter. Note: due to lack of time, the final poll worker group did not participate in the examiner role-plays.

The Accessibility Examiner took notes about aspects of the system that worked well and problems they encountered during all three phases of the examination. The issues were then categorized 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 hesitated and had 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 will prevent successful independent and private voting for voters with some disabilities, even with good knowledge about how to use the system and accessibility features

The Accessibility Examiner then compiled the findings including categorizations from the examination into a report submitted to the Secretary.

Security Testing

The Security Testing was done at SLI lab facilities in Wheat Ridge, Colorado. The

Security Examiner received the hardware devices from Dominion and the software and firmware were obtained from the Voting System Test Lab (VSTL) which tested the system for EAC certification testing. The Examiner installed the Trusted Build prior to the evaluation using the appropriate media for installation. The Security Testing is comprised of a series of test suites which are utilized for verifying that a voting system will correspond to applicable security requirements within the Pennsylvania Election Code and PA Security Standards. The Security Examiner evaluated each component of the Democracy Suite 5.5 system and the system as a whole for interactions between components. These test suites covered areas of documentation review, design, software security, network capabilities, audit logging, physical security of the voting systems.

The requirements associated to each area of testing were applied to the Democracy Suite 5.5 system in the following manner. The Security Examiner did a review of the EAC testing reports of the system and executed tests for a cross section of Voluntary Voting System Guidelines (VVSG)1.0 requirements to reconfirm compliance. The Security Examiner then designed tests that included in depth verification and validation of reports, audit logs and physical and logical access controls for each of the components of the voting system. The physical security examination included security seals, lock/key combinations, measures for collection of voting in the event of an extended power outage, ballot box and system access points. Tests were done to ensure that election results, media used, reports and audit logs were protected from attempts to decrypt, manipulate and corrupt election data. The Security Examiner also created a vulnerability assessment and performed penetration testing of the Democracy Suite 5.5 system.

Dominion Democracy Suite 5.5A examination

Functional Examination

The follow-up examination was conducted on December 5 and 6, 2018, at SLI Global Solutions facility, 4720 Independence Street, Wheat Ridge, Colorado, and was observed by Department staff remotely in a conference room in BCEL, 210 North Office Building, 401 North Street, Harrisburg, Pennsylvania via web conference. Dominion supplied all the

hardware equipment required for the examination. All software and firmware necessary to perform the examination was received directly from the VSTL that tested the voting system for EAC certification. The Functional Examiner installed and/or verified the Trusted Build for each system component. A primary and general election were then run using EMS, ICX-Classic and Prime, ICP and ICC. Results were then tabulated and validated against expected results. The Functional Examiner performed the Source Code and Documentation Review before the witnessed examination.

C. Examination Results

Democracy Suite 5.5 Functional Examination

On November 17, 2018, the Functional Examiner issued his draft report for the testing of Democracy Suite 5.5 with a recommendation that the system was not in compliance with Section 1107-A(10) and (15), 25 P.S. §§ 3031.7(10) & (15), of the Pennsylvania Election Code. The report noted the following concerns:

- 1) The ICX BMD did not allow the user to cast a “no vote” in a contest after voting straight party without exiting the straight party option. The system behavior was not intuitive enough for the user to understand and did not adequately communicate to the voter what they needed to do to accomplish their vote intent.
- 2) The ICX BMD indicated to the voter that they were casting their ballot even though the ballot was only being printed for scanning and tabulation on ICP or ICC.

The Functional Examiner’s report indicated successful completion of tests executed to ascertain compliance to all other requirements mandated by the Pennsylvania Election Code. The Examiner report for Democracy Suite 5.5 (Test Report – PDV-003-FTR-01) included details of the test cases, execution and successful completion. The following section is a summary of the results of the examination as set forth in fuller detail in the Examiner's Report.

1. Source Code Review

Source Code Review for Democracy Suite 5.5 was performed, with a focus on determining whether any vulnerabilities could be found. The Functional Examiner reported that the code review was completed with no malicious software, cryptographic software, process control or password management vulnerabilities being found. The Examiner concluded that no deficiencies were found during source code review.

2. Documentation Review

The Documentation Review testing performed by the Functional Examiner demonstrated that the Democracy Suite 5.5 meets the relevant requirements of the Pennsylvania Election Code. The Examiner reviewed the “Test Report for EAC 2005 VVSG Certification Testing of Dominion Democracy Suite 5.5 Voting System”

The review of the EAC test reports by the Functional Examiner and the EAC certifications submitted by Dominion satisfy the requirements of Section 1105-A(a) of the Election Code, 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 VSTL as such authorities are now called, as meeting the applicable performance and test standards established by the federal government.

Functional Examiner 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 combination of EAC hardware Non-Operating Environmental Tests, which included bench handling, vibration, low temperature, high temperature, humidity and product safety tests. The system accuracy testing 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 Functional Examiner reviewed the system summative usability test report submitted to EAC to ascertain compliance to the usability requirement of Section 1107-A(15) of the Pennsylvania Election Code, 25 P.S. § 3031.7(15). The review determined that

the system documentation provided met EAC criteria for usability².

Accuracy testing performed during EAC certification testing provided confirmation of system accuracy to ascertain compliance to Section 1107-A(13) of the Pennsylvania Election Code, 25 P.S. § 3031.7(13). Additional testing to ensure system accuracy in tabulating PA specific voting scenarios was done during the Primary and General Election runs.

3. 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 political parties (Republican, Democratic), three precincts Precinct 1, Precinct 2 - split into Precinct 2a and 2b, Precinct 3, was run utilizing EMS, ICX (Classic and Prime), ICP and ICC (two scanners). For the Republican ballot, there were 21 contests: 19 partisan contests and 2 referendums, 10 “Vote for One”, 1 “Vote for no more than Two”, 3 “Vote for no more than Three”, 4 “Vote for no more than Four” and 1 “Vote for no more than Fifteen”. For the Democratic ballot, there were 21 contests: 19 partisan contests and 2 referendums, 11 “Vote for One”, 1 “Vote for no more than Two”, 1 “Vote for no more than Three”, 5 “Vote for no more than Four” and 1 “Vote for no more than Fifteen”. Referendum contests were added to test the generation of non-partisan ballots. The Functional Examiner validated compliance of the system to Sections 1101-A and 1107-A(2), (5)-(11) and (13), 25 P.S. §§ 3031.1, 3031.7(2), (5)-(11) & (13). All test cases passed without anomalies.

A general election consisting of four political parties (Republican, Democratic, Green and Libertarian), three precincts (Precinct 1, a split precinct 2, consisting of splits 2a and 2b, Precinct 3)), and 21 contests (19 partisan contests and 2 retentions, 11 “Vote for

² The Functional Examiner, however, further identified during Usability Analysis that the system did not comply with Section 1107-A(15) of the Pennsylvania Election Code, 25 P.S. § 3031.7(15).

One”, 1 “Vote for no more than Two”, 5 “Vote for no more than Three”, 1 “Vote for no more than Four” and 1 “Vote for no more than Fifteen”) was run utilizing EMS, ICX (Classic and Prime), ICP and ICC (two scanners). The Functional Examiner examined the compliance of the system to Sections 1101-A and 1107-A(2)-(8), (10)-(11) and (13), 25 P.S. §§ 3031.1, 3031.7(2)-(8), (10)-(11) & (13). All test cases except those validating 25 P.S. § 3031.7(10) passed without anomalies.

Functional Examiner included test cases to validate Sections 1107-A(16) and (17), 25 P.S. § 3031.7(16) & (17), that mandate voting systems to generate zero proof reports and correctly handle over-votes during the election runs. The remainder of the requirements of 25 P.S. § 3031.7(16) and (17) were validated by the Functional Examiner during the Security/Penetration Analysis.

Election definitions for both primary and general elections were created within EMS-EED, and transport media was created to populate ICP, ICX and ICC. Polls were opened and ballots were marked manually, as well as electronically via the ballot marking devices ICX (Prime and Classic). Ballots were tabulated utilizing the ICP and ICC (Canon DR-G1130 and Canon DR-M160-II) scanners.

The Functional Examiner used English 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 Democracy Suite 5.5 is a paper based system and paper ballots provide a permanent physical record of each vote cast adhering to Section 1101-A(1) of the Election Code, 25 P.S. § 3031.1. Hand-marked paper ballots and ballots marked electronically using ICX are tabulated when voters insert the ballots into the ICP polling place scanner or when the ballots are tabulated at the central location using ICC.

The primary and general election definitions were created using EMS-EED and loaded to polling place devices and central scanners, which provided assurance that the

system can perform ballot creation activities. The Functional Examiner successfully added contests including straight party, parties, choices, precincts, districts, ballot styles, referendum questions and retention contests with appropriate candidates and choices. Media was created to load the election to ICP, ICX (Classic and Prime) and ICC. The ICP and ICX (Classic and Prime) components of the Democracy Suite 5.5 successfully permitted votes for "1 of 1," "N of M," and "Question" contests for a standard and ADA voting session. The test cases also included straight party voting to confirm that all appropriate candidates were selected. The Functional Examiner thus concluded that the system is in compliance with Section 1107-A(2), 25 P.S. § 3031.7(2).

Each of the applicable components of Democracy Suite 5.5 allowed the test voter to cast votes for candidates on the ballot and also a write-in vote, demonstrating compliance with Section 1107-A(5), 25 P.S. § 3031.7(5).

Democracy Suite 5.5 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 ICX (Classic and Prime) displayed only contests for which the voter was entitled to vote.

The system's compliance to Section 1107-A(7), 25 P.S. § 3031.7(7), was demonstrated since ICP has the capability to indicate overvotes for any office and the voter has the ability to either spoil the ballot or cast the ballot with overvotes if the voter decides to do so. Ballot marking device ICX (Classic and Prime) did not allow overvotes. The Functional Examiner also noted that the system allowed undervotes, but warned the user about the undervote if configured to do so.

The successful validation of the election results showed that ICC as well as precinct tabulator ICP 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).

The Democracy Suite 5.5 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.

The Functional Examiner validated adherence to Section 1107-A(10), 25 P.S. § 3031.7(10), for both ADA and standard voting sessions. Ballot marking device ICX (Classic and Prime) allowed the voters to review their ballots before printing for tabulation on ICP or ICC. The Functional Examiner attempted to change votes on ICX (Classic and Prime) 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 ICX allowed changing the selections until the voter decides to print the ballot. The Functional Examiner noted that the system did not intuitively allow the voter to deselect all candidates in a contest after voting straight party. The BMD, ICX (Prime and Classic), also showed a message to the voter that they were casting the ballot even though the ballots were being printed to be scanned and tabulated on the ICP or ICC. The ICP, precinct scanner of Democracy Suite 5.5 provides the voter with a caution message when the ballot contains errors, such as 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 spoil the ballot and fill out another ballot.

Accuracy requirements of 1107-A(11), 25 P.S. § 3031.7(11), previously ascertained by reviewing EAC test reports were further validated by the successful tabulation and validation of the primary and general elections run by the Functional Examiner.

The Functional Examiner validated via test cases during the primary and general election that the tabulating devices ICP and ICC generated zero proof reports only before ballots were cast, the system rejected all votes for the contest in an overvote situation, and 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 Examiner confirmed that the zero-proof report cannot be generated on demand after a ballot is cast.

Ballots were marked by hand including write-in votes during the general election to

examine the system's ability to properly enact the PA method of straight party voting. The ICP, ICC and ICX (Classic and Prime) demonstrated compliance to Sections 1107-A(3) and (4), 25 P.S. § 3031.7(3) & (4). The ballot marking devices allowed marking ballots following the PA method and the scanners/tabulators appropriately tabulated ballots with PA method test scenarios.

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 votes including write-in votes.

4. Security/Penetration Analysis

The Functional Examiner adopted a strategy to review each pertinent requirement for this test individually and then created test cases to address it in either a documentation review, a functional test, or both.

Precinct tabulation devices and ballot marking devices were configured for delivery to a polling place from 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 for the ability to be tampered with. The Functional Examiner examined the polling place equipment to confirm the following:

- Adequate seals and locks are present to prevent tampering, and the system provides noticeable evidence if any tamper attempt (successful or failed) occurs (ICP, ICX - Classic and Prime);
- There is no access to the ballots/ballot cards, either via printer, the ICP or ballot card stock, to tamper or substitute any ballots (processed, unprocessed, challenged or provisional) (ICP, ICX – Classic and Prime);
- Devices are not accessible to unauthorized personnel to programmatically tamper with the device that would affect ballot presentation, print, or any other feature/activity (ICX – Classic and Prime);

- Devices not accessible to unauthorized personnel to programmatically tamper with the device that would affect ballot processing, delivery to ballot box, or any other feature/activity (ICX – Classic and Prime and ICP); and
- The Ballot box is tamper proof and/or tamper evident.

The Functional Examiner physically examined the central count equipment ICC for ballot security procedures, and verification of the system adequately preventing the tampering and substitution of ballots.

The Functional Examiner also examined the components of the Democracy Suite 5.5 system for password management of administrative functions and ensured that the system counter could not be reset by unauthorized persons. In addition, the Functional Examiner also reviewed Dominion 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 Democracy Suite 5.5 securely for Election. Based on the tests the Functional Examiner concluded that the system complies to 1107-A(12), 25 P.S. § 3031.7(12).

The Functional Examiner included test cases during the Security/Penetration analysis phase of the testing to evaluate the security requirements mandated by Section 1107-A(16) and (17), 25 P.S. § 3031.7(16) & (17). The Functional Examiner validated that the polling place tabulation device, the ICP, had a visible public counter and the system prevented authorized and unauthorized users access to vote data while polls are open. Tests were completed to verify that USB ports do not allow any data or information to be transferred to the ICP and no maintenance, poll worker or administrator accessible screens 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 zero-proof 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 Examiner concluded that

Democracy Suite 5.5 complies with all requirements mandated by 25 P.S. §§ 3031.7(16) and (17).

5. Privacy Analysis

The Functional Examiner reviewed and inspected the privacy aspects of the Democracy Suite 5.5 system to determine compliance with Section 1107-A(1) of the Election Code, 25 P.S. § 3031.7(1). The Functional Examiner 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 Examiner for adequate visual secrecy. The Functional Examiner also verified that no voter data, including stored ballot images are tied back to any specific voter, in a manner that would compromise voter secrecy.

6. Usability Analysis

The Functional Examiner determined that Democracy Suite 5.5 demonstrated compliance with the usability requirements of Section 1107-A(14) of the Election Code, 25 P.S. § 3031.7(14) , by reviewing appropriate EAC certification reports and vendor documentation. The Examiner determined that the ICX (Classic and Prime) BMD did not comply with the requirements of Section 1107-A(15) of the Election Code, 25 P.S. § 3031.7(15), since the system did not allow the user to cast a “no vote” in a contest after voting straight party without exiting the straight party option. The system behavior was not intuitive enough for the user to understand and did not adequately communicate to the voter what they needed to do to accomplish their vote intent. Additionally, the ICX-BMD informed the voter that they are “casting” their vote even though the ballot was only being printed for scanning and tabulation on ICP or ICC.

Democracy Suite 5.5 Accessibility Examination

The tests included examiner review, and sessions with voters and poll workers. A summary of the test details and findings is discussed in this section.

Examiner Review

The Accessibility Examiner conducted a review of the voting system under examination prior to sessions with voters and poll workers. The Accessibility Examination team included both accessibility and usability expertise to ensure background and knowledge of the issues for accessible voting. The Accessibility Examiner had experience working with people with a wide variety of disabilities and their impact on daily life, knowledge of the range and use of assistive technologies that voters with disabilities might rely on for access, experience conducting usability evaluations with voters and strong knowledge of best practices and design principles for digital technology and voting systems. The expert review gave the examiners a chance to make sure they understand how the system and accessibility features works and to note anything they want to watch for during other testing.

Voter Sessions

The following voter population was represented in the test sessions:

- 4 blind from birth
- 1 late onset blindness
- 1 dexterity/limited use of hands

Age Ranges: 35 thru 70. All but one (a 70-year old) were in the 35-60-year-old age range.

Counties: Allegheny, Dauphin, Lebanon, Philadelphia, or York

Voters had a range of voting experiences. The Accessibility Examiner noted that the test population included a limited range of disabilities and the top problems with the ICX and ICP machines largely focused on issues a low or no vision voter would experience.

Poll worker Sessions

Poll workers were invited to come in teams. We had a total of fourteen participants across five sessions, which represented poll workers in Perry and Dauphin counties. The poll worker groups:

- Had between five and twenty-six years of experience.
- Had at least one election judge
- Were experienced with the Danaher ELECTronic 1242 and the ES&S iVotronic systems
- Had mostly limited experience serving voters with disabilities.

Unique facts about the poll worker groups:

- Three poll workers had blind family members
- One poll worker was blind
- One poll worker was a retired user interface designer

The Accessibility Examiner noted that poll workers with a wider range of voting system experience and different sized communities would have provided a better sample size for the test.

The Accessibility Examiner compiled the findings from the examiner review, voter sessions and poll worker sessions into positives, annoyances, problem solving, needs assistance and likely to prevent independent voting for voters with some disabilities. The Accessibility Examiner included recommendations for improving the accessible voting experience with each of the top five accessibility issues identified. The report also included recommendations on how election officials can support voters and poll workers when the new system is fielded. This section presents a summary of the report. Attachment B of this document lists these issues and recommendations in fuller detail and also describes all the observations from the Accessibility Examination.

The Accessibility Examiner noted in the summary section of the report that the

Dominion systems are an advance in independence and privacy for Pennsylvania voters with disabilities, and identified several positive aspects of the system including the following:

- Voters could vote privately and independently.
- Access features were easily learned by voters and poll workers, and poll workers reported the features would help their voters.
- Sufficient default text size for all sighted voters and the ability to increase to a larger font, if desired.
- Visual interface is clean and generally intuitive.
- Printed ballots could easily be read by app-based screen readers

The top five accessibility issues identified by Accessibility Examiner and voters are summarized in the following section. The Department further evaluated each of the findings and recommendations from the Accessibility Examiner and included the fielding recommendations as conditions for certification of the system³. The Department also discussed the findings from the Accessibility testing, specifically the ones that were marked as “Likely to prevent independent voting for voters with some disabilities” to ensure that appropriate fielding recommendations would alleviate the concerns for most voters.

Top 5 Accessibility Issues:

Privacy and independence restrictions -

- Poll workers must create a special voter card and initialize the assistive devices for voters. This means voters have to disclose disabilities to poll workers or poll workers have to guess voter’s abilities.
- The large ICX touchscreen and placement inside the voting booth may make it possible for other voters and people in the polling location to see how the

³Examples of conditions for certification can be found in this report at identification numbers B, R, T, U, V, FF and GG which relate to the top five accessibility issues found during the examination findings.

voter is voting, unless the county mitigates this risk when configuring the polling place.

Assistive technologies quality, instructions, and feedback –

- For the ICX audio, one voice provides voting instructions and the other announces ballot content. These appeared to use different technologies. Initially, there was a dramatic volume difference between the two, but the vendor was able to correct this problem. The rate of speech is different for the two voices, and the content voice is difficult to understand at very slow or high speeds because of how the audio playback managed the speed.
- The tactile keypad has duplicated buttons and a help button that is not helpful.
- The voting instructions are persistent and repetitive, with poor phrasing that makes it difficult for voters to understand. Lastly, the content of the instructions is too wordy, confusing, and ultimately unhelpful. Voters found it easier to ignore the instructions.

Write-in process

- The write-in process was difficult for the blind voters, and each required some facilitator aid to successfully finish.
- For voters using the audio assistance, there are no instructions to help a voter edit and verify their write-in.

Silent/Hidden selection and deselection

- The implementation of the straight party option made candidate selection and deselection confusing for some voters.
- When candidates overrode their straight party vote in a longer contest, candidates could be deselected off screen and out of the voter's view, without any system alert.
- Overvote protections on the system greys out the remaining options once the maximum number of selections are reached. This may cause the voter using the audio ballot to not hear all of the options in a contest.

Paper ballot handling

- The scanner bed is very shallow and cannot support the entire ballot, and if the ballot is not inserted properly, the scanner will return it to the voter. Since the scanner bed is not full size, the ballot may fall on the floor.
- There are no audible cues to assist blind voters, and the scanner screen is not easy to see.
- Contest alerts used on the paper ballots are not used or worded differently on the touchscreen device.
- The Accessibility Examiner noted that paper ballot is printed on cardstock and can be read by personal assistive devices. It was noted that the system uses a COTS printer for printing the ballots and the voters need not handle blank ballots before making the choices. The implementation reduces the verifiability for voters using assistive devices, since the ballot cannot be reinserted to be “read back”. Three out of the five blind voters were able to use app-based print readers to read the ballot back to them.
- There are no audible cues on the ICP to assist blind voters, and the scanner screen is not easy to see.

The Accessibility Examiner noted that both test voters and poll workers stressed the need for a strong education program to introduce the new systems, including opportunities for hands on training or practice as a new system is rolled out. The examination team also stressed the need for well thought out deployment of any new voting machines (recommendations listed in Attachment B) and effective poll worker training.

Democracy Suite 5.5 Security Examination

As mentioned in the Examination Approach section of this document, the Security Examiner defined the Security Testing to be comprised of a series of test suites which are utilized for verifying that a voting system will correspond to applicable security requirements within the Pennsylvania Election Code. The examiner analyzed the test results

and summarized any identified deficiencies into 4 major categories: documentation, source code, hardware, and functional. The Security Examiner then evaluated the physical and logical security, software hardening and control measures in place and identified items that required remediation before the system is certified for use in Pennsylvania.

The security testing identified the need to modify the hardening procedures for EMS and the ICX BMD printer for a more secure installation. The examiner also provided recommendations on secure implementation and deployment.

Democracy Suite 5.5A Examination Results

Democracy Suite 5.5A Functional Examination

As identified in the test approach section of this document the follow-up examination of Democracy Suite 5.5A included Documentation Review, Source Code Review and System Level Testing and Usability Analysis.

1. Documentation Review

The Examiner reviewed the draft “Test Report for EAC 2005 VVSG Certification Testing Dominion Voting Solutions Democracy Suite 5.5A voting system”. The review confirmed that the Dominion Democracy Suite 5.5A has been evaluated to federal standards by a VSTL. Democracy Suite 5.5A was provided the initial certification decision by EAC on December 20, 2018, which serves as an acknowledgement by EAC that the system has successfully completed conformance testing to VVSG 1.0, 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.

2. Source Code Review

A Source Code Review for the code modifications for Democracy Suite 5.5A was performed, with a focus on determining whether any vulnerabilities could be found that would warrant additional testing. The Functional Examiner concluded that no vulnerabilities

were found during source code review that would warrant additional testing.

3. System Level Testing

The System Level Testing was divided into two tests, a primary election and general election. The Functional Examiner included test cases to specifically test the PA method anomalies identified during Democracy Suite 5.5 testing as part of the general election.

A closed primary election consisting of two political parties (Republican, Democratic), three precincts (Precinct 1, Precinct 2 - split into Precinct 2a and 2b, Precinct 3 was run utilizing EMS, ICX (Classic and Prime), ICP and ICC (two scanners - Canon DR-G1130 & Canon DR-M160-11). For the Republican ballot, there were 21 contests: 19 partisan contests and 2 referendums, 10 “Vote for One”, 1 “Vote for no more than Two”, 3 “Vote for no more than Three”, 4 “Vote for no more than Four” and 1 “Vote for no more than Fifteen”. For the Democratic ballot, there were 21 contests: 19 partisan contests and 2 referendums, 11 “Vote for One”, 1 “Vote for no more than Two”, 1 “Vote for no more than Three”, 5 “Vote for no more than Four” and 1 “Vote for no more than Fifteen”. Referendum contests were added to test the generation of non-partisan ballots. The Functional Examiner validated compliance of the system to Sections 1101-A and 1107-A(2), (5)-(11) and (13), 25 P.S. §§ 3031.1, 3031.7(2), (5)-(11) & (13). 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 political parties (Republican, Democratic, Green and Libertarian), three precincts one of which was a split precinct (Precinct 1, split precinct 2, consisting of splits 2a and 2b, Precinct 3) , and 21 contests (19 partisan contests, and 2 retentions, 11 “Vote for One”, 1 “Vote for no more than Two”, 5 “Vote for no more than Three”, 1 “Vote for no more than Four” and 1 “Vote for no more than Fifteen”) was run utilizing EMS, ICP, ICX and ICC. The Functional Examiner examined the compliance

of the system to Sections 1101-A and 1107-A(2)-(8), (10)-(11) and (13), 25 P.S. §§ 3031.1, 3031.7(2)-(8), (10)-(11) & (13).

