

**COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF STATE**

**REPORT CONCERNING THE EXAMINATION RESULTS OF
CLEARBALLOT CLEARVOTE 2.0 WITH CLEARCAST PRECINCT
SCANNER, CLEARCOUNT CENTRAL SCANNING SOLUTION,
CLEARACCESS BALLOT MARKING DEVICE, AND CLEARDESIGN
ELECTION MANAGEMENT SYSTEM**



Issued By:

Kathy Boockvar

**Kathy Boockvar
Secretary of the Commonwealth
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CLEARDESIGN EMS**

I. INTRODUCTION

Article XI-A of the Pennsylvania Election Code, 25 P.S. §§ 3031.1 et seq., authorizes the use of electronic voting systems. Section 1105-A of the Pennsylvania Election Code, 25 P.S. § 3031.5, requires that the Secretary of the Commonwealth (Secretary) examine all electronic voting systems used in any election in Pennsylvania and that the Secretary make and file a report stating whether, in her opinion, the electronic voting system can be safely used by voters and meets all applicable requirements of the Pennsylvania Election Code (the Code). The ClearVote 2.0 voting system submitted for examination includes the software enhancement to display cross-endorsed candidates only once on the general election ballot among other enhancements. Upon the request of Clear Ballot Group (Clear Ballot), the Department of State's Bureau of Election Security and Technology (Department) scheduled an examination of the ClearVote 2.0 voting system.

The Secretary of the Commonwealth (Secretary) appointed SLI Global Solutions (SLI) and the Center for Civic Design (CCD) as professional consultants to conduct an examination of the ClearVote 2.0 voting system. The examination process included a functional examination of the ClearVote 2.0 at SLI facilities located in Wheat Ridge, Colorado, and an expert review of the ClearAccess changes by accessibility examiner via web conference. Mike Santos, Senior Test Manager, and Kyle Johnson, Senior Test Engineer, (Functional Examiner) of SLI, led the functional examination of the ClearVote 2.0 pursuant to Section 1105-A(a) of the Code, 25 P.S. § 3031.5(a). Whitney Quesenbery and Denis Anson (Accessibility Examiner), representing CCD, performed an expert review of the ClearVote 2.0 system. The functional examination commenced on September 12, 2019 and lasted approximately 2 days. Department staff observed the examination via web conference. Sindhu Ramachandran, Voting Systems Analyst, Bureau of Elections Security and Technology and John Hartzell, Deputy Chief Counsel Office of Chief Counsel,

represented the Secretary of the Commonwealth. Clear Ballot Group (CBG) was represented by then Manager Certification Afua Twamasi-Ankrah. Additional staff members from the Department also attended the examination.

The Department, in consultation with the accessibility examiner, determined that the accessibility examination required only an expert review of ClearAccess software changes for displaying cross-endorsed candidates once, since none of the other changes between ClearVote 1.5 and 2.0 affected the accessible voting experience. The expert review of the Clear Access software changes was done on September 18, 2019 via web conference.

Clear Ballot submitted a report of the security assessment and testing of the CBG ClearVote 2.0 Voting System. The testing effort was performed by the Voting System Test Lab (VSTL) that tested the system for EAC certification and concentrated on the changes made to the system from the previously certified ClearVote 1.5 voting system. The Department further worked with SLI, the appointed Security Examiner, to review the test report. Jesse Peterson and Mike Santos, representing SLI, reviewed the report to evaluate the testing effort.

II. THE CLEARVOTE 2.0 VOTING SYSTEM

ClearVote 2.0 is a paper-based voting system that provides end-to-end election support; from defining an election to generating final reports. The system presented for certification in Pennsylvania is comprised of the following components -

- ClearDesign election management system
- ClearAccess in-person accessible voting solution
- ClearCast in-person precinct-scan voting solution
- ClearCount central scanning, tabulation, results consolidation and reporting solution

The following is a description of the ClearVote 2.0 components summarized from the System Overview section of the Functional Examiner's report and ClearVote System

Overview document submitted by CBG as part of the Technical Data Package (TDP).

ClearDesign

ClearDesign is an election management system consisting of an interactive set of applications which are responsible for all pre-voting activities necessary for defining and managing elections. This includes ballot design, ballot proofing, ballot layout, and ballot production. All of the hardware components are unmodified Commercial Off the Shelf (COTS) that are connected via a wired, closed, and isolated network not connected to any other systems or the Internet. The election management system (EMS) is used for the following tasks:

- Create and import jurisdiction data
- Lay out, proof, and produce both paper and accessible ballots in supported languages
- Program the other ClearVote products

Election department staff can design ballots, proof their design (including accessible ballots), lay out and review one or all ballot styles, generate PDFs for ballot-printing companies and ballot-on-demand printers, and generate the election definition files that program the other components.

ClearAccess

The ClearAccess system is an in-person ballot-marking system designed to ensure access for all voters. The ClearAccess solution runs on a COTS touchscreen computer. The voter can privately and independently indicate his or her choices on the touchscreen, review the selections, make corrections as necessary, and print a machine-marked ballot. The ballots can then be scanned and tabulated by ClearCast or ClearCount. The ClearAccess software logs all transactions without compromising voter privacy and stores no results data because its output is a marked paper ballot.

ClearCast

The ClearCast tabulator is a precinct count ballot scanning solution and processes hand-marked paper ballots and ballots printed by the ClearAccess accessible ballot marking device. The ClearCast application runs on the precinct count-based tabulator, and is used to scan, count and tally marked ballots. Its functionality is divided into three essential modes: 1) Election Mode (Early Voting and/or Election Day), which is used to process voter cast ballots; 2) Pre-Election Mode, which occurs prior to Election Mode, and is used to test all system functionality subsequent to the start of the election; and 3) Post-Election Mode, which is used to perform administrative functions following the close of the election.

ClearCount

ClearCount is a central, high-speed, optical scan ballot tabulator coupled with ballot processing applications. The ClearCount tabulation system processes ballots and captures voter intent. It handles four important functions:

1. Central count tabulation
2. Consolidating results imported from precinct voting stations
3. Generating operational reports and contest reports
4. Logging the activities and data required for independent audits

The ClearCount tabulation system consists of the following physical components (all of which are unmodified COTS hardware and are connected via closed, wired Ethernet connections):

- ScanServer—A computer running the ClearCount software and hosting its election database and the web server that serves its election reports. The ScanServer uses a Linux operating system (a configured version of which is installed with the ClearCount software).
- ScanStations—One or more computer-scanner pairs used to scan and tabulate ballots. The ScanStation computers use the Microsoft Windows operating

system.

- Router—Connects the ScanStations and the election administration stations to the ScanServer via a closed, wired Ethernet. (Optionally, a switch can be added for larger elections that require more ScanStations.)
- Election administration stations—One or more Microsoft Windows computers installed with browser software. Election officials use this computer to manage elections and county users, to monitor and interact with election reports, and to adjudicate unreadable cards. System administrators use it to monitor the ClearCount system.

Manufacturer Software/Firmware

The **ClearVote 2.0** voting system consists of the following software and firmware components:

Application	Version
ClearDesign	2.0.1
ClearCast	2.0.0
ClearAccess	2.0.1
ClearCount	2.0.1

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 Clear Vote

2.0 system categorized by system functionality:

Component	Model
<i>ClearDesign Components</i>	
Dell Latitude Laptop (client)	5580, 5590
Dell OptiPlex (client)	7440
Dell Precision Tower (client)	T3620
Dell PowerEdge Server (server)	T130, T140, T440, T630
Dell 24 inch Monitor	SE2416H
Dell 22 inch Monitors	E2216HV
Cisco 8-Port Switch	SG250-08
LG DVD Burner	GP65NB60
Anker 10 port USB 3.0 Hub	AK-68ANHUBB10A
SySTOR Multiple USB Duplicator	SYS-USBD-11
Corsair Flash Padlock 3 32 GB	Secure USB 3.0 Flash Drive
SanDisk Extreme Go 64 GB USB	3.1 USB Drive
SanDisk Ultra Flair 32 GB USB	3.0 Drive
<i>ClearAccess Components</i>	
ELO 15 inch AIO	E-Series (ESY15E2)
Dell OptiPlex AIO	5250
Oki Data Laser Printer	B432dn
ELO 20 inch AIO	X-Series (ESY20X2)
Oki Data Laser Printer	B432dn
Dell Inspiron 15"	7000 Series
Brother Laser Printer	HL-L2340DW , HL-L2350DW
Brother Laser Printer	HL-L2350DW
Micrologic Tray Kit	B432TrayKit
Zebra Technologies Bar Code Scanner	DS457-SR, CBL-58926-05
Storm EZ Access Keypad	EZ08-222013
Origin Instruments Sip/Puff Breeze	AC-0313-MUV
Samson Over-Ear Stereo Headphones	SASR350
Clear Ballot Privacy Screen	CB-1097-1.5
Ergotron Neo-Flex	Widescreen Lift Stand
Corsair Flash Padlock 3 32 GB	Secure USB 3.0 Flash Drive
SanDisk Extreme Go 64 GB USB	3.1 USB Drive
SanDisk Ultra Flair 32 GB USB	3.0 Drive
Wurth	742-711-32, 742-712-22, 742-717-22

Component	Model
Polymide Film Tape	1" 2 mil
Polymide Film Tape	2" 2 mil
Polymide Film Tape	4" 2 mil
APC Smart-UPS	SMT2200C
Lifetime 4-Foot Folding Table	4428
LG DVD Burner	GP65NB60
CyberPower Smart App UPS	PR1500RT2U
<i>ClearCount Components</i>	
Dell Latitude Laptops (ScanStation)	5580, 5590
Dell Precision Tower (Election Administration)	T3620
Dell Latitude Laptops (Election Administration)	5580, 5590
Dell PowerEdge Server (ScanServer)	T130, T140, T330, T440
Dell OptiPlex (Election Administration)	7440
Fujitsu Scanner	fi-7180
Fujitsu Scanner	fi-6800
Fujitsu Scanner	fi-6400
LG DVD Burner	GP65NB60
Western Digital 4 TB External HD	WDBFJK0040HBK -NESN
Western Digital 8 TB External HD	WDBFJK0080HBK -NESN
Netac Keypad Encryption Portable Hard Disk	K390
Dell 24 inch Monitor	P2415Q
Dell 22 inch Monitor	P2217
Cisco 8-Port Switch	SG250-08
Cisco 26-Port Switch	SG250-26
Corsair Flash Padlock 3 32 GB	Secure USB 3.0 Flash Drive
SanDisk Extreme Go 64 GB USB	3.1 USB Drive
SanDisk Ultra Flair 32 GB USB	3.0 Drive
Anker USB Hub	AK-68ANHUBB10A)
APC Smart-UPS	SMT-1500C
WorkeZ Executive Scanning Shelf	WEES (661799222990)
StarTech 4-Port VGA KVM Switch w/Hub	SV431USB

Component	Model
<i>ClearCast Components</i>	
ClearCast	Model D Revision 5
Corsair Flash Padlock 3 32 GB	Secure USB 3.0 Flash Drive
SanDisk Extreme Go 64 GB USB	3.1 USB Drive
SanDisk Ultra Flair 32 GB USB	3.0 Drive
Ballot Bag	CV-1032-1.5, CV-113-1.5
Ballot Box	CV-1082-2.0
Würth Ferrites	74271142,74275812 74275813,74271132 ,74271722

Please refer to Attachment A of this report for the EAC certification scope document, which lists all software and hardware components of the EAC certified system.

Test Materials

Test support materials utilized during the examination included:

- Thermal Receipt paper for printing reports
- Ballot card stock for processing ballots on the ClearAccess
- Ballot stock for printing of ballots to be processed by the ClearCast and ClearCount
- USB thumb drives
- Ballot-marking pens

III. EXAMINATION APPROACH, PROCEDURES AND RESULTS

A. Examination Approach

ClearVote 2.0 Functional Examination

To ascertain whether ClearVote 2.0 can be safely used by voters at elections in the Commonwealth and whether it meets all the requirements of the Code, the Examiners developed test protocols for the examination. The test protocols separated the requirements of Article XI-A of the Code, Sections 1101-A to 1122-A, 25 P.S. §§ 3031.1 - 3031.22, into five main areas of test execution: (1) Documentation Review; (2) System Level Testing; (3)

Security/Penetration Testing; (4) Privacy Analysis; and (5) Usability Analysis. The Functional Examiner leveraged Security/Penetration Testing, Privacy Analysis and Usability Analysis from the ClearVote 1.5 examinations and performed additional testing on the components that changed from ClearVote 1.5 to ClearVote 2.0.

Documentation Review was performed to verify that the portions of the Code, which reference documentation detail, are sufficiently met by the ClearVote 2.0 documentation. The Functional Examiner validated compliance of the system with the following sections of the Code during the documentation review.

- 1105-A(a), 25 P.S. § 3031.5(a), requiring that an electronic voting system has been examined and approved by a federally recognized Independent Testing Authority (ITA);
- 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 Testing examined the ClearVote 2.0 voting system in terms of conducting an election. The Functional Examiner created election definitions using ClearDesign and populated the voting devices (ClearAccess, ClearCast and ClearCount) with election definitions using appropriate election media. Votes were captured using ClearAccess and ballots were printed and tabulated via a ClearCast precinct scanner. Pre-printed ballots were marked manually and then tabulated through the polling place ClearCast scanner. All ballots (hand-marked paper ballots and ClearAccess ballots) created were then tabulated through the ClearCount central scanners (Fujitsu - fi-6400, fi-6800, and fi-7180). Tabulation results were then processed using the ClearCount consolidation and reporting solution, write-in votes were counted, and reports were generated with results for

the election. The results reports were then validated against the expected results of the voted ballots.

