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Institute for Cyber Law, Policy, and Security

EXHIBIT 17

Certification Test Report - Modification

Report Number: ESY-18004-CTR-01

Prepared for:

Vendor Name	*Election Systems and Software (ES&S)*
Vendor System	*EVS 6.0.4.0*
EAC Application No.	*ESSEVS6040*
Vendor Address	*11208 John Galt Boulevard* *Omaha, Nebraska 68137*

Prepared by:

4720 Independence St.
Wheat Ridge, CO 80033
303-422-1566
www.SLICompliance.com

NVLAP TESTING
NVLAP Lab Code 200733-0

Accredited by the Election Assistance Commission (EAC) for Selected Voting System Test Methods or Services

Revision History

Date	Version	Author	Revision Summary
March 18th, 2019	1.0	J. Panek	Initial Draft
April 23rd, 2019	1.1	J. Panek	Updates to address EAC comments

Disclaimer

The Certification Test results reported herein must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government. Results herein relate only to the items tested.

The tests referenced in this document were performed in a controlled environment using specific systems and data sets, and results are related to the specific items tested. Actual results in other environments may vary.

Opinions and Interpretations

There are no opinions or interpretations included in this report, except as noted under Recommendations.

TABLE OF CONTENTS

1 INTRODUCTION

SLI Compliance is submitting this Certification Test Report as a summary of the modification and regression testing performed on the **ES&S EVS 6.0.4.0** system against the Voluntary Voting System Guidelines 1.0 (VVSG 1.0). **ES&S EVS 6.0.4.0** is a modification of the **ES&S EVS 6.0.2.0** voting system, certified by the EAC on October 4th, 2018. The system was tested based on the "modified system" requirements, as set forth in section 4.6.2.3 of the "EAC Voting System Testing and Certification Program Manual, version 2.0". The purpose of this document is to provide an overview of the testing and findings for the **ES&S EVS 6.0.4.0** voting system.

This effort included review of updates made to the Technical Data Package, source code changes, modification, and regression testing of the **ES&S EVS 6.0.4.0** voting system. The process consisted of the development of a test plan, managing system configurations, component and system level tests prepared by SLI, and analysis of results. The review and testing were performed at SLI's Wheat Ridge, Colorado facility.

1.1 Certification Test Report Attachments

The following attachments apply to this Certification Test Report:

- Attachment A – ES&S EVS6040 Attestation Letter
- Attachment B – ES&S EVS6040 Implementation Statement
- Attachment C – ES&S EVS6040 TDP Document List
- Attachment D – ES&S EVS6040 Trusted Build Record
- Attachment E – Accredited Hardware Test Lab Certifications
- Attachment F – ES&S EVS6040 Hardware Test Plans
- Attachment G – ES&S EVS6040 As Run Test Plan
- Attachment H – ES&S EVS6040 Discrepancy Report
- Attachment I – ES&S EVS6040 Hardware Test Reports
- Attachment J – ES&S EVS6040 Safety Report

1.2 References

The following key documents were used in preparing this test plan.

1. Election Assistance Commission Voluntary Voting System Guidelines (EAC VVSG), 2005 Version 1.0 Volumes I and II.
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5. SLI VSTL Quality System Manual, v 3.0, February 12, 2019.

1.3 Terms and Abbreviations

The following terms and abbreviations will be used throughout this document:

Table 5 – Terms and Abbreviations

Term	Abbreviation	Description
American Association for Laboratory Accreditation	A2LA	A nonprofit, non-governmental, public service, membership society whose mission is to provide comprehensive services in laboratory accreditation and laboratory-related training.
Cast Vote Record	CVR	Permanent record of all votes produced by a single voter whether in electronic, paper or other form. Also referred to as ballot image when used to refer to electronic ballots.
Compact Flash card	CF	This is a type of flash memory card in a standardized enclosure often used in voting systems to store ballot and/or vote results data.
Commercial Off the Shelf	COTS	Term used to designate computer software, hardware or accessories that are ready-made and available for sale, lease, or license to the general public.
Direct Recording Electronic	DRE	Voting systems that, using touch screen or other user interfaces, directly record the voter's selections in each race or contest on the ballot in electronic form.
Election Assistance Commission	EAC	An independent, bipartisan commission created by the Help America Vote Act (HAVA) of 2002 that operates the federal government's voting system certification program.
Election Management System	EMS	Typically, a database management system used to enter jurisdiction information (district, precincts, languages, etc.) as well as election specific information (races, candidates, voter groups (parties), etc.). In addition, the EMS is also used to layout the ballots, download the election data to the voting devices, upload the results and produce the final results reports.
Electromagnetic Compatibility	EMC	The goal of EMC is to validate the correct functioning of different equipment in the same environment and the avoidance of any interference effects between them.
Functional Configuration Audit	FCA	The testing activities associated with the functional testing of the system.
Hybrid Device	No Abbreviation	A device that combines features of two or more functionalities that traditionally have been implemented separately. For example, ExpressVote HW2.1 can function as a vote capture device and as a precinct scanner, two functions that traditionally have not been implemented in the same hardware device.