The Functional Examiner created election definitions and executed appropriate test cases on all components of Democracy Suite 5.5A to ensure that the modified system satisfies all requirements of the Election Code. The Functional Examiner used English 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 Functional Examiner confirmed with appropriate test cases and voting patterns that Democracy Suite 5.5A maintains compliance to Sections 1101-A and 1107-A(2), (4)-(11) and (16)-(17), 25 P.S. §§ 3031.1, 3031.7(2), (4)-(11), (16) & (17), via tests cases in a similar manner as done during the Democracy Suite 5.5 examination. The Functional Examiner validated that the issues identified during the examination of Democracy Suite 5.5 are resolved and demonstrated compliance to Section 1107-A(10), 25 P.S. § 3031.7(10).

4. Usability Analysis

The Functional Examiner validated that the usability issues on the ICX BMD noted during the Dominion Democracy Suite 5.5A were resolved. The ICX-BMD did not have any references to the word “cast” during the printing process. The ICX-BMD displayed a pop up message requiring user acknowledgement indicating that the voter has to exit out of the straight party option to cast a “no vote” in a contest. The Functional Examiner hence concluded that the system demonstrated compliance to Section 1107-A(15), 25 P.S. § 3031.7(15).

Additional Security/Penetration and Privacy analysis were not conducted during the Democracy Suite 5.5A examination since the test cases validated during these tests were not affected by the isolated modification done to the ICX-BMD to resolve the anomalies noted during the Democracy Suite 5.5 examination.

The Functional Examiner also noted that the paper ballots will allow recounts as required by Sections 1117-A, 25 P.S. § 3031.17. The Functional Examiner identified that the following 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, 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; and
- 25 P.S. § 3031.22.

After all the testing activities, the examiners and Department concluded that the Democracy Suite 5.5A 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. The conclusion was drawn based on the examination of Democracy Suite 5.5A in conjunction with the Democracy Suite 5.5 examination.

Democracy Suite 5.5A Security Examination

The Security Examiner evaluated the documentation changes made to the system hardening procedures and confirmed that if the system is implemented following the hardening procedures, it provides a secure implementation.

D. Observations

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

1. The system presented for examination had undervote warnings turned on for straight party contest on ICX (Classic and Prime). This may make the voter believe that there is a need to make a selection in that contest.
2. Observations/Findings from the Accessibility Examination are listed on pages 32 thru 34 and as Attachment B of this document.
3. Dominion Democracy Suite 5.5A does not support cumulative voting.
4. The configuration of the system complying with the Pennsylvania Election Code requirements including the PA method of straight party voting will require the use of appropriate selections of configurable parameters.
5. The ADA compliant ballot marking device ICX (Classic and Prime) presented as part of the Democracy Suite 5.5A system, could be effectively used by all voters. This allows jurisdictions to expand the use of these devices for a larger universe of voters and not restrict their use to voters using assistive devices.
6. The system allows configuration of button labels, warning/alert messages, voter instructions etc. There are some configuration elements that can be configured via the EMS Graphical User Interface (GUI) while there are some elements like button labels that cannot be configured via Graphical User Interface and will need to be done by editing a configuration (JSON) file on the EMS server.
7. The use of voter access cards for activation will create a lot of components to

manage and track on Election Day. Creating a large number of voter activation cards prior to Election Day would make it difficult to keep track of the card inventory. If jurisdictions choose to create cards on demand that would necessitate the need for an additional system at the polling place.

8. The ICX (Classic and Prime) BMDs use a COTS printer for printing marked ballots. The printer settings need to be appropriately adjusted for the printed ballots to be read by ICP or ICC.

IV. Conditions for Certification

Given the results of the examination that occurred in October and December 2018 and the findings of the Examiners as set forth in their reports, the Secretary of the Commonwealth certifies the Democracy Suite 5.5A subject to the following conditions:

A. This certification for Democracy Suite 5.5A is based on the EAC initial certification decision dated December 20, 2018, and will be appended with the final EAC certification documentation after the final EAC certification is issued.⁴ Any jurisdictions purchasing and implementing the system before the final EAC certification must perform a trusted build validation after the final EAC certification to ensure that the certified system components are installed. This validation must happen even if the jurisdiction has done a trusted build validation during the system acceptance.

B. Pennsylvania counties using the Democracy Suite 5.5A 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, and any future revisions or directives. In particular, Pennsylvania counties must adhere to item four (4) of the directive when setting up and positioning the ICX in the

⁴ This certification is being issued due to the unique circumstances of the federal government shutdown after the successful initial certification decision was issued by the EAC and notice was given that no further testing is necessary. Consequently, only ministerial documentation remains, which will be appended once issued.

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)). The ICX (Classic and Prime) screens have large size and high-resolution display and are very clear and can be viewed at wide angles without distortion. Jurisdictions must make a note of this while setting up polling places and purchase privacy booths.

C. No components of the Democracy Suite 5.5A shall be connected to any modem or network interface, including the Internet, at any time, except when a standalone local area wired network configuration 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 Democracy Suite 5.5A, including wireless LAN cards, network adapters, etc. must be uninstalled or disabled prior to delivery or upon delivery of the voting equipment to a county board of elections.

D. Because Democracy Suite 5.5A is a paper-based system, counties using the Democracy Suite 5.5A 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 via a manual count of the voter marked paper ballots exclusively. Counties must include in the sample ballots 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 and any future revisions or directives that may apply to audits of electronic voting systems.

E. All jurisdictions implementing the Democracy Suite 5.5A 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. Jurisdictions must include audio ballots and accessible devices during

L&A 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. Counties must ensure that the L&A test cases include all applicable scenarios of the PA straight party method identified in Attachment C to the Directive for electronic voting systems published by BCEL on September 11, 2017.

F. Democracy Suite 5.5A is a paper-based system and hence, implementation of the system for precinct or central count scanning is scalable. Jurisdictions should calculate the number of voting booths necessary to accommodate the number of registered voters in a precinct to avoid long lines. Jurisdictions must include the ICX as an ADA compliant device in configuring a precinct polling place. Jurisdictions must also take into consideration the ICP scanning speed, ballot box and Transport Media capacities on polling place components when deciding on the number of voting booths.

G. All jurisdictions implementing the Democracy Suite 5.5A must implement administrative safeguards and proper chain of custody to facilitate the safety and security of electronic systems pursuant to the Guidance on electronic Voting System Preparation and Security, September 2016.

H. Jurisdictions implementing the Democracy Suite 5.5A with the Central Count Tabulator 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.

I. All jurisdictions implementing the Democracy Suite 5.5A 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 to avoid any password compromise. The passwords and permissions management must at a minimum comply to 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>.

J. All jurisdictions implementing Democracy Suite 5.5A must configure the polling place components of the voting system to notify voter on overvotes.

K. All jurisdictions implementing Democracy Suite 5.5A must work with Dominion to ensure that only the certified system configuration is installed on purchase or anytime 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. A sample format that can be used for the attestation is added as Attachment C to this document.

L. Dominion must work with the jurisdictions implementing Democracy Suite 5.5A to ensure that the system has been hardened for a secure implementation. Jurisdictions must implement processes to ensure that all components of the voting system have been hardened per the instructions in the TDP.

M. Jurisdictions can make use of the adjudication functionality to adjudicate write-ins and evaluate questionable ballots, contests or selections to determine voter intent. Any decisions made during review of the ballot must be agreed upon by a team of at least two reviewers authorized by the election official. The election official can also consult the paper ballot to assist with determinations made during adjudication. In the event of a recount, the voter verified paper ballots must be used for the count.

N. Jurisdictions implementing Democracy Suite 5.5A must work with Dominion 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.

O. Jurisdictions using the services of Dominion or a third-party vendor for election preparation activities must work with Dominion or the vendor to ensure that systems used for ballot definition activities are considered part of the voting system and use certified voting system components. The systems used for ballot definition must be configured securely following conditions outlined in this report and following any Directives and Guidance issued by the Secretary. Any data transfer between the vendor and county must be done using encrypted physical media or 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.

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

Q. Jurisdictions must not use individual voter access cards for activating the ICX Ballot Marking device. This is to avoid lost, stolen or misplaced cards with the activator chip, which would be a potential vulnerability. Jurisdictions using poll worker cards for ICX activation must ensure that poll workers are trained to maintain strict chain of custody of the activation card.

R. Dominion must ensure that any implementations in Pennsylvania counties must appropriately indicate that the ICX BMD is printing the ballot and the final messaging on the ICX must instruct the voter on how to complete the voting process. Any references to “casting the ballot” must not be present. The changes must be done during implementation by Dominion support personnel and verified by county election officials.

S. Jurisdictions must have appropriate instructions on the ICX BMD to ensure that the voter reviews the entire ballot before printing the ballot. This is to avoid voters

missing selections in contests, especially after voting straight party.

T. Jurisdictions must work with Dominion to ensure that the entire audio ballot including audio rates and volumes on the audio ballot are tested before deploying to polling places. Jurisdictions must also ensure that poll worker training includes potential situations and questions from voters using the audio ballot. This is specifically important for Dominion Democracy Suite 5.5A. Jurisdictions must note that the general instructions and ballot instructions are configured separately and could have different volume setting and audio rates. This was noted during the Accessibility Examination and made the audio ballot almost unusable before adjusting the volume settings. Specific attention must be given to ensure that the audio ballots are tested by multiple personnel to evaluate the voice quality and the instruction accuracy.

U. Jurisdictions must work with Dominion during the ballot definition to ensure that voters using assistive devices have clear instructions for the write-in process. The on-screen instructions must be adjusted to have the audio ballot explain the process. The audio instructions must include instructions on how to navigate and find the write-in keyboard.

V. Jurisdictions must work with Dominion 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 on the system 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; and
- The audio ballot must provide feedback on the reason for the changes in any selections and the interaction with straight-party choices.

W. Jurisdictions must make voters aware that voting straight party is optional via clear instructions on paper, on screen and audio ballots. This is to ensure that the voter

doesn't assume that he/she must make a selection for the straight party contest. The ballot instructions must be approved by the Department and follow any directives and/or guidance issued by the Department. Jurisdictions must also ensure during the election definition process that the straight party contest is excluded from undervote warnings. This is to ensure that the voter doesn't assume that he/she must make a selection for the straight party contest.

X. Dominion must ensure that the COTS printer used for ICX BMD (HP LaserJet Pro Printer M402dn /HP LaserJet Pro Printer M402dne) must be configured to ensure that the printer settings cannot be changed by the voter at the polling place. The configuration must ensure that the printer settings can only be modified by authorized personnel.

Y. The electronic voting system must be physically secured while in transit, storage, or while in use at their respective locations. Unmonitored physical access to devices can lead to compromise, tampering, and/or planned attacks.

Z. Jurisdictions must implement processes and procedures involving management, monitoring and verification of seals, locks/keys, 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 Dominion 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 that can be removed by authorized personnel when the port is needed.

BB. Jurisdictions using standalone installation of the EMS server on portable devices must protect the laptops to prevent lost or stolen device.

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 and reported in a timely manner.

DD. Jurisdictions implementing Democracy Suite 5.5A must ensure that the USB devices and any other removable or transportable media used for election activities is maintained with strict chain of custody. There must be a process to manage the removable/transportable media inventory to avoid misplaced and lost media. The devices must either be replaced or 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 Democracy Suite 5.5A must work with Dominion to ensure appropriate levels of training for election officials is planned on implementation. Counties must ensure that the trainings adhere to the “Minimum Training Requirements” specified in Attachment D of this document.

FF. Jurisdictions implementing Democracy Suite 5.5A must include voter and poll worker training as part of the implementation plan. The training must include hands on practice for both voters and poll workers. Specific consideration must be given to voters using assistive devices and also poll worker education to assist voters with disabilities. Refer to Attachment B, listing detailed recommendations for deployment noted by the Accessibility Examiner.

GG. Jurisdictions implementing Democracy Suite 5.5A must consider the following during voting booth set up for serving voters requiring assistive devices

- 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.
- The path between ICX and the ICP 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.

- The cords for tactile keypads, headphones and BMD printer need to be placed so that they don't interfere with the printed ballot and the voter's ability to find and take the ballot.

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

HH. Jurisdictions implementing Democracy Suite 5.5A must ensure that the iButton used for activating administrative access on ICP is managed with strict chain of custody. The iButton pass codes must be modified at a minimum for every election. If an iButton pass code requires change after the initial assignment, appropriate EMS options must be selected to ensure that only the latest assigned iButton pass code is active.

II. Dominion 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 publicly available social media platform. The videos must have audio instructions and must be closed captioned.

- A video (in an electronic format) for voters that demonstrates how to cast a vote 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. Must be provided in additional languages for any jurisdictions required to meet thresholds in the Voting Rights Act.

JJ. Dominion 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;
- Ownership, Financing, Employees, Hosting Location. Any changes of 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, Dominion 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; and
- SOC 2 Reporting – Dominion shall provide the Secretary with its annual American Institute of Certified Public Accountants (AICPA) Attestation Standard (AT) Sec. 101 Service Organization Control (“SOC”) 2, Type 2 certification (AT Sec. 101 SOC 2, Type 2), or an equivalent certification approved by the Commonwealth. Equivalent certifications include, but are not limited to: International Organization of Standards (ISO) 2700x certification; certification under the Federal Information Security Management Act

(FISMA); and AT Sec. 101 SOC 3 (SysTrust/WebTrust) certification.

KK. Dominion must adhere to the “Source Code and Escrow Items Obligations” specified in Attachment E of this document. In addition, Dominion must provide a copy of the source code on a password protected CD to the Secretary.

LL. Dominion must work with jurisdictions to ensure that the system is configured to comply with all applicable requirements of PA 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.

MM. Jurisdictions implementing the Democracy Suite 5.5A and Dominion must work together to implement 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. § 3031.5(a)-(b). Dominion must ensure that future releases of the voting system with enhanced security and accessibility features are presented for approval to the Secretary.

NN. Dominion must work with counties and Department to ensure that the system can integrate with the 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 Democracy Suite 5.5A. If the vendor or a County Board of Elections makes any changes to the Democracy Suite 5.5A Voting System subsequent to 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 Democracy Suite 5.5A Voting System in the Commonwealth of Pennsylvania.

V. Recommendations

A. All jurisdictions implementing Democracy Suite 5.5A Voting System should 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 implementing Democracy Suite 5.5A should take appropriate steps to ensure that voter education is part of the implementation plan.

C. All jurisdictions implementing the Democracy Suite 5.5A should ensure that precinct election officials and poll workers receive appropriate training and are comfortable using the system.

D. All jurisdictions considering purchase of the Democracy Suite 5.5A should review the System Limits as mentioned in the EAC certification scope.

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

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

G. Secretary recommends configuring the election with only one contest being displayed on each screen presented to the voter on ICX. This is to ensure that all screens presented to the voter are similar and voters don't need to adapt to the situation that there may be multiple contests displayed on a screen.

VI. Conclusion

As a result of the examination, and after consultation with the Department's staff and the Examiners, the Secretary of the Commonwealth concludes that the Democracy Suite 5.5A 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 Code, **provided the voting system is implemented with the conditions listed in Section IV of this report.** Accordingly, the Secretary certifies Democracy Suite 5.5A for use in this Commonwealth.

The ICX can accommodate 4 to 5 voters using assistive devices per hour or around 19 voters per hour when used as the primary voting system depending on the size of the ballot. The ICP precinct scanner can serve 30 voters per hour depending on the length of the ballot.

Attachment A – EAC Certification Scope⁵



CertConf&Scope_D
Suite5.5-A.pdf

⁵ Certification scope added on February 01, 2019 after final EAC certification was granted. Also corrected the version number of ImageCast X on page #7 to read 5.5.10.30.



United States Election Assistance Commission



Certificate of Conformance

Dominion Voting Systems Democracy Suite 5.5-A

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: Democracy Suite

Model or Version: 5.5-A

Name of VSTL: SLI Compliance

EAC Certification Number: DVS-DemSuite5.5-A

Date Issued: January 30, 2019

Executive Director

Scope of Certification Attached

Manufacturer: *Dominion Voting Systems (DVS)*
System Name: *Democracy Suite 5.5-A*
Certificate: *DVS-DemSuite5.5-A*

Laboratory: *SLI Compliance*
Standard: *VVSG 1.0 (2005)*
Date: *January 30, 2019*



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.

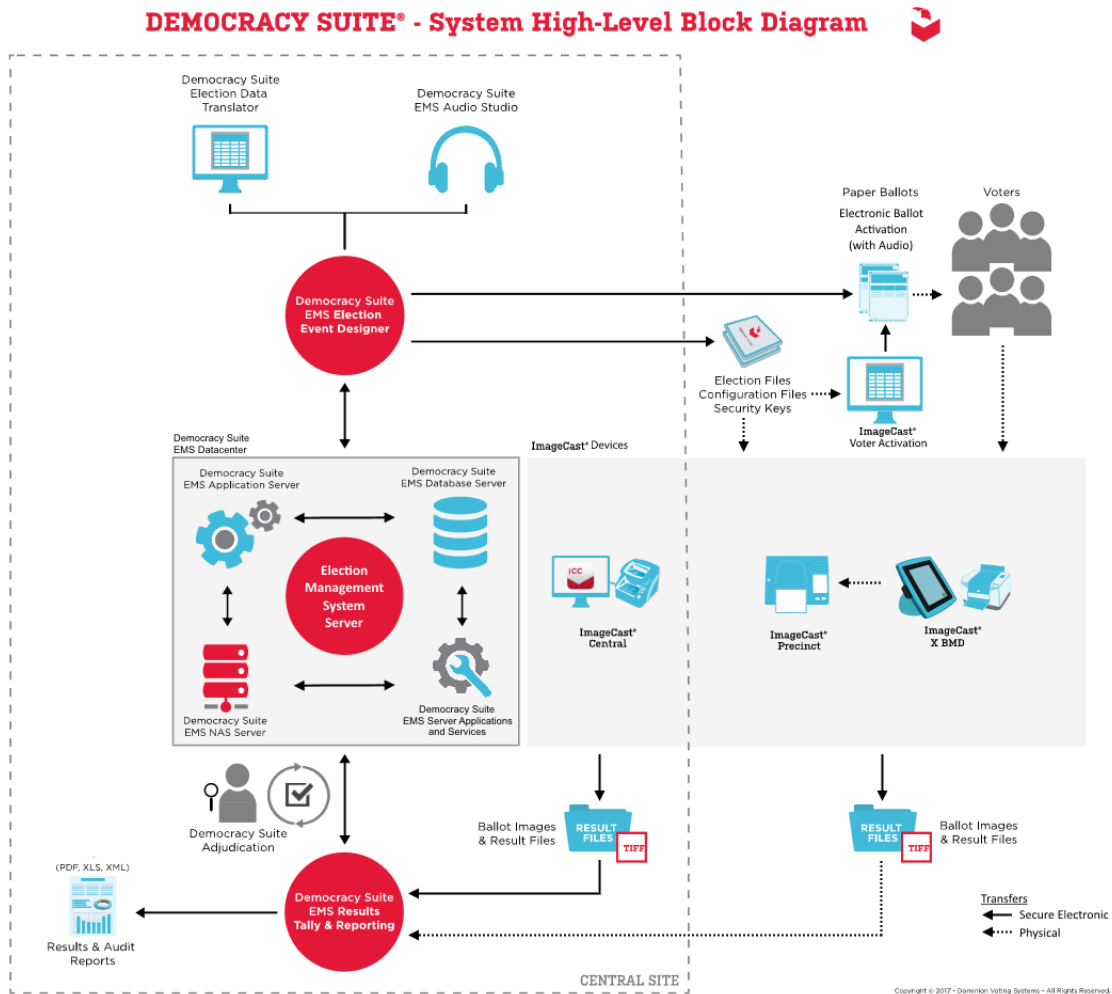
System Overview:

The D-Suite 5.5-A Voting System is a paper-based optical scan voting system with a hybrid paper/DRE option consisting of the following major components: The Election Management System (EMS), the ImageCast Central (ICC), the ImageCast Precinct (ICP), and the ImageCast X ballot marking device (BMD). The D-Suite 5.5-A Voting System configuration is a modification from the EAC approved D-Suite 5.5 system configuration.

Language capability:

System supports Alaska Native, Apache, Bengali, Chinese, English, Eskimo, Filipino, French, Hindi, Japanese, Jicarilla, Keres, Khmer, Korean, Navajo, Seminole, Spanish, Thai, Towa, Ute, Vietnamese, and Yuman.

Democracy Suite 5.5-A System Diagram



Components Included:

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

Voting System Software Components:

System Component	Software or Firmware Version	Operating System or COTS	Comments
EMS Election Event Designer (EED)	5.5.12.1	Windows 10 Pro	EMS
EMS Results Tally and Reporting (RTR)	5.5.12.1	Windows 10 Pro	EMS
EMS Application Server	5.5.12.1	Windows Server 2012 R2 Windows 10 Pro	EMS
EMS File System Service (FSS)	5.5.12.1	Window 10 Pro	EMS
EMS Audio Studio (AS)	5.5.12.1	Windows 10 Pro	EMS
EMS Data Center Manager (DCM)	5.5.12.1	Windows Server 2012 R2 Windows 10 Pro	EMS
EMS Election Data Translator (EDT)	5.5.12.1	Windows 10 Pro	EMS
ImageCast Voter Activation (ICVA)	5.5.12.1	Windows 10 Pro	EMS
EMS Adjudication (ADJ)	5.5.8.1	Windows 10 Pro	EMS
EMS Adjudication Services	5.5.8.1	Windows 10 Pro	EMS
Smart Card Helper Service (SCHS)	5.5.12.1	Windows 10 Pro	EMS
Election Firmware	5.5.3-0002	uClinux	ICP
Firmware Updater	5.5.3-0002	uClinux	ICP
Firmware Extractor	5.5.3-0002	uClinux	ICP
Kernel (uClinux)	5.5.3-0002	Modified COTS	ICP
Boot Loader (COLILO)	20040221	Modified COTS	ICP
Asymmetric Key Generator	5.5.3-0002	uClinux	ICP
Asymmetric Key Exchange Utility	5.5.3-0002	uClinux	ICP
Firmware Extractor (Technician Key)	5.5.3-0002	uClinux	ICP
ImageCast Central Application	5.5.3.0002	Windows 10 Pro	ICC
ICX Application	5.5.10.30	Android 5.1 (ICX Prime)	ICX

Voting System Platform:

System Component	Version	Operating System or COTS	Comments
Microsoft Windows Server	2012 R2 Standard	Unmodified COTS	EMS Server SW Component
Microsoft Windows	10 Professional	Unmodified COTS	EMS Client/Server SW Component
.NET Framework	3.5	Unmodified COTS	EMS Client/Server SW Component
Microsoft Visual J#	2.0	Unmodified COTS	EMS Client/Server SW Component
Microsoft Visual C++ 2013 Redistributable	2013	Unmodified COTS	EMS Client/Server SW Component
Microsoft Visual C++ 2015 Redistributable	2015	Unmodified COTS	EMS Client/Server SW Component
Java Runtime Environment	7u80	Unmodified COTS	EMS Client/Server SW Component
Java Runtime Environment	8u144	Unmodified COTS	EMS Client/Server SW Component

System Component	Version	Operating System or COTS	Comments
Microsoft SQL Server 2016Standard	2016 Standard	Unmodified COTS	EMS Client/Server SW Component
Microsoft SQL Server 201 Service Pack 2	2016 SP1	Unmodified COTS	EMS Client/Server SW Component
Microsoft SQL Server 2016 SP1 Express	2016 SP1	Unmodified COTS	EMS Client/Server SW Component
Cepstral Voices	6.2.3.801	Unmodified COTS	EMS Client/Server SW Component
Arial Narrow Fonts	2.37a	Unmodified COTS	EMS Client/Server SW Component
Maxim iButton Driver	4.05	Unmodified COTS	EMS Client/Server SW Component
Adobe Reader DC	AcrobatDC	Unmodified COTS	EMS Client/Server SW Component
Microsoft Access Database Engine	2010	Unmodified COTS	EMS Client/Server SW Component
Open XML SDK 2.0 for Microsoft Office	2.0	Unmodified COTS	EMS Client/Server SW Component
Infragistics NetAdvantage Win Forms 2011.1	2011 Vol. 1	Unmodified COTS	EMS SW Platform
Infragistics NetAdvantage WPF 2012.1	2012 Vol. 1	Unmodified COTS	EMS SW Platform
TX Text Control Library for .NET	16.0	Unmodified COTS	EMS SW Platform
SOX	14.3.1	Unmodified COTS	EMS SW Platform
NLog	1.0.0.505	Unmodified COTS	EMS SW Platform
iTextSharp	5.0.5	Unmodified COTS	EMS SW Platform
OpenSSL	1.0.2K	Unmodified COTS	EMS SW Platform
OpenSSL FIPS Object Module	2.0.14 (Cert 1747)	Unmodified COTS	EMS SW Platform
SQLite	1.0.103.0	Unmodified COTS	EMS SW Platform
Lame	3.99.4	Unmodified COTS	EMS SW Platform
Speex	1.0.4	Unmodified COTS	EMS SW Platform
Ghostscript	9.04	Unmodified COTS	EMS SW Platform
One Wire API for .NET	4.0.2.0	Unmodified COTS	EMS SW Platform
Avalon-framework-cvs-20020806	20020806	Unmodified COTS	EMS SW Platform
Batik	0.20-5	Unmodified COTS	EMS SW Platform
Fop	0.20-5	Unmodified COTS	EMS SW Platform
Microsoft Visual J# 2.0 Redistributable Package – Second Edition (x64)	2.0	Unmodified COTS	EMS SW Platform
Entity framework	6.1.3	Unmodified COTS	EMS SW Platform
Spreadsheetlight	3.4.3	Unmodified COTS	EMS SW Platform
Open XML SDK 2.0 for Microsoft Office	2.0.5022.0	Unmodified COTS	EMS SW Platform
Open SSL	1.0.2K	Unmodified COTS	ICP
OpenSSL FIPS Object Module	2.0.10 (Cert 1747)	Unmodified COTS	ICP
Zlib	1.2.3	Unmodified COTS	ICP
uClinux	20070130	Modified COTS	ICP
Google Text-to-Speech Engine	3.11.12	Unmodified COTS	ICX SW
Zxing Barcode Scanner	4.7.5	Modified COTS	ICX SW
SoundTouch	1.9.2	Modified COTS	ICX SW
ICX Prime Android 5.1.1 Image	0405	Modified COTS	ICX SW
ICX Classic Android 4.4.4 Image	0.0.98	Modified COTS	ICX SW
OpenSSL FIPS Object Module	2.0.10 (Cert 2473)	Unmodified COTS	ICX SW Build Library