All components of the ClearVote 2.0 system were exercised to verify that they meet all pertinent requirements of the Code. The test cases were designed to ascertain compliance with the following sections of the 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 voting¹;
- 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

¹ The testing included verification of 25 P.S. § 3031.7(3). This requirement was removed from the Code by enactment of Act 77 of 2019.

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 System Level Testing to further evaluate the design and accuracy aspects of the system as required by Sections 1107-A(11) and (13) of the Code, 25 P.S. §§ 3031.7(11) & (13), through his use during the functional examination, even though the requirements were already validated in the documentation review phase by reviewing Election Assistance Commission (EAC) certification testing reports.

The Security/Penetration Testing examined the voting system's compliance with the requirements of the Code by analyzing physical security procedures and impoundment of ballots. The Functional Examiner used this phase of testing to analyze 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 relate to system security. For the Security/Penetration Analysis, the Functional Examiner utilized the results from the ClearVote 1.5 examination for all components that were unchanged between both versions. The newly introduced folding ballot box on the ClearCast scanner was examined for compliance with the Code requirements as part of the ClearVote 2.0 examination.

The Privacy Analysis examined the voting system's compliance with Section 1107-A(1) of the Code, 25 P.S. § 3031.7(1), requiring that an electronic voting system provide for

absolute secrecy of the vote. The functional examiner utilized results from the ClearVote 1.5 examination since there were no changes to the voting system that would impact the test results from the previous examination.

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. For the Usability analysis, the Functional Examiner utilized results from the ClearVote 1.5 examination, since the voting system changes did not impact the test results from the previous examination.

Accessibility Examination

The Department in consultation with the accessibility examiner evaluated the changes to the accessible voting experience on ClearVote 2.0 voting system. The only changes that affected the accessible voting session was the software change on ClearAccess to display and print candidates endorsed by multiple parties only once during the general election voting session. The Accessibility Examiner did an examiner review of the changes to evaluate the enhancement specifically to confirm that the updates to ClearAccess did not create any problems for accessibility. All test results and observations from ClearVote 1.4.5/1.5 remain unchanged for ClearVote 2.0, since the changes to the system do not impact any of the findings.

Security Testing

The Security Testing provided a means to assess the required security properties of the voting system under examination, and to ascertain compliance with the Code's requirements, including 25 P.S. §§ 3031.7(11), (12), (16), & (17). Clear Ballot submitted a test report of security assessment of the ClearVote 2.0 voting system to the requirements set forth in Pennsylvania Voting System Security Standards. The testing was done by Pro V&V Labs, the Voting System Test Lab (VSTL) that tested ClearVote 2.0 voting system for

federal certification. The Department further worked with SLI compliance to ensure that the testing meets the requirements set forth in Pennsylvania Voting System Security Standards.

B. Examination Process and Procedures

Functional Examination

Clear Ballot 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 a Clear Ballot representative. The Functional Examiner further compared and confirmed that all the captured hash codes matched the hash codes for the EAC certified system executables.

The Functional Examiner created the election definition using ClearDesign. The election definition process included pre-election activities, including adding parties, precincts, contests, choices and ballot styles. The Functional Examiner prepared the precinct tabulation device ClearCast, polling place Ballot Marking Device ClearAccess, and ClearCount central scanning solution with central scanners Fujitsu fi-7180, fi-6400 and fi-6800 using transport media. The polling place was set up and a primary election was run using ballots printed on 60, 65 and 90 lb paper stock and a general election was then run using ballots printed on 90 lb paper stock. Ballots were marked by hand, and also using the Clear Access ballot marking device. All ballots were then tabulated through the Clear Access precinct scanner and central scanners. Polls were closed and reports were printed from the ClearCast precinct scanner and ClearCount tabulation system to reconcile results against expected results.

Accessibility Examination

The Accessibility Examiner conducted an expert review of the software changes to

Clear Access. It was determined that the results accessibility examination from ClearVote 1.4.5/1.5 can be leveraged since the only changes to accessible voting experience were the software changes to have cross-endorsed candidates displayed once on the screen and the printed ballot. For a detailed description of the examination approach and processes for ClearVote 1.5 refer to the Secretary's certification report issued for the ClearVote 1.5 voting system on March 22, 2019.

Security Testing

Clear Ballot submitted a security test report with the results obtained by conducting the security assessment and penetration testing of the ClearVote 2.0 system to the requirements set forth in the Pennsylvania Voting System Security Standard. The report identified test procedures and results of the testing. The testing focused on the assessment of the modifications to the voting system from the previously tested and certified system ClearVote 1.5. The security testing was done as part of the voting system EAC certification test campaign at Pro V&V labs, the VSTL that tested the system for federal certification.

The Department further reviewed the report with SLI Compliance, the contracted voting system examiner, to ensure that the test report shows enough evidence of the testing done to the PA voting system security standard.

C. Examination Results

ClearVote 2.0 Functional Examination

The Functional Examiner's report indicated that the system had successfully completed tests executed to ascertain compliance with requirements of the Code.

The Examiner report for ClearVote 2.0 included details of the test execution and indicated 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. Documentation Review

The Documentation Review testing performed by the Functional Examiner demonstrates that the ClearVote 2.0 meets the relevant requirements of the Code. The Examiner reviewed the “Test Report for EAC 2005 VVSG Certification Testing of ClearVote 2.0 Voting System”.

The review of the EAC test reports by the Functional Examiner and the EAC certifications submitted by ClearBallot satisfy the requirements of Section 1105-A(a) of the Code, 25 P.S. § 3031.5(a): requiring that an electronic voting system has been examined and approved by a federally recognized ITA, or Voting System Test Lab (VSTL) as such authorities are now called, as meeting the applicable performance and test standards established by the federal government.

The Functional Examiner concluded that the design requirements of Sections 1107-A(11) and (14) of the 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 Code, 25 P.S. §§ 3031.7(11) and (13).

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 Code, 25 P.S. § 3031.7(15).

2. System Level Testing

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

A closed primary election consisting of two parties (Republican, Democratic), and three precincts was run utilizing ClearDesign, ClearAccess, ClearCast and ClearCount. The Republican ballot contained 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”. The Democratic ballot contained 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”. Non-partisan ballots contained only the referendums. 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), was run, using three precincts: Precinct 1, split Precinct 2 (with splits 2a and 2b), and Precinct 3, and 21 contests: 19 partisan contests and 2 retentions, 11 “Vote for One”, 1 “Vote for no more than Two”, 6 “Vote for no more than Three”, and 1 “Vote for no more than Fifteen”. This used ClearDesign, ClearAccess, ClearCast and ClearCount. 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 ballots included straight party option and cross-endorsed candidates.

The Functional Examiner included test cases to validate Sections 1107-A(16) and (17), 25 P.S. §§ 3031.7(16) & (17), which mandate that voting systems generate zero proof reports and correctly handle over-votes during the election runs. The 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 Clear Design and transport media was used to transfer those definitions to ClearCast, ClearAccess and ClearCount. Polls were opened, zero reports were printed and verified, and ballots were marked manually, as well as electronically via the Clear Access Ballot Marking Device, then tabulated through the polling place ClearCast scanner. All ballots created (hand-marked, and ClearAccess) were then tabulated through the ClearCount central scanning solution using three available COTS central scanners, Fujitsu fi-6800, fi-6400 and fi-7180. Thus, each ballot was tabulated four times. Tabulation results for precinct and central scanning solution were then processed into ClearCount, and reports were generated with results for the election. The result reports were confirmed to match the expected results of the voted ballots.

The Functional Examiner used English and Spanish ballots for the test. Each specific hardware and software component were tested for compliance with the required sections of the Code.

ClearVote 2.0 is a paper-based system. 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 ClearAccess marked ballots are printed and tabulated on ClearCast precinct scanner or ClearCount central scanner.

The primary and general election definitions were created using ClearDesign 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 ClearAccess and ClearCast components of the ClearVote 2.0 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 ClearVote 2.0 allowed the test voter to cast a write-in vote and demonstrated compliance with Section 1107-A(5), 25 P.S. § 3031.7(5).

ClearVote 2.0 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 ClearAccess displayed only contests for which the voter was entitled to vote.

The system's compliance with Section 1107-A(7), 25 P.S. § 3031.7(7), was demonstrated since ClearCast 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. ClearAccess 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 scanning solution ClearCount, as well as precinct tabulator ClearAccess, 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 ClearVote 2.0 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. ClearAccess allowed the voters to review their ballots before printing for tabulation on precinct scanner ClearCast or central scanning solution ClearCount. The Functional Examiner attempted to change votes on ClearAccess 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

ClearAccess allowed changing the selections until the voter decides to print or cast the ballot. The ClearCast precinct scanner of ClearVote 2.0 provides the voter with a caution message when the ballot contains potential errors, such as the presence of overvotes or undervotes. The voter is presented with a message that explains the error on the screen when the tabulator detects potential errors and the ballot is returned. 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 further validated the system accuracy and performance during the System Accuracy validation phase of testing.

The Functional Examiner validated via test cases during the primary and general election that the tabulating devices ClearCast and ClearCount 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 voting². The ClearCast and ClearCount demonstrated compliance with Sections 1107-A(3) and (4), 25 P.S. §§ 3031.7(3) & (4), by appropriately tabulating the votes. The Functional Examiner also validated PA method compliance of the ClearAccess ballot marking device with appropriate test cases.

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

² Straight party voting was tested during the examination but is now eliminated pursuant to Act 77 of 2019.

official to tabulate all cast votes, including write-in votes. The ClearAccess ballot marking device allowed to include write-in votes. The ClearCast and ClearCount systems identified write-in votes during tabulation. The Functional Examiner noted that the system allowed identifying the write-ins but required the jurisdiction to develop a process to adjudicate the count of write-in votes. The Functional Examiner hence concluded that ClearVote 2.0 complies to Section 1107-A(13), 25 P.S. § 3031.7(13).

3. Security/Penetration Analysis

The Functional Examiner performed this portion of the test during the ClearVote 1.5 examination and then conducted a follow-up examination on ClearVote 2.0 for the newly added folding plastic box. For a detailed report of the Security/Penetration analysis done during ClearVote 1.5 refer to the Secretary's certification report for ClearVote 1.5 issued on March 22, 2019. For the folding ballot box the Functional Examiner configured the ClearCast scanner and the ballot box with all the seals and locks recommended by the manufacturer. The ClearCast scanner and ballot box were inspected for the ability to withstand tampering. 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.

4. Privacy Analysis

The Functional Examiner performed this portion of the test during the ClearVote 1.5 examination and then conducted a follow-up examination on ClearVote 2.0. The Functional Examiner reviewed and inspected the privacy aspects of ClearVote 1.4.5/1.5 system to determine compliance with Section 1101-A(1) of the 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.

5. Usability Analysis

The Functional Examiner performed this portion of the test during the ClearVote 1.5 examination and then conducted a follow-up examination on ClearVote 2.0. The Functional Examiner determined that ClearVote 2.0 demonstrated compliance with the usability requirements of Section 1107-A(14) and (15) of the 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.

ClearVote 2.0 Accessibility Examination

This section contains the details of the examiner review, performed on the ClearVote 2.0 voting system. The examiner review was specifically aimed at evaluating the changes to the Clear Access software done to display candidates endorsed by multiple parties once. The Accessibility examiner noted that the system lists both endorsements, and reads both endorsements accurately when using an audio ballot. They also validated that the printed ballot displays the candidates correctly.

Details and findings identified during the examiner review, voter and poll worker sessions of the ClearVote 1.4.5 and 1.5 system are also applicable to ClearVote 2.0 voting system. For a detailed description of the accessibility examination results for ClearVote 1.5 refer to the Secretary's certification report issued for the ClearVote 1.5 voting system on March 22, 2019. Attachment B of this document also lists all the findings from the ClearVote 1.4.5/1.5 accessibility examination.

ClearVote 2.0 Security Examination

Clear Ballot submitted a test report documenting the security examination on the ClearVote 2.0 voting system. The report noted that the baseline system for the ClearVote 2.0 system modification is the previously certified ClearVote 1.5 Voting System and the submitted modifications to the ClearVote 2.0 System consisted primarily of software

changes to accommodate defect resolutions, enhancements, and improved security and user interface features. A complete security evaluation including penetration testing was performed on the baseline system and the modifications were evaluated during the EAC test campaign to determine the effectiveness of their physical security measures and to determine if the modification adversely impacted results from the baseline test campaign. Following completion of the evaluation to the EAC VVSG 1.0, an assessment of the modifications to the system was performed against the requirements set forth in the Commonwealth of Pennsylvania Voting System Security Standards (PVSSS). This assessment utilized testing conducted on the baseline system; only modifications were evaluated to determine impact on the previous test results. SLI Compliance, the appointed voting system Examiner for Department of State, reviewed the test report to ensure that the system is tested to PA security standards.

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

ClearVote 2.0 was certified by the EAC on October 21, 2019, and hence complies with Section 1105-A(a) of the 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.