Term	Abbreviation	Description
National Institute of Standards and Technology	NIST	A non-regulatory federal agency within the U.S. Dept. of Commerce. Its mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life.
National Voluntary Laboratory Accreditation Program	NVLAP	A division of NIST that provides third-party accreditation to testing and calibration laboratories.
Physical Configuration Audit	PCA	Confirms that the documentation submitted meets the national certification requirements. Includes Trusted Build activities.
Technical Data Package	TDP	The data package supplied by the vendor, which includes Functional Requirements, Specifications, End-user documentation, Procedures, System Overview, Configuration Management Plan, Quality Assurance Program, and manuals for each of the required hardware, software, firmware components of a voting system.
Test Method	No Abbreviation	SLI proprietary documents which are designed to group sets of EAC VVSG requirements in a logical manner that can be utilized to efficiently validate where and how requirements, or portions of a requirement, are met.
Test Module	No Abbreviation	An actionable component of a Test Method, that functionally verifies that a requirement is met within a voting system. Test Modules are at a generic level within the Test Method, and are customized for a particular voting system, within a Test Suite.
Test Suite	No Abbreviation	An actionable grouping of test modules designed to test a set of functions of a voting system or component in a specific way.
Trusted Platform Module	TPM	A dedicated microcontroller designed to secure hardware through integrated cryptographic keys.
Universal Voting Console	UVC	The UVC features large, color-coded keys labeled with both visible text and Braille characters. The UVC keys enable the voter to adjust the audio volume and tempo, navigate the ballot, make contest selections, open the help screen, and use the blank privacy screen feature.
Voluntary Voting System Guidelines	VVSG	A set of specifications and requirements against which voting systems can be tested to determine if the systems provide all the basic functionality, accessibility and security capabilities required for EAC certification.
Voting System Test Lab	VSTL	An independent testing organization accredited by NVLAP and the EAC to conduct voting system testing for EAC certification.

1.4 System Identification

This section provides a description of the scope of **ES&S EVS 6.0.4.0** voting system and components.

The **ES&S EVS 6.0.4.0** voting system is composed of software applications, central count location devices and polling place devices with accompanying firmware, and COTS hardware and software.

1.4.1 Electionware®

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

1.4.2 ExpressVote XL™

ExpressVote XL Full-Faced Universal Voting System (**ExpressVote XL**) is a hybrid paper-based polling place voting device that provides touch screen vote capture that incorporates the printing of the voter's selections as a cast vote record, and tabulation scanning into a single unit. **ExpressVote XL** is capable of operating in either marker or tabulator mode, depending on the configurable mode that is selected in **Electionware**.

1.4.3 ExpressTouch®

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

1.4.4 ExpressVote® Hardware 1.0

ExpressVote Universal Voting System Hardware 1.0 (**ExpressVote HW1.0**) is a hybrid paper-based polling place voting device that provides touch screen vote capture that incorporates the printing of the voter's selections as a cast vote record, to be scanned for tabulation in any one of the ES&S precinct or central scanners.

1.4.5 ExpressVote® Hardware 2.1

ExpressVote Universal Voting System Hardware 2.1 (**ExpressVote HW2.1**) is a hybrid paper-based polling place voting device that provides touch screen vote capture that incorporates the printing of the voter's selections as a cast vote record, and tabulation scanning into a single unit. **ExpressVote HW2.1** is capable of operating in either marker or tabulator mode, depending on the configurable mode that is selected in Electionware.