System Component	Version	Operating System or COTS	Comments
OpenSSL	1.0.2K	Unmodified COTS	ICC SW Build Library
OpenSSL FIPS Object Module	2.0.10 (Cert 1747)	Unmodified COTS	ICC SW Build Library
1-Wire Driver (x86)	4.05	Unmodified COTS	ICC Runtime SW
1-Wire Driver (x64)	4.05	Unmodified COTS	ICC Runtime SW
Canon DR-G1130 Driver	1.2 SP6	Unmodified COTS	ICC Runtime SW
Canon DR-G1130 TWAIN Driver	1.2 SP6	Unmodified COTS	ICC Runtime SW
Visual C++ 2013 Redistributable (x86)	12.0.30501	Unmodified COTS	ICC Runtime SW
Machine Configuration File (MCF)	5.5.10.19_20180706	Proprietary	ICX Configuration File
Device Configuration File (DCF)	5.4.01_20170521	Proprietary	ICP and ICC Configuration File

Hardware Components:

System Component	Hardware Version	Proprietary or COTS	Comments
ImageCast Precinct (ICP)	PCOS-320C	Proprietary	Hybrid Precinct Scanner/DRE
ImageCast Precinct (ICP)	PCOS-320A	Proprietary	Hybrid Precinct Scanner/DRE
ICP Ballot Box	BOX-330A	Proprietary	Ballot Box
ICP Ballot Box	BOX-340C	Proprietary	Ballot Box
ICP Ballot Box	BOX-341C	Proprietary	Ballot Box
ICX UPS Inline EMI Filter	1.0	Proprietary	EMI Filter
ICX Tablet (Classic)	aValue 21" Tablet (SID-21V)	COTS	Ballot Marking Device
ICX Tablet (Prime)	aValue 21" Tablet (HID-21V)	COTS	Ballot Marking Device
Server	Dell PowerEdge R630	COTS	Standard Server
Server	Dell PowerEdge R640	COTS	Standard Server
Server	Dell Precision T3420	COTS	Express Server
ICC Workstation HW	Dell OptiPlex 7440 All in One	COTS	
ICC Workstation HW	Dell OptiPlex 9030 All In One	COTS	
ICC Workstation HW	Dell OptiPlex 3050 All In One	COTS	
ICC Scanner	Canon imageFormula DR-G1130	COTS	Central Count Scanner
ICC Scanner	Canon imageFormula DR-M160II	COTS	Central Count Scanner
Client Workstation HW	Dell Precision T3420	COTS	
Client Workstation HW	Dell Latitude E7450	COTS	
Client Workstation HW	Dell Latitude e3480	COTS	
ICX Printer	HP LaserJet Pro Printer M402dn	COTS	
ICX Printer	HP LaserJet Pro Printer M402dne	COTS	
Monitor	Dell Monitor KM632	COTS	
Monitor	Dell Monitor P2414Hb	COTS	
Monitor	Dell Ultrasharp 24" Monitor U2414H	COTS	
CD/DVD Reader	Dell DVD Multi Recorder GP60NB60	COTS	
iButton Programmer	Maxim iButton Programmer DS9490R# with DS1402	COTS	
UPS	APC Smart-UPS SMT1500	COTS	
Network Switch	Dell X1008	COTS	
Network Switch	Dell X1018	COTS	

System Component	Hardware Version	Proprietary or COTS	Comments
Network Switch	Dell X1026	COTS	
Network Switch	Dell PowerConnect 2808	COTS	
Sip and Puff	Enabling Devices Sip and Puff	COTS	
Headphones	Cyber Acoustics ACM-70	COTS	
4-way Joystick Controller	S26	Modified COTS	
Rocker (Paddle) Switch	Enablemart #88906	COTS	
Footswitches	ABLENET Jelly Bean Twist 10033400	COTS	
CF Card Reader	IOGEAR SDHC/microSDHC OU51USC410	COTS	
CF Card Dual-Slot Reader	Lexar USB 3.0	COTS	
CF Card Reader	Hoodman Steel USB 3.0 102015	COTS	
CF Card Reader	Lexar Professional CFR1	COTS	
CF Card Reader	Kingston FCR-HS4	COTS	
ATI	ATI handset	Proprietary	
ATI	ATI-USB handset	Proprietary	
ACS PC-Linked Smart Card Reader	ACR39U	COTS	

System Limitations

This table depicts the limits the system has been tested and certified to meet.

Characteristic	Limiting Component	Limit	Comment
Ballot positions	Ballot	292*/462**	Both
Precincts in an election	EMS	1000; 250	Standard; Express
Contests in an election	EMS	1000; 250	Standard; Express
Candidates/Counters in an election	EMS	10000; 2500	Standard; Express
Candidates/Counters in a precinct	Ballot	240*/462**	Both
Candidates/Counters in a tabulator	Tabulator	10000; 2500	Standard; Express
Ballot Styles in an election	Tabulator	3000; 750	Standard; Express
Ballot IDs in a tabulator	Tabulator	200	Both
Contests in a ballot style	Ballot	38*/156**	Both
Candidates in a contest	Ballot	240*/231**	Both
Ballot styles in a precinct	Tabulator	5	Both
Number of political parties	Tabulator	30	Both
"vote for" in a contest	Ballot	24*/30**	Both
Supported languages in an election	Tabulator	5	Both
Number of write-ins	Ballot	24*/462**	Both

* Reflects the system limit for a ballot printed in landscape.

** Reflects the system limit for a ballot printed in portrait.

Functionality

2005 VVSG 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 Standard (provide definition of how supported)	YES	
Primary: Open Blanket (provide definition of how supported)	YES	
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.	NO	
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	Equal time rotation
Straight Party Voting:		
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	
Split Precincts:		
Split Precincts: Multiple ballot styles	YES	

Feature/Characteristic	Yes/No	Comment
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	
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)	YES	
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 2 nd 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 2 nd 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		
Ranked Order Voting: Voters can write in a ranked vote.	NO	
Ranked Order Voting: A ballot stops being counting when all ranked choices have been eliminated	NO	
Ranked Order Voting: A ballot with a skipped rank counts the vote for the next rank.	NO	
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.	NO	
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	

Feature/Characteristic	Yes/No	Comment
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	NO	
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 cause a warning to the voter and can be configured to allow voter to override.
Overvotes: DRE: Prevented from or requires correction of overvoting.	YES	
Overvotes: If a system does not prevent overvotes, it must count them. Define how overvotes are counted.	YES	If allowed via voter override, overvotes are tallied separately.
Overvotes: DRE systems that provide a method to data enter absentee votes must account for overvotes.	N/A	
Undervotes		
Undervotes: System counts undervotes cast for accounting purposes	YES	
Blank Ballots		
Totally Blank Ballots: Any blank ballot alert is tested.	YES	Precinct voters receive a warning; both precinct and central scanners will warn on blank ballots.
Totally Blank Ballots: If blank ballots are not immediately processed, there must be a provision to recognize and accept them	YES	Blank ballots are flagged. These ballots can be manually examined and then be scanned and accepted as blank; or precinct voter can override and accept.
Totally Blank Ballots: If operators can access a blank ballot, there must be a provision for resolution.	YES	Operators can examine a blank ballot, re-mark if needed and allowed, and then re-scan it.
Networking		
Wide Area Network – Use of Modems	NO	
Wide Area Network – Use of Wireless	NO	
Local Area Network – Use of TCP/IP	YES	Client/server only
Local Area Network – Use of Infrared	NO	

Feature/Characteristic	Yes/No	Comment
Local Area Network – Use of Wireless	NO	
FIPS 140-2 validated cryptographic module	YES	
Used as (if applicable):		
Precinct counting device	YES	ImageCast Precinct
Central counting device	YES	ImageCast Central

Baseline Certification Engineering Change Orders (ECO)

There are no ECOs applied to this modification that are not certified as part of the baseline Democracy Suite 5.5 voting system.

Attachment B – Accessibility Examination Findings and Recommendations

A) Top problems and Recommendations as listed in the accessibility examiner's report



Top problems -
Dominion.pdf

B) All observations from Accessibility Examination



All
observations.pdf

C) Other Recommendations for Deployment from Accessibility Examiner report



Other issues and
recommendations fc

D) Top positives



Top positives -
Dominion.pdf

Top problems

The following discusses the problems that surfaced during the expert examinations and voter/poll worker observations with the Dominion Voting ICX ballot marking system.

Testing identified five problems that could reduce the ability of people with disabilities to vote independently and privately on the ICX voting machine.

1. Privacy and Independence

What Happened?

The ICX voting system, as it was configured during certification testing, presents two impediments to voters with disabilities voting privately and independently.

- **Machine set up.** The ICX has a 27-inch, portrait oriented diagonal display, which is very large and produces very clear print. Also, as with most modern displays, the screen can be viewed at wide angles without distortion. Also, the machine and printer take up a sizable operating footprint. Which means in most voting booths, the screen will sit near the front of the booth in order to fit.
- **Voter check-in and disclosure.** With the ICX system, voters receive a voter “smart card” from the check-in table that contains all the information the machine needs to pull up the correct ballot. There are many ways a county could implement this system, but it was clear that a card would need to be created for each voter in advance or on demand. There were two types of voter cards: standard and accessibility devices enabled. The second type of card must be inserted by a poll worker to activate the accessibility device options screen, where the preferred device, such as the tactile keypad, switch input, or audible output is chosen. Then, the preferred device is given to the voter.
- **Accommodation screen.** The accommodation selection screen is available only once in the voting process, so it is not possible to try

different accommodations to see which would work best. And, once the voter has begun voting, they cannot change the type of accommodation without canceling the ballot and starting again.

- **Really only two options.** The accommodation screen presents four choices: Audio-Tactile Interface (ATI), Paddles, Sip and Puff, or Audio/Visual mode. While this suggests that there are four modes of interaction, there are, in fact, only two. The ATI, Paddles, and Sip and Puff selections produce identical behavior. The Paddles and Sip and Puff choices, from the point of view of the voting machine, are identical, as would be any user-provided switch input. In all three methods, the machines “listens” for input from the switches and provides auditory feedback. In the fourth choice, Audio/Visual mode, the system provides auditory navigation and feedback, but does not listen for switch input.
- **Active touchscreen, all the time.** In all four modes, the touch-screen remains active. When the voter touches a control for the first time, its purpose and content is announced, but not selected. A second touch selects the control and activates it (if a button). On second touch, the content of the choice is repeated aloud, which allows a voter with low-vision to explore the screen by touching various controls and hearing their function without accidentally making choices.

This behavior for various switch and audio modes is not well implemented. A person who elects to use the switch input will not touch the screen for control, as that is beyond their capability (hence the use of the switch interface). However, if a switch user needs assistance from another person, the double-touch function means the poll worker or aide must touch each choice twice. In these cases, the two-step selection is an unnecessary burden. Since the switch user (blind or sighted) would be using a personal listening device such as the provided headphones or personal headset, the selected choice being read prior to the selection would not be apparent to the

person helping, and learning the two-step selection could be difficult.

Why is this a problem?

The poll worker setup and required voter disclosure are problems for three reasons.

- **Bright and clear.** Anyone within 10 feet of a booth, including in nearby booths, can observe the selections of any voter.
- **Voters cannot independently choose and initiate their preferred voting method.** For a voter to have access to the assistive devices they must declare their need at sign-in, and receive a different activation card than that provided to non-disabled voters. In some cases, such as blindness or mobility impairment, the disability is overt, and there is no loss of confidentiality. When such a voter enters the polling place, their need for accommodation is readily apparent, and there is no additional exposure from requesting an accommodations card (and generally the assistance of a poll worker in setting up the machine).

Because a poll worker must initiate the accommodations, and then walk away, there's no method where the voter could do this by themselves and then test the different devices.

- **Social stigma and privacy.** There are other types of disability that are not readily apparent, and those living with these limitations would also benefit from the available accommodations. For example, voters with low literacy or cognitive impairment would benefit from the audio/visual assistive option, but might not understand that the accessibility options can help them vote more effectively, or they may not wish to reveal their status to the poll workers and the community. The ICX voting machine requires this disclosure to activate the accommodations.

Recommendations

The recommendation for the physical privacy concern is relatively straightforward. Counties will need to think about how a polling location is set up. Keeping the open side of the voting booth close to a wall and ensuring adequate clearance around the voting machine can help. Also, exploring different voting booth manufacturers and types. One that is deeper and allowed the machine to be pushed back into the booth could provide enough side-to-side privacy.

A county choosing this machine will have to do at least two things *before* Election Day to ensure poll workers and voters are successful.

- **Poll Worker accessibility training.** Counties can create a poll worker accessibility training component that gives poll workers tools to effectively help voters with disabilities. Counties that already have this type of program can evaluate it against this machine's requirements. Such training programs could include ways to identify voters who may need assistance, how to appropriately ask a voter if they need assistance, and how to assist a voter once identified.
- **Voter education and demonstrations.** Officials can create voters with disabilities education and demonstration events around the county. Here, voters can learn how to use the new machine, and the county can demonstrate all the machine's accessibility features. While demonstrating them, officials can give examples of who could benefit from using each assistive device, and especially include examples of voters most would not immediately identify as having a disability. For example, an older voter with sight problems might benefit from the additional audio instructions. Or a diabetic with neuropathy in their hands may prefer to use the dual-switch paddles. Both examples of voters may not have known the options and devices were available before.

A strong two-pronged training and education program will help poll workers be more comfortable with assisting voters with disabilities. Having who know all of the accessibility options and well-trained poll workers will make voters feel more comfortable asking for assistance on Election Day.

2. Audio Quality, Instructions, and Feedback

The ICX voting machine had a number of problems with the audio quality, instructions, and feedback.

What happened?

The ICX machine uses two distinct voices for its audio interface.

- **Instructions.** One voice, used for instructions, appears to be prerecorded synthesized voice that will remain constant across elections. This voice is well articulated and clear, but was considered “harsh,” “not good,” and “rinky-dink” by voters who were more experienced with the state-of-the-art voices provided on their personal devices. The pacing and phrasing of this voice meant it was difficult to know when a sentence started and ended. For a brief announcement, this voice would be acceptable, but the long-term use was a problem (see below).
- **Ballot content.** The second voice uses text-to-speech and reads the content of the ballot. Unlike the pre-recorded voice, this voice is “live,” somewhat “fuzzier,” and less harsh than the instructional voice.

As delivered, these two voices had five problems, one of which was corrected before the voters arrived.

- **Volume difference.** The first, correctable, issue was that the voices started at quite different volumes. When the instructional voice was set to a comfortable level, the content voice was nearly inaudible. This problem was fixed by an adjustment by the manufacturer, but should have been tested before delivery.
- **Rate of speech and voice quality.** The system allowed voters to change the rate of speech, which is common for audio assistive devices. The range of speech rates was very different between the two voices. The instructional voice could be slowed by as much as 50%, and accelerated by approximately 200%. The content voice, by contrast, could be sped up by about 600%. An increase in the rate of the instructional voice from 100 words per minute to 110 words per

minute might result in a change of the content voice from 100 wpm to 200 words per minute. After the initial orientation to the machine, voters were more interested in the information provided by the content voice. These two voices need to respond similarly to the settings.

- **Audio and tactile keypad.** At the top of the keypad, there are controls to adjust the rate and volume of the auditory feedback. These buttons are convex on top to indicate increasing, or concave to indicate decreasing the assigned function. Below this are five buttons: a right-left pair, the select button, and an up-down pair. At the bottom of the keypad is a “Help” button that reaches from side to side.

On the lower edge of the keypad are ports for headphones or access switches. These ports are physically identical (3.5mm phono jacks), and have nearly invisible raised labels (black on black). There is no Braille marking on the ports.

The tactile keypad’s navigation buttons do not have a unique function in this voting system.

- The yellow, left and right buttons and the blue, up and down buttons do exactly the same thing. During the ATI instructions, this was not stated. The instructions described the yellow-and blue-buttons as having different functions. At each step, the buttons were described by color, shape, and function: “the yellow, left-arrow button to move left,” or “the blue up-arrow button to move up.”
- The single exception to this was the select button. In the Help instructions, this was identified as the “red, x-shaped select button.” However, throughout the audio narration on the machine, this was only described as the “red select button.” Several blind voters commented, “Why do I care what color it is?” When it was explained that a person with low vision might use this interface, and might be able to use the color as an aid, they were accepting, but the select button, being used so

often, should have been identified, using this logic, as x-shaped rather than simply “red.”

- **Persistence and repetition.** The phrasing of audio commands should place the most important information first. This allows the voter to attend when the narration of interest, and think about other things when it is not.
 - The same instructions played every time a voter pressed a button in the same contest area. The instructions only changed when they moved to a new contest area or page. Also, if the voter paused to think about the next action, the instructions would immediately start to play again. Voters stopped thinking about voting to listen to the voice to ensure no new information was available. After voters figured out the pattern, they stopped listening to the instructions altogether.
- **Instructions content.** The content instructions are also long, confusing, or unhelpful.
 - The audio instructions for the Dominion system repeatedly said “Use the yellow, right-arrow button or the blue down arrow button to move to the next item.” This long text was confusing. More efficient wording might simply ignore one set of buttons, for example, “To move to the next item, use the blue down-arrow button.”
 - The introduction to the write-in screen says that you can write-in a candidate of your choice, but does not provide guidance on how to do that. This disturbed even the sighted voters, but every blind voter had to be cued to move beyond the box announced as “Write-in candidate, blank” to find the keyboard.

Sometimes the voting instructions on the screen are poorly worded.

- The screen to select a straight party vote, the instructions say “You may select the party of your choice by selecting the party of your choice.”

Why is this a problem?

To some extent, the audio instructions and content feature of the Dominion system may suffer from an “uncanny valley” where it is close enough to good to be annoying, though it is actually better than the feedback from some of the other machines we have evaluated.

Blind users typically want their text-to-speech voices to speak at rates above 400 words per minute, so that they can listen at the same rate sighted people can read. Many blind individuals read at speeds in excess of 600 words per minute, and up to 1000 words per minute (the limit of current technology). People with cognitive limitations such as auditory processing disorders may need the voice to speak more slowly, to give them time to understand it.

Voices designed for screen reading do not necessarily sound like human voices, but remain understandable over a wide range of speeds. To accomplish this, the components of voice that carry information are identified, and the filler sounds between those components are stretched or shortened to change the overall speech rate without loss of intelligibility. People who routinely listen to synthetic voices expect this.

The voices used in the Dominion voting machine are not this sophisticated. To increase speech rate, it appears that they simply slice sections from the sound stream. To slow the voice down, they insert silence at intervals in the sound stream. This approach is “effective” for compressions and stretches of 10 to 20%, as the human brain can fill in the blanks fairly effectively. However, the Dominion system attempts to use this technique with slowing to as little as 50% of the speech rate, and increasing rate by several hundred percent.

The use of two audio voices for instructions and ballot content in and of itself is not a problem (in fact, it meets the VSG requirement that they be different). But Dominion’s implementation of the voices is a problem for at least two reasons.

- **Election Day Ready.** The ICX seems to have a lot of configuration points, which could be a good thing for counties. However, when many of the settings, like the disparate volumes between instructions and content speech, are not usable out-of-the-box, some counties

may not know that they need to make those changes for an option to be usable.

- **Cognitive overhead.** Voters had to concentrate excessively to understand what was being said. At the lower three speed settings, the instructional voice was noticeably broken up, and at the highest two settings the gaps made it impossible to process what was being said.

When voters have to interpret poorly written instructions, it means they are not thinking about voting. This is made harder for voters using the audio when the quality, rate, and phrasing mean they are spending more time figuring out how to use the machine than they are on which candidate is best for the contest.

Recommendations

Counties choosing this machine can ensure that they:

- Test the audio rates and volumes before deployment to make sure they are usable for both blind voters and others who might use the audio.
- Train poll workers well on the potential issues and questions voters might have about using the audio while voting.
- Provide community demonstrations so voters can practice with the machine. Voting on Election Day may be smoother if they know what to expect.

Also, if the audio style and content is configurable, counties should ask the vendor to do the following:

- **Use better voices.** Many of the blind voters demonstrated the voices they use on their personal assistive devices, and explained why they were better. Much better voices than those on the tested system are available for purchase or license. The vendor could provide a synthetic voice that is designed for high compression levels such as those used in commercial screen readers or cell phones.

- **Include verbosity control and contextual help.** The blind voters all indicated that they would prefer some verbosity control on the audio instructions, or changing the level and wordiness of the help as needed. In the initial orientation, the full names could be used. Once the voter is oriented, though, this could be contracted to “Use the arrows to move forward or back.” If the voter got confused, the Help button on the ATI could be configured to provide more detailed instructions about the current screen.

3. The Write-In Process

The write-in screen and process presented two problems for voters using the audio assistance.

What happened?

When visually choosing to write in a candidate on the ICX, the voter enters the write-in screen and is presented with a text box, where the write-in name will appear, editing buttons (“Clear all” and “Delete”). Below this is an on-screen keyboard in alphabetical order to enter the name of the chosen candidate. At the bottom of the screen is a button to confirm the write-in and return to the ballot. This all makes sense for a sighted voter because the layout is clear.

- **No instructions.** There were very few instructions for sighted voters, but the layout of the screen made use self-explanatory for everyone in this test. The audio had no additional instructions beyond “Please enter your write in candidate.” Then when the voter navigated to the next option, they only heard the voice say the text box was empty. Voters became caught in this area for a long time. The “Help” button on the tactile keypad only gave voters instructions on how to use the tactile keypad.

All of the blind voters needed facilitator assistance to successfully write in a candidate. Each voter had trouble moving beyond the write-in name box. But once they advanced to, and heard, “A,” they rapidly and generally accurately typed the name of the write-in candidate. At intervals, the users *could* navigate to the write-in name box to hear

their entry spelled back to them, then return to typing. None of our blind voters discovered this capability.

- **Editing Problems.** The Dominion ICX had implementation problems with editing a name once it had been entered and using the audio assistance.
 - **Deleting.** The only option for editing an error in name entry is to delete letters or the entire name and start from scratch. For sighted voters, this makes sense visually. They can see the letters disappearing and can easily see what letters remain. For blind voters using the audio, each letter is announced when typed, but when deleted, the key announces only “Delete,” and not what has been deleted.
 - **Repeating too soon.** If the voter stops to consider what they are doing while editing a name, the ICX repeats the last audio instruction given. While this is not ordinarily more than an annoyance, in text entry it can be challenging. If the name being written in has a double letter, and the user pauses to think about the spelling of the name, the system will repeat the last instruction, “You selected ‘M’.” If this occurs as the user presses the select key to double the “M,” it is not clear whether a second “M” has been typed, or if the audio has just repeated the previous letter. The user must navigate to the name box to hear the name spelled out to find out how many letter “Ms” have been typed. (This process is not described in the audio instructions, and must be discovered by the voter.)
 - **Does not voice the “Space.”** The “space” character between names is not voiced. A blind voter may have forgotten to enter a space, but would not know.
 - **No reentry.** True for all voters: If a voter has entered a write-in name, returns to the ballot, and then realizes that the name was misspelled, touching the write-in option again clears the text in the box.

Why is this a problem?

While it is arguable that the write-in process has very little impact in most contests, all of our voters and poll workers were very interested in the usability of the write-in process. And all functions of a voting machine should work effectively for each voter. It does not always have to be the same method, but the outcome should be the same. Not being able to effectively edit a write-in name is a major problem for two reasons.