The Functional Examiner identified that the following within Article XI-A of the 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 ClearVote 2.0 demonstrates compliance with all requirements as delineated in Article XI-A of the Code, Sections 1101-A to 1122-A, 25 P.S. §§ 3031.1 – 3031.22.

D. Observations

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

1. ClearVote 2.0 does not support cumulative voting.
2. ClearVote 2.0 doesn't provide a systematic method for adjudicating write-ins and including the results in the final tabulation reports. The jurisdiction can identify the ballots with write-ins and must implement a process to count the write-in votes for each candidate.
3. Observations/Findings identified during the Accessibility Examination for ClearVote 1.5 and Clear Vote 2.0 identified in Appendix B.
4. ClearVote 2.0 uses COTS components as printers for the ballot marking devices and as scanning equipment. The OKI 432 printer used as a printer for the ClearAccess device is used at the polling place and hence appropriate precautions will need to be taken to ensure that the printer settings are not altered while polls are open.

5. The ADA compliant ballot marking device ClearAccess presented as part of the ClearVote 2.0 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 configuration of the system complying with the Code requirements including the PA method will require the use of appropriate selections of configurable parameters³.

7. ClearAccess ballot marking device produces ballots that look like a hand marked paper ballot. In order for the tabulation logic to accommodate the situation where a voter intentionally deselects all candidates in a contest after voting straight party, the system identifies a ballot where the voter has made changes after voting straight party, by adding a diamond mark notation near the straight party contest on the printed ballot³.

IV. Conditions for Certification

Given the results of the examination that occurred in October 2018 and January thru February 2019, and the findings of the Examiners as set forth in his reports, **the Secretary of the Commonwealth certifies the ClearVote 2.0 subject to the following conditions:**

A. Pennsylvania counties using the ClearVote 2.0 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 ClearAccess in the polling place to assure compliance with the constitutional and statutory requirements

³ This observation is not relevant since straight party voting was removed from the Code after the testing by Act 77 of 2019.

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

B. No components of the ClearVote 2.0 voting system shall be connected to any modem or network interface, including the Internet, at any time, except when a standalone local area wired network configuration is used, 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 ClearVote 2.0, 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 ClearVote 2.0 is a paper-based system, counties using the ClearVote 2.0 must comply at a minimum with Section 1117-A of the 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. ClearBallot must ensure that the COTS printer used for ClearAccess 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.

E. ClearVote 2.0 implementations in Pennsylvania must use only 60, 65 and 90 lb paper stock for elections. This is to ensure that only paper stock that has been tested and validated is used on Election Day. Clear Ballot must work with jurisdictions to ensure that the printer and scanner settings adhere to the identified values in TDP. Clear Ballot and

jurisdictions must report to the Department any ballot printing smearing and flaking issues that is noticed during acceptance testing and/or L&A testing. ClearBallot must work with Department of State and the jurisdictions to add training sessions during implementation to ensure that the quality of ballots is maintained while handling, before during and after elections.

F. All jurisdictions implementing the ClearVote 2.0 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 fully automated L&A testing and discourages the use of preprinted ballots provided by vendors. All components being used on Election Day, including accessible devices and any Electronic Poll Books, must be part of the L&A testing.

G. ClearVote 2.0 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 ClearAccess 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.

H. All jurisdictions implementing the ClearVote 2.0 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.

I. Jurisdictions implementing the ClearVote 2.0 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.

J. All jurisdictions implementing the ClearVote 2.0 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>.

K. All jurisdictions implementing ClearVote 2.0 must configure the polling place components of the voting system to notify voters when they attempt to cast overvotes. 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).

L. All jurisdictions implementing ClearVote 2.0 must work with Clear Ballot 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.

M. “ClearAudit,” identified as a system component per the TDP, is not certified for use in Pennsylvania with ClearVote 2.0. This software was not presented to the Secretary for certification by Clear Ballot.

N. Jurisdictions must incorporate a process to adjudicate and tabulate write-ins since the system doesn’t include a functionality for adding write-in candidates to the system

and tallying their votes. Jurisdictions can use the software functionality to 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. Jurisdictions must always consider the voter verified paper ballot as the ballot of record and in the event of a recount, the voter verified paper ballots must be used for the count.

O. Jurisdictions implementing ClearVote 2.0 must work with ClearBallot 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.

P. Jurisdictions using the services of Clear Ballot or a third-party vendor for election preparation activities must work with Clear Ballot 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 a secure file transfer process. The file transfer and download must be tracked and audited to make sure that data has not been accessed by unauthorized personnel.

Q. Jurisdictions must work with ClearBallot to make sure that the sip-and-puff devices are calibrated, and the devices works for completing a ballot marking session. Jurisdictions must use it during L&A testing to complete a ballot. The jurisdictions implementing the ClearVote 2.0 system must hold voter education sessions specifically addressed to voters using accessible devices including sip-and-puff and must clearly communicate the unavailability of the dual switches and allow enough sessions for the voters to get used to the sip-and-puff device for use on Election Day.

R. Jurisdictions implementing ClearVote 2.0 must implement the use of privacy sleeves to be used by voters carrying marked ballots between the ClearAccess ballot marking device and ClearCast precinct scanner. Poll worker training must emphasize the need for helping voters without violating their privacy. This must include but not be limited to 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.

S. The ClearAccess printer allows the ballot stock to be secured inside the printer tray, if it is less than 22 inches long. If the ballots are longer than 22 inches, ample care must be taken to make sure that the voter education materials instruct voters on how to insert ballot stock into the printer. Poll worker training must include sessions on identifying issues surrounding the insertion of the ballot and getting the print outs, without violating the privacy of the voter.

T. The USB port used for attaching the sip-and-puff device must be sealed with a tamper evident seal and must be opened for any session needed and resealed after the session. Poll worker training must include details around how to manage the device securely during Election Day.

U. Jurisdictions must work with ClearBallot to thoroughly test and review the audio ballot instructions to ensure that the voters using an audio ballot can cast the ballot without requesting assistance.

V. 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.

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

X. 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 Clear Ballot 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 all components of the voting system housed in county offices that can be removed by authorized personnel when the port is needed. Jurisdictions must also implement a process to periodically verify the integrity of seals and tamper evident tapes.

Y. Jurisdictions must protect installations of the EMS server on portable devices and must protect the laptops to prevent lost or stolen device.

Z. 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.

AA. Jurisdictions implementing ClearVote 2.0 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.

BB. Jurisdictions implementing ClearVote 2.0 must work with ClearBallot 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.

CC. Jurisdictions implementing ClearVote 2.0 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 training during deployment noted by the Accessibility Examiner.

DD. Jurisdictions implementing ClearVote 2.0 must consider the following during voting booth set-up for serving voters requiring assistive devices

- Voters with disabilities may have assistive technology that they use in their daily life which may need to be brought to the polling place. These technology/devices must be allowed at the polling place. The voting booth set up must account for the requirements to keep the 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 to the ClearCast precinct 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 Attachment B, listing detailed recommendations for deployment noted by the Accessibility Examiner.

EE. Clear Ballot 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.

FF. Clear Ballot 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 requiring 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, Clear Ballot 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 – Clear Ballot 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.

GG. Clear Ballot must adhere to the “Source Code and Escrow Items Obligations” specified in Attachment E of this document.

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

II. Jurisdictions implementing the ClearVote 2.0 and Clear Ballot 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 Code, 25 P.S. § 3031.5(a)-(b). Clear Ballot must ensure that future releases of the voting system with enhanced security and accessibility features are presented for approval to the Secretary.

JJ. 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 Code, 25 P.S. § 3031.5(d), this certification and approval is valid only for ClearVote 2.0. If the vendor or a County Board of Elections makes any changes to the ClearVote 2.0 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 ClearVote 2.0 voting system in the Commonwealth of Pennsylvania. Conditions identified during the ClearVote 2.0 examination

KK. Jurisdictions using the ballot box (identified with model # CV-1082-2.0 in Attachment A, EAC certification scope) must use tamper resistant/evident tapes between the front of the ClearCast scanner and the ballot box. This is to further add a layer of security to avoid tampering with the ballot box.

LL. Jurisdictions implementing ClearVote 2.0 must review the Secretary's certification report for ClearVote 1.5 issued on March 22, 2019 for a detailed review of the accessibility examination approach, process and procedures and results. The accessibility examination of this release was limited to only an expert review of the enhancements done to the accessible ballot marking device and any findings from the initial examination remain the same for the ClearVote 2.0 voting system, as well.

V. Recommendations

A. All jurisdictions implementing ClearVote 2.0 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 ClearVote 2.0 should take appropriate steps to ensure that voter education is part of the implementation plan.

C. All jurisdictions implementing the ClearVote 2.0 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 ClearVote 2.0 should review the System Limits as mentioned in the EAC certification scope added as Attachment A to this report.

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

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

VI. Conclusion

As a result of the examination, and after consultation with the Department's staff, counsel and the examiners, the Secretary of the Commonwealth concludes that the ClearVote 2.0 can be safely used by voters at elections as provided in the Code and meets all of the requirements set forth in the Code, **provided the voting system is implemented under the conditions listed in Section IV of this report.** Accordingly, the Secretary certifies ClearVote 2.0 for use in this Commonwealth.

The ClearAccess ballot marking device can accommodate 10-12 voters with disabilities an hour or 20-60 voters an hour when used as the primary voting system depending on size of the ballot. ClearCast precinct scanner can serve 45-60 voters per hour. The ClearCount system performance and speed depends on the COTS scanner used as part of the system. ClearBallot system documentation suggests that the central scanners Fujitsu fi-6400, fi-6800 and fi-7180 can support large jurisdictions that have more than 100,000 voters.

Attachment A – EAC Certification Scope



CBG_ClearVote_2.0_
Certificate_and_Scope



United States Election Assistance Commission

Certificate of Conformance

ClearVote 2.0



The voting system identified on this certificate has been evaluated at an accredited voting system testing laboratory for conformance to the *2005 Voluntary Voting System Guidelines Version 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: **ClearVote**

Model or Version: **2.0**

Name of VSTL: **Pro V&V**

EAC Certification Number: **CBG-CV-20**

Date Issued: **October 21, 2019**

A handwritten signature in blue ink, appearing to be "BDL", is written above a horizontal line.

Executive Director, U.S. Election Assistance Commission

Scope of Certification Attached

Manufacturer: Clear Ballot Group
System Name: ClearVote 2.0
Certificate: CBG-CV-20

Laboratory: Pro V&V
Standard: VVSG 2005
Date: October 21, 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 ClearVote 2.0 voting system is a paper-based optical-scan voting system consisting of the following major components: ClearDesign (ballot design and EMS), ClearCount (central count, tabulation, and election reporting), ClearCast (precinct count and tabulation), and ClearAccess (accessible voting and ballot marking device).

ClearDesign

ClearDesign is an election management system consisting of an interactive set of applications that are responsible for all pre-voting activities necessary for defining and managing elections. This includes ballot design, ballot proofing, ballot layout, and ballot production. The ClearDesign system consists of the physical components listed below. All the components and the

generation of voting machine election definition file packages are unmodified COTS that are connected via a wired, closed, and isolated network not connected to any other systems or to the Internet.

- DesignServer: A desktop computer that runs the ClearDesign software on an Ubuntu operating system and hosts the election database.
- DesignStation(s): One or more laptop or desktop computers that runs Microsoft Windows with a browser-based user interface. DesignStations connect to the DesignServer, and users with administrative privileges can define users and manage the elections.
- Router: Connects the DesignStations to the DesignServer using a wired, closed Ethernet-based network with FIPS 140-2 certified encryption.

ClearCount

ClearCount is a central, high-speed, optical-scan ballot tabulator coupled with ballot-processing applications. The ClearCount software runs on unmodified COTS laptop or desktop computers running the Linux and Windows operating systems, and supports specific models of Fujitsu scanners. The ClearCount central-count system consists of the following physical components, all of which are unmodified COTS hardware that are connected via a wired, closed, and isolated network not connected to any other systems or to the Internet.

- ScanServer: A computer running the ClearCount software and hosting its election database and the web server that serves its election reports. The ScanServer runs on the Ubuntu operating system.
- ScanStation(s): One or more computer/scanner pairs used to scan and tabulate ballots. The ScanStations run on the Microsoft Windows operating system.
- Router: Connects the ScanStations and election administration stations to the ScanServer using a wired, closed Ethernet-based network with FIPS 140-2 certified encryption.
- Election Administration Stations (Adjudication Stations): One or more laptop or desktop computers that runs Microsoft Windows with installed browser software. This station can serve multiple purposes: user administration, election administration, adjudication, and reporting. This station is also used to consolidate the vote totals and ballot images from the ClearCast precinct tabulator. The vote totals and ballot images are consolidated by the ClearCount software via the ClearCast USB drive.

All files that make up the ClearCount software reside on a single ScanServer that is shared by all client ScanStations. The only software programs installed on ScanStations, other than the Windows operating system, are the Fujitsu ScandAll Pro software and drivers required by the scanner hardware. The ClearCount software consists of the following components:

- Tabulator: The Tabulator application handles ballot tabulation. The Tabulator software is stored on the ScanServer and is executed by each ScanStation at run-time from files that reside on the ScanServer. The Tabulator program analyzes the incoming image and transfers them to the local output folder named CBGBallotImages. The ScanServer retrieves the images from the folder and uploads them into the election database.