- An entry the voter thought was cast correctly because there were no audible mistakes might still be voided because of inaudible errors.
- Limited instructions combined with editing problems can lead to voter confusion. Even if they can figure out a method to get the system to voice what is actually in the text box, it takes an inordinate amount of mental resources. Resources that some voters cannot spare and should be reserved to deciding who to vote for.

Recommendation

We recommend the following changes to the write-in system:

- Adjust the on-screen instructions so that the audio reads it.
- Include audio instructions how to navigate to find the keyboard.
- Rework how the system voices deleted characters and the frequency it repeats them.
- Include any and all spaces and special characters in the text box when reading the entry to the voter.

4. Silent/Hidden selection and deselection

What happened?

There were three elements of silent and/or hidden selection and de-selection on the ICX that voters found confusing. In most cases, voters were able to mark their ballot as instructed through trial and error, but in others, they did

not notice changes made by the system and might vote in a way that does not match their intent.

- **Destructive candidate deselection when changing a straight party contest**

After making a straight party choice, if voters wanted to vote for additional candidates from another party or “scratch” and change party for that contest, the system automatically deselects all of the other pre-marked candidates. In a contest with a short list of candidates, this behavior, dictated by the PA Method, caused confusion, but with persistence voters were able to select the candidates specified in the instructions. When the voters were asked to vote for just one of the three automatically selected candidates, they universally attempted to deselect an unwanted candidate by pressing on that candidate’s name. Because of the interpretation of the PA Method, this resulted in confirming the vote for that candidate, instead of deselecting that candidate, as the voters stated they had expected. The voters were, in this case where the changes were evident, able to correct the error and vote as instructed. (Please see more about candidate selection in the next section)

- **When the contest was long, candidates were often de-selected on a different screen, with no notification from the system.** For sighted voters, this automatic change resulted in candidates who had been selected not being voted for as intended by the voter. For audio users, no deselection is voiced at any time.
- **Overvoting protections do not protect audio users.** Once a voter selects the maximum number of candidates in a contest, the system greys out the remaining options. This is a strong protective feature and intuitive for a sighted voter. The sighted voter is able to scan through the remaining candidates and find others who s/he might prefer, and change selections. However, when using the audio assistance, this way of handling overvote protection removes the ability for the system to read the remaining candidates, so a voter may not hear all of the options.

Why is this a problem?

The system relies on voters perceiving the change in selections and understanding why those changes have happened. This is a problem because:

- All voters should have control of all selections.
- Off-screen actions force all voters into problem solving. This is worse for voters using the audio format or a dual switch because navigation is more difficult.
- Voters with cognitive disabilities may be unable to understand what has happened when the interface is unpredictable and/or inconsistent.
- If a voter has to ask for assistance in the middle of the ballot, their privacy and independence are compromised.
- Ultimately, voters may vote in a way they had not intended.

Recommendations

While the machines must comply with the “Pennsylvania Method” of straight party voting, there are ways to fully inform the voter of selection and deselection changes. For example:

- Create meaningful audio feedback messages and confirmation processes to tell voters what is happening—including the number and names of the candidates being deselected. No selection or deselection should ever take place without explicit action or confirmation from the voter. Language should be included like: “If you do X, these voters will be deselected” or “Are you sure you want to....”
- Be consistent and toggle all selections on and off when touched or selected with the tactile keypad, including selections made when the straight party option is active. This is consistent with how selection and deselection works in general and is not destructive.

5. Paper ballot handling

One of the goals of the voting machine upgrade is to allow all voters to vote independently and privately, including verifying their ballot. All paper ballots introduce barriers for voters with low-vision, no-vision, and with limited dexterity.

Most voters appreciated the printed ballot, which allowed a second chance to review the vote before casting. The implementation of the printing and paper-handling of these paper ballots had some issues that limited the ability of voters to use them effectively.

Reading the paper ballot

For the Dominion ICX ballot marking system, the ballot is printed using a separate, off-the-shelf printer on 8.5 x 11-inch cardstock. The cardstock is stored inside the printer next to the tablet. This means that voters do not have to handle a blank ballot before making choices.

It also means that there is no feature to allow a voter to “read back” the ballot by reinserting the printed, completed ballot into the voting system. Three of our five blind voters were able to use app-based print readers on their phone to take a picture of the ballot and read it back to them. This is only an option for voters with this technology. There is no built-in option for all voters.

The paper ballot included alerts and language that was not used on the touchscreen. For example, undervoted contests are called out with “UNDER_VOTE_BY_N” where N is the number of positions still available. The ballot review screen does not do this, which means it is not announced to visually impaired voters using the audio assistance.

Interacting with the ICP ballot scanner

The scanner had both positives and negatives. In general, the ballot scanner does not produce any major accessible voting barriers.

Only one feature stood out and could be considered a positive for voters with disabilities.

- Voters may insert the ballot in any orientation. This provides another layer of privacy and limits the potential failures. However, this was not clear to any of the voters or poll workers. Each asked how to insert it.

The most serious problems are:

- The scanner bed is very shallow so the entire ballot does not fit on it. Only the top third of the page can be rested on the scanner. Voters with no/low use of their hands would rely on assistance for feeding the ballot into the scanner. And the supplied privacy sleeve was of little help because it was not designed for use with these ballots. Some of the test participants commented on these issues.
- There are no audible cues. The scanner did not include robust features to alert voters that their ballot has been cast successfully.
- If the ballot is not perfectly aligned as the scanner begins to grab it, the scanner will spit it back out. If the voter is not ready for this, the ballot will fall to the floor. This is a problem for all voters but potentially very embarrassing and frustrating for those with disabilities.
- There are subtle visual cues from a small screen that notify voters that the scanner is ready, reading a ballot, and finished scanning. These were not available for voters with low or no vision. Also, the quality of the screen is poor. If the voter or poll worker is not directly over the screen, it is difficult or impossible to read.

While the voter does not spend as much time interacting with the ballot scanner as the touchscreen machine, there are barriers for voters with disabilities that can limit voter privacy and independence. If a voter must ask a poll worker for ballot scanning assistance, this increases the likelihood that the poll worker will see how the individual voted.

Recommendations

For the printed ballot layout

- Make the alerts and language on the ballot and touch screen consistent.

For the scanner

- Increase the length of the scanner bed so that the full ballot can sit on it before inserting it into the machine. This will help low mobility and dexterity voters and will catch the ballot if it is inserted incorrectly.
- Make the cues more obvious that the ballot is cast. Large print words or simple images to indicate the scanning steps on the screen, and a stronger visual cue can show that the ballot scanned successfully. Adding a subtle audio cue that the ballot scanned properly would help blind or low vision voters confirm their ballot was cast.
- Train poll worker to assist voters in ways that do not compromise the voter's privacy. This might include having standard instructions for poll workers to use to guide a voter in casting their own ballot, or narrating the poll worker's actions so that the voter understands what the poll worker is doing.

Other issues for deployment

A few other issues produced consistent enough observations to call them out in some detail.

Alerts

Both the poll workers and the voters were uncomfortable with the language of the on-screen warnings.

In general, they felt that warnings were appropriate for conditions that might invalidate a ballot, where “alerts” would be appropriate for acceptable conditions that could be changed.

- **“If left blank, this contest will have implicit choice selections for party [straight party choice].”** One of the most egregious involves any contest that is left blank, but the voter selected a straight party. In this case, the system provides an alert that says “If left blank, this contest will have implicit choice selections for party [straight party choice].” The system does not have an immediate way to straight party vote *and* abstain from a contest, which is a problem in and of itself. But the high-level language in the alert confused most voters and poll workers. And all said that the message needed to change.
- **“Your ballot is valid, but there are warnings.”** If a voter does not select a straight party, the review screen first indicates that “Your ballot is valid, but there are warnings.” Then, the straight party contest alert indicates that “This contest is blank.” The wording of this alert suggests that the straight party selection is a ballot contest rather than a convenience, and that selection is mandatory. In either case, the language is unnecessarily harsh and coercive.
- **“This contest is undervoted!”** If a voter does not select all of the available candidates in a contest, they receive a warning that the contest is undervoted. “Undervoted” is not a clear language term, and is potentially confusing to voters. The warning also suggests that full voting is required.

The language of on-screen or audio “warnings” should be informative, not coercive, and should be in plain language. Where possible, counties should work with the vendor to reconfigure or rewrite these warnings.

Poll Worker Concerns

Poll workers were very excited about the ability of the scanner to tabulate absentee ballots. However, they had some concerns about the touchscreen and general process.

- **Power needs and cords.** Several poll workers commented that the machine included the ballot marking tablet and a separate printer. They were concerned about the power requirements this would present in some of their polling places. Combined with the wires for the headphones and access switches, they felt that the number of cables would be a burden to manage in the polling site.
- **Lots of pieces.** The poll workers were concerned about managing the “parts” of the process. This machine uses activation cards to select the appropriate primary ballot by party, and uses different cards for “normal” versus “accommodated” voting. In polling places that serve more than one precinct, each might have a different ballot. This suggests the need for many types of cards, or new system entirely to manage at the voter check-in area. The scanner also has compact flash cards and security keys. They did not like the idea of complicating the voting process with additional things.
- **Casting the ballot and traffic management.** Poll workers were also worried that the voter must carry the ballot from the voting machine to the scanner and ensuring they actually fed the ballot into the scanner. This has been a common concern from poll workers who do not currently use paper ballots. However, this concern was justified in this instance because of the language on the print ballot screen.
 - When you press the “Print” button at the end of voting, the machine produces a new window with an alert. It has a message “Some warning detected on your ballot. You cannot make any more changes after casting the ballot.” Then there are two buttons labeled: “Cast your ballot” and “Review your

choices.” To make it worse, the final screen says “Thank you for voting! Your ballot is successfully cast.” This language choice is misleading and incorrect. The touchscreen device just creates the ballot and printer prints it. The ballot is not “cast” until it has been scanned by the tabulator.

- Poll workers became worried that voters may misinterpret these screens and just walk away. Since many voters desire a receipt for voting (to validate time off from work or credit for school), they might think that they had indeed cast their ballot (because the machine said they had), and the printed copy is their receipt.
- The poll workers were anxious about traffic management to assure that the ballots and cards all came to the scanner. They suggested that a message on screen when the ballot was printed would help. It could instruct voters to take their ballot and activation card to the scanner to cast their ballot.
- The poll workers were uneasy about the comfort level of the older voters with change in the process. They all agreed that having the machines available in public spaces (libraries) prior to the election to allow voters to try them would be important.
- There was some apprehension about the use of compact flash cards to record tallies. These are small, and may be difficult to manage from some workers with limited dexterity.

Candidate Selection

The Dominion software uses two levels of candidate selection, which interact in two different ways from the point of view of the voter.

- **Soft Selection vs Hard Selection.** The first level of selection might be called “soft-selection.” When a voter selects a straight party ballot, the candidates from that party are soft-selected and pre-marked throughout the ballot. This will count as a vote unless modified by action of the voter, as discussed in the “implicit” alert area above.

If a voter touches the screen to select a candidate without a straight party choice, this direct action creates a “hard selection.” If a soft-selected candidate is touched by the voter, this converts the soft-selection to a hard selection.

- **Cannot leave a straight party contest blank.** Once a voter selects a straight party, the machine will not allow a voter to abstain from any contest. As mentioned in the “Alerts” section, the machine informs the voter that a blank contest will be marked as straight party—even if the voter leaves the names unselected. As one voter discovered on her own, she could effectively abstain from the contest by submitting a blank write-in entry. This is not an appropriate work around.

To the voter, soft-selected and hard-selected votes look the same. This is logically sound, but has unexpected repercussions.

- **Destructive behavior.** If a voter decides that they want to remove a straight party selected candidate in a “Vote for N” contest, they will try to deselect that candidate by touching or selecting that candidate. Instead of deselecting the soft-selected candidate, it converts it to a hard selection. This was not what the voter intended, so naturally the voter touches the selection again. This results in deselecting the candidate, and also deselecting all of the other straight party votes in that contest. This unexpected destructive behavior confused sighted voters.
- **Soft-selection cue.** All of our blind voters, when instructed to vote for an in-party candidate, reselected that candidate, making the selection a hard selection. This suggests that the cue that the candidate had already been soft-selected was not adequate to alert the voter, and might result in unintended cancellation of other in-party candidates.

There were additional candidate selection issues that confused voters.

- **Number of available candidates vs number of selected candidates.** In contests where the voter is allowed to select multiple candidates from the presented roster, there is no indication of the number of candidates available. Nor, after selecting one or more

candidates, is there indication of how many candidates have been selected.

When the roster of candidates is longer than a single screen, or for all blind voters, it is not clear how many candidates are available. This could be remedied by messages that say “Vote for 5 of the 23 candidates” and “You have voted for three of the allowed five votes.” When the voter has selected fewer than the allowed number of candidates, they are presented with a warning that they have “undervoted” the contest. It was not clear to our voters what “undervoted” meant, and the language of the warning suggested that this was not a valid vote, and that all five candidates must be selected to be appropriate.

Not all of the issues in this section have clear workarounds or immediate vendor-provided solutions. Counties should have extensive poll worker trainings and many opportunities for voter education to ensure all poll workers and voters know how to successfully cast each vote at the polls.

Reviewing and verifying the ballot

Voters with disabilities will also need voter education on how the ballot review and verification process works for the combination of presentation and interaction mode they are using. This is particularly important because of the use of straight party voting in Pennsylvania

In this voting system, it is possible for a voter to select a straight party option, go directly to the review screen, and then directly to print without any notification from the ballot marking device that they have undervoted any nonpartisan contests or ballot questions.

A blind or low-vision voter who cannot easily verify the printed ballot might never learn that they skipped contests, especially if the precinct ballot scanners are not programmed to report undervotes.

One solution to this would be for the audio at the beginning of the review to announce if there are undervoted contests (and perhaps how many there are).

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.

Advanced 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.

Poll workers felt strongly that any new system – particularly those with 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.
- Have voting machine hands-on demonstrations at disability events so that voters can get to know the machines, practice voting, and be prepared for what they may need on Election Day.

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

Training for poll workers 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 their 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 ICX 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 ICX, the setting and preferences buttons are at the top of the screen at all times. The poll worker can review these with the voter (reading the instructions to be sure they are consistent and accurate).

Poll worker procedures

Poll worker 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 that the ballot must be placed in the center of the scan bed, 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 that their ballot can be inserted into the scanner in any orientation. Using the privacy sleeve is the most secure. However, inserting the ballot upside down, with the print toward the floor, is sufficient.

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 Braille, audio, and large print.
- Test all assistive aids with local voters.

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 ICX screen can be adjusted to change its angle for a closer approach, adapting to standing or sitting postures, and avoiding glare.
- Provide help 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. On the ICX, the tactile keypad includes two 3.5mm jacks that seems appropriate to insert a headset. One is marked in very small letters that it is for audio. However, the other jack is where the dual switch connects. Counties should ensure poll workers explain the two jacks to voters, at a bare minimum.
- Make sure voters are oriented and know where all parts of the voting system are, including the privacy shields. The ICX includes options to blank the screen during the audio ballot, but then poll workers could bring back the visual mode if the voter has a question.
- Remind voters how to cast their ballot and how to know when they are finished.

Polling place setup

Ensure all polling locations have at least one accessible voting booth with a chair that is easily removed if a voter uses a mobility device.

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 when using simple personal technology, such as magnifiers or text readers to verify it.

For all voting machines, the path to the touch screen and 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.

Use assistive technology to support blind and low-vision voters in verifying their ballot, for example, a magnification unit or a simple OCR scanner.

Voting booth setup for this system

Two issues were identified specifically for this system during the examination and usability testing related to how the system and attached devices are placed. The system fits very tightly in the accessible voting booth supplied by the vendor for the exam.

- **Cable management for assistive devices.** The tactile keypad is normally stored behind the screen, connected on a semi-permanent cord. The headphone is plugged in on the right-side front of the tactile keypad. The printer could be set up to the right or left.
Recommendation: The cords need to be placed so that they don't interfere with the printed ballot or the voter's ability to find and take it.
- **Privacy.** The screen for this system sits close to the front of the booth. It is easy to read the crisp, clear screen display over the shoulder of someone sitting down, or from the side, especially when large text is used.
Recommendation: Position the booth so the voter's back is to a wall, so no one can walk behind them, and with sufficient space to the left and

right that people cannot “peek” from the side. However, be sure that there is a good path for a manual or motorized wheel chair to get to the voting booth easily (see above).

All observations

Voter comments and reviewer observations about each machine are described below. For each are, the observations are organized by the machine function then by the severity.

Positives

Function	Observation	System	Severity
General	Blind voter/poll worker - "Once I understand the system, I can whiz!"	ICX	Positive
Display and Navigation	Large, clear, easy to read screen. The screen angle can be changed to three angles: flat, slight incline, and almost vertical.	ICX	Positive
	Default font large enough for most sighted voters.	ICX	Positive
	The system prevents overvotes by greying out the remaining options once the voter has selected the maximum number of candidates in a contest.	ICX	Positive
	Alerts are generally well formatted and in appropriate places. The wording in the alerts is not good, however. (See Problems section below)	ICX	Positive
	The ballot review button is always visible and functional. Voters don't have to review the entire contest or ballot to navigate to the review screen. Likewise, the print ballot button is always available from the review screen.	ICX	Positive
	Large "scroll down/up" buttons at the top and bottom that span the width of the screen.	ICX	Positive
	Straight party vote indicator that allows you to turn on and off straight party votes at any point.	ICX	Positive

Function	Observation	System	Severity
Display and Navigation	Ballot review screen is generally well formatted. Alerts are present in each contest where necessary. In blank or undervoted contests, a "No selection made" label is present for each potential vote for number.	ICX	Positive
Assistive Technology (AT)	Voter - "The disability functions are the best features."	ICX	Positive
	AT includes an audio mode that leaves the screen enabled. The first screen touch reads the selection, and then the same item touched a second time selects it.	ICX	Positive
	If the voter chooses the assistive technology, the touch screen is still active for those who may want to use both.		
	Poll worker commented that these machines would help counties find accessible locations for the machines.		
Write-In Screen	Once a blind voter found the on-screen keyboard, they were able to enter the candidate name quickly.	ICX	Positive
	After completing the write-in, one blind voter said, "That was easy."	ICX	Positive
Printed Ballot & Scanner	While sighted voters (and poll workers) generally did not want to check the printed ballot, blind voters generally did. The use of card stock made the ballot easy to handle. The card reader at the base of the screen created a make-shift easel. Voters could rest the ballot against the machine and use personal AT devices to verify their ballot. Seeing AI and other personal AT were able to read the printed ballot to the voters successfully who attempted it.	ICX/ICP	Positive

Function	Observation	System	Severity
Printed Ballot & Scanner	After the ballot printed, one voter responded "Neat!"	ICX	Positive

Problems

Function	Observation	System	Severity
Setup for Voters	Concern about the power requirements (marker and printer use separate power cords) and confused cables for tactile keypad, speaker, switches, and headphones with power cords. Counties will need to ensure polling locations have enough outlets available, and they will need to think of strategies to contain the cords.	ICX/ICP	Annoyance
	This machine has a lot of additional parts: memory cards, voter cards, access keys.	ICX/ICP	Annoyance
	"Seems like a lot of parts to the process. Our voters will get confused."	ICX/ICP	Annoyance
	Poll workers were concerned if their county did not switch to an electronic poll book, then they would have to have another system to create voter cards on demand.	ICX/ICP	Annoyance
	Poll workers felt that early hands-on exposure to the machines should be provided several weeks before the election, so that voters could become familiar with the process.	ICX/ICP	General comment
Privacy	Because of the large screen size and clear print, some voters were concerned about privacy. It was easy to read the display from several feet away.	ICX/ICP	Annoyance
	When privacy cover is used on ballot, the ballot cannot be inserted to the bottom of the sleeve. The top of the ballot must be outside the sleeve for the scanner to pick it up.	ICX/ICP	Annoyance
Orientation and Navigation	For one contest on the sample ballot, (County Commissioner), the down-contest candidates are not visible on the initial screen. If it were indicated that there were "X Candidates" in total, the voter would be cued to scroll down to find them.	ICX	Problem solving

Function	Observation	System	Severity
Orientation and Navigation	If a voter wants to quickly vote straight party, the system allows selecting straight party, then review, then print. In this process, however, the voter is never presented with the ballot questions. If they do not review their ballot entirely, they receive no warning that any non-partisan contests are blank.	ICX	Problem solving
	As part of the overvote protection, the additional candidates or options are greyed out once the maximum number of selections has been reached. However, this means that the audio does not announce the additional candidate names. This could lead to a voter missing a desired candidate.	ICX	Likely to prevent independent voting for voters with some disabilities
	When using the audio, the straight party button is present in all contests. Every blind voter got stuck on this button and the instructions are unclear as to what the button is or how to navigate away from it.	ICX	Needs Assistance
	No blind voter was able to do the write-in process without some assistance. Most navigated to the box where the name appears, and stopped. No instructions describing the process are available. Once the voter pressed the down or right arrow buttons enough times, they discovered the keyboard, and oriented themselves within the layout.	ICX	Needs Assistance
	It is not obvious that to change your vote, you have to deselect the chosen candidate to bring back the check boxes on the other candidates.	ICX	Problem Solving
Orientation and Navigation	In ballot contests, the keypad navigation wraps from bottom to top, but not from top to bottom. In dialogs, the navigation wraps both ways. This inconsistent behavior can be confusing, and results in inefficient operation.	ICX	Problem Solving

Function	Observation	System	Severity
	On contests that have a number of votes allowed, there must be the same number of write-in opportunities. When navigating by audio, each of these is announced as "Write-in" with no variation in speech. For those depending on this feedback, it is not clear that they are moving through different selections on the ballot. A voter recommended that it say "Write in #1, Write-in #2..." to clarify this.	ICX	Problem Solving
	One voter accidentally selected the ballot "Review" button rather than "Next," after making the first selection in a contest.	ICX	Problem Solving
	There are four ways to insert the card, only one of which works. For a blind voter, the activation card does not have an indication of the correct orientation. (Only the visual display provides instructions). Although all of our blind voters were able to feel the integrated circuit on the card, some instruction is needed on how to insert the card. One voter suggested a small Braille dot on the card as a cue.	ICX	Problem Solving
	At the top of the display at all times there are controls for text size, contrast, and language. For AT users to navigate to these controls, they must press "Select" while the contest title is active, then they can scan through the settings. Used in this way, the select button is inconsistent between selecting choices and navigation, which will be an issue for those with cognitive disabilities. Some blind voters were tripped up by this.	ICX	Problem Solving
Orientation and Navigation	Sighted voter felt that the instruction for the number of available votes (Vote for N) should be larger, and spaced down from the contest title.	ICX	Annoyances
	A sighted poll worker was surprised when the "Next" button changed to "Review." Suggested "End of Ballot" message.	ICX	Annoyances

Function	Observation	System	Severity
	While reviewing the ballot, the voter can jump back to individual contests and make changes. The review ballot button, to return to the review process always returns to the top of the ballot. On long ballots, with voters who make multiple changes, this is an unnecessary burden.	ICX	Annoyances
	If the voter is looking at the second contest on a single screen, making the text larger can cause that contest "disappear." It actually moves to the next page, but that isn't obvious.	ICX	Annoyances
	Poll worker (retired user interface designer) indicated that there should be more space between "Scroll down" and "Print" buttons on the review screen. He accidentally pressed it a few times.	ICX	Annoyances
	The Up/Down and Left/Right buttons on the tactile keypad perform the same navigation. Once voters discovered it, they used only one set of buttons.	ICX	Annoyances
	Several voters and candidates attempted to navigate by swiping, it is not enabled on this system.	ICX	Annoyances
	For voters using the dual switch input, on contests with many candidates, the "Next" button requires many, many button presses. It can cause voters to overshoot their target, and have to do it again.	ICX	Annoyances
	When text is enlarged, text size stays the same in alert messages in a different window.	ICX	Annoyances
Audio Instructions	Ballot header instructions are centered. When instructions are longer than a few words, the justification can chop up sentences strangely.	ICX	Annoyances
	Blind poll worker said "Oh!" In response to the content voice. Then said, "Oh, that's terrible!"	ICX	Problem Solving

Function	Observation	System	Severity
	The voice used for the audio feedback was described by voters as "crappy" and "rinky-dink." Truncates words at high speeds. The word "write-in" was rendered as "ret."	ICX	Problem Solving
	The rate range of the content voice (difference between slowest and fastest rate) was much higher than the instruction voice. When adjusting, the voter can only hear the instruction voice, so may require several tries to get the voice to a desired rate.	ICX	Problem Solving
	The audio instructions are repeated too quickly after pausing on a selection, and they are repeated too often after each navigation.	ICX	Problem Solving
	"The audio instructions are needlessly complicated."	ICX	Problem Solving
	"The [audio] instructions are kind of confusing."	ICX	Problem Solving
	Blind voters indicated that they wanted a verbosity control for the audio instructions. "Give me detailed instructions the first time, then shorter after that, but let me get full instructions again if I need them."	ICX	Problem Solving
	Several voters indicated that they wanted contextual help, not a repeat of the instructions for the tactile keypad when pressing "Help"	ICX	Annoyance
	After going through the instructions for the keypad, the voter asked, "How do I get out of here." It wasn't clear that pressing the "Select" button ended the instructions and moved back into the ballot.	ICX	Problem Solving
Audio Instructions	At the ballot header screen, the audio instructions do not say what to do to enter the contests. Voters repeatedly got stuck.	ICX	Problem Solving