- **Election Database:** A centralized election database that resides on the ScanServer and collects the output of each Tabulator.
- **Election Reports:** A browser-based suite of reports that provides election results and analysis, and allows election officials to review individual ballot images. A web server on the ScanServer serves the reports.
- **Card Resolutions Tool:** A web application that allows election officials to review and appropriately resolve unreadable voted ballots.
- **User and Election Database Management through Web Applications:** From the User Administration page, the administrator can add, rename, or delete users; assign permissions; and change user passwords. From the Election Administration pages, the administrator can create or delete an election, set an election as active or inactive, back up or restore an election, merge election results, withdraw contests/choices, and export the Cast Vote Record.

ClearCast

The ClearCast tabulator is a precinct-count ballot-scanning solution suitable for early and election in-person voting, including processing ballots printed by the ClearAccess accessible ballot-marking device. The ClearCast application runs on the precinct-count-based tabulator, and is used to scan, count and tally marked ballots.

ClearCast functionality is divided into three essential modes, Election Mode (early voting and Election Day), which is used to process voter cast ballots; Pre-Election Mode, which occurs prior to Election Mode, and is used to test all system functionality subsequent to the start of the election; and Post-Election Mode, which is used to perform administrative functions following the close of the election. Ballots tabulated on the ClearCast system are transmitted via one of the redundant USB drives to the central ClearCount system for consolidation and reporting.

ClearAccess

ClearAccess is an accessible touchscreen ballot-marking device used for the creation of paper ballots that can be scanned and tabulated by ClearCast or ClearCount. Like other components of the ClearVote voting system, ClearAccess uses modified and unmodified COTS hardware, such as laptop and desktop computers, combined with personal assistive devices, printers, and uninterruptible power supplies to form a ballot-marking device.

Mark Definitions

Twenty percent or more of the voter target (oval) marked anywhere within the oval (left/right, above, or below its center) provides mark recognition. The manufacturer recommends black ink, but many colors will tally in accordance with VVSG 1.0 accuracy requirements. There are no required dropout colors.

Tested Marking Devices

The manufacturer recommends black and blue ballpoint pens, Sharpie® markers, and number 2 pencils.

Language Capability

In addition to English, the voting system supports Chinese, Danish, Dutch, Flemish, French, German, Italian, Japanese, Korean, Norwegian, Portuguese, Spanish, Swedish and Vietnamese.

Components Included

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

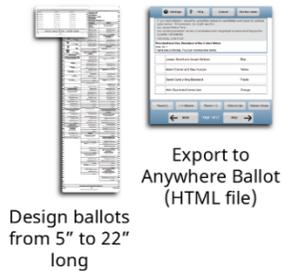
ClearVote

The first visual voting system to bring transparency to democratic elections



ClearDesign

Interactive ballot design, proofing, layout, and programming



Export to Anywhere Ballot (HTML file)

Design ballots from 5" to 22" long

USB drives program ClearAccess, ClearCast, and ClearCount



ClearAccess

Accessible ballot-marking device (BMD)



BMD and low-cost printer



Accessible input device Sip-and-puff input device



Machine-marked ballot

ClearCast

In-person tabulation for vote centers and polling places



ClearCast voting station and collapsible ballot bag

ClearCount

Central-count tabulation, consolidation, and election reporting



ScanServer

ScanStation with scanner

System Component	Software or Firmware Version	Hardware Version	Operating System or COTS	Comment
ClearAccess software	2.0.1			ClearAccess
ClearCast software	2.0.0			ClearCast
ClearCount software	2.0.1			ClearCount
ClearDesign software	2.0.1			ClearDesign
Brother printer driver	1.0.1.0		Windows 10 Pro	ClearAccess
Google Chrome	61.0.3163.100		COTS software	ClearAccess
jquery	1.10.2		COTS software	ClearAccess

System Component	Software or Firmware Version	Hardware Version	Operating System or COTS	Comment
jsmin	2003.12.04		COTS software	ClearAccess
nsis	3.01		COTS software	ClearAccess
Okidata printer driver	1.0.0.0		Windows 10 Pro	ClearAccess
pefile	2018.8.8		COTS software	ClearAccess
PyInstaller	3.2		COTS software	ClearAccess
Python	2.7.10		COTS software	ClearAccess
Python-future	0.15.2		COTS software	ClearAccess
pywin	223		COTS software	ClearAccess
webpy	0.38		COTS software	ClearAccess
Zebra Scanner Driver	3.03.0001		COTS software	ClearAccess
Windows 10 Pro	Build 1607		Windows 10 Pro	ClearAccess
DataTables	1.10.16		COTS software	ClearCast
google_chrome	76.0.3809.87-1		COTS software	ClearCast
jquery	1.12.4		COTS software	ClearCast
jQuery.NumPad	1.4		COTS software	ClearCast
jquery.ui	1.11.3		COTS software	ClearCast
JTSage DateBox	4.0.0		COTS software	ClearCast
libScanAPI.a	1.1.4		COTS software	ClearCast
OpenSSL (standard)	1.0.2g		COTS software	ClearCast
OpenSSL FIPS Object Module	2.0.10		COTS software	ClearCast
pdi_ps3_drv_scanner.ko	2.0.5		COTS software	ClearCast
Pyinstaller	3.2.1		COTS software	ClearCast
scanner_control	0.0.33		COTS software	ClearCast
Ubuntu LTS	18.04.1		COTS software	ClearCast
zeromq	4.2.3		COTS software	ClearCast
Apache	2.4.29		COTS software	ClearCount
ColVis	1.0.8		COTS software	ClearCount
Fujitsu fi-6400 PaperStream	1.30.0		Windows 10 Pro	ClearCount
Fujitsu fi-6800	10.10.710		Windows 10 Pro	ClearCount
Fujitsu fi-7180 PaperStream	1.4.0		Windows 10 Pro	ClearCount
Google Chrome	55.0.2883.87		COTS software	ClearCount

System Component	Software or Firmware Version	Hardware Version	Operating System or COTS	Comment
J JavaScript jQuery-migrate library	1.2.1		COTS software	ClearCount
JavaScript Bootstrap library	2.3.2		COTS software	ClearCount
JavaScript Chosen library	1.0.0		COTS software	ClearCount
JavaScript DataTables library	1.9.4		COTS software	ClearCount
JavaScript FixedHeader library	2.0.6		COTS software	ClearCount
JavaScript hotkeys library	0.8		COTS software	ClearCount
JavaScript jQuery library	1.10.2		COTS software	ClearCount
JavaScript LESS library	1.3.3		COTS software	ClearCount
JavaScript pep library	1.0		COTS software	ClearCount
JavaScript TableTools library	2.1.5		COTS software	ClearCount
JavaScript tooltip library	1.3		COTS software	ClearCount
libapache2-mod-fcgid	2.3.9		COTS software	ClearCount
MySQLdb (part of Ubuntu)	5.7.26		COTS software	ClearCount
OpenSSL (standard)	1.1.0g		COTS software	ClearCount
OpenSSL FIPS Object Module	2.0.10		COTS software	ClearCount
PollyReports	1.7.6		COTS software	ClearCount
PyInstaller	3.2.1		COTS software	ClearCount
Python (part of Ubuntu)	2.7.15		COTS software	ClearCount
Ubuntu LTS	18.04.1		COTS software	ClearCount
Windows 10 Pro	Build 1607		Windows 10 Pro	ClearCount
ZeroClipboard TableTools2	1.0.4		COTS software	ClearCount
Aptitude	1.6.11		COTS software	ClearCount
auditd	2.8.2		COTS software	ClearCount
debconf	1.5.66		COTS software	ClearCount
pmount	0.9.23		COTS software	ClearCount
Samba	4.7.6		COTS software	ClearCount
udisks	2.7.6		COTS software	ClearCount
Apache	2.4.18		COTS software	ClearDesign
Bootstrap	3.0.0		COTS software	ClearDesign

System Component	Software or Firmware Version	Hardware Version	Operating System or COTS	Comment
DataTable	1.10.16		COTS software	ClearDesign
DataTable Buttons	1.4.2		COTS software	ClearDesign
DataTable Buttons JSZip	2.5.0		COTS software	ClearDesign
DataTablePlugins	1.10.16		COTS software	ClearDesign
DataTable Buttons Pdfmake	0.1.32		COTS software	ClearDesign
Google Chrome	55.0.2883.87		COTS software	ClearDesign
jquery	1.10.2		COTS software	ClearDesign
jquery-impromptu	5.2.3		COTS software	ClearDesign
jquery-qrcode	1.0		COTS software	ClearDesign
jquery-splitter	0.14.0		COTS software	ClearDesign
jquery-ui	1.10.4		COTS software	ClearDesign
jscolor	1.4.2		COTS software	ClearDesign
jsmin	2003.12.04		COTS software	ClearDesign
jszip	3.1.2		COTS software	ClearDesign
libapache2-mod-fcgid	2.3.9		COTS software	ClearDesign
libmp3lame	0.5.0		COTS software	ClearDesign
MySQL	5.7.26		COTS software	ClearDesign
OpenSSL (standard)	1.0.2g		COTS software	ClearDesign
OpenSSL FIPS Object Module	2.0.10		COTS software	ClearDesign
papaparse	4.1.2		COTS software	ClearDesign
PhantomJS	1.9.8		COTS software	ClearDesign
Pyinstaller	3.2.1		COTS software	ClearDesign
Python	2.7.15		COTS software	ClearDesign
Python DBUtils	1.1		COTS software	ClearDesign
Python Flup	1.0.2		COTS software	ClearDesign
Python FontTools library	3.0		COTS software	ClearDesign
Python JSMIN	2.2.1		COTS software	ClearDesign
Python MySQL DB	1.3.10		COTS software	ClearDesign
Python Pillow	5.1.0		COTS software	ClearDesign
Python PIP	9.0.1		COTS software	ClearDesign
Python RTF	0.2.1		COTS software	ClearDesign
Python webpy	0.38		COTS software	ClearDesign
Python XLRD	0.9.4		COTS software	ClearDesign

System Component	Software or Firmware Version	Hardware Version	Operating System or COTS	Comment
Samba	4.7.6		COTS software	ClearDesign
SQLAlchemy	1.0.15		COTS software	ClearDesign
tinymce	4.1.9		COTS software	ClearDesign
Ubuntu LTS	18.04.01		COTS software	ClearDesign
Unzip	6.0.21		COTS software	ClearDesign
Windows 10 Pro	Build 1607		Windows 10 Pro	ClearDesign
Dell Inspiron 15"		7000 Series	COTS hardware	ClearAccess
Dell OptiPlex AIO		5250	COTS hardware	ClearAccess
ELO 15 inch AIO		E-Series (ESY15E2)	COTS hardware	ClearAccess
ELO 20 inch AIO		X-Series (ESY20X2)	COTS hardware	ClearAccess
Brother Laser Printer		HL-L2340DW	COTS hardware	ClearAccess
Brother Laser Printer		HL-L2350DW	COTS hardware	ClearAccess
Okidata Laser Printer		B432dn	COTS hardware	ClearAccess
Micrologic Tray Kit		B432TrayKit	COTS hardware	ClearAccess
Okidata Laser Printer		B432dn-B	COTS hardware	ClearAccess
Storm EZ Access Keypad		EZ08-222013	COTS hardware	ClearAccess
Zebra Technologies Bar Code Scanner		DS457-SR, CBL-58926-05	COTS hardware	ClearAccess
Origin Instruments Sip/Puff Breeze with Headset		AC-0313-MUV	COTS hardware	ClearAccess
Samson Over-Ear Headphones		SASR350	COTS hardware	ClearAccess
Clear Ballot Privacy Screen		CB-1097-1.5	COTS hardware	ClearAccess
APC Smart-UPS		SMT2200C	COTS hardware	ClearAccess
Ergotron Neo-Flex		Widescreen Lift Stand	COTS hardware	ClearAccess
Corsair Flash Padlock 3 32 GB		Secure USB 3.0 Flash Drive	COTS hardware	ClearAccess
SanDisk Extreme Go 64 GB USB		3.1 USB Drive	COTS hardware	ClearAccess
SanDisk Ultra Flair 32 GB USB		3.0 Drive	COTS hardware	ClearAccess
Würth		742-711-32, 742-712-22, 742-717-22	COTS hardware	ClearAccess
Polymide Film Tape		1" 2mil	COTS hardware	ClearAccess
Polymide Film Tape		2" 2 mil	COTS hardware	ClearAccess

System Component	Software or Firmware Version	Hardware Version	Operating System or COTS	Comment
Polymide Film Tape		4" 2 mil	COTS hardware	ClearAccess
Lifetime 4-Foot Folding Table		4428	COTS hardware	ClearAccess
LG DVD Burner		GP65NB60	COTS hardware	ClearAccess
CyberPower Smart App UPS		PR1500RT2U	COTS hardware	ClearAccess
ClearCast		Model D, Revision 5	COTS hardware	ClearCast
Ballot Bag		CV-1032-1.5, CV-113-1.5	COTS hardware	ClearCast
Corsair Flash Padlock 3 32 GB		Secure USB 3.0 Flash Drive	COTS hardware	ClearCast
Wurth ferrites		74271142,74275812 74275813,74271132 ,74271722	COTS hardware	ClearCast
SanDisk Extreme Go 64 GB USB		3.1 USB Drive	COTS hardware	ClearCast
SanDisk Ultra Flair 32 GB USB		3.0 USB Drive	COTS hardware	ClearCast
Ballot Box		CV-1082-2.0	COTS hardware	ClearCast
Dell Latitude Laptops (Election Administration)		5580, 5590	COTS hardware	ClearCount
Dell Latitude Laptops (ScanStation)		5580, 5590	Windows 10 Pro	ClearCount
Dell Precision Tower (Election Administration)		T3620	Windows 10 Pro	ClearCount
Dell PowerEdge Server (ScanServer)		T130, T140, T330, T440	Ubuntu 18.04.1 LTS	ClearCount
Dell Optiplex (Election Administration)		7440	Windows 10 Pro	ClearCount
Fujitsu Scanner		fi-7180	COTS hardware	ClearCount
Fujitsu Scanner		fi-6800	COTS hardware	ClearCount
Fujitsu Scanner		fi-6400	COTS hardware	ClearCount
LG DVD Burner		GP65NB60	COTS hardware	ClearCount
Western Digital 4 TB External HD		WDBFJK0040HBK-NESN	COTS hardware	ClearCount
Western Digital 8 TB External HD		WDBFJK0080HBK-NESN	COTS hardware	ClearCount
Netac Keypad Encryption Portable Hard Disk		K390	COTS hardware	ClearCount
Dell 24 inch Monitor		P2415Q	COTS hardware	ClearCount

System Component	Software or Firmware Version	Hardware Version	Operating System or COTS	Comment
Dell 22 inch Monitor		P2217	COTS hardware	ClearCount
Cisco 8-Port Switch		SG250-08	COTS hardware	ClearCount
Cisco 26-Port Switch		SG250-26	COTS hardware	ClearCount
APC Smart-UPS		SMT-1500C	COTS hardware	ClearCount
Corsair Flash Padlock 32 GB		Secure USB 3.0 Flash Drive	COTS hardware	ClearCount
SanDisk Extreme Go 64 GB USB		3.1 USB Drive	COTS hardware	ClearCount
SanDisk Ultra Flair 32 GB USB		3.0 Drive	COTS hardware	ClearCount
Anker USB Hub		AK-68ANHUB-B10A)	COTS hardware	ClearCount
WorkeZ Executive Scanning Shelf		WEEs (661799222990)	COTS hardware	ClearCount
StarTech 4-Port VGA KVM Switch w/Hub		SV431USB	COTS hardware	ClearCount
Dell Latitude Laptop (client)		5580, 5590	Windows 10 Pro	ClearDesign
Dell Precision Tower (client)		T3620	Windows 10 Pro	ClearDesign
Dell PowerEdge Server (server)		T130, T140, T630, T440	Ubuntu 16.04.4 LTS	ClearDesign
Dell Optiplex (client)		7440	Windows 10 Pro	ClearDesign
Dell 24 inch Monitor		SE2416H	COTS hardware	ClearDesign
Dell 22 inch Monitors		E2216HV	COTS hardware	ClearDesign
Cisco 8-Port Switch		SG250-08	COTS hardware	ClearDesign
LG DVD Burner		GP65NB60	COTS hardware	ClearDesign
SySTOR Multiple USB Duplicator		SYS-USBD-11	COTS Hardware	ClearDesign
Corsair Flash Padlock 32 GB		Secure USB 3.0 Flash Drive	COTS hardware	ClearDesign
SanDisk Extreme Go 64 GB USB		3.1 USB Drive	COTS hardware	ClearDesign
SanDisk Ultra Flair 32 GB USB		3.0 Drive	COTS hardware	ClearDesign
Anker 10 port USB 3.0 Hub		AK-68ANHUB-B10A	COTS hardware	ClearDesign

System Limitations

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

System Characteristic	Boundary or Limitation	Limiting Component
Precincts in an election	3200	ClearDesign database
Contests in an election	3200	ClearDesign database
Candidates/Counters in an election	3200	ClearDesign database
Ballot Styles in an election	3200	ClearDesign database
Contests in a ballot style	60	ClearDesign database
Candidates in a contest	300	ClearDesign database
Ballot styles in a precinct	50	ClearDesign database
Number of political parties	50	ClearDesign database
“vote for” in a contest	50	ClearDesign database
Supported languages in an election	15	ClearDesign database
Number of write-ins	50	ClearDesign database
Maximum oval positions per side: 5-inch ballot	60	Ballot length
Maximum oval positions per side: 11-inch ballot	180	Ballot length
Maximum oval positions per side: 14-inch ballot	240	Ballot length
Maximum oval positions per side: 17-inch ballot	300	Ballot length
Maximum oval positions per side: 19-inch ballot	360	Ballot length
Maximum oval positions per side: 22-inch ballot	420	Ballot length

System Limits for ClearCount

Scanner Model	Sustained (not burst speed) ballots per hour						Typical county size (central count)
	8.5x5	8.5x11	8.5x14	8.5x17	8.5x19	8.5x22	
fi-6400	5592	3624	2928	2448	2350	2236	Large (>100k voters)
fi-6800	7822	5508	4155	3352	3000	2800	Large (>100k voters)
fi-7180	3396	2040	1692	1400	1300	1200	Small (<25k voters)
ClearCount can have a maximum of 10 ScanStation/Scanner pairs							

Functionality

2005 VVSG Supported Functionality Declaration

Feature/Characteristic	Yes/No	Comment
<ul style="list-style-type: none"> Precinct and BMD accessible via Parallel (Side) and Forward Approach 	Yes	
Closed Primary		
<ul style="list-style-type: none"> Primary: Closed 	Yes	
Open Primary		
<ul style="list-style-type: none"> Primary: Open Standard (provide definition of how supported) 	Yes	Open Primary
<ul style="list-style-type: none"> Primary: Open Blanket (provide definition of how supported) 	Yes	General "top two"
Partisan & Non-Partisan:		
<ul style="list-style-type: none"> Partisan & Non-Partisan: Vote for 1 of N race 	Yes	
<ul style="list-style-type: none"> Partisan & Non-Partisan: Multi-member ("vote for N of M") board 	Yes	
<ul style="list-style-type: none"> Partisan & Non-Partisan: "vote for 1" race with a single candidate and write-in voting 	Yes	
<ul style="list-style-type: none"> Partisan & Non-Partisan "vote for 1" race with no declared candidates and write-in voting 	Yes	
Write-In Voting:		
<ul style="list-style-type: none"> Write-in Voting: System default is a voting position identified for 	Yes	
<ul style="list-style-type: none"> Write-in Voting: Without selecting a write in position. 	Yes	
<ul style="list-style-type: none"> Write-in: With No Declared Candidates 	Yes	
<ul style="list-style-type: none"> Write-in: Identification of write-ins for resolution at central count 	Yes	
Primary Presidential Delegation Nominations & Slates:		
<ul style="list-style-type: none"> Primary Presidential Delegation Nominations: Displayed delegate slates for each presidential party 	Yes	
<ul style="list-style-type: none"> Slate & Group Voting: one selection votes the slate. 	Yes	
Ballot Rotation:		
<ul style="list-style-type: none"> Rotation of Names within an Office; define all supported rotation methods for location on the ballot and vote tabulation/reporting 	Yes	Rotation by precinct and district
Straight Party Voting:		
<ul style="list-style-type: none"> Straight Party: A single selection for partisan races in a general 	Yes	
<ul style="list-style-type: none"> Straight Party: Vote for each candidate individually 	Yes	
<ul style="list-style-type: none"> Straight Party: Modify straight party selections with crossover votes 	Yes	
<ul style="list-style-type: none"> Straight Party: A race without a candidate for one party 	Yes	
<ul style="list-style-type: none"> Straight Party: "N of M race (where "N">1) 	Yes	
<ul style="list-style-type: none"> Straight Party: Excludes a partisan contest from the straight party 	Yes	
Cross-Party Endorsement:		
<ul style="list-style-type: none"> Cross party endorsements, multiple parties endorse one candidate. 	Yes	
Split Precincts:		
<ul style="list-style-type: none"> Split Precincts: Multiple ballot styles 	Yes	
<ul style="list-style-type: none"> Split Precincts: P & M system support splits with correct contests and ballot identification of each split 	Yes	
<ul style="list-style-type: none"> Split Precincts: DRE matches voter to all applicable races. 	N/A	Not a DRE system

Feature/Characteristic	Yes/No	Comment
<ul style="list-style-type: none"> 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:		
<ul style="list-style-type: none"> Vote for N of M: Counts each selected candidate, if the maximum is not exceeded. 	Yes	
<ul style="list-style-type: none"> Vote for N of M: Invalidates all candidates in an overvote (paper) 	Yes	
Recall Issues, with options:		
<ul style="list-style-type: none"> Recall Issues with Options: Simple Yes/No with separate race/election. (Vote Yes or No Question) 	Yes	
<ul style="list-style-type: none"> Recall Issues with Options: Retain is the first option, Replacement candidate for the second or more options (Vote 1 of M) 	Yes	
<ul style="list-style-type: none"> Recall Issues with Options: Two contests with access to a second contest conditional upon a specific vote in contest one. (Must vote Yes to vote in 2nd contest.) 	No	
<ul style="list-style-type: none"> Recall Issues with Options: Two contests with access to a second contest conditional upon any vote in contest one. (Must vote Yes to vote in 2nd contest.) 	No	
Cumulative Voting		
<ul style="list-style-type: none"> Cumulative Voting: Voters are permitted to cast, as many votes as 	No	
Ranked Order Voting		
<ul style="list-style-type: none"> Ranked Order Voting: Voters can write in a ranked vote. 	No	
<ul style="list-style-type: none"> Ranked Order Voting: A ballot stops being counting when all ranked choices have been eliminated 	No	
<ul style="list-style-type: none"> Ranked Order Voting: A ballot with a skipped rank counts the vote for the next rank. 	No	
<ul style="list-style-type: none"> 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	
<ul style="list-style-type: none"> Ranked Order Voting: A ballot with two choices ranked the same, stops being counted at the point of two similarly ranked choices. 	No	
<ul style="list-style-type: none"> 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		
<ul style="list-style-type: none"> Provisional/Challenged Ballots: A voted provisional ballots is identified but not included in the tabulation, but can be added in 	Yes	via jurisdiction processes
<ul style="list-style-type: none"> Provisional/Challenged Ballots: A voted provisional ballots is included in the tabulation, but is identified and can be subtracted in the 	No	

Feature/Characteristic	Yes/No	Comment
<ul style="list-style-type: none"> Provisional/Challenged Ballots: Provisional ballots maintain the secrecy of the ballot. 	Yes	
Overvotes (must support for specific type of voting system)		
<ul style="list-style-type: none"> Overvotes: P & M: Overvote invalidates the vote. Define how overvotes are counted. 	Yes	If the system detects more votes than allowed by the vote rule, it is counted as an overvote
<ul style="list-style-type: none"> Overvotes: DRE: Prevented from or requires correction of overvoting. 	Yes	Yes for ClearAccess
<ul style="list-style-type: none"> Overvotes: If a system does not prevent overvotes, it must count them. Define how overvotes are counted. 	Yes	If the system detects more votes than allowed by the vote rule, it is counted as an overvote
<ul style="list-style-type: none"> Overvotes: DRE systems that provide a method to data enter absentee votes must account for overvotes. 	N/A	No method to data enter absentee via ClearAccess
Undervotes		
<ul style="list-style-type: none"> Undervotes: System counts undervotes cast for accounting purposes 	Yes	
Blank Ballots		
<ul style="list-style-type: none"> Totally Blank Ballots: Any blank ballot alert is tested. 	Yes	
<ul style="list-style-type: none"> Totally Blank Ballots: If blank ballots are not immediately processed, there must be a provision to recognize and accept them 	Yes	via adjudication in ClearCount
<ul style="list-style-type: none"> Totally Blank Ballots: If operators can access a blank ballot, there must be a provision for resolution. 	Yes	via adjudication in ClearCount
Networking		
<ul style="list-style-type: none"> Wide Area Network – Use of Modems 	No	
<ul style="list-style-type: none"> Wide Area Network – Use of Wireless 	No	
<ul style="list-style-type: none"> Local Area Network – Use of TCP/IP 	Yes	
<ul style="list-style-type: none"> Local Area Network – Use of Infrared 	No	
<ul style="list-style-type: none"> Local Area Network – Use of Wireless 	No	
<ul style="list-style-type: none"> FIPS 140-2 validated cryptographic module 	Yes	
Used as (if applicable):		
<ul style="list-style-type: none"> Precinct and Central counting devices 	Yes	
<ul style="list-style-type: none"> Ballot Marking Device 	Yes	
Overvotes (must support for specific type of voting system)		
<ul style="list-style-type: none"> Overvotes: P & M: Overvote invalidates the vote. Define how overvotes are counted. 	Yes	If the system detects more votes than allowed by the
<ul style="list-style-type: none"> Overvotes: DRE: Prevented from or requires correction of 	Yes	Yes for ClearAccess
<ul style="list-style-type: none"> Overvotes: If a system does not prevent overvotes, it must count them. Define how overvotes are counted. 	Yes	If the system detects more votes than allowed by the
<ul style="list-style-type: none"> Overvotes: DRE systems that provide a method to data enter absentee votes must account for overvotes. 	N/A	No method to data enter absentee via ClearAccess
Undervotes		
<ul style="list-style-type: none"> Undervotes: System counts undervotes cast for accounting purposes 	Yes	
Blank Ballots		
<ul style="list-style-type: none"> Totally Blank Ballots: Any blank ballot alert is tested. 	Yes	
<ul style="list-style-type: none"> Totally Blank Ballots: If blank ballots are not immediately processed, there must be a provision to recognize and accept them 	Yes	via adjudication in ClearCount