Function	Observation	System	Severity
	The straight party button at the beginning of every contest confused all of the voters. The audio announces it as "Selected straight party candidate republican" and then immediately beings to give instructions on how to select the button.	ICX	Problem Solving
	The straight party button audio instructions are confusing to voters. The visual version is confusing as well. (See more in Alerts section below.)	ICX	Problem Solving
	When you override a straight party vote, the audio still announces the straight party button as "selected straight party" even though none are selected.	ICX	Problem Solving
	One blind voter was confused by the audio instructions. When the machine instructed her to press the "right" button, she interpreted this as the right-hand button, not the right arrow under her left hand.	ICX	Problem Solving
	When the blind voter hit the wrong button on the "Review Screen" button, and moved to the top of the contest, "I doesn't tell me that I didn't go to the review. It takes me back to the top."	ICX	Problem Solving
	All blind users reselect candidates selected by straight party choice. This could suggest that the cue that they are selected is not strong enough.	ICX	Problem Solving
	In the testing process, the voter was instructed to vote for the candidate that was endorsed by both parties. On first pass, this was missed because the pause between "Republican" and "Slash" made it sound as if only one party was involved.	ICX	Needs Assistance
	There are no audio or on-screen instructions for any of the other assistive devices (buttons, sip-and puff).	ICX	Needs Assistance

Function	Observation	System	Severity
Straight Party Voting	Once a voter chooses a straight party option, the system will not let them abstain from a partisan contest. It gives the voter an alert that says that even though the contest is blank, the candidates that match the straight party will be selected. (See more in the Alerts section below.)	ICX	Likely to prevent independent voting for voters with some disabilities
	Overriding a straight party vote deselects the straight party selections. In contests where the Vote for N number is greater than the straight party candidates, voters tried to select additional candidates, but had to reselect straight party candidates.	ICX	Problem Solving
	If you have overridden your straight party vote in any contest, the system will not allow you to cancel your straight party choice without de-selecting the out-of-party votes. All voters who tried to cancel their straight party had to ask how to do it.	ICX	Needs Assistance
	Voters complained that the system seemed to require a straight party vote. They thought it should have instructions indicating that if they do not want to vote straight party, they should select "Next."	ICX	Problem Solving
	Some voters thought that the straight party option selected the party's ballot, as in the primary. Poll workers independently reported the same concern, even they knew the function. Both groups said the instructions were unclear.	ICX	Annoyances
Alerts	The wording of the alerts is not good. Some language was too high level. One message uses the word "implicit."	ICX	Problem Solving

Function	Observation	System	Severity
Alerts	Alert: If left blank, this contest will have implicit choice selections for party [straight party choice] appeared in any contest where a voter made no candidate selection. Most voters and poll workers had no idea what this meant.	ICX	Problem Solving
	One poll worker said "This will get us sued. Voters will say that 'You changed my vote!'" in response to the "implicit" alert in a blank straight party contest.	ICX	Problem Solving
	Most alerts begin with "Warning" which voters and poll workers found too overbearing.	ICX	Problem Solving
	One blind vote indicated "I don't like 'warnings.' I would like to have information about how to proceed or correct an error."	ICX	Problem Solving
	The poll workers did not like "warnings." They preferred information about options to fix them.	ICX	Problem Solving
	When no selection is made in the straight party contest, the system generates a message "Warning, this contest is left blank!" Voters thought they had to make a selection.	ICX	Problem Solving
	The straight party cancel alert language and button labels are overly confusing. This is especially true in the audio instructions.	ICX	Problem Solving
	The straight party audio instructions are too wordy and complicated. It asks the voter to "select 'Confirm' to cancel or 'Cancel' to cancel."	ICX	Problem Solving
	Many voters thought that the undervoted contests warning implied that they were required to vote for the maximum number of candidates.	ICX	Problem Solving

Function	Observation	System	Severity
	On the review screen, a poll worker questioned the location of the message that "Your ballot is valid, but you have warnings." Rather than being located at the top of the screen, she suggested that it be placed between Scroll Down and Print. She said she almost missed it.	ICX	Problem Solving
	On the review screen, a poll worker thought it would be better if the alert icons could be touched for more information and options.	ICX	Problem Solving
Printing/Ballot Verification	After you press "Print" at the bottom of the screen, the alert window warns you that you are about to "Cast" your ballot. This action does not cast your ballot.	ICX	Likely to prevent independent voting for voters with some disabilities
	After you print your ballot, the machine displays a message "Thank you for voting! Your ballot is successfully cast." This action does not cast your ballot.	ICX	Likely to prevent independent voting for voters with some disabilities
	Poll workers reported that the "your ballot is cast" language will be a problem because voters might leave without putting their ballot in the scanner thinking it is their receipt.	ICX	Needs assistance
	Poll workers thought that the final screen should instruct voters to take their ballot and their voter card to the scanner.	ICX	Likely to prevent independent voting for voters with some disabilities
	The printed ballot reports undervoted contests as "UNDER_VOTE_BY_N" where N is the number of positions still available. The ballot review screen does not do this, which means it is not announced to visually impaired voters using the audio assistance	ICX	Likely to prevent independent voting for voters with some disabilities
	Printed ballot displays no straight party selection as being "Blank contest."	ICX	Problem Solving
	Alerts on printed ballot not informative and confusing. Poll workers thought that voters might think something is wrong since the ballot review screen said something different.	ICX	Problem Solving

Function	Observation	System	Severity
	One voter suggested printing arrows at the top of the ballot to match those on the scanner, indicating the correct alignment. Even when the scanner accepts the ballot in all orientations, this provides a hint that will reduce confusion.	ICX	Annoyances
	One poll worker suggested that the printed ballot should look more like the historical paper ballots.	ICX	Annoyances
Write-In Screen	Using the audio, when a typo is being corrected, the letter just deleted is not announced. This makes it difficult to impossible to know where you are in the process.	ICX	Problem solving
	Using the audio, when deleting characters to correct a misspelling, the audio feedback is "Delete" but does not announce the letter being deleted.	ICX	Likely to prevent independent voting for voters with some disabilities
	When the voter leaves the Write in screen, the audio instructions say "You have written in " and spells the name entered. However, it does not voice the space, so the voter may think that they failed to enter it. "It didn't tell me I had a space. I know I put one in." when writing in a candidate using the audio assistance.	ICX	Likely to prevent independent voting for voters with some disabilities
	No blind voter was able to complete the write-in process without some coaching to continue moving down the write-in page until they found the alphabet. Once they found the alphabet, they were able to proceed quickly.	ICX	Needs Assistance

Function	Observation	System	Severity
	When writing in a candidate using the audio, each letter typed is spoken. If the user pauses, the last audio information is repeated. If the letter is entered again, (for names with double letters), the spoken feedback sounds exactly the same as the repeated feedback from the last entry. There is a high risk of inadvertent doubles or single letters. Repeated feedback and new feedback should sound different.	ICX	Likely to prevent independent voting for voters with some disabilities
	No blind voter was able to complete the write-in process without some coaching to continue moving down the write-in page until they found the alphabet. Once they found the alphabet, they were able to proceed quickly.	ICX	Needs Assistance
Write-In Screen	In standard mode, once you have entered a write-in, you cannot correct it because touching it deselects it. Then when you go back into the write-in screen, it has removed the entry.	ICX	Problem Solving
	The page for write-in candidates doesn't actually provide instructions on how to do the write-in. This is true for standard mode and audio instructions. Audio voters must continue to press down or right to get beyond the text box and editing buttons to find the keyboard.	ICX	Problem Solving
	While using the audio, one blind voter suggested that she might use Help to figure out how to use the Write-In Screen. Help only repeats the instructions for the keypad, and does not provide contextual help as expected.	ICX	Problem Solving
	"It doesn't tell you how to do a write-in, does it? You would never know to press down again."	ICX	Problem Solving
	"OK, I guess I have to go all the way to the end," said one voter when trying to find the write-in screen keyboard in audio mode.	ICX	Problem Solving

Function	Observation	System	Severity
	When navigating the keyboard, the “period” key is announced as “dot.” While this makes sense in some applications, names include periods, not dots.	ICX	Annoyances
	Poll Workers: Expected QWERTY layout for on-screen keyboard, but when saw that switch access scanned in order, saw the logic of the layout.	ICX	Annoyances
Assistive Devices	Poll workers felt that the keypad has too many buttons.	ICX	Annoyances
	The “Left/Right” and “Up/Down” buttons do exactly the same thing. Why are they both included?	ICX	Annoyances
Assistive Devices	There is no dedicated button on the tactile keypad to move to the next contest.	ICX	Annoyances
	The help button of the tactile keypad repeats the instructions for how to use the keypad. Blind voters suggested context help on the contests, indicating how to write in a candidate, how to select candidates, etc.	ICX	Annoyances
	The headphone and switch ports on the tactile keypad have no Braille markings, and are very difficult to see for sighted voters.	ICX	Annoyances
	If a voter chooses any assistive device, the touchscreen remains active, but each selection must be touched twice.	ICX	Annoyances
	When used for long ballots, the buttons tend to slide. A person who needs to use the paddle switches may not be able to effectively reposition them. They should be provided with small non-slip pads to hold them in place more strongly.	ICX	Annoyances
	The colors of the button switches (red and blue) were taken to indicate party affiliation. The buttons are provided with green and yellow caps as well, and non-partisan colors should be used.	ICX	Annoyances

Function	Observation	System	Severity
Scanner	The scanner provides no audio feedback to the blind voter.	ICP	Annoyances
	Scanner screen very hard to read at all, impossible from seated position	ICP	Annoyances
	Entry tray for ballots is very small – not long enough to support the entire ballot	ICP	Annoyances
Scanner	Memory cards for poll workers are very small – hard to handle – dexterity problems handling them. But at least not the teeny tiny ones (Compact Flash cards rather than SD cards)	ICP	Annoyances
	“All that [absentee] paperwork after the election [is gone]. Whoopee!” One poll worker said after realizing they could scan absentees instead of tallying them by hand.	ICP	Annoyances

Top positives

The expert examination, voter experiences, and poll worker sessions recognized several positives of these voting systems.

Independent voting

Generally, voters were able to complete their ballot on the ICX and ICP independently, once the facilitator/poll worker provided them with the appropriate accessibility features. No one found the system so difficult or frustrating that they were unable to vote, although several participants identified features that they felt would frustrate less competent voters.

Access features easily learned and helpful

As voters explored the access features, they seemed to learn them relatively easily. Most of the voters use similar assistive devices daily or when they vote.

After a very brief overview of each machine, the facilitator asked poll workers to demonstrate that they understood the function of each access feature by offering the appropriate option to the roll-play voter. Poll workers set up the machines successfully with minimal help – a reasonable outcome for an initial introduction to the system.

All four poll worker groups reported that the access features would help voters who already visit their location on Election Day. They also agreed that these features would likely assist other voters with disabilities that do not currently come to the polls on Election Day.

Default text size

The default text size was large enough for most of the participants. Once the voters discovered the settings button and options, they could easily change the font size. Only one voter required a larger font size to read the screen more easily.

Visual interface clean and intuitive

The examiners observed that the visual interface had aspects that would be intuitive to voters. Some voters echoed this as they experienced the machines, and others demonstrated the good design through use.

- **Selection behaviors.** As voters make selects, the screens behaved as expected for a modern touch interface.
 - **Candidate selection.** Selecting options within each contest was intuitive for voters. Touching the option once put a mark in the box for that candidate. Touching again removed the mark. Straight party votes were cleanly marked in each contest.
 - **Overvoting.** When voters have selected the maximum number of available candidates in a contest, the remaining candidates grey out. In this state, they are visible to the voter, but the voters are unable to select them. This behavior is not mirrored in the audio, though, and is a major problem for audio users. More discussion on this issue can be found in the problems section.
 - **Undervotes.** If voters have not selected the maximum number of allowed candidates in a contest, the candidates remain highlighted and available for selection. Visually, this becomes a noticeable pattern and voters quickly learn in which contests they could select additional candidates.
 - **Straight party.** If the voter selected a straight party option at the beginning of the ballot, the system placed a button just below the contest header and instructions in each partisan contest. This was an intuitive reminder to the voters that they had voted straight party.
- Furthermore, If the voter had selected a straight party option, the system did not grey out the remaining candidate names, but the matching straight party candidates had a check next to them. Voters who understood the straight party method seemed to understand

that they could make changes if necessary, but did not need to make additional selections.

- **Alerts structure.** While marking the ballot, if the voter left a contest blank or undervoted in a contest, for example, the system would alert the voter. The alerts were generally well placed and formatted in a way that makes sense to the voter. Also, if the voter wanted to change a straight party selection, the system alerted the voter in a new differently formatted tile. The same is true right before they printed the ballot.

All this said, the text in the alerts is small and the wording used in the alerts *was not* good and will be discussed in the problems section below.

- **Review screen.** The review screen was formatted well and generally intuitive. For any contest that was blank or undervoted, the system provided an alert and the label “No selection made” for each of the available candidate spots. This made it easy for voters to recognize how many selections they could make.

Printed ballots verifiable and accessible

The ICX prints the ballot selections on an 8.5 x 11-inch piece of heavy weighted paper. The text is small but could be read by all the sighted voters. They all agreed that this satisfied verification for them.

Voters with low-vision, however would not be able to read the printed ballot without a magnifier or other assistive technology. The print on the ballot was much smaller than the on-screen text.

Three of the blind voters were able to use a phone-based app that took a picture of the ballot and then read its contents back to them. Each of the voters who used this option were satisfied with this as the verification step.

Attachment C – Implementation Attestation



Implementation
attestation Dominio



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 <small>(Please specify the implementation details, single device /(desktop/laptop), Client/server/ as applicable)</small>
EMS Election Event Designer (EED)	5.5.12.1			
EMS Results Tally and Reporting (RTR)	5.5.12.1			
EMS Application Server	5.5.12.1			
EMS File System Service (FSS)	5.5.12.1			
EMS Audio Studio (AS)	5.5.12.1			
EMS Data Center Manager (DCM)	5.5.12.1			
EMS Election Data Translator (EDT)	5.5.12.1			
ImageCast Voter Activation (ICVA)	5.5.12.1			
EMS Adjudication	5.5.8.1			

EMS Adjudication Service	5.5.8.1			
Smart Card Helper Service	5.5.12.1			
ImageCast Precinct	5.5.3-0002			
ImageCast Central	5.5.3.0002			
ImageCast X	5.5.30			

Further to the key hardware/software components listed above, any of the COTS software and

ancillary components like switches, ballot boxes, charging carts sold on this contract are EAC certified components of the Dominion Democracy Suite 5.5A electronic voting system. (Attach a list of items sold on this contract.)

Dominion 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

Dominion 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.
- b) A training session on the Voting System's election management system and/or EPBs 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:
 - i. programming of all voting units and ancillary devices;
 - ii. tabulating results during the unofficial and official canvass;
 - iii. ensuring accuracy and integrity of results;
 - iv. preparing polling places and setting up the system for election day operation;
 - v. Training on accessibility options of the voting system
 - vi. Election day operating procedures;
 - vii. auditing procedures;
 - viii. conducting a recount;
 - ix. preserving records;
 - x. printing, designing, and formatting election reports;
 - xi. troubleshooting common issues;
 - xii. safeguarding and preventing tampering and unauthorized access to all parts of the Voting System; and

xiii. Post-election care, maintenance and storage.

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 Dominion

The Supplier must maintain an escrow agreement covering all source codes of the Voting System and/or EPB for a period of ten 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 subject to the conditions specified below in subsection (d). 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, EPB software, and/or any Supplier Property placed in escrow from the escrow agent.

COMMONWEALTH OF PENNSYLVANIA

DEPARTMENT OF STATE

RESULTS OF KNOWINK ELECTRONIC POLL BOOK

POLL PAD 1.3.3 EVALUATION



Issued By:

A handwritten signature in black ink, appearing to read "Robert Torres", written over a horizontal line.

Robert Torres
Acting Secretary of the Commonwealth
October 5, 2018

RESULTS OF THE KNOWINK ELECTRONIC POLL BOOK POLL PAD 1.3.3 EVALUATION

I. INTRODUCTION

Pennsylvania's voter registration law, Act 3 of 2002 (Act 3), 25 Pa.C.S. §§ 1101 et seq., requires that the poll book or district register "shall be in a form prescribed and approved by the Secretary" for both paper and electronic poll books, (25 Pa. C.S. §1402(b)(2)). Pursuant to the request by Knowink, the Department of State (Department) evaluated the Poll Pad 1.3.3, Electronic Poll Book (EPB) to ensure that the system complies with all the applicable requirements of Act 3, including the regulations implementing Act 3, 4 Pa. Code §§ 183.1 et seq., and the Pennsylvania Election Code, 25 P.S. §§ 2601 et seq., and therefore can be used in Pennsylvania elections. The evaluation consisted of in person system demonstration conducted by Mitch Milleville, Product Manager representing Knowink, email communication and conference calls with Knowink personnel, and documentation review. The system demonstration happened on May 30, 2018 in Ocean room of Keystone Building located at 400 North Street, Harrisburg, Pennsylvania. Jonathan Marks, Commissioner of the Department's Bureau of Commissions, Elections and Legislation, Jessica Myers, Deputy Director of Policy; and Sindhu Ramachandran, Voting Systems Analyst represented the Secretary of the Commonwealth during the demonstration. Staff members of Bureau of Commissions Elections and Legislation (BCEL) and the Department's Office of Chief Counsel also attended the demonstration. The Department videotaped the demonstration.

II. Poll Pad 1.3.3 ELECTRONIC POLL BOOK

The Poll Pad 1.3.3 EPB demonstrated for use in Pennsylvania included the following components:

1. Poll Pads – Poll Pads are iPads configured for use at the polling place to perform voter check in activities. The Poll Pad 1.3.3 software application installed on

iPad, allows poll workers to perform the polling place activities typically performed using a printed paper poll book. The Poll Pads work in kiosk mode allowing the poll workers to access only the poll pad application.

2. ePulse 1.3.3 (ePulse) - ePulse is a web based platform that supports the management functions of the EPB system. ePulse allows the election officials to prepare the voter and precinct data for use on Poll Pads. It also provides an Election Day monitoring platform that connects election officials to polling places. The system facilitates managing election day operations by providing functionalities like monitoring polling place status, hardware health, and operational status etc. Monitoring functionalities allow election officials to address potential issues and have better control of polling places on Election Day. The system also allows election officials to prepare customizable reports for analysis.
3. Poll Pad case and stand with assembling accessories
4. Label Printer Star Micronics Printer, Model TSP 650

(Refer to Attachment D for a list all the items in the Poll Pad EPB system case)

III. EVALUATION APPROACH, PROCEDURES AND RESULTS

A. Evaluation Approach

To evaluate whether Poll Pad 1.3.3 EPB can be successfully used for elections in the Commonwealth of Pennsylvania and meets all the requirements mandated by Act 3 and the Pennsylvania Election Code the following approach was used: (1) System Demonstration; and (2) Documentation Review.

The Department requires a System Demonstration to examine and confirm on a field-ready system that the EPB satisfies all the statutory requirements. The demonstration also allows the Department to understand the complete capabilities of the system. The

documentation review consisted of analyzing the system specifications, user manuals, state certification and third-party test reports pertaining to Knowink Poll Pad system. Electronic poll books are heavily configurable distributed systems, typically consisting of networked tablets or laptops used at the polling place to check-in voters. They work in conjunction with a central server performing the management functions, which include: preparing the election data, performing voter history updates and monitoring deployed devices at polling places. The documentation review was conducted to confirm that the system can be efficiently used for elections in the Commonwealth of Pennsylvania and to aid in deciding the EPB connectivity configuration to be approved for use in Pennsylvania.

B. Procedures

1. System Demonstration

A Knowink representative demonstrated the Poll Pad 1.3.3 system on May 30, 2018. The demonstration included an end to end set up and capability walkthrough of both the Apple iPad tablet installed with Poll Pad 1.3.3. application used at the polling place, and the ePulse 1.3.3 system used to perform the data preparation and management functions. Knowink used the test data supplied by the Department for the demonstration. The purposes of the demonstration were to (a) validate that the system complies with Pennsylvania's statutory requirements for poll books; (b) discuss the overall capabilities of the system; and (c) to evaluate level of compliance with the Commonwealth Information Technology Policies(ITPs) outlined in Attachment C of this report.

2. Documentation Review

The Department requested the following documentation from Knowink for review.

1. System Specifications;
2. Hardware/Software/Peripherals/Additional Equipment Requirements;
3. Technical Data Sheet;
4. User Manual;
5. Usability Reports;

6. Security and Penetration Testing Reports and;
7. Test Reports from other states using the system.

Department staff reviewed the supplied documentation and analyzed the documentation of the system in detail.

3. Results

1. System Demonstration Results

- a) Conformance to statutory requirements - The vendor successfully demonstrated that the Poll Pad 1.3.3 EPB system conforms to the statutory requirements outlined in Pennsylvania law. The demonstration proved that the system can be configured to meet the statutory requirements. *See Attachment A* for the list of statutory requirements discussed and validated during the demonstration.
- b) Review of system capabilities - The Department reviewed the overall system capabilities during the demonstration and documentation review. *See Attachment B* for a summary of the demonstration discussion points.
- c) Level of Compliance with Commonwealth IT policies – The Department provided Knowink with a copy of the Commonwealth of Pennsylvania IT policies relating to the security of distributed systems and network connectivity. The Department also provided Knowink with a questionnaire to evaluate the system security posture, which was completed and submitted as part of the evaluation request. Time was set aside during the demonstration to discuss the security of the system. The written response to the questionnaire and the security discussion with Knowink team during the demonstration allowed Department staff to evaluate the system's level of compliance to Commonwealth IT policies, and to understand the security features of the system. *See Attachment C* for the specific policies and discussion summary that occurred during the demonstration and the questionnaire.

2. Documentation Review Results

Department staff analyzed the documentation provided by Knowink to understand the system capabilities in detail. The submitted documentation included test reports for Poll Pad EPB system by NTS Huntsville (Wyle Laboratories), a federally recognized VSTL at the time of testing, to attest conformance to Ohio and Indiana state statutory requirements. The VSTL report indicates successful validation of all the requirements for the state of Indiana and Ohio. Knowink Poll Pad EPB system was approved for use in State of California on May 22, 2018. The Department reviewed examiner test reports prepared by SLI Compliance, a federally recognized VSTL, and the system approval report prepared by the California Secretary of State's office, as part of the California State approval. The review of the test reports allowed the Department to understand in depth the functionality of the system and further assess the security and accessibility properties of the EPB system.

The demonstration and documentation review determined that Poll Pad 1.3.3 consists of iPads installed with Poll Pad 1.3.3 application configured as Poll Pad kiosks (Poll Pads) to perform voter check-in activity at the polling place and ePulse 1.3.3 hosted on a cloud server to perform administrative functions. The system allows the following modes of configuration:

- A live (fully connected) mode where data flows continuously between cloud-based ePulse servers and all Poll Pads in use at a polling place;
- A restricted server communication mode where the system can be configured to transfer only operational/performance data from the Poll Pads to the ePulse cloud server. The data transmitted doesn't contain any voter check-in data. This configuration allows monitoring of the polling place devices remotely;
- A peer to peer communication mode where the Poll Pads at a polling place communicate to each other without any connection to the ePulse cloud server. This configuration allows voter check-in data to sync up in a polling place, thus allowing the use of multiple Poll Pads at a polling place.

The networked environment makes the EPB system vulnerable to hacking attempts that can compromise the integrity of check-in data and/or result in unauthorized access to voter data. The Department staff analyzed the connectivity configurations discussed during the demonstration in conjunction with the documentation provided and existing Department test protocols for Electronic Poll Books to come up with the connectivity approved for use in Commonwealth of Pennsylvania, which minimizes the security risks and maximizes the benefits in moving to an EPB solution.

3. Observations

Department staff noted the following as part of the demonstration and documentation review.

- 1) Poll Pad 1.3.3 uses software configuration features to determine the final functional behavior of the system. Even though the demonstration and subsequent evaluation showed that the system can be configured to satisfy all the statutory requirements, the Department will need assurance that the system setup complies with the approved configuration after purchase.
- 2) The deployed system security posture will depend on the parameters selected during setup. This will necessitate validating the configuration during and after setup to ensure that the system is configured in a secure manner.
- 3) Poll Pad 1.3.3 deployed in live (fully connected) and restricted server communication mode communicates with the cloud server located outside of the polling place and transmits transactional and operational data throughout Election Day to the ePulse server. The demonstration included a discussion of the complete capabilities of the system. The live (fully connected) and restricted communication mode maintains a communication channel between the polling place and cloud server for the entire time the polls are open on Election Day.
- 4) The data from Statewide Uniform Registry of Electors (SURE) system is prepared for loading on Poll Pads using the ePulse system. The data preparation process runs scripts on the extracted data from SURE system to prepare a proprietary database for use on Poll Pads. The script used in the data preparation process splits the extracted

data file from the SURE system into two separate files, one file with only the voter signatures, and the other file with the rest of the voter data. The data preparation process is reconciled via a high-level onscreen summary of the records processed on ePulse, but the prepared data will need to be validated for accuracy and completeness after loading to the Poll Pads to avoid any data inconsistencies on Election Day.

- 5) The review of California State testing reports suggests that there were security test findings with minimal overall impact that will be remediated in a future release. The vendor response to the findings indicate that a future release will be presented for administrative approval to the State of California.
- 6) Knowink provided system manuals and a Technical Data Package (TDP) to describe the functionality of the system. However, the supplied documentation lacked a full TDP containing details of election setup, secure configuration, etc.
- 7) The system log files do not contain the device identifier of the originating device. The county election official uploading the log file will have to ensure that the uploaded log file name has the device identifier.

IV. CONDITIONS FOR APPROVAL

Based on the evaluation, the Secretary of the Commonwealth of Pennsylvania approves Poll Pad 1.3.3 subject to the following conditions:

- A. The Poll Pads in operation at a polling place **must not** be configured to communicate to the ePulse server during the polling hours on Election Day. The tablets in operation at a polling place can communicate to synchronize voter check-in data between each other at the polling place during the polling hours. Any data transfer required between the ePulse system and Poll Pads must happen outside of polling hours.
- B. The tablets at an individual polling place communicating with each other must be configured and managed in a secure manner and may never connect to a publicly accessible network. The network at the polling place must be a “closed network”

allowing only components of the EPB system to connect and encryption must be enabled. The security settings must prevent other devices from detecting and connecting to the network at the polling place.

- C. Any components which are/were part of the EPB system, including removable media, must not be connected to the Electronic Voting system. This includes, but is not limited to: PEB encoders and Voter Access Cards encoded on the EPB systems; USBs; SD cards; printers; CDs; etc.
- D. Jurisdictions implementing Poll Pad 1.3.3 EPB system **must not** use the driver's license or ID card bar code scanning capability to check in voters. This is to avoid voters being asked for an ID when not required by law. Counties must implement the system with the bar code scanning option disabled. The system must not present poll workers the option of checking in voters by scanning an identification card with bar code.
- E. Portable media used to transfer files between any components of the EPB system must be new, unmodified and not refurbished. Alternatively, removable media that is being reused must be fully reformatted before each election. All removable media used for elections must be managed with proper chain of custody and administrative safeguards to protect against disclosure, theft, or damage.
- F. Any unused ports in the Poll Pad used at the polling place must be sealed with tamper-evident seals. The Poll Pad case also must be locked and sealed.
- G. Counties purchasing the Poll Pad 1.3.3 EPB system must work with Knowink and BCEL (Bureau of Commissions, Elections and Legislation) to do the following:
 - 1. Implement Poll Pad 1.3.3 EPB system in a manner that satisfies all statutory requirements outlined in Act 3 and the Pennsylvania Election

Code. The parameter configuration and the text of informational messages must be approved by BCEL.

2. Implement Poll Pad 1.3.3 EPB system in a secure manner that complies with applicable county and Commonwealth IT policies and any directives or guidance published by Department of State BCEL. The system configuration, connectivity set up, password configuration and password management policies must be approved by BCEL; and
3. Implement Poll Pad 1.3.3 EPB system with sound administrative practices and proper chain of custody in the same manner as counties deploy Electronic Voting Systems.

- H. Counties implementing Poll Pad 1.3.3 must change all default passwords during implementation. County election officials must implement processes to confirm and maintain records that default passwords were changed before fielding the system. The proof must be documented using export of the system log files whenever possible. In situations where the log entries are not detailed enough a screenshot of the password change action performed at the election office or checklist can suffice. County election officials with administrative access on ePulse server must take proper precautions for password management and protection.
- I. Counties must work with Knowink to ensure that the Poll Pads are configured in kiosk mode or Guided Access Mode. The iPads must be hardened with only the required software for the EPB system. No additional software applications or utilities shall be installed on the Apple iPads being used at the polling place.
- J. Counties implementing Knowink Poll Pad 1.3.3 EPB system shall implement at least two (2) Poll Pads per polling location and must allow peer to peer communication to enable check-in activity to synchronize between the Poll Pads. This is necessary to ensure data storage redundancy.

- K. Jurisdictions implementing the Poll Pad 1.3.3 EPB system must keep an inventory of all the device ids deployed in the county. The systems must be audited at the beginning of the Election cycle for any required maintenance. Any devices sunset, returned or otherwise disposed of at the end of a lease or end of useful life must be free of any software and voter data. Counties must implement processes to ensure that the “clean wipe” is validated documented and maintained for audit purposes.
- L. Counties must have a contingency plan to ensure that an election will not be affected should any component (including connectivity and power supply) of the EPB system fail due to malfunction or cyber incident on Election Day. The contingency plan must ensure that no “check in” information is lost. The contingency plan must be reviewed and approved by BCEL. At a minimum, the contingency plan must ensure the availability of a full voter list and a process for maintaining and reproducing a list of voters who have already checked in if the EPB fails during voting hours.
- M. Counties purchasing the Poll Pad 1.3.3 must work with BCEL to decide what portion of the data from the Statewide Uniform Registry of Electors (SURE) system can be shared with the vendor. The counties shall not allow the vendor to run any data extraction utilities against the SURE database/system. Any data transfer must happen via a file extract and secure file transfer process and must be encrypted. The voter data extract must not contain any additional data elements than what was shared during the evaluation. The data elements and sharing mechanism must be approved by BCEL. Counties must ensure the accuracy of data loaded to the EPB system and maintain appropriate reports as necessary for auditability.
- N. Counties purchasing the Poll Pad 1.3.3 must work with BCEL to finalize the process of voter history updates. Knowink must be able to adhere to the extract format and timing of the update suggested by SURE system administrators.

- O. Knowink must notify the Department of State of any changes made to Poll Pad 1.3.3 EPB system. This includes any changes to the software of the EPB system and to the environment of the EPB system, including but not limited to Knowink's development locations, cloud service vendors, data center locations, for example.
- P. Knowink must escrow a copy of the code, trusted build, any verification/identification software used and installation instructions for safekeeping to the Commonwealth of PA and add the Commonwealth as a beneficiary to any Escrow accounts they have for safekeeping of the Poll Pad 1.3.3 code.
- Q. Knowink must provide fully prepared and version controlled user and system manuals for counties purchasing the EPB. The manuals must clearly identify each user configurable parameter. Copies of the final user manuals and any subsequent updated user manuals must be submitted to the Department before sale of the product or any subsequently approved product upgrades in Pennsylvania.
- R. Counties must perform a thorough evaluation and User Acceptance Test of the EPB system before purchase. This test should include all expected activities occurring as part of the election including interactions to the SURE system. This approval is based on a demonstration by the vendor and documentation review. Demonstration by the vendor cannot be considered equivalent to testing.
- S. Counties implementing the Poll Pad 1.3.3 must work with Knowink to define and implement policies on data retention and archiving of the EPB system including external servers and any removable media. Any election data stored on devices outside of the county network must be deleted and/or archived to physical media with access control as soon as it is no longer required or no later than ninety (90) days after Election Day. Voter data shared with the vendor must be tracked and deleted to avoid data breaches. Counties must retain, as required by law, archived copies of data sent and received from the vendor for audit purposes. Knowink must keep audit logs of

every data access event and make those audit logs available for inspection to the counties or BCEL upon request.

- T. All jurisdictions implementing the Poll Pad 1.3.3 must carry out full Logic and Accuracy testing prior to every election on each device and maintain records of this testing. The Department recommends creating a county specific plan for Logic and Accuracy testing that includes all peripherals and anticipated check in scenarios on Election Day. The vendor supplied Logic and Accuracy checklist should be used as a reference but must not be accepted in lieu of a county specific plan.
- U. Knowink must provide audit log specification documentation to BCEL and counties purchasing Poll Pad 1.3.3 system. The county election officials and IT personnel must work with Knowink to understand the system logging capabilities. The county must be able to identify and gather logs that provide audit trail of the election data preparation and transactions at the polling place, and logs that aid in identifying and managing security incidents, fraudulent activity and operational problems. Processes must be implemented to harvest and safekeep the logs after the election for future analysis and review. The log files must be extracted and saved in a manner that allows identifying the device from which the logs files were extracted. The EPB log files must be retained for five (5) years in accordance with the statutory retention period for poll books.
- V. Knowink must ensure that future releases of the software with enhanced security features are presented for approval to Department. This includes the version released remediating the test findings from California State testing. Refer to Observation 5, on page 8 of this document.
- W. Knowink shall not assign, in whole or in part, its rights, duties, obligations, or responsibilities with respect to software development, manufacturing of any

proprietary hardware, service and maintenance of a system approved by the Secretary, without written notification to the Department and approval from the Secretary. For the purposes of this condition, the term “assign” shall include, but shall not be limited to, the sale, gift, assignment, pledge or other transfer of any ownership interest in the system approved by the Secretary. The vendor must submit to the Secretary a request notifying the change, including information regarding the ownership and business interests of the assignee, and evidence the submission by a written assignment agreement executed by the vendor and its assignee in which the assignee agrees to be legally bound by all of the terms and conditions of the approval and to assume the duties, obligations, and responsibilities being assigned. If a transfer of ownership/assignment of rights occurs such as in the event that the vendor assigns its rights and/or duties to another entity and once the assignment of said rights and duties to the new entity has been approved by the Secretary, the new entity shall be required to execute all security, confidentiality and Non-Disclosure Agreements that were executed by the originating vendor.

- X. Knowink must ensure that all the involved entities in the system supply chain will follow all the applicable conditions in this report.

V. RECOMMENDATIONS

The Secretary makes the following recommendations to the counties purchasing the Poll Pad 1.3.3 EPB system:

- a) Counties should consider using the EPB in pilot mode during the first use in an election. This allows the jurisdictions to ensure that all appropriate checks and balances are in place before using the EPB system in full production mode. For larger counties, the county should also consider implementing in a phased approach to mitigate any unforeseen issues that may arise during implementation.

- b) The Secretary urges counties to ensure that all poll workers and election officials receive appropriate training and are comfortable using the EPB. The training activities should include, but not be limited to: hands-on training on devices to perform election set up and operations at a polling place, cyber hygiene practices and procedures for detecting cyber-attacks. The training should ensure that poll workers and elections officials can detect any warnings that signal cyber-attacks and immediately respond to it. Involvement of poll workers during the implementation project from start to finish with onsite trainings at the polling place is also recommended.
- c) Counties using EPBs should implement processes of reconciliation at the open and close of polls to avoid any data discrepancies. Checklists should be developed for poll workers to ensure compliance with all requirements and reduce the chance of human error. Counties should also work with Knowink to produce quick reference cards and/or help files for use at the polling place on election day.
- d) The Secretary recommends that counties purchasing the Poll Pad 1.3.3 EPB system perform proof of concept testing onsite at all polling places to ensure peer to peer connectivity and power supply availability. The Secretary further recommends that the test is conducted with a test system using components of the same make, model and configuration as that being used on Election Day.
- e) Counties using the Poll Pad 1.3.3 EPB system should develop and implement a disaster recovery plan that is considerate of the possibility of a data breach or cyber-attack on the EPB. The plan should detail processes and procedures to be followed by poll workers and election officials in the event of a malfunction or cyber-attack.

VI. CONCLUSION

Based on the demonstration, documentation review, and consultation with the Department staff, the Secretary of Commonwealth concludes that the Knowink Poll Pad 1.3.3 EPB meets all of the applicable requirements set forth in Act 3 and the Pennsylvania Election Code, and can be used for checking in voters during elections, provided that all of the conditions listed in Section IV of this report are met.

Attachment A - Statutory Requirements

Requirement	Demonstrated (Yes/No)
The computer list shall be in a form prescribed and approved by the Secretary. (25 Pa. C.S. §1402(b)(2)).	Yes
Form of the Electronic Poll Book	
Each screen of the EPB shall contain the name of the county. (25 Pa.C.S. § 1402(b)(2))	Yes
Each screen of the EPB shall contain the election district. (25 Pa.C.S. § 1402(b)(2)).	Yes
Each screen of the EPB shall contain the date of the election. (25 Pa.C.S. § 1402(b)(2)).	Yes
Each screen of the EPB shall contain the date and time the list was prepared. (25 Pa. C.S. § 1402(b)(2)).	Yes
Content of the List:	
For each election district, the EPB shall contain an accurate list of the names of the registered electors- alphabetically by last name. (25 Pa.C.S. §1402(b)(2) and 1402(c)).	Yes
<p>Poll workers must have access to the list at all times so that voters can be checked in without interruption. The Electronic Poll Book should provide for the following relating to data recovery and adequate contingencies should one or more elements of the Electronic Poll Book fail:</p> <ul style="list-style-type: none"> ▪ Memory Redundancy <ul style="list-style-type: none"> • Internal • External ▪ Data Preservation 	Yes

<ul style="list-style-type: none"> ▪ If the contingency for Electronic Poll Book failure is the printing of paper poll books/precinct lists from the EPB, the EPB must provide for the printing of a paper poll book AND a copy of the list of registered voters within the precinct. <p>Demonstration Comments: EPB system keeps the data during operation on the hard disk of the Poll Pad. Data redundancy at a polling place can be maintained by having multiple Poll Pads in a polling place, and having the check in data synchronized between them. The system also allows using an iSync drive and the poll workers can create backups as needed. Reports can be configured, exported, and saved to preserve data at any point in time.</p> <p>The EPB must prevent multiple “check-ins” by the same voter.</p> <p>Demonstration Comments: The system demonstration showed that the system identifies an attempt to check in an already checked in voter. The Poll Pad displays an indication of the original check in. The system can be configured for the poll worker to take additional actions like cancelling the check in, reprinting the voter slip etc. In an environment where there are multiple Poll Pads connected, data syncing between the devices must be functioning to ensure multiple “check ins” are prevented on different devices.</p>	
<p>A legible digitized signature for each registered elector. (25 Pa.C.S. § 1402(b)(2)).</p> <p>The official digitized signature for each registered elector must be obtained from the Statewide Uniform Registry of Electors (SURE) and it must be displayed in such a manner as only the poll worker can see the official signature at the time a voter is signing the EPB.</p>	<p>Yes</p>
<p>Street address of each registered elector. (25 Pa.C.S. § 1402(b)(2)).</p>	<p>Yes</p>

Political party designation of each registered elector. (25 Pa.C.S. § 1402(b)(2)).	Yes
Suitable space for insertion of the signature of the registered elector. (25 P.S. § 3050(a.3); 25 Pa.C.S. § 1402(b)(2)).	Yes
Suitable space for insertion by the proper election official of the number and letter of the stub of the ballot issued to the registered elector or the registered elector's number in the order of admission to the voting systems. (25 P.S. § 3050(a.3); 25 Pa.C.S. § 1402(b)(2)).	Yes
<p>Suitable space for insertion of the initials of the election official who enters the record of voting in the district register. (25 P.S. § 3050(a.3); 25 Pa.C.S. § 1402(b)(2)).</p> <p>If the EPB is designed in such a manner as it provides for unique login credentials for each election official, this requirement can be satisfied by a system-generated audit report that identifies by unique election official ID which voters were checked in by that election official.</p> <p>Demonstration comments: The application has a "Poll Worker Initial" box that captures the initials of the poll worker performing the check in.</p>	Yes
Indication of whether the elector needs assistance to vote and, if so, the nature of the disability. (25 Pa.C.S. § 1402(b)(2)).	Yes
The date of birth of the registrant. (4 Pa. Code § 183.11(b)(4)).	Yes
The SURE registration number of the registrant. (4 Pa. Code § 183.11(b)(5)).	Yes

The following elector's affirmation must appear above the signature area: "I hereby certify that I am qualified to vote in this election." (25 P.S. § 3043).	Yes
An identification of whether the registrant's status is active or inactive. (25 Pa.C.S. § 1901(c); 4 Pa. Code § 183.11(b)(6)).	Yes
Voter Status Flags required by the SURE system:	
For voters who are "Inactive," affirmation is required. (25 Pa.C.S. § 1901(c) and (d)(3); 4 Pa. Code § 183.11).	Yes
"ID Required"-identification of whether the voter needs to present voter identification. An elector who appears to vote in an election district for the first time must present valid voter identification. (25 P.S. § 3050(a)).	Yes
"Absentee Ballot"-If an elector who voted an absentee ballot is in the municipality on Election Day, he or she must vote in the precinct, and the absentee ballot is voided. (25 P.S. § 3146.6(b)).	Yes
"Must vote in person"-Identification of whether the voter needs to present voter identification if the elector votes for the first time by mail. (Federal: 42 U.S.C. § 15483(b)).	Yes

Attachment B - EPB Functionalities

Specific “check in”/voter handling Scenarios demonstrated

- a) **Provisional Ballot -**
The process of performing a provisional check in and issuing a provisional ballot was demonstrated. The system allows the poll worker to enter a reason for issuing the provisional ballot. The dropdown options for the reason can be configured by the county. The system can also be configured to print the statutorily required affirmations on demand using the receipt printer.
- b) **Absentee Ballot -**
The system functionality that allows the poll worker to check in a voter who voted an absentee ballot was demonstrated. The county can configure the system to give appropriate instructions to the poll workers about any reconciliations that will need to be performed at the close of polls to ensure that the submitted absentee ballot is voided since the voter was allowed to vote at the polling place.
- c) **Cancel Check in -**
The system allows cancelling a check in that was already performed. Counties can configure the system to require an additional password for performing the cancel check in function. The system also allows capturing a reason for cancellation. It was also demonstrated that the system can be configured to add additional workflow steps to the process, like having the poll worker/supervisor review and sign before committing the cancel check-in.
- d) **Reissue Ballot -**
The procedure for reissuing a new ballot in place of a spoiled ballot was demonstrated. The system allows tracking the number of ballots issued to a voter and allows capturing a reason for reissue.
- e) **Inactive Voter Check in -**
The process of checking in an Inactive voter with required affirmations was demonstrated. The county can configure the system to give appropriate instructions to the poll workers about the affirmation process and any reconciliations that will need to be performed at the close of polls. The system allows the voter affirmation process to be configured for on-demand printing using the receipt printer.
- f) **Redirecting a voter to the correct polling place -**

If the voter is at the wrong polling location, the system can assist the poll worker in identifying the correct polling location. The poll worker can perform a voter look up and the system shows the record highlighted, with an indication “wrong precinct”. Upon navigating to the voter record, the system shows a pop-up window with the correct polling location address. The address can be printed out and given to the voter. Additional functionalities like driving directions, email, text message etc. can be configured depending on the connectivity at the polling place.

g) Search/Lookup voter Capabilities of the EPB -

The system allows a poll worker to look up the voter list to find a specific voter, by scanning an ID with a barcode or by manual entry of voter details. The basic manual entry search allows the poll worker to enter the last name and first name of the voter. The poll worker can enter any number of characters in the fields and the search results will get filtered as additional characters are entered. The vendor recommends entering 3 characters in both the first name and last name field to reduce the number of records returned. The system also provides an advanced search option which allows searching the voter by Date of Birth, Address etc. The search options available under the advanced search are configurable.

h) Check-in a voter multiple times -

System behavior/messages when poll worker tries to check in an already checked in voter was demonstrated.

SURE System Interaction

a) Capability to import data files from SURE -

It was demonstrated that the system allows loading data extracted in an agreed upon format from SURE system. The process was explained as follows:

- 1) The data from SURE system is extracted and uploaded to ePulse system via a file loader within ePulse system.
- 2) The extracted .mdb file is first converted to a csv file. The converted file contains all data elements except signature.
- 3) The signature is extracted separately from the mdb file using a script written by Knowink.
- 4) The csv file and signature file is processed on ePulse to generate the database file for use on the Poll Pad.

The data preparation process on ePulse displays the steps involved, progress, and records processed. The display also shows a breakdown of the number of voters by status. The breakdown allows monitoring and reconciliation during the

data preparation process. The ePulse system also displays any errors encountered in the data preparation process.

The converted data can be loaded to Poll Pads used at each of the polling places. Poll Pads are connected to ePulse, and data transfer request is initiated from the Poll Pad application. The process of loading the election requires enhanced access to the Poll Pad application for additional security. The system allows loading incremental voter data extract files from SURE using the same process.

b) Reconciliation of the data load to the EPB -

The demonstration and discussion showed that the voter list/data load to the EPB system is reconciled and there is a process to handle exceptions.

c) Voting History Updates -

The process of generating a voter history update file that can be loaded to SURE system was discussed.

- 1) After the election, the data from each Poll Pad is synchronized with ePulse by initiating the data transfer request from Poll Pad application
- 2) After all the Poll Pads are synchronized, the county can create an import file that can be used to update voter history in SURE.

In a fully connected environment the Poll Pads at each polling place will be automatically synchronized with ePulse and, hence counties will not need to perform the step of synchronizing the data after the Election Day.

d) County self-sufficiency in managing the interactions with SURE -

The system allows the county personnel to use the ePulse system to prepare the data from SURE for use in elections. Knowink personnel is available for any support required.

Usability/User Interface

a) Procedures for setting up the Field System/Poll Pad -

The procedures for setting up the Poll Pad at the polling place was demonstrated. The system comes in a lime green carrying case and contains only the required components. The assembly at the polling place was demonstrated and requires

- Taking the components out of the case
- Attaching the stand arm to the iPad
- Connecting the arm to the base

- Connecting the printer and power adapter, if a printer is being used by the jurisdiction.

The poll worker may also need to set up the battery base/power adapter for the iPad depending on the configuration selected by county.

The system also has a photo id tray that can be used to scan IDs that contain barcodes. The user manual describes the set-up process with easy to follow instructions and images.

- b) Poll worker ability to access the system and login -
The process of poll worker accessing the application was demonstrated. The passwords are managed and configured as part of the data preparation process on ePulse. The system allows the county election officials to set up unique passwords for each poll worker.
- c) Screen navigation capabilities -
The screen navigation capabilities of the Poll Pad application were demonstrated and further discussed. The system navigation was clear enough to follow and used colors to identify flags on the voter data, like absentee, needs assistance, wrong precinct etc. Knowink representative pointed out that there is customization possible with messages and colors for better readability using configurable parameters without software changes. The system does not allow customization of the screens based on individual voter profiles. Any settings decided during the data conversion process will apply to the entire EPB system.
- d) Languages Supported by the system -
Knowink representatives suggested that the system can support multiple languages. The poll worker screens and voter facing screens can be translated if required. The discussion suggested that most counties in the United States use the approach of translating the voter facing screens. Spanish is one of the supported languages. The system is currently being modified to support all the 14 languages required to be supported by California state statutes. The system demonstrated was configured for English display only. The actions required by the poll worker to change the language was discussed.
- e) Clarity of the messages displayed to the poll worker -
The system messages displayed to the poll worker during operation was demonstrated. The discussion suggested that the wording of the messages can be configured based on county requirements without software changes.
- f) System power up and shutdown procedures -

The processes for powering up the iPad and launching the Poll Pad 1.3.3 was demonstrated. The power on process will automatically launch the Poll Pad application. The user manual has a checklist for poll worker to ensure that the system is set up appropriately for use at the polling place.

g) System help availability -

The system allows to configure and display customized messages for poll workers. The messages guide poll workers through the voter processing steps. The county has the capability to edit the wording of the messages and link it to the criteria that will trigger the message to be displayed.

h) Peripheral Connection Capabilities -

The Poll Pad used at the polling place allows to connect only restricted external devices. Only Apple approved iSync drive, which communicates to the Poll Pad application can be used. The system allows to connect a label printer Star Micronics TSP 650. The printer communicates to the Poll Pad application via Bluetooth.

i) Other functionalities discussed -

Administrative maintenance functions including tools and settings, status report, poll worker attendance tracking, security key management options, software installation, removal options, and use of training mode were demonstrated and discussed.

j) Election setup -

The steps used by county officials to create an election and preparing the Poll Pad for use at the polling place was demonstrated and discussed. The steps also include appropriate check points that officials can use to ensure the correctness of data. The system also allows importing polling place and poll worker data.

k) EPulse Polling Place Monitoring Capabilities –

The election official dashboards on ePulse “at a glance” page was demonstrated and discussed. Additional monitoring and messaging functionalities available on ePulse was discussed.