Feature/Characteristic	Yes/No	Comment
<ul style="list-style-type: none"> Totally Blank Ballots: If operators can access a blank ballot, there must be a provision for resolution. 	Yes	via adjudication in ClearCount
Networking		
<ul style="list-style-type: none"> Wide Area Network – Use of Modems 	No	
<ul style="list-style-type: none"> Wide Area Network – Use of Wireless 	No	
<ul style="list-style-type: none"> Local Area Network – Use of TCP/IP 	Yes	
<ul style="list-style-type: none"> Local Area Network – Use of Infrared 	No	
<ul style="list-style-type: none"> Local Area Network – Use of Wireless 	No	
<ul style="list-style-type: none"> FIPS 140-2 validated cryptographic module 	Yes	
Used as (if applicable):		
<ul style="list-style-type: none"> Precinct and Central counting devices 	Yes	
<ul style="list-style-type: none"> Ballot Marking Device 	Yes	

Attachment B – Accessibility Examination Findings and Recommendations

Accessibility Examination Report for ClearVote 2.0



ClearBallot Update
Report - 9-30-2019 -

Accessibility Examination Report Sections for ClearVote 1.4.5/1.5

A) Top positives



Top positives
ClearVote.pdf

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



Top problems
ClearVote.pdf

C) All observations from Accessibility Examination



All findings
ClearVote.pdf

D) Additional Recommendations for Deployment from Accessibility Examiner report



Recommendations
for deployment Clea

Accessibility testing retest of the ClearBallot ClearAccess for candidates endorsed by more than one party

September 30, 2019

Denis Anson
Misericordia University

Whitney Quesenbery
Center for Civic Design

Summary and Recommendation

This is a report of recommendations for the ClearBallot ClearAccess certification following a review of the way candidates with more than one party endorsement are presented

Background

In the initial certification, the test ballot included a candidate who was endorsed by two parties. The ballot presented on ClearBallot ClearAccess for the October 2018 testing, listed the candidate as once for each endorsement, specifically once as a Democrat and a second time as a Republican.

The newer release which we reviewed via web conference on September 18, 2019 lists the candidate endorsed by multiple parties as one option, with both endorsements listed on a single line.

This review was specifically to confirm that the updates to ClearAccess did not create any problems for accessibility.

Discussion

One of our guiding principles in these examinations has been that the voting system should not only support voters in marking a ballot, but that the design of the marking and review screens and the printed ballot should accurately reflect how the system interprets those marks.

Working through the interactions during the remote exam session, we found that:

- The system now lists each endorsement in a vertical column to the right of the candidate's display, making it easier to see the dual endorsement.
- The system reads the endorsements accurately.
- The printed ballot also displays the candidates correctly, with both endorsements listed.

We were shown that configuration options allow an election administrator to determine the placement of the dual-endorsed candidate in the list to meet local laws.

We discussed the diamond symbol on the printed ballot. The diamond symbol is added next to the party name if the ballot contains a straight-party selection with overrides in individual contests. The diamond symbol allows the ballot to acknowledge that the

voter has selected a party, while communicating to the tally system that the voter made changes to the straight party selection.

- Understanding the meaning of the mark will require voter and poll worker education.
- The symbol may be less easy for a blind voter to read through personal assistive technology, but the display of the selections in each contest is more important, and is accurate.

Recommendations

In complex interactions, it is important that elections staff, poll workers, and voters have access to appropriate and accurate information about the features. This would include:

- Clear vendor documentation for elections staff configuring the voting system, so that they understand the meaning of each setting and how it interacts with other settings.
- Good poll worker and voter education about how straight party (and override) votes are printed on the ballot so they can be accurately counted.
- Information available when needed for poll workers and voters about what happens when a candidate is endorsed by more than one party.

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 ClearAccess system independently, once the facilitator 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.

In part, this was because the primary limitation among our voters was low-vision/blindness. One voter with significant tremor was better able to vote using the tactile keypad rather than the touch-screen. We did not have any volunteers with limited hand dexterity for this testing. Had we had such voters, they would probably not have been able to use this machine because the supplied sip-and-puff switch did not work, and it was not possible to attach a dual switch option.

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.

All five 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.

Great audio quality and implementation

The examiners felt voice quality was great and voters commented that they also liked the voice. The phrasing was good and followed natural speech patterns. In most areas, it sounded natural and there was neither too little nor too much space between words.

ClearBallot implemented the audio features well.

- For the most part, the voice read what was on the screen, but where necessary, it provided additional instructions that were important to blind voters. When a voter selected a straight party, it clearly read the pre-marked, straight party votes in each contest. Also, when a voter overrode a straight party vote, the system announced what was and was not selected on the screen. This meant that no candidates were silently deselected.
- While several voters indicated that the initial keypad instructions were very long and provided too much information at once, the advantage of this approach is that they were not repeated at each navigation step. The voice reads only the contest instructions and selections, and if the voter needed the full instructions again, they can press the help button on the keypad.

Helpful contest instructions and selections

The wording of the contest instructions and selections was good.

- For each, it stated how many total options there were and then how many additional selections the voter could make. When voters were using the audio, the voice read this after each selection so voters knew the status.
- If voters overrode a straight party vote, the numbers would reset and indicate how many additional selections could be made. This meant that even if deselections were made out of the voter's view, information about this change was provided to the voter.

Excellent straight party method implementation

ClearAccess implemented the PA straight party method intuitively.

- The system uses a light blue to indicate pre-marked straight party votes in each contest. Manual selections are dark blue. If a voter confirms a pre-marked, straight party selection by re-selecting the candidate, the color changes to dark blue.

- The system uses audio cues to help voters know if they are focused on a pre-marked selection, confirmed selection, or an unselected candidate.
- The contest header indicates how many additional selections can be made, if any.
- If the voter changes a straight party vote, the counter showing the number of additional selections counter changes as well.

Easy flow through the ballot

At each step, navigation seemed intuitive for all voters.

- If a contest has not been voted, the “Next” button becomes “Skip,” indicating they could leave a contest blank.
- Overvote and undervote alerts were worded well and they allowed the voter to proceed or return to voting, rather than completely interrupting their process.

Additional positive observations can be found in the “All Observations” section of this report.

Top problems

While the ClearBallot Clear Access ballot marking system, as tested, had a well-thought-out and well implemented system to allow blind individuals the ability to vote privately and independently, the same could not be said for voters with physical disabilities. As implemented, any voter who could not use the touch screen or tactile keypad to navigate this machine **would be completely unable to use the system independently.**

The following discusses the problems that surfaced during the expert examinations and voter/poll worker observations with the ClearBallot Clear Access ballot marking system.

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

1. Poor assistive device implementation

What Happened?

While the tactile keypad and audio performed well, the other assistive device options were poorly implemented or not available.

- **Sip-and-puff did not work effectively.** The only device ClearBallot provides is a USB connected sip-and-puff switch from Origin Instruments. During the first round of testing, the examiners were unable to get the device to work. In a retest of the sip-and-puff the examiners were able to make the device work, but found it difficult to use it to complete the ballot.
- **The sip-and puff interface is complicated.** Rather than using the sip-and-puff as a dual-switch device, the developers chose to create complex breath actions: short sips/puffs move forward and back, with a long puff to select the current item, double sips/puffs move between contests, triple sips/puffs access settings and instructions. This would be a good solution for an expert sip-and-puff user, but makes this single device not very useful for voters who cannot use the tactile keypad.

- **No other personal assistive technology.** The only two inputs available on the ClearAccess voting machine were a USB port and a 3.5mm audio jack. Although this meets VVSG 1.0, it means that without a 3.5mm input jack, most personal AT, such as dual-switch buttons, cannot be used. During the retest, we tried using the a Swifty adaptor to connect dual switches, but were unable to get this alternative to work.
- **Ports not easily accessed.** The ClearAccess tablet has an aftermarket case that creates a bezel around the screen and secures most of the ports and cords. The downside to this is that it makes the exposed USB port and 3.5mm audio jack very difficult to get to. The ports are located on the bottom of the tablet, within a few inches of the tabletop.

Why is this a problem?

Poor assistive device implementation is a problem for two reasons.

Switch access is critical for some voters with disabilities.

- The intent of accessible voting features is to allow the widest possible range of voters with disabilities to vote privately and independently. This includes both voters with low/no vision and those with physical disabilities. The use of a single access method (sip-and-puff) will enable some voters, but will limit many others, even if implemented properly.
- Voters with physical limitations include those who access personal electronics with “accessibility switches.” The industry standard for such switches is to use 3.5mm phono plugs to connect to devices. These switches are available to accommodate an enormous range of disabilities and abilities, from simple thumb switches to eye-blink switches, but require that voters be able to bring their own technology to the polling place.

The ability to connect personal assistive technology through a standard port is required in the VVSG 1.1. Locating this port where a

voter or their personal assistant can connect it easily also adds to the usability of this accessibility feature.

- These switches are not a security threat. From the point of view of the voting machine, all of these are simply two individual switch closures, regardless of the movement used to activate the switches. Similar to the signal sent from an individual switch on the tactile keypad.
- Vendor provided assistive technology should just work: in the expected way, connecting easily, and without 'tinkering' by the voter. If an expert is unable to get a device to work, then a poll worker or voter will be more frustrated. It makes the poll worker feel inadequate and the voter insecure when voting machines do not work properly on Election Day.

Recommendations

The sip-and-puff device should work correctly the first time and every time. Any anomalies should be fixed before deployment.

Ideally, ClearBallot should provide a way for other 3.5mm dual-switch assistive devices to be used.

A note about exposed USB ports. While out of the scope of this report, it should be noted that the USB port intended for assistive devices would be open and exposed during voting. Vendor representatives indicated that this should be sealed and resealed with a sticker seal after each use. This seems like an unnecessary burden on poll workers, and a procedure unlikely to be followed. This security risk is unnecessary if the simpler 3.5mm jack is used instead of a USB port.

2. Tactile keypad issues

Examiners and voters found four problems with the tactile keypad.

What happened?

The EZ Access research-based, standard design tactile keypad included eight buttons: two small, rectangular buttons: one black and one red with a raised arrow shape on the upper surface of each; a blue, diamond help button in the top-middle; two white, right and left arrow-shaped buttons; two yellow, triangle-shaped up and down buttons; and a green, round selection button.

- **The two sets of buttons with raised arrows confused voters.** The EZ Access keypad used by this machine is an industry standard keypad, but has some design issues in the context of voting. Because both the right and left, white arrow buttons and the rectangular red and black buttons had raised arrow symbols on their upper surface, and because these buttons differed only slightly in size, they could be easily confused. Voters indicated that if they felt the shapes with two fingers, they could discern the differences, but when just using one finger or thumb on the top of the buttons, it was difficult to tell which one should be pressed. One voter mistakenly pressed the top right button instead of the middle arrow button five times before she learned the button placements.
- **No Braille labels.** The confusion over the keys might have been lessened if there were Braille labels specific to how the keypad is used in the ClearAccess interface. As implemented, only the blue diamond-shaped Help key was labeled in Braille (a letter H). While only 10% of people who are blind are able to read Braille, its presence does not disturb non-Braille readers and helps those who can use it.
- **Too many instructions.** At the beginning of each audio/tactile keypad voting session, the machine reads the keypad instructions. They are very detailed, and complex, including both the primary and secondary functions of each button rather than focusing first on basic navigation instructions. For example, the white, right and left arrow buttons in the middle of the keypad allow the voter to move the next or previous contest. But, if the right arrow button is pressed and held, the voter is taken to the top of the ballot review screen. Worse, if the white, left-arrow button is held for more than one second, the voter can cancel the voting session.

In addition to their primary and secondary functions, most buttons had a third function, based on key combinations. Pressing and holding the top-right button and then pressing the right or left arrow buttons, turns the volume up and down. These multiple actions are possibly too complicated for the limited interaction of a voting system, though they might be learned through advanced training.

Several voters indicated that instructions should be provided that are relevant to the current task rather than providing all of the instructions at the beginning of the process, and when the voter presses the “Help” button.

- **Button descriptions could be better.** The button descriptions and their location did not help blind voters tell them apart, such as describing the top button as having a raised arrow on the button cap. Descriptions of where the buttons are located on the keypad would also be helpful. Blind voters commented that it isn’t helpful to describe the color of the button to them. Examiners pointed out that the keypad could be used by many different voters with disabilities, and they understood.

Why is this a problem?

Voters only need the minimum number of instructions to successfully navigate the ballot. When instructions include too much detail or are too long, it is difficult to retain all that has been said. This is especially true when the most important navigation functions are buried in the middle or at the end of the list. Voters have either stopped listening or are fatigued from trying to remember it all.

Cognitive overhead. Voters had to concentrate to determine how to use the keypad. Whether it was trying to understand and remember all of the instructions or choosing the correct similarly-shaped button, significant effort was required to think through the process of voting. When voters have to concentrate on how to perform the tasks, they are not as able to determine on who or what they would like to vote for.