Auditability - Transaction Logging and Reports

a) Transaction Logging capability for EPB -

The logging capabilities for the Poll Pad and ePulse were discussed. The Poll Pad logging capabilities were demonstrated and discussed in detail. The log viewer

functionality and the types of logs available were elaborated. The mechanism to export the logs was discussed. Knowink further provided a copy of the logs to the Department for analysis.

b) Reporting -

The capability to configure and create reports from the EPB system was discussed. The system provided a utility that allows election officials to customize reports using a WYSIWIG editor. It was suggested that county can work with Knowink personnel to customize and configure reports if necessary.

Communication and Multiple Unit Synchronization

a) Modes of configuration –

It was discussed that the system allows, peer to peer, restricted and fully connected modes of connectivity. These modes are discussed in detail on Page 6 of this report.

b) Frequency of check in activity sync up between tablets -

The Poll Pads at a polling place, if connected, synchronizes near real time. If there is a connectivity issue, then the units in operation at a polling place will not communicate check in data. Once the connectivity is restored the transaction sync up will happen and will include all the transactions during the period of connectivity loss.

c) ePulse Hosting -

It was discussed that Knowink uses cloud hosting services from a leading vendor for ePulse system.

Capacity, Redundancy, Fault tolerance and Continuity of Operations

a) Data Preservation -

Knowink representatives explained that there are multiple ways to ensure data preservation and redundancy. On each individual Poll Pad, the data is stored on the tablet local hard drive. If the system is running in peer to peer mode voter check in data is synchronized between all iPads in a polling place. If the jurisdiction is running EPB system connected to the ePulse server, all voter check in transactions are synchronized to the ePulse server throughout the day. The tablet also allows to back up data as required to an iSync drive.

- b) **Power Supply and Battery Life -**
The power supply and battery life of the system was discussed to ensure that the system can work on battery as well as power. Jurisdictions purchasing the system can customize the battery options as required.
- c) **Ability to remove/add new units without disturbing existing units -**
A new Poll Pad can be introduced to the polling place without disturbing the existing units in operation.
- d) **System capability to support the volume of voters in any county in Pennsylvania -**
It was discussed that the system will be able to support the volume of voters in any of the counties in PA without any performance degradations.

System Monitoring and Notification of system Errors or Deviations

- a) **Capability to perform a self-test for peripheral connectivity -**
The printer allows to perform a test print once the setup is completed. The system also shows a green printer icon on the Poll Pad once when the connection is completed.
- b) **Visible display indicating system connectivity -**
The demonstration showed that the system has a display of whether the unit is connected and communicating to other tablets and/or the ePulse server.
- c) **Visible display indicating power supply/batter power -**
The demonstration showed that the system has an indication that alerts the poll worker when running on battery. The system alerts the poll worker when the battery charge reaches 30% by changing the color of the battery indicator.

Security and Chain of Custody

- a) **Password configuration on tablet -**
The system allows passwords to be set up for each device, polling place or poll worker. The system has the capability to configure a supervisor password for functions requiring enhanced security. Multiple password requirement can be configured for accessing functions. The functions requiring enhanced security can be defined by the county during set up.
- b) **Information displayed to the voter on the signature pad -**

The screen presented to the voter for signature doesn't display the signature on file. It contains the voter affirmation and has an assigned location for the voter to sign using the stylus.

- c) Access controls for ePulse -
ePulse system allows administrators to create new users. The user can then setup their password with an expiring token sent via email. ePulse can also be configured to require MFA.
- d) Data in Motion Security -
Please refer to Item H in Attachment C.
- e) Data at Rest Security -
Please refer to Item D in Attachment C.

Maintenance, Support and Training

- a) Hardware and software acquisition options and support -
Knowink representatives suggested that they work with the county to configure an optimal system for use in the county. County can purchase the hardware from any of their existing contract options if available. The iPads are hardened and per-enrolled in the Mobile Device Management (MDM) system before deployment. Support personnel and call center support is available for jurisdictions. It was suggested that the usual practice is to have personnel onsite for the first few elections.
- b) Service Agreement and Warranty Options -
Knowink representatives explained that there are several Service Agreement and Warranty options available for the jurisdictions interested in the system.
- c) Training Options -
Knowink suggested that the county will be offered training options at purchase. The usual practice is to have a training session at county site and then providing the county with poll worker training materials. Knowink personnel also is available to hold the training if necessary.

Attachment C - Commonwealth IT Policies

- A) ITP-SEC001 – Policy that governs Commonwealth’s antivirus agent, host intrusion prevention agent (host-based intrusion prevention system), incident response servlet and patch management agent for all servers.

Discussion Summary:

Poll Pads used at the polling place use iOS which has unique security features that negate the need for anti-virus software. It was represented that, iOS also achieves a reduced attack surface by limiting listening ports and removing unnecessary network utilities such as telnet, shells, or a web server. No additional firewall software is needed on iOS devices. The Poll Pads run in kiosk mode where only the required software is installed and available for use. The Mobile Device Management (MDM) system also serves as an intrusion monitoring and prevention system. Capability to connect external media is also very limited.

ePulse system is hosted by a leading cloud services provider. The answers to the IT policy evaluation questionnaire suggest multiple layers of security for the data hosted.

Knowink represented that they test all patches before deployment and has a patch management policy that considers the election schedule and use the MDM for deployment of the patches. The MDM solution also allows locking and erasing the device if a compromise happens.

- B) ITP -SEC004 - Establishes policy and enterprise-wide standards for commonwealth agencies on Web Application Firewalls

Discussion Summary:

The discussions suggest that the Poll Pad and ePulse systems maintain multiple levels of security to ensure confidentiality and integrity of all devices, communications, data, and systems. Poll Pads use iOS and ePulse is cloud hosted. The ePulse system uses many defenses to keep the system both secure and available during peak periods, like an election. Traffic is encrypted and the database resources are isolated from public Internet. Traffic is distributed using application load balancer to maintain high availability and scalability of internal resources. Application servers are hosted on different availability zones. ePulse follows best practices for access control and provides detailed audit trail of transactions.

- C) ITP-SEC019 and ITP -SEC016 – Establishes policy and procedures to protect commonwealth electronic data.

Discussion Summary:

Knowink represented that they have an appointed contact for security coordination who adheres to the company's Information Security Policy for handling security related duties. A copy of the information security policy was made available for review to the Department. It was also represented that Knowink uses a third-party company for yearly security assessment of software and facilities.

- D) ITP-SEC020 - Establishes policy and standards for encryption of data at rest

Discussion Summary:

Knowink represented that all data is encrypted at rest. Data at rest on Poll Pads and ePulse is encrypted. All data is encrypted to FIPS 140-2 standards.

- E) ITP-SEC024 – Establishes policies, procedures and standards related to reporting and managing of cyber security incidents.

Discussion Summary:

Knowink supplied their information security policy which suggests defined process in responding to security incidents. It was also represented that Knowink uses a third-party security service provider to perform security assessments of the software and facilities.

- F) ITP-SEC025 – Establishes guidelines for the proper electronic use and disclosure of Personally Identifiable Information.

Discussion Summary:

Knowink suggested that it complies with ITP-SEC025. Knowink provided the company Information Security Policy which governs the use of sensitive data. It was represented that they have not had a breach and have never had a client that suffered a data breach for implementing the EPB solution.

- G) ITP-SEC029 - Establishes policy and procedures for commonwealth agencies for physical security of IT resources.

Discussion Summary:

The Poll Pad device and peripheral components including printers, ID scanning trays, stylus, charging cables and stand is locked in the Nanuk weatherproof/shockproof cases provided as part of the solution. Authentication requirements will prevent access to the Poll Pad and ePulse application. External hardware connection capability is limited to the Apple-approved, proprietary Knowink iSync drive and printers

- H) ITP-SEC031 - Establishes policy and standards for encryption of data in transit to improve the confidentiality and integrity of data.

Discussion Summary:

Knowink suggested that the poll book system involves encryptions and secure transmission protocols. All traffic to and from ePulse and between Poll Pad and ePulse is encrypted using TLS 1.2 encryption, a certificate authority signed certificate, and AES 128 or 256-bit encryption, depending on what the user's browser supports. This data encryption applies equally to wireless traffic encryption as well as application-level data encryption which is based on Apple's "sandbox" wherein applications on a device do not share or access each other's data. The Nanuk weatherproof/shockproof cases are lockable to further ensure there is no physical tampering with the devices.

- I) ITP-SEC032 Establishes compliance standards for enterprise Data Loss Prevention (DLP).

Discussion Summary: The policy refers compliance to the below mentioned policies.

- 1) ITP-SEC019 - Policy and Procedures for Protecting Commonwealth Electronic Data

Refer to Item C above.

- 2) ITP-SEC020 - Encryption Standards for Data at Rest

Refer to Item D above.

- 3) ITP-SEC031 - Encryption Standards for Data in Transit

Refer Item H above

- 4) ITP-SEC017 - CoPA Policy on Credit Card Use for e-Government Applications (if applicable)

Not applicable.

The information security policy suggests that Knowink enforces secure coding guidelines. The system had undergone code review and security testing as part of approval for California State certification testing.

- J) ITP-SEC035 - This Information Technology Policy establishes policy, responsibilities, and procedures for connecting and using mobile communication devices to access commonwealth IT resources.

Discussion Summary:

The discussion suggests that EPB Solution utilizes an MDM solution to manage the Poll Pads. The county can work with Knowink to configure the system in the most effective way to manage election cycles. The iPads are hardened and patches are controlled not to conflict with the election cycles. The discussion suggests that the Poll Pad can be configured to adhere to the MDM configuration guidelines mentioned in ITP-SEC035.

- K) ITP-SEC007 - This Information Technology Policy establishes establish minimum standards for the implementation and administration of user, system, network, device, application account IDs, passwords, and requirements around multi-factor authentication.

Discussion Summary:

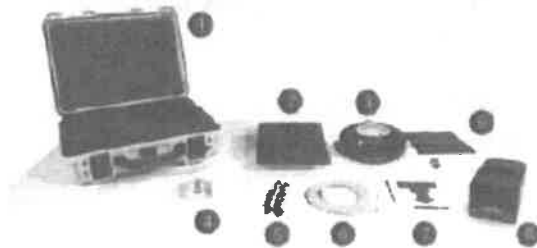
The discussion suggests that the PollPad 1.3.3 EPB system can be configured in compliance with the Commonwealth ITP-SEC007. ePulse management system usernames and passwords are customizable and can only be set and known by the user. Poll Pad field system passwords may be set by the election administrator. Poll Pad passwords may be set to be the same for each device, or customized by specific polling place or user. The default password requirements ensure the use of strong passwords. Multi-factor authentication (MFA) can be required to launch the Poll Pad application or access the Tools and Settings menu in the application. ePulse also allows configuring with MFA. ePulse user access levels may also be customized and restricted to certain modules and functions.

Attachment D - Poll Pad Components

(The below screenshot is Page 4 of the Poll Pad Guide submitted as part of the application for approval)

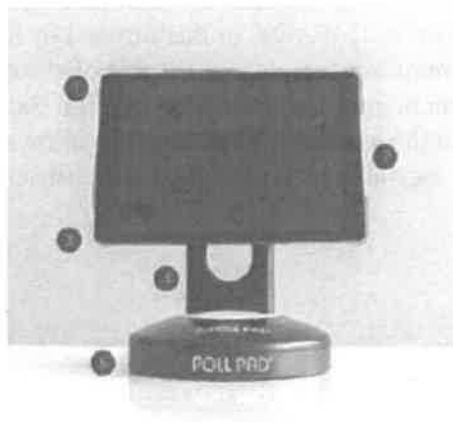


WHAT'S IN THE POLL PAD CASE



1. Green Case
2. Poll Pad & Stand Arm
3. Poll Pad Base or Battery Base
4. Lightning to USB Cable & USB Power Adapter
5. (2) Stylus
6. Green Power Cable
7. ID Tray
8. Printer
9. iPad Screen Cloth

POLL PAD STAND & ACCESSORIES



- | | |
|-----------------------------|-----------------|
| 1. Power Button | 5. Battery Base |
| 2. Home Button | 6. Camera |
| 3. Poll Pad & Plastic Shell | 7. ID Tray |
| 4. Stand Arm | |



COMMONWEALTH OF PENNSYLVANIA

DEPARTMENT OF STATE

**RESULTS OF TENEX SOFTWARE SOLUTIONS ELECTRONIC POLL
BOOK PRECINCT CENTRAL 3.2.0.1 DEMONSTRATION**



Issued By:

Pedro A. Cortes

Pedro A. Cortes
Secretary of the Commonwealth
September 20, 2017

RESULTS OF THE TENEX PRECINCT CENTRAL ELECTRONIC POLL BOOK DEMONSTRATION

I. INTRODUCTION

Pennsylvania's voter registration law, Act 3 of 2002 (Act 3), 25 Pa.C.S. §§ 1101 et seq., requires that the poll book or district register "shall be in a form prescribed and approved by the Secretary" for both paper and electronic poll books. 25 Pa. C.S. §1402(b)(2). Pursuant to the request by Tenex Software Solutions (Tenex), the Department of State (Department) evaluated the Tenex Precinct Central Touchpad Version 3.2.0.1 Electronic Poll Book (Tenex Precinct Central EPB) to ensure that the system complies with all the applicable requirements of Act 3, including the regulations implementing Act 3, 4 Pa. Code §§ 183.1 et seq., and the Pennsylvania Election Code, 25 P.S. §§ 2601 et seq., and therefore can be used in Pennsylvania elections. The evaluation consisted of system demonstrations conducted by the Department with Tenex on April 5 and April 28, 2017. The in-person demonstration on April 5, 2017 occurred in Hearing Room 3, Keystone Building, 400 North Street, Harrisburg, Pennsylvania. The Department recorded the demonstration on video. Marian Schneider, then-Deputy Secretary for Elections and Administration; Jonathan Marks, Commissioner of the Department's Bureau of Commissions, Elections and Legislation (BCEL); and Kathleen Kotula, the Department's Deputy Chief Counsel, represented the Secretary of the Commonwealth (Secretary) at the demonstration. Tenex President, Ravi Kallem, represented Tenex. Staff members of BCEL and the Department's Office of Chief Counsel also attended the demonstration.

II. THE TENEX Precinct Central 3.2.0.1 ELECTRONIC POLL BOOK

The Tenex Precinct Central 3.2.0.1 EPB demonstrated for use in Pennsylvania included the following components: (1) Precinct Central Touchpad; (2) Precinct Central Console; and (3) Precinct Central Data Studio. The following is a brief description of the components summarized from the documentation supplied by Tenex.

- **Precinct Central Touchpad** is the part of the electronic poll book solution that is used at the polling place. The primary function of this module is to facilitate voter check in at the polling place.
- **Precinct Central Console** is the real-time comprehensive monitoring platform that allows election staff to monitor devices, users, communications and performance metrics on a secure computing environment. Precinct Central Console is also the election office portal for all pre-election setup activity and post-election data reconciliation, auditing, and exporting.
- **Precinct Central Data Studio** forms the communication backbone for the product suite. This module provides all interfaces for integrating with the voter registration system and for communicating information between all Precinct Central Touchpads deployed.

Below is the Hardware/Software/Peripherals/Additional Equipment list provided by Tenex.

Hardware Components

Component	Required or Optional
32 GB iPad Mini 2	Required
16 GB iPad Air 2	Optional (not required if iPad Mini 2 is used)
Capacitive Stylus	Required
Brother QL710W	Optional
Epson TM-m30 Bluetooth Printer	Optional
Flip & Share Case/Stand Model 2.2	Optional
Jetpack MiFi 6620L (other local carrier models may differ)	Optional

Additional Equipment

Item	Description	Required or Optional
DD-WRT COTS Router	Four (4) Linksys or ASUS Routers to be used in a mesh configuration in warehouse for download and data activities	Optional
Download Appliance Windows Server	Local management and caching server for data	Optional
Mac Mini	Used for MDM of all Touchpad devices	Optional
Charging Chart	Stores and charges up to 75 EPBs	Optional
10 ft. MFi Certified Charging Cables	Chargers for EPBs to be used on Election Day	Optional

Consumables

Item	Description	Required or Optional
Epson TM-m30 Receipt Printer Paper Refills	Paper refill cartridge to be used in Epson printer	Required as needed
Brother QL710W Label Printer Refills	Label paper refill cartridge to be used in Brother printer	Required as needed
Capacitive Stylus	Stylus used by both the election workers and voters for tablet interactions	Required as needed

Software Components

License Type	Description
Precinct Central Touchpad Software	EPB application used on the iPad-based Precinct Central Touchpads
Precinct Central Data Studio Software	Data conversion utility used to create voter databases for use on the Touchpads
Precinct Central Console Software	Backend monitoring and election set-up web based system

III. EVALUATION APPROACH, PROCEDURES AND RESULTS

A. Evaluation Approach

To evaluate whether Tenex Precinct Central 3.2.0.1 EPB can be successfully used in elections in the Commonwealth of Pennsylvania and meets all the requirements mandated by Act 3 and the Pennsylvania Election Code, the following approach was used: (1) System Demonstration, and (2) Documentation Review.

The Department requires a System Demonstration to evaluate and confirm on a field-ready system that the EPB satisfies all the statutory requirements and to understand the capabilities of the system. The Documentation Review consisted of analyzing the system specifications, user manuals, and VSTL (Voting System Test Laboratories) and other third-party test reports. EPBs are heavily configurable distributed systems, typically consisting of networked tablets or laptops used at the polling place to check-in voters and a central server performing the management functions including preparing the election data, performing voter history updates and monitoring deployed devices at polling places. The Documentation Review confirms that the EPB can be efficiently used for elections in the Commonwealth of Pennsylvania and to aid in deciding the EPB connectivity configuration that can be approved for use in Pennsylvania.

B. Procedures

1. System Demonstration

Representatives from Tenex demonstrated the Tenex Precinct Central 3.2.0.1 EPB system. The demonstration included an end-to-end set-up and capability walkthrough of the Precinct Central Touchpad, the Precinct Central Console, and the Precinct Central Data Studio. The purpose of the demonstration was to: (1) validate that the system complies with Pennsylvania's statutory requirements for poll books; (2) discuss the overall capabilities of the system; and (3) discuss compliance with the Commonwealth Information Technology Policies (ITPs) outlined in Attachment C of this report. During the in-person demonstration conducted on April 5, 2017, the system did not successfully display the assistance codes extracted from the Statewide Uniform Registry of Electors (SURE) system on the Precinct Central Touchpad. Tenex representatives worked with Department staff to display the data correctly on the Precinct Central Touchpad. The demonstration of the display of the

assistance codes was completed via email exchange of system screenshots on April 28, 2017.

2. Documentation Review

The Department requested the following documentation from Tenex for review:

- (a) System Specifications;
- (b) Hardware/Software/Peripherals/Additional Equipment Requirements;
- (c) Technical Data Sheet;
- (d) User Manual;
- (e) Usability Reports;
- (f) Security and Penetration Testing Reports;
- (g) Known Anomalies; and
- (h) Reports from other States using the system.

Department staff reviewed and analyzed all relevant information and documentation for the Tenex Precinct Central 3.2.0.1 EPB system.

C. Results

1. System Demonstration Results

- (a) Conformance to statutory requirements - The vendor successfully demonstrated that the Tenex Precinct Central 3.2.0.1 EPB system conforms to the statutory requirements outlined in Act 3 and the Pennsylvania Election Code. *See* Attachment A for the list of statutory requirements discussed and validated during the demonstration.
- (b) Review of system capabilities - The Department reviewed the overall functional and nonfunctional capabilities of the Tenex Precinct Central 3.2.0.1 EPB system during the demonstration. *See* Attachment B for the list of system functional and nonfunctional capabilities discussed during the demonstration and a brief overview of the discussion points.

- (c) Compliance with Commonwealth ITPs - The Department provided Tenex with a copy of the Commonwealth of Pennsylvania ITPs relating to the security of distributed systems and system connectivity. Time was set aside for discussion during the demonstration to determine the level of compliance to Commonwealth policies. *See Attachment C* for the specific policies and discussion summary that occurred during the demonstration.

2. Documentation Review Results

The Department staff analyzed the documentation provided by Tenex to understand the system capabilities.

In addition, the Department reviewed the Tenex Precinct Central 3.2.0.1 EPB certification reports issued by the State of Ohio. The certification reports included testing reports by a federally recognized VSTL to affirm conformance to Ohio state standards. The documentation included a security assessment report by MAD Security (MAD), an independent organization providing cybersecurity solutions. MAD stated that their assessment methodology focused on assessing the security of networks, systems, devices and applications that comprise the EPB system as separate entities each that could contribute to and build upon each other to create a secure environment. MAD identified four vulnerabilities and categorized them as “medium” and “low” risk. The vulnerabilities were remediated and the system was reexamined by MAD for confirmation. The MAD report documented the overall risk rating for the Tenex Precinct Central 3.2.0.1 EPB system as “low” and the overall security posture for the system as “robust.”.

The demonstration and documentation review determined that Tenex Precinct Central 3.2.0.1 EPB consists of iPads configured as Precinct Central Touchpads to perform voter check-in activity at the polling place. Election preparation and monitoring activities are performed using Precinct Central Data Studio and Precinct Central Console. Precinct Central Console and Precinct Central Data Studio utilizes cloud-based servers and

computing services. The system allows the following modes of configuration:

- A live (fully connected) mode where data flows continuously between cloud-based servers and all Precinct Central Touchpads in use at a polling place;
- A restricted server communication mode where the system can be configured to transfer only operational/performance data from the Precinct Central Touchpads to the cloud server. The data transmitted doesn't contain any voter check-in data. This will allow monitoring of the polling place devices remotely;
- A configuration where only Precinct Central Touchpads at a polling place communicate to each other without any connection to the cloud server. This configuration allows voter check-in data to sync up in a particular polling place, thus allowing the use of multiple Precinct Central Touchpads at a polling place.

The networked environment makes the Tenex Precinct Central 3.2.0.1 EPB system vulnerable to hacking attempts that can compromise the integrity of check-in data and/or result in unauthorized access to voter data. Department staff analyzed the connectivity configurations discussed during the demonstration in conjunction with the documentation provided and existing Department test protocols for EPBs to determine the connectivity configuration for use in the Commonwealth of Pennsylvania. The Department is focused on minimizing the security risks and maximizing benefits in moving to an EPB solution.

3. Observations

Department staff noted the following during the demonstration and documentation review:

- (a) The Tenex Precinct Central 3.2.0.1 EPB uses software configuration features to determine the final functional behavior of the system. Even though demonstration showed that the system can be configured to satisfy all the statutory requirements, the Department will need assurance that the system setup complies with the approved configuration after purchase.
- (b) The demonstration showed that Tenex Precinct Central 3.2.0.1 EPB can be configured to comply with applicable Commonwealth ITPs. The final system configuration will depend on the parameters selected during the set up. System compliance will be ascertained after purchase.
- (c) Tenex provided system manuals to describe the functionality of the Tenex Precinct Central 3.2.0.1 EPB system. However, the supplied documentation did not include all the manuals for the system. Delivery of a complete Tenex Precinct Central 3.2.0.1 EPB system user manual will be verified on acquisition of the system.
- (d) Tenex Precinct Central 3.2.0.1 EPB deployed in live (fully connected) or restricted server communication mode communicates with a cloud server located outside of the polling place. The demonstration discussed the full capabilities of the system. The live or restricted mode maintains a communication channel between the polling place and cloud server for the entire time the polls are open on Election Day. The product manufacturers represent the transmission to be secure but in absence of penetration testing, it is not advisable to approve a connectivity configuration where the Touchpads communicate to the cloud server in real-time on Election Day.

IV. CONDITIONS FOR APPROVAL

Based on the demonstrations and the documentation review, the Secretary of the Commonwealth of Pennsylvania approves Tenex Precinct Central 3.2.0.1 EPB subject to the

following conditions:

- A. The Precinct Central Touchpads in operation at a polling place **shall not** be configured to communicate to the central cloud server during polling hours on Election Day. The connection to the central server for election preparation shall occur before polling hours and voter history updates shall happen after the polls close on Election Day. The Precinct Central Touchpads in operation at a polling place can use sideways communication to synchronize voter check-in data during the polling hours.
- B. The Precinct Central Touchpad systems communicating with each other shall be configured and managed in a secure manner that they may never connect to a publicly accessible network. The network at the polling place must be a “closed network” allowing only components of the EPB system to connect and encryption must be enabled. The security settings must prevent other devices from detecting and connecting to the network at the polling place.
- C. Any components which are/were part of the EPB system, including removable media, shall not connect to the Electronic Voting System. This includes, but is not limited to, any Voter Access Cards encoded on the EPB systems, USBs, SD cards, printers, CDs, etc.
- D. Portable media used to transfer files holding voter data between any components of the EPB system shall be new and unused. Alternatively, removable media reused from previous elections shall be reformatted before each election. All removable media used for elections shall be managed with proper chain of custody and administrative safeguards to protect against data disclosure, theft, or damage.
- E. Any unused ports in the Precinct Central Touchpad must be sealed with tamper-evident seals.