Recommendations

Voter's tactile keypad experience can be improved in three ways

- Remove the top two red and black buttons, or at a minimum, remove the raised tactile arrows from the upper surface of these buttons. The confusion of which button to press may outweigh any benefits from secondary functions.
- Rewrite the instructions page to include only the basic and necessary navigation functions for each button. Provide contextual help on pages where it makes sense, and mention how to access secondary button function instructions, but do not force voters to listen to it all at once.
- When writing button descriptions, use shape words first, then color words. So instead of the "green, round button" it becomes the "round, green button." This helps blind voters zero in on the correct button faster and if a voter with a different ability is using the keypad, they can also use the color word to find the correct button.

3. The write-in process

The write-in screen and process presented several problems for voters.

What happened?

When visually choosing to write in a candidate on the CA, the voter selects the write-in option and is presented with a pop-up screen. It has a text box, where the write-in name will appear and a full QWERTY keyboard. Below this is an "Accept" button that confirms your write-in entry and takes the voter back to the ballot. This all makes sense for a sighted voter because the layout is clear. When using the audio and the tactile keypad, the process is much less clear.

The problems are partly caused by the design decision to add some functions not available in other voting systems, such as editing within the name being entered rather than only at the final position. It is not clear that this additional functionality is worth the confusion it causes.

- **Tactile keypad buttons change function.** Upon entering the write-in screen, audio voters listen to a set of instructions specifically for the write-in process. This is very good implementation of task-specific help. The problem arises because the functions of the buttons change.

For regular ballot navigation, the left and right arrows are used to move between contests, the up and down arrows move up and down within a list of candidates, and the round, green button makes a selection. However, in the write-in screen, the list of letters is treated like a list of voting options, navigated with the up and down arrow keys.

- Counter-intuitively, the up arrow moves to the next letter and the down arrow to the previous letter in the alphabet. This is reversed from their function throughout the rest of the interface.
- The right and left arrow keys move within the letters entered for a candidate's name.
- The round, green button confirms the write-in entry and returns to the ballot.

In addition, the action of selecting each letter after the first starting from the beginning of the alphabet ("Space" "A" "B"), rather than maintaining the position in the alphabet, is confusing. It was not possible to wrap from the top of the alphabet to the bottom, nor from the bottom to top. Thus, selecting "W" required moving through all of the letters from A to V rather than just through Z, Y, and X. Voters expected to be able to start at the same character as entered because it is likely closer to the next desired letter than starting from the beginning. This would be an even greater problem for voters using the sip-and-puff switch or dual-paddle switches, if provided. For these voters, one switch action advances to the next letter, and the second action selects the letter. There is no option to back-up, so if the user over-shoots a letter, there is no alternative to restarting the name entry from the beginning.

- **Editing Problems.** The ClearAccess system did not appear to map the delete letter button to the tactile keypad, nor was it an option when scrolling through the alphabet. The only option available was to accept the improperly spelled entry, return to the ballot, and then re-select the write-in option to clear the text box and start again. This is not included in the instructions and voters in the exam did not know to do this.
- **Does not voice the "Space."** The "space" character between names is not voiced each time it repeats the name. One blind voter did not enter a space, yet the system still pronounced the entered name "ChrisSmith" as "Chris Smith." She was not aware until the facilitator told her that the name did not contain a space.
- **Formatting issues.** Once a candidate name has been entered, the contest screen layout has no space between the write-in label and the name. This may have confused the text-to-speech engine, so that the name displayed "Write-in:Chris Smith" was voiced as "Write-in Chris Chris Smith."
- **Write-in keyboard includes entire ASCII character set.** It appears that the designers are using the complete Windows 10 on-screen keyboard for the write-in process. For visual users, this is not an issue, but for blind voters navigating through the alphabet using the tactile keypad or sip-and-puff switch, it would mean scrolling through "&," "}" and the rest of the printable characters to return to the top of the alphabet. Many of these characters are unlikely to be used in a name and could be omitted.

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.

- Keypad button functions should be consistent throughout the voting process. All blind voters commented that it was confusing or strange to use the up-arrow button to move through the alphabet. Also, voters continually pressed the round select button to confirm a letter entry because that was the function of the button in the main ballot. They were confused when that button took them back to the ballot. Some voters figured it out, but others needed help from the facilitator to know how to re-enter the write-in screen. These same voters would have needed help on Election Day, and poll workers would have to know and understand this issue to give a blind voter adequate assistance.
- Limited instructions combined with editing problems can lead to voter confusion, and ultimately may result in not being able to cast a vote as intended. 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.
- The unnecessary inclusion of the entire ASCII character set makes an accidental overshoot of the desired letter very burdensome for the disabled voter.

Recommendation

Before a county deploys the ClearAccess the vendor should:

- Re-map and re-write the on-screen instructions to align with their functions for main ballot navigation.
 - Map the down-arrow so it pages through the alphabet to the next letter. Then, map the up-button to go the opposite way through the letters.
 - Make the alphabet wrap from the last option to the first option and vice-versa. This is vital to two-switch access.
 - Include only characters that are found in names in the write-in keyboard. While some accent symbols should be included, “*,” “&,” and “%” are not necessary.

- Map the round button to confirm a character and move to the next character, and make the next character entry start where the previous character was.
 - Make the right-arrow key confirm the entire write-in entry, and return to the ballot.
- Provide a way for voters using the keypad to delete a character both from the end of the write-in and from the middle of the name.
- Include any and all spaces and special characters in the text box when reading the entry to the voter. For example, the audio should pronounce and spell “Chris Smith” (“C-H-R-I-S ‘space’ S-M-I-T-H”). This way there is no confusion for a blind voter that the entry is as intended.

4. 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 for voters and poll workers.

Reading the paper ballot

For the ClearAccess ballot marking system, the ballot is printed using a separate, off-the-shelf OKI printer on 8.5 x 17-inch cardstock. The printer sits next to the voting machine and the blank cardstock sits in the manual feed tray. The CA printed ballot is in an optical scan format, which looks identical to a pre-printed ballot used for absentee or provisional voters, and prints each contest in a three-column table.

Having the ballot marking device print an optical scan ballot means that voters do not have to handle a blank, pre-printed ballot before making choices.

However, 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.

Using a traditional optical scan ballot is a problem for two reasons.

- **Verification is not independently possible.** Blind and low vision voters often use personal assistive devices that read documents to them. Because all candidates and choices are listed on the regular ballot and laid out in three columns, assistive technology could not read it back and did not know which candidate or option the voter selected. All voters that tried to use this technology were unable to verify their ballot. The readers could not understand the layout. Although the AT was able to identify that the information was in three columns, it could not identify the top or bottom of individual contests, so simply read each line across the page, jumbling up to three contests together.
- **Ballot stock is too big for the printer.** Using an 8.5 x 17-inch ballot meant that the blank cardstock could not be stored securely inside the printer. Instead, it had to sit in the manual feed tray where it is easy to disturb, knock to the floor, or otherwise remove. Also, when stock runs low, the OKI printer provided had trouble picking up the paper, and jammed twice.

Recommendation

- Always print ballots in a maximum of two columns, with plenty of space in between the columns and between contests. The printout should be a “Voter Selection Only” (VSO). This allows personal AT to simply read the names on the print-out, rather than attempt to identify the filled ovals on the ballot. This format allows voters with personal assistive technology to read back their choices.
- Find a way to secure or cover the blank ballot cardstock, and ensure poll workers keep the trays filled so that printing errors do not occur.

Interacting with the ClearCast ballot scanner

As mentioned above, the ClearCast optical scanner was present for voter and poll worker sessions, but it was not set up for the accessibility election. This

meant that no voters were able to cast their ballot after printing it. However, examiners were able to evaluate a scanner set up with a different election.

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

Some features stood out and could be considered a positive for voters with disabilities.

- The ClearCast scanner tray is just wide enough for the ballot and has tall guides along the sides to minimize the chance that the ballot will be improperly inserted.
- Voters may insert the ballot in any orientation. This may lessen the interaction a poll worker will have to have with a voter with disabilities to cast their ballot.
- The scanner has a large touchscreen that indicates when a ballot has been accepted and cast successfully.
- There is a faint but audible tone to indicate ballot insertion and a successfully cast ballot.

Examiners identified two negatives with the scanner.

- Since the ballot is printed on both sides, privacy is decreased while standing in line before scanning or being helped by a poll worker.
- There is a significant delay between when the ballot is inserted and when the scanner feeds it into the machine. If voters let go thinking that it will be accepted immediately, the ballot can fall to the floor.

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

- Make the cues more obvious that the ballot is cast. Use large print words or simple images on the screen to indicate the scanning steps and show that the ballot scanned successfully. The audio cue should be louder and the space between the two tones should be filled with a repeated tone so that low visions or blind voters know it is still working.

- Counties should purchase privacy sleeves to cover the ballot after the voter has reviewed it and until it is scanned. This will minimize invasions of privacy and will allow poll workers to assist more confidently.
- 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.

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	Screen and stand require a small footprint, which could allow it to be pushed further back in a voting booth allowing voters more privacy. Screen is adjustable up and down as well as tilt.	CA	Positive
	Best straight party/ PA Method implementation of all the machines this group has tested.	CA	Positive
	"I found this one a lot more logical and faster to use," said one voter who had previously voted on multiple systems.	CA	Positive
	By page 8 of 14, a voter who was initially very tentative had figured out the system, and was comfortable moving between contests. The voter stated, "This machine would take some practice."	CA	Positive
	"Not so confusing I can't figure it out."	CA	Positive
Display and Navigation	Large, clear screen. Scrolling animation is very smooth and easy to track.	CA	Positive
	Four print sizes available: Small, Normal, Large, and Extra Large. The middle two sizes met the needs of most of the sighted test voters.	CA	Positive
	Contrast settings include yellow on black and a low contrast, grey scale, with the usual white on black and black on white.	CA	Positive
	In each contest header, the system displays the number of total options and how many additional selections can be made.	CA	Positive

Function	Observation	System	Severity
Display and Navigation	One voter correctly interpreted the voting instructions as "You can vote for up to three;" "You can vote for 1, 2 or 3."	CA	Positive
	No silent or off-screen deselection. When overriding a straight party vote, the system displays an increase in the number of additional selections that can be made. It also announces this change in the audio and states "No other candidates selected."	CA	Positive
	Before making a selection on the straight party ticket, or any race not pre-marked by a straight party vote, the "Next" button changes to "Skip."	CA	Positive
	Straight party selections are in light blue. Manual selections are in a darker blue background. Once a voter confirms a straight party selection, that option turns darker blue as well.	CA	Positive
	Manually selecting a candidate on a straight party ballot cancels all straight party selections. This was fairly intuitive, and not a problem for voters.	CA	Positive
	"You don't have to touch in the check box. Anywhere in the name box works."	CA	Positive
	Alert messages for overvotes and undervotes are generally well worded and draw the voter's attention. Voters did not feel coerced to cast a vote or scolded for doing something wrong. From the messages, you can proceed or go back, instead of disrupting ballot flow.	CA	Positive
Assistive Technology (AT)	The machine can be set up so that accessibility options are on by default for each voter, or the poll worker can customize each session for the voter.	CA	Positive

Function	Observation	System	Severity
Assistive Technology (AT)	When the audio is on, buttons are included on the screen for "Pause, Slower, Faster, Volume Down, and Volume Up." These buttons stay but are moved to the top when the screen is blanked.	CA	Positive
	High quality instructions/text-to-speech voice. It uses clear speech, has a good range of speeds, and remains understandable at the lowest and highest speeds. When necessary, it announced instructions that were not included on the screen, but were important to low-vision or blind voters.	CA	Positive
	The system uses a standard "Easy Access" keypad with a minimum number of buttons. However, voters found the upper-most square buttons unhelpful.	CA	Positive
	The tactile keypad voting instructions are given at the beginning. These instructions are repeated only if the voter presses the help button. This means once the voter understands the instructions, they do not have to listen to them for each contest and navigation step. The last statement says that voters do not have to vote in every contest, which was well received by voters. On the down side, these instructions are long, and a lot of information is given at once.	CA	Positive
	"You can cut him off, if you know what he's going to say."	CA	Positive
	The keypad user can jump to the review screen by holding down the next button. However, this is only mentioned in the keypad instructions at the beginning or when the voter presses help.	CA	Positive
	The audio always announces "Page [x] of [y]," giving voter information about the progress being made.	CA	Positive

Function	Observation	System	Severity
Assistive Technology (AT)	Voter spontaneously moved to the header to confirm how many votes they had left, since the current selections are announced.	CA	Positive
	On entering a contest with straight party votes, the header includes "The following choices are already selected." It then names the current selections with name and party.	CA	Positive
Write-In Screen	For audio users, the write-in screen includes its own set of instructions. The keypad buttons do change functions, which was confusing for some voters.	CA	Positive
	The write-in screen includes a QWERTY lay out keyboard. One sighted voter stated, "This is a regular keyboard. Yes, this is QWERTY."	CA	Positive
	For audio users, letter selection happens by pressing the keypad up button until they arrive at the desired letter. If they overshoot a letter, they may press the down button to correct it. As each letter is entered, the voice reads it back to them until enough of a word is generated for it to pronounce.	CA	Positive
	One voter correctly used the right arrow button on the keypad to move to the next letter.	CA	Positive
	By the third letter, one blind voter had figured out the process and completed it rapidly.	CA	Positive
	"See, I can do this very quick now. It's very straight forward."	CA	Positive
Printed Ballot & Scanner	The scanner has a large display screen, a deep tray with grooves, and tall tray guides along the side. It also has a quiet but audible ballot accepted tone.	CC	Positive