F. Counties purchasing the Tenex Precinct Central 3.2.0.1 EPB system shall work with Tenex and BCEL to:

1. Implement Tenex Precinct Central 3.2.0.1 EPB in a manner that satisfies all statutory requirements outlined in Act 3 and the Pennsylvania Election Code. The parameter configuration and the text of informational messages shall be approved by BCEL;
2. Implement Tenex Precinct Central 3.2.0.1 EPB system in a manner that complies with applicable Commonwealth ITPs and any best practices published by Department of State BCEL. The system configuration, connectivity set up, password configuration and password management policies shall be approved by BCEL; and
3. Implement Tenex Precinct Central 3.2.0.1 EPB system with sound administrative practices and proper chain of custody in the same manner as counties deploy Electronic Voting Systems.

G. Counties must have a contingency plan to ensure that elections will not be affected should any component of the EPB system fail or any or all Touchpads malfunction on Election Day. The contingency plan shall ensure that no “check in” information is lost. The contingency plan shall be reviewed and approved by BCEL. At a minimum, the contingency plan must ensure the availability of a full voter list and a process for printing out voters who have already checked in if the EPB fails during voting hours.

H. Counties purchasing the Tenex Precinct Central 3.2.0.1 EPB must work with BCEL to decide what portion of the data from the Statewide Uniform Registry of Electors (SURE) system can be shared with the vendor. The counties shall not allow the vendor to run any data extraction utilities against the SURE database/system using scheduled programs. Any data transfer must happen via a file extract and secure file

transfer process and must be encrypted. The extract must not contain any additional data elements than what was shared for the demonstration. The data elements and sharing mechanism must be approved by BCEL. Counties must ensure the accuracy of data loaded to the EPB system and maintain appropriate reports as necessary for auditability.

- I. Counties implementing Tenex Precinct Central 3.2.0.1 EPB system shall implement at least two (2) Precinct Central Touchpads per polling location and must allow sideways communication to enable check-in activity to synchronize between the Touchpads. This is necessary to ensure data storage redundancy.
- J. Counties implementing Tenex Precinct Central 3.2.0.1 EPB system must configure the system in such a manner that the poll worker cannot access other programs or applications during the polling hours. At a minimum, it is recommended that the poll worker training emphasizes that the poll workers shall not access any other programs or applications during polling hours.
- K. Tenex must notify the Department of State of any changes made to the Tenex Precinct Central Electronic 3.2.0.1 EPB system. This includes any changes to the software or the environment of the EPB system including, but not limited to, Tenex Software Solutions development locations, cloud service vendors, data center locations, etc.
- L. Tenex must escrow a copy of the code, trusted build and installation instructions for safe-keeping to the Commonwealth of PA and add the Commonwealth as a beneficiary to any Escrow accounts they have for safekeeping the Precinct Central Electronic 3.2.0.1 EPB system code.
- M. Tenex must provide fully prepared and version controlled user manuals for all components of the Tenex Precinct Central 3.2.0.1 EPB system. The user manuals

shall clearly identify all the user configurable parameters. Final user manuals shall be submitted to the Department before sale of product in Pennsylvania.

- N. The counties must work with Tenex to define and implement policies on data retention and archiving on all parts of the EPB system including external servers and removable media. Any election data stored on devices outside of the county network must be deleted as soon as it is no longer required or no later than ninety (90) days after Election Day. Voter data shared with the vendor must be tracked and deleted to avoid data breaches. Counties must retain, as required by law, archived copies of data sent and received from the vendor for audit purposes. Tenex must keep audit logs of every data access event and make those audit logs available for inspection to the counties or BCEL upon request.
- O. All jurisdictions implementing the Tenex Precinct Central 3.2.0.1 EPB shall perform Logic and Accuracy Testing on each device and maintain records of this testing. The Department recommends creating a county specific plan for Logic and Accuracy Testing that includes all peripherals and anticipated check-in scenarios on Election Day. The vendor supplied Logic and Accuracy checklist should be used as a reference, but shall not be accepted in lieu of a county specific plan.

V. RECOMMENDATIONS

The Secretary makes the following recommendations to counties purchasing the Tenex Precinct Central 3.2.0.1 EPB system:

- A. The counties should perform a thorough evaluation and User Acceptance Test of the EPB system before purchase. This test should include all expected activities occurring as part of the election, including data upload and download to the SURE system. This approval is based on a demonstration done by vendor and available documentation review. Demonstration by the vendor should not be considered equivalent to testing.

- B. The counties should consider using the EPB in “pilot mode” during the first use in an election. This allows the jurisdictions to ensure all appropriate checks and balances are in place before using the EPB in full production mode.
- C. The Secretary urges counties to ensure that all poll workers and election officials receive appropriate training and are comfortable using the EPB on Election Day. The training should include cyber hygiene practices and procedures for detecting cyber-attacks. Training should ensure that poll workers are trained to detect warnings that signal cyber-attacks and immediately respond to those warnings. The counties should develop and implement a disaster recovery plan that includes the possibility of a data breach or cyber-attack on the EPB,
- D. The Secretary recommends counties purchasing the Tenex Precinct Central 3.2.0.1 EPB system perform proof of concept testing onsite at all polling places to ensure connectivity and power supply availability. The Secretary further recommends the test be conducted with a test system using components of the same make, model and configuration as to what will be used on Election Day.

VI. CONCLUSION

Based on the demonstration, documentation review, and consultation with the Department staff, the Secretary of Commonwealth concludes that the Tenex Precinct Central 3.2.0.1 EPB meets all of the applicable requirements sets forth in Act 3 and the Pennsylvania Election Code, and can be used for checking in voters during elections, provided that all of the conditions listed in Section IV of this report are met.

Attachment A - Statutory Requirements

Requirement	Demonstrated (Yes/No)
The computer list shall be in a form prescribed and approved by the Secretary. (25 Pa.C.S. §1402(b)(2)).	Yes
Form of the Electronic Poll Book	
Each screen of the EPB shall contain the name of the county. (25 Pa.C.S. § 1402(b)(2)).	Yes
Each screen of the EPB shall contain the election district. (25 Pa.C.S. § 1402(b)(2)).	Yes
Each screen of the EPB shall contain the date of the election. (25 Pa.C.S. § 1402(b)(2)).	Yes
Each screen of the EPB shall contain the date and time the list was prepared. (25 Pa.C.S. § 1402(b)(2)).	Yes
Content of the List:	
For each election district, the EPB shall contain an accurate list of the names of the registered electors- alphabetically by last name. (25 Pa.C.S. §§ 1402(b)(2) and 1402(c)).	Yes
<p>Poll workers must have access to the list at all times so that voters can be checked in without interruption. The EPB should provide for the following relating to data recovery and adequate contingencies should one or more elements of the EPB fail:</p> <ul style="list-style-type: none"> ▪ Memory Redundancy • Internal • External ▪ Data Preservation ▪ If the contingency for EPB failure is the printing of paper poll books/precinct lists from the EPB, the EPB must provide for 	Yes

<p>the printing of a paper poll book AND a copy of the list of registered voters within the precinct.</p> <p>Demonstration Comments: The manufacturer represented that Tenex Precinct Central 3.2.0.1 maintains redundancy when multiple Touchpads are used at the polling place. The system allows a capability to connect printers and configure reports.</p> <ul style="list-style-type: none"> • The EPB must prevent multiple “check-ins” by the same voter. <p>Demonstration Comments: The system could identify a checked in voter and displayed a message indicating that the voter had already voted. In an environment where there are multiple Precinct Central Touchpads are connected data syncing between the devices must be operational to ensure multiple “check ins” are prevented.</p>	
<p>A legible digitized signature for each registered elector. (25 Pa.C.S. § 1402(b)(2)).</p> <p>The official digitized signature for each registered elector must be obtained from the Statewide Uniform Registry of Electors (SURE) and it must be displayed in such a manner as only the poll worker can see the official signature at the time a voter is signing the EPB.</p>	Yes
<p>Street address of each registered elector. (25 Pa.C.S. § 1402(b)(2)).</p>	Yes
<p>Political party designation of each registered elector. (25 Pa.C.S. § 1402(b)(2)).</p>	Yes
<p>Suitable space for insertion of the signature of the registered elector. (25 P.S. § 3050(a.3); 25 Pa.C.S. § 1402(b)(2)).</p>	Yes
<p>Suitable space for insertion by the proper election official of the number and letter of the stub of the ballot issued to the registered elector or the registered elector’s number in the order of admission to the voting systems. (25 P.S. § 3050(a.3); 25 Pa.C.S. § 1402(b)(2)).</p>	Yes

<p>Suitable space for insertion of the initials of the election official who enters the record of voting in the district register. (25 P.S. § 3050(a.3); 25 Pa.C.S. § 1402(b)(2)).</p> <p>If the EPB is designed in such a manner as it provides for unique login credentials for each election official, this requirement can be satisfied by a system-generated audit report that identifies by unique election official ID which voters were checked in by that election official.</p>	Yes
<p>Indication of whether the elector needs assistance to vote and, if so, the nature of the disability. (25 Pa.C.S. § 1402(b)(2)).</p>	Yes
<p>The date of birth of the registrant. (4 Pa. Code § 183.11(b)(4)).</p>	Yes
<p>The SURE registration number of the registrant. (4 Pa. Code § 183.11(b)(5)).</p>	Yes
<p>The following elector's affirmation must appear above the signature area: "I hereby certify that I am qualified to vote in this election." (25 P.S. § 3043).</p>	Yes
<p>An identification of whether the registrant's status is active or inactive. (25 Pa.C.S. § 1901(c); 4 Pa. Code § 183.11(b)(6)).</p>	Yes
<p>Voter Status Flags required by the SURE system:</p>	
<p>For voters who are "Inactive," affirmation is required. (25 Pa.C.S. §§ 1901(c) and (d)(3); 4 Pa. Code § 183.11)).</p>	Yes
<p>"ID Required"-identification of whether the voter needs to present voter identification. An elector who appears to vote in an election district for the first time must present valid voter identification. (25 P.S. § 3050(a)).</p>	Yes

<p>“Absentee Ballot”-If an elector who voted an absentee ballot is in the municipality on Election Day, he or she must vote in the precinct, and the absentee ballot is voided. (25 P.S. § 3146.6(b)).</p>	<p>Yes</p>
<p>“Must vote in person”-Identification of whether the voter needs to present voter identification if the elector votes for the first time by mail. (Federal: 42 U.S.C. § 15483(b)).</p>	<p>Yes</p>

Attachment B – Tenex Precinct Central 3.2.0.1 EPB Functionalities

Specific “check in”/voter handling Scenarios

(a) Provisional Ballot -

Process of performing a provisional check in and issuing a provisional ballot was demonstrated. The discussion included situations under which a provisional ballot will be required in Pennsylvania and how the system captures the reason for the provisional ballot. The Precinct Central System allows the poll worker to issue a manual provisional ballot when the reason for the provisional ballot is not configured in the system.

(b) Absentee Ballot -

The system functionality that allows the poll worker to cancel an Absentee Ballot and allow the voter to vote in person was demonstrated. The system demonstrated considered this to be a provisional ballot. It was mentioned by Department staff that the regulations in Pennsylvania doesn't equate cancelling an absentee ballot as a provisional ballot situation. It was explained by the Tenex representatives that the system can be customized without software changes to achieve the result required.

(c) Reissue Ballot -

The procedure for reissuing a new ballot in place of a spoiled ballot was demonstrated.

(d) Inactive Voter Check In -

The process of checking in an Inactive voter with required affirmations was demonstrated. Tenex representatives mentioned that the process can be customized as required by jurisdictions.

(e) Redirecting a Voter -

The system behavior when the poll worker does a search for a voter who is at an incorrect polling place was demonstrated. It was demonstrated that the system will not allow the poll worker to check-in a voter who is not at the correct polling place. The system allows the poll worker to check-in the voter provisionally if needed. The system also allows printing and/or emailing or texting the directions to the redirected polling location.

(f) Search/Lookup Voter Capabilities of the EPB -

It was discussed that the system can search the voter list by using different search combinations. The system allows the following relevant search options:

- Last Name and House Number;

- Last Name and First Name;
- Last Name and Birth Year;
- Last Name and Birth Date; and
- Voter ID.

(g) System behavior/messages when poll worker tries to check in an already checked in voter was demonstrated.

SURE System Interaction

(a) Capabilities to import full and incremental data files from SURE -

It was demonstrated that the system allows loading data in standard agreed upon format from SURE system. It was ascertained that the system allows loading either full files or incremental files as needed for set up before the elections. The data can be extracted from the SURE system either by using file export/import process or using a program that runs at scheduled intervals to extract the data. The extracted data is then prepared on cloud servers to be loaded to the Precinct Central touchpads. Tenex representatives expressed interest in having “.txt” files of a specific layout if possible to reduce data massaging, but it was suggested that the system can use the format that Department provided test data.

(b) Reconciliation of the data load to the Electronic Poll Book -

The demonstration and discussion showed that the data load to the EPB system is reconciled and there is a process to handle exceptions.

(c) Voting History Updates -

The process of getting an extract from the Tenex Precinct Central 3.2.0.1 system to be loaded to SURE system for voting history updates was discussed. The format of the files required by the SURE system would need to be shared with the vendor and further testing performed before implementation.

(d) County self-sufficiency in extracting and uploading data files from SURE to the

EPB during election preparation was discussed. The entire process of data extraction and election preparation was discussed during the demonstration.

Tenex representatives suggested that after initial training the counties will be able to complete the processes by themselves.

Usability/User Interface

(a) Procedures for setting up the field system -

The procedure for setting up the Precinct Central Touchpads at the polling place was demonstrated. The set-up process was not complicated.

(b) Poll worker ability to access the system and login -

The process of poll worker login was demonstrated and was not complicated. The passwords are configurable and the system allows setting up unique passwords for each poll worker.

(c) Screen navigation capabilities -

The screen navigation capabilities for the EPB system were demonstrated and further discussed. Tenex representatives explained that there is customization possible with layout, fonts and colors for better readability using configurable parameters without software changes.

(d) Languages Supported by the system -

The documentation provided suggested that the Precinct Central can be configured to translate voter-facing screens into any language required by the State of Pennsylvania. This configurable option allows the poll worker to select a language for the voter by touching a button. It was mentioned that to date, Precinct Central customers have used the language option to translate voter facing screens into Spanish, Creole, and French.

(e) Clarity of the messages displayed to the poll worker -

It was demonstrated the system displayed appropriate messages to the poll worker. The discussion suggested that there is a possibility to configure the verbiage of the messages without any software changes.

(f) System power up and shutdown procedures -

System power up and shutdown procedures were discussed and were found to be easy enough for use on Election Day.

(g) Election set up -

The Procedure for accessing the Precinct Central Data Studio and Precinct Central Console to prepare for elections and loading the data to the Precinct Central Touchpad for election was discussed. Tenex representatives suggested the availability of training, user manuals and manufacturer support to aid in election preparation.

(h) Usability tests -

The discussion and documentation provided suggested that Tenex uses the following methods to conduct usability tests

- (1) Mock Elections
- (2) Field Studies

- (3) Focus/User groups
- (4) Customer feedback
- (5) Internal Usability Testing

Auditability - Transaction Logging and Reports

- (a) Transaction Logging capability for the Tenex Precinct Central 3.2.0.1 system was discussed. The logging capabilities of the system were discussed in detail to validate that the EPB system provides sufficient logging required for auditability.
- (b) The mechanism to access the logs was discussed.
- (c) The capability to configure and create reports from the EPB system was discussed.

Communication Protocols and Multiple Unit Synchronization

- (a) Precinct Central Touchpads communicate to each other (Sideways communication) to synchronize voter check in data. Sideways communication is achieved using Wi-Fi with back up adhoc Wi-Fi or vice versa.

Documented details from Precinct Central specification

Each Touchpad registers with the neighboring Touchpads and communicates limited voter check-in data. This process gives jurisdictions that do not allow central server communications the ability to share information and allow data redundancy. This process also allows a voter to get service from any check-in station regardless of where the initial check-in was done. This bank teller like model keeps the voting process moving by allowing voters who need assistance (spoiling a ballot for example) to visit any check-in station because their initial check-in data will already be shown on all Touchpads in the precinct. When Election Day is over and the Touchpads are brought back to the Election Offices, they will then have the ability to communicate all saved voter check-ins and information to the Cloud.

- (b) Precinct Central Touchpad to central server communication -
The communication between Precinct Central Touchpad and central server was discussed. The poll book allows communication between Touchpads and central server via secure wireless networks. The communication can happen in real-time throughout Election Day or can be achieved at the end of the day after polling is completed. Further discussions with Tenex Software Solutions and Cuyahoga county after the demonstration determined that the system can be configured in a mode whereby the Touchpads can communicate performance data to the Central

server thereby allowing counties to monitor the electronic poll books on election day.

- (c) Frequency of sync up transmissions between Precinct Central Touchpads -
The Precinct Central Touchpads at a polling place synchronizes check in data near real time. If there is a connectivity issue during operation the data sync up will automatically happen when the connectivity is restored.

Capacity, Redundancy, Fault tolerance and Continuity of Operations

- (a) Data Preservation –
The data is stored on iPad and once synchronized multiple devices at the polling place can provide redundancy if there is no central server communication. If there is communication to central server then it provides additional redundancy.
- (b) Power supply and Battery Life -
The power supply and Battery life of the system was discussed to ensure that the system can work on battery as well as power. It was discussed that the iPad can work for around 10 hours on battery. Tenex Software Solutions representatives suggested that Tenex recommends plugging in the systems during the polling hours.
- (c) Ability to remove/add new units without disturbing existing units -
Tenex Software Solution representatives suggested that new units could be added/removed into the Electronic Poll Book system without affecting existing functioning systems.
- (d) Ability to add additional printers –
There is capability to add additional printers based on county's requirement.
- (e) System capability to support the volume of voters in any county in Pennsylvania -
It was discussed that the system will be able to support the volume of voters in any of the counties in Commonwealth of PAA without any performance degradations.

System monitoring and notification of system Errors or Deviations

- (a) Capability to perform a self-test to determine if all peripherals are operational -
The system ensures that a printer is connected on set up and prints a poll opening slip prior to the start of the election.

- (b) The demonstration showed that the system has a display of whether the unit is connected and communicating with other field systems.
- (c) The demonstration showed that the system has an indication that alerts the poll worker when running on battery and life of battery

Security and Chain of Custody

- (a) Password configuration for admin and poll worker on Precinct Central Touchpad

-
Precinct Central Electronic Poll Book allows centrally administered password configuration that supports configuring uniquely identifiable user name and password. The system further requires password/s (one or two based on configuration) to open the polls

- (b) Information displayed to the voter on the signature pad -
The signature pad doesn't display the signature on file when being presented for signature to the voter.
- (c) Access controls for setting up elections using Precinct Central Data Studio and Precinct Central Console -
Pre-Election set up activities using Precinct Central Console and Precinct Central Data Studio are password protected. This includes but are not limited to set up, full and incremental Data loads and any configuration functions.
- (d) Data in Motion Security -
Please refer to Item H in Attachment C.
- (e) Data at Rest Security -
Please refer to Item F in Attachment C.

Maintenance, support and Training

- (a) Hardware and software acquisition options and support -
The hardware and software acquisition options from Tenex Software Solutions were discussed. The poll book is generally sold as a system including the hardware and software.
- (b) Service Agreement and Warranty Options -
The Service Agreement and Warranty options available for the system were discussed.

(c) Training Options -

The training options available for jurisdictions implementing the Precinct Central system was discussed.

Attachment C - Commonwealth ITPs Discussion

- (A) ITP-SEC001 – Policy that governs Commonwealth’s antivirus agent, host intrusion prevention agent (host-based intrusion prevention system), incident response servlet and patch management agent for all servers.

Discussion Summary: Precinct Central Touchpad uses iPads for field systems and doesn’t use any antivirus software on the touchpads. Touchpad Patching is controlled and is done with support from Tenex Software Solutions. The antivirus used on Precinct Central Console was discussed. Patching is controlled by Tenex Software Solutions and is done within a month from the release of the patch.

The discussions suggest that system can be configured with appropriate antivirus and host intrusion prevention programs.

- (B) ITP -SEC004 - Establishes policy and enterprise-wide standards for commonwealth agencies on Web Application Firewalls

Discussion Summary: Firewall policies on the AWS instances were discussed. Tenex software solutions maintain a block list that is refreshed periodically to avoid ransomware/malware. The discussion suggested that the system can be configured to satisfy compliance to the policy. The Windows server implementation was represented to be CIS 1.7 compliant

Do you have, as a part of your operational security standards, policies, procedures and scans for on-going security, including audits?

It was mentioned that the benchmarks for Windows Server 2008 R2 and IIS 7.0 were applied to all the servers to make sure that system files were secure, malicious code could not be executed, and unauthorized users would not be allowed access to the server. CIS 7.0 has been attested by the security assessment by MAD security, the firm that performed penetration testing of the system. The vendor representatives suggested that Tenex Software Solutions is also evaluating the use of other products like Thycotic to secure account passwords and endpoints.

- (C) ITP-SEC007 - This ITP establishes establish minimum standards for the implementation and administration of user, system, network, device, application account IDs, passwords, and requirements around multi-factor authentication

Discussion Summary: The system has multiple levels of password protection and all of them are configurable to satisfy the Commonwealth policy. The Touchpads provide a capability of having unique passwords configured for poll workers accessing the system. Precinct Central Touchpad is equipped with security features to ensure that check in activities at a polling place are started with appropriate password controls. System also has a timeout/lock feature that allows election officials to temporarily lock the device if they step away from their station. The Touchpad can be configured to close the election

and lock the device to close the polls. The Precinct central console access is also password protected and has timeout configuration. The vendor also suggests best practices for management of passwords in the system documentation.

- (D) ITP-SEC010 – Establishes policy and procedures associated with the use of Virtual Private Networks (VPNs).

Discussion Summary – All data transmission is encrypted and web portal access to Precinct Central and Precinct Central Data Studio has time outs configured. It was represented that the highest level of encryption was used for any client connections to the server and remote desktop connections.

The policy specifically mentions about Commonwealth VPN policies but the discussion suggested that the product can be configured in a manner that satisfies the requirements mentioned in the policy for secure connections.

- (E) ITP-SEC019 – Establishes policy and procedures to protect commonwealth electronic data.

Discussion Summary: The poll book system has the voter data and the vendor realizes the importance of the data. Precinct Central uses industry standard leading edge technologies to secure and protect sensitive information. Every component of the system has hardware, software and physical safeguards to protect the data.

- (F) ITP-SEC020 - The purpose of this ITP is to improve the confidentiality and integrity of data at rest by requiring the use of encryption.

Discussion Summary: It was discussed that all data at rest is encrypted. The Touchpads used have hardware encrypted file system. The database is encrypted. The implementation also uses encryption and hashing together for configuration files to ensure that there is an additional level of protection.

- (G) ITP-SEC025 – Establishes guidelines for the proper electronic use and disclosure of Personally Identifiable Information.

Discussion Summary: The discussion suggested that the vendor realizes that the data needs to be protected and attack prevention is the best course of action. All data on the poll book is encrypted and all data transmission is also encrypted. In addition, the communication payload is encrypted using encryption libraries. Tenex Software Solutions representatives suggested that since the payload is encrypted, even if someone could sniff the package, parsing will be difficult due to the encrypted content

- (H) ITP-SEC031 - Establishes policy and standards for encryption of data in transit to improve the confidentiality and integrity of data.

Discussion Summary: It was discussed that data transmission between components of the system uses encryption protocols which demonstrate compliance to this policy. Any file transfer is done using secure file transfer process. The system uses a Wi-Fi connection to sync check in data and the transmission is encrypted. There is an additional level of protection whereby the communication payload is encrypted using encryption libraries.

(I) ITP-SEC032 Establishes compliance standards for enterprise Data Loss Prevention (DLP).

Discussion Summary: The policy refers compliance to the below mentioned policies.

1) ITP-SEC019 - Policy and Procedures for Protecting Commonwealth Electronic Data

Item E above.

2) ITP-SEC020 - Encryption Standards for Data at Rest

Item F above.

3) ITP-SEC031 - Encryption Standards for Data in Transit

Item H above

4) ITP-SEC017 - CoPA Policy on Credit Card Use for e-Government Applications (if applicable)

Not applicable

The vendor represented that the system has been built with a prevention approach in mind and has multiple levels of security to ensure that the attack is prevented and there is another layer of security to ensure that even if the attack happens the data and executables cannot be used due to the additional levels of protection.

(J) ITP-SEC035 - This Information Technology Policy establishes policy, responsibilities, and procedures for connecting and using mobile communication devices to access commonwealth IT resources.

Discussion Summary: The EPB Solution utilizes an iPad at the polling place. The EPB does not connect to the Commonwealth network but the discussions suggest that the touchpad can be configured with the appropriate configuration mentioned in the policy.