Problems

Function	Observation	System	Severity
Setup for Voters	On the poll worker set up screen, the text is small and the options are not immediately intuitive. Also, poll workers did not know how to advance to the ballot because the only button that looked like an option took you back to the log in screen.	CA	Annoyances
	When using the on-screen keyboard, some poll workers missed numbers because the visual feedback indicates that they had pressed a key was not sufficient.	CA	Annoyances
	Poll workers must type in a county supplied activation code for each voter, choose the ballot type and style, and then configure any assistive devices options.	CA	Neutral
	Poll workers were concerned about the mechanics of the polling place, since this machine has both the marking device and the printer, and a separate scanner.	CA	Annoyances
Orientation and Navigation	Voters have access to a "Cancel" button that if pressed and confirmed will cancel their ballot. This option exists on the tactile keypad as well by pressing and holding the left arrow button. No ballot should be able to be cancelled without poll worker assistance to be sure all proper steps are taken.	CA	Likely to prevent independent voting for voters with some disabilities
	If you press too long on the screen, it doesn't read it as a touch. This was a problem for a voter with hand tremor. The initial touch did nothing, so his response was to touch longer.	CA	Problem Solving
	Candidates that were endorsed by two parties lists them twice. All voters looked for a candidate labeled "Republican/Democrat."	CA	Problem Solving

Function	Observation	System	Severity
Orientation and Navigation	When entering a contest with a straight party selection, the contest header instructions indicate that "You can choose no more." Some voters thought this was bad wording because they could actually choose other options.	CA	Problem Solving
	Voter suggested "Vote for no more than four" rather than "There are four choices" as choices (number of candidates) can be confused with available votes.	CA	Problem Solving
	One voter pressed select as the ballot choices were being read. When asked, she said she was trying to confirm her vote, and wasn't sure how that worked.	CA	Problem Solving
	On the review screen, one sighted voter did not like the bottom scroll down button label that said 'Touch to see more contests.' The voter suggested it might say 'Touch to see more of my choices.'	CA	Problem Solving
	For sighted voters, there is no intuitive way to return to the same place in the review screen after making a change. Voters had to stop and think about how to return, and all had to be asked if there was a button on the screen to do this.	CA	Problem Solving
	There is no audio instruction on how to print from the review screen. It is the Right arrow button, and printing is the next step. Also, audio voters had trouble returning to the review screen after making a change. When giving instructions on the review screen, it could include how to return to it and how to move on to printing.	CA	Problem Solving
	Slight delay in touch screen. At times, voters touch twice because they didn't think the touch worked, then see selection and deselection. This affected several voters who used the touch screen	CA	Annoyances

Function	Observation	System	Severity
Orientation and Navigation	Alerts and write-in screen “pop-up” windows are all located at the top of the screen. Since the screen is so tall, it happened out of view for one low-vision voter, and difficult to read for bi-focal voters.	CA	Annoyances
	At the bottom of the Cancel voting dialog, "Proceed" is on the left, and "Cancel" on the right. On the keypad, "Proceed" is the right arrow, back (Cancel) is on the left.	CA	Annoyances
	When using the tactile keypad, the contests do not wrap around to the top. Voters must press the up button to move back up the list.	CA	Annoyances
	The full contest header “President and Vice President of the United States” was not all on one line. On the review screen it cut off at “of the”.	CA	Annoyances
	“Thank you for voting” should fill the entire final screen with instructions about where to take your ballot.	CA	Annoyances
	Several voters tried to swipe to scroll down the screen. Swiping and gestures were not available for this machine.	CA	Annoyances

Function	Observation	System	Severity
Audio Feedback & Instructions	<p>Some ballot layout configuration issues resulted in voter comments and questions.</p> <ul style="list-style-type: none"> The full "President and Vice President of the United States" was not all on one line. It sounded parsed but okay in the ballot, but it stopped reading at "of the" on the review screen. The audio read text mark-up that could not be seen on the screen, for example "Slash P" and "Slash PP." Inexperienced blind voters paused but were not stopped by it. Write-ins are displayed as "Write-In:FIRST LAST" with no space between the colon and the first name. The audio reads this all in one phrase without a pause, then repeats the name. Example: "Write-In:Chris Smith" as 'Write-in Chris Chris Smith.' The entire ballot questions were on the review screen instead of a label. For short questions this is okay, but for long questions like the referendum, voters found it annoying. 	CA	Annoyances
	<p>The audio reads the preferred language set up screen and describes which buttons to press on the tactile keypad, but the instructions for the tactile keypad are on the next page. Voters were able to navigate this page, but poll workers may need to make this selection for the voter before stepping away.</p>	CA	Annoyances
	<p>After reading the contest title and instructions, the audio reads the pre-marked, straight party selections. This confused one blind voter who thought he was already in the list of candidates.</p>	CA	Annoyances
	<p>The audio instructions describe the "Up and down, diamond shaped buttons." These are diamonds when combined, but each button is triangular.</p>	CA	Annoyances

Function	Observation	System	Severity
Audio Feedback & Instructions	In each contest, the audio read the name and then the candidate's party. At the typical reading speeds, this pause is long enough to make it difficult to associate the two. There is little to no pause using the fastest speeds.	CA	Annoyances
	For audio voters, it was ineffective to change the tone to indicate a pre-marked straight party candidate vs a selected candidate. Several voters did not notice the change. When one who did was asked if it helped, he said, "I'm going more by name than the tones."	CA	Neutral
	One voter was confused by the similarity of sound of the letters "C," "B," "D," etc. This was with the speed turned up.	CA	Annoyances
	One voter was confused by "is selected" and "deselected." Voter said "I thought I said to deselect."	CA	Problem Solving
	When navigating the list of candidates, the narration says "Choice 2 of 4. You can choose one more." This can lead to confusion between the number of available choices, and the number of selections. It could be worded "You can select one more."	CA	Annoyances
Assistive Devices	As delivered, the machine has a tactile keypad and sip-and-puff option. The sip-and-puff option is USB connection only. A voter with their own non-audio, assistive device with a 3.5mm connection would not be able to use it.	CA	Likely to prevent independent voting for voters with some disabilities
Assistive Devices	The sip-and-puff interaction is complicated, requiring different length breaths. This is an advanced interface, making it difficult for voters who are used to dual switches to use effectively.	CA	Likely to prevent independent voting for voters with some disabilities

Function	Observation	System	Severity
Assistive Devices	Most blind voters found the length of tactile keypad instruction be too long. They would move on before hearing all of the instructions or did not show evidence of retaining all of the instructions. Some suggested more "Just in time" instruction, as is used for write-in voting.	CA	Problem Solving
	One blind voter exclaimed, "That's a lot to remember!"	CA	Problem Solving
	There should be an instruction at the end of the keypad description to move to the next screen to continue. It does mention how to move to the next page early in the list, but voters did not remember it. Currently, it just stops after the last instruction.	CA	Problem Solving
	The instructions for the keypad emphasize the color, not the shape. Some blind voters did not like this. Because the color may be helpful to low-vision voters, it should not be the primary description. The "right-arrow, white button" is faster to interpret than the "white, right-arrow button."	CA	Problem Solving
	The black and red buttons at the top of the keypad are rectangular in shape, but have raised arrow shapes. When touched with two fingers, they felt rectangular, but several blind voters were confused by the raised arrows, and confused these keys with the arrow keys just below them. One voter accidentally arrived on the Settings screen five times during the session.	CA	Problem Solving
	For all ballot navigation, the up arrow moves to the previous selection, down-arrow moves to the next. In the write-in screen, up-arrow moves to the next letter, down arrow moves to the previous. This reversal caught all voters off guard and they had to figure out which button moved down through the alphabet.	CA	Problem Solving

Function	Observation	System	Severity
Assistive Devices	The tactile keypad is heavy and some voters could not hold it the entire time. They had to place it on the table.	CA	Annoyances
	The tactile keypad has two adjacent keys on each side that are similar to the touch, but have different functions. The red and black rectangular keys have raised arrows that make the keys feel "arrow shaped." These leads to confusion for blind voters.	CA	Annoyances
Straight Party Voting	Ballot worker suggests "Straight Party" screen should have an option for "No straight party." This would also avoid warnings when no party selected.	CA	Annoyances
	When voting straight party, the header information for audio indicates the number of selections already made, and says that "you can choose no more." This is not accurate, because you can over-ride the straight party by voting normally. This will erase all straight party selections.	CA	Annoyances
	"It said I could select one more, but deselect the others." On contest where there were not as many straight party candidates as "vote fors" allowed, the voter expected to be able to add to the straight party selection without deselecting the pre-marked, straight party candidates.	CA	Problem Solving
Alerts	One group of poll workers said, "I don't like 'Warning.' I'd prefer 'Attention.' Warning is too urgent."	CA	Annoyances
Write-In Process	Using the audio and tactile keypad, there is no way to delete a character.	CA	Likely to prevent independent voting for voters with some disabilities

Function	Observation	System	Severity
	The audio pronounces the name once entered and does not announce a space. One voter did not select a space, but the audio still read the name as ChrisSmith all one word. She did not detect that this was not what she had intended.	CA	Likely to prevent independent voting for voters with some disabilities
Write-In Process	There does not seem to be any way to exit the write-in screen without accepting what is entered. There is no on-screen cancel function. You must accept, then "deselect" from the contest screen. In the audio instructions, there is information that holding down the rectangular key cancels the write-in, but no voter discovered this.	CA	Needs Assistance
	While the write-in screen window was open, one poll worker repeatedly tried to select parts of the screen that were darkened and out of focus.	CA	Problem Solving
	Several voters initially tried to use the select button to confirm letters rather than the right arrow button. This is an expected behavior since the select confirms choices everywhere else in the interface. One voter repeated the error three times before successfully writing in a candidate.	CA	Problem Solving
	While entering a write-in candidate, one voter was confused by the alphabet starting with space. When the audio said "C space", he said, "No, I want to be next to the C."	CA	Problem Solving
	One voter using the audio expected the system to move to the next letter by pausing after selecting it.	CA	Problem Solving
	When using the on-screen keyboard, some voters missed letters because the visual feedback indicates that they had pressed a key was not sufficient.	CA	Annoyances

Function	Observation	System	Severity
	Several blind voters felt that the write-in process was inefficient because you had to start at the beginning of the alphabet each time. The next letter is generally closer to the current letter than to the front of the alphabet.	CA	Annoyances
Write-In Screen	"This is silly that you have to start at the beginning for each letter." The voter wanted the next letter to start where the last was chosen.	CA	Annoyances
Printing/Ballot Verification	On the print confirmation screen, there is a "Poll Worker" button. Many poll workers pushed it thinking it would somehow signal a poll worker. When they found out that it did not, they were concerned voters would press it and then wait for them to come over.	CA	Needs Assistance
	For blind voters using personal AT to review the printed ballot, their device was unable to read the ballot because it is formatted in three columns. For personal AT, voter selection only ballot is required.	CA	Needs Assistance
	There is a lever on the output area of the supplied OKI printer to direct the paper upward. If this is not deployed, the card stock ballot can become stuck in the slot between the gray plastic tray and the white plastic body of the printer, resulting in a paper jam when the printer tries to print the second side.	CA	Needs Assistance
	On the printed ballot, the write-in name is in very small print. It will be too small for anyone without at least normal vision.	CA	Needs Assistance
	The ballot paper is not secure and extends well beyond the body of the printer, and is at risk of being knocked to the ground by those with movement limitations, children, etc.	CA	Needs Assistance

Function	Observation	System	Severity
	One voter said, "I think that since it reviews aurally, I don't need to review it visually." Other voters wanted to be able to do visual confirmation.	CA	Neutral
Scanner	The scanner was not set up for the accessibility election definition, therefore we were unable to observe voters and poll workers using it.	CC	Neutral
Scanner	There is a significant delay between when the paper is inserted into the scanner and when it grabs the paper. If voters let go of their ballot before the scanner grabs it, it will fall out of the machine.	CC	Needs Assistance
	Because some ballots may be two sided, there is no way for voters to hide their ballot before inserting it into the scanner.	CC	Annoyances

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 ClearAccess touchscreen 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 ClearAccess, 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 CA screen can be adjusted to change its angle and height for a closer approach, adapting to standing or sitting postures, and avoiding glare.
- Provide help plugging in personal headsets with verbal instructions or by doing it for the voter. The jack on this machine is located under the bottom of the touchscreen behind the black, plastic bezel. It can be difficult for voters to access, so poll workers should practice inserting and removing a headphone plug.
- The sip-and-puff is currently the only additional assistive device that comes with the ClearAccess machine, and its input is USB-based. Poll workers will need training on how to use this device.
- Make sure voters are oriented and know where all parts of the voting system are, including the privacy shields or covers. The ClearAccess machine 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 at the bottom of the touchscreen. 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 their printed ballot.
- **Privacy.** The footprint for this system is relatively small so it can be pushed to the back 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).

Attachment C – Implementation Attestation



Implementation
Attestation ClearVote



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
ClearDesign				(Please specify the implementation, single device (desktop/laptop), Client/server Number of units, cots component selected as part of the configuration etc.)
ClearCount				
ClearCast				
ClearAccess				

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 ClearVote 2.0 system. Any ancillary components like switches, ballot boxes, charging carts sold on this contract are EAC certified components of the ClearVote 2.0 electronic voting system. (Attach a list of items sold on this contract.)

ClearBallot 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

Clear Ballot 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 Clear Ballot

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.