1.4.6 DS200®

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

1.4.7 DS450®

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

1.4.8 DS850®

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

1.4.9 Event Log Service (ELS)

Event Log Service (**ELS**) monitors and logs users' interactions with the Election Management System. Events that happen when a connection to the database is not available are logged to the Windows Operating System log through the **ELS**.

1.4.10 Removable Media Service (RMS)

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

1.4.11 Block Diagrams

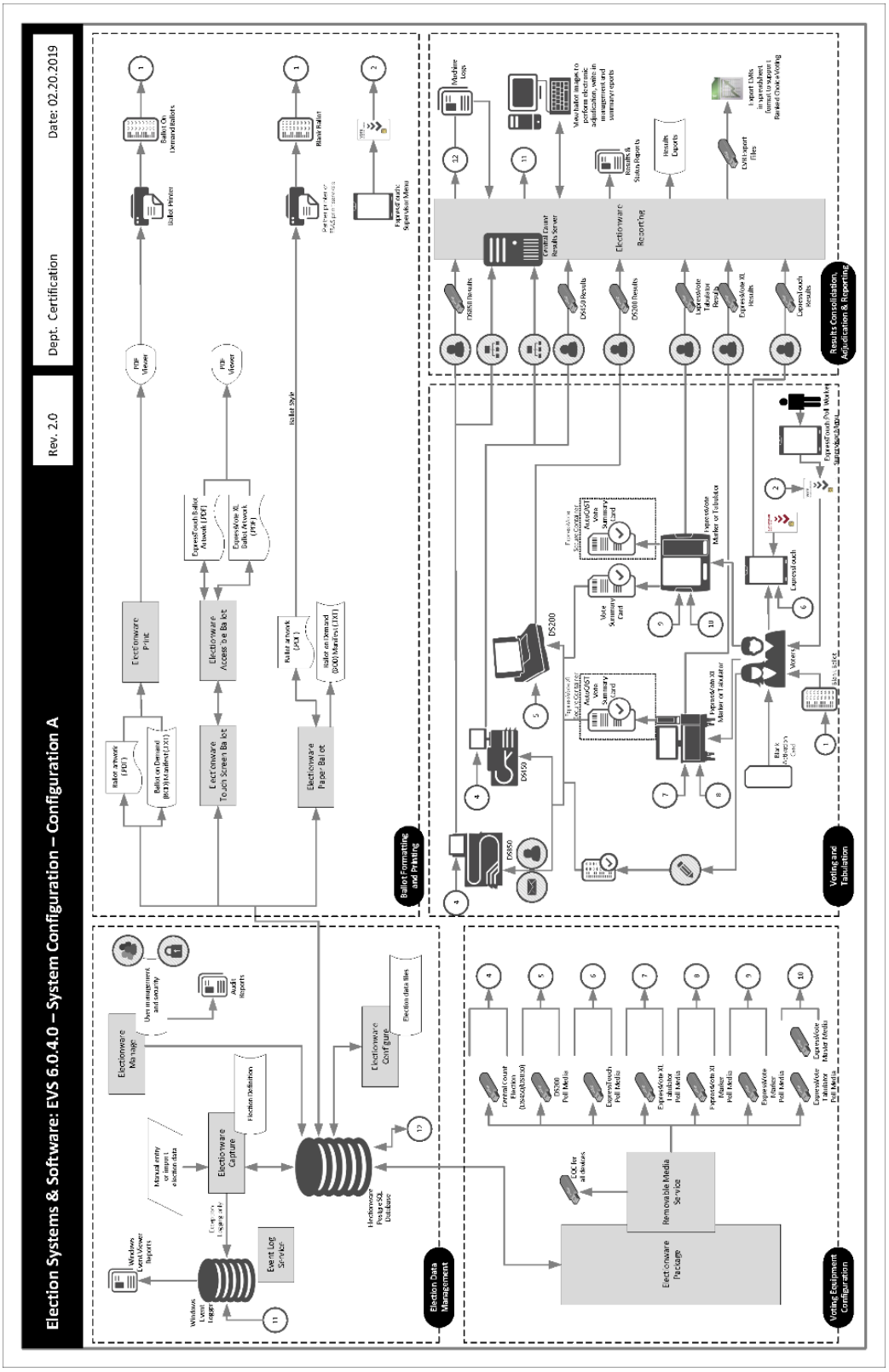

Figure 1: Voting System Overview – Configuration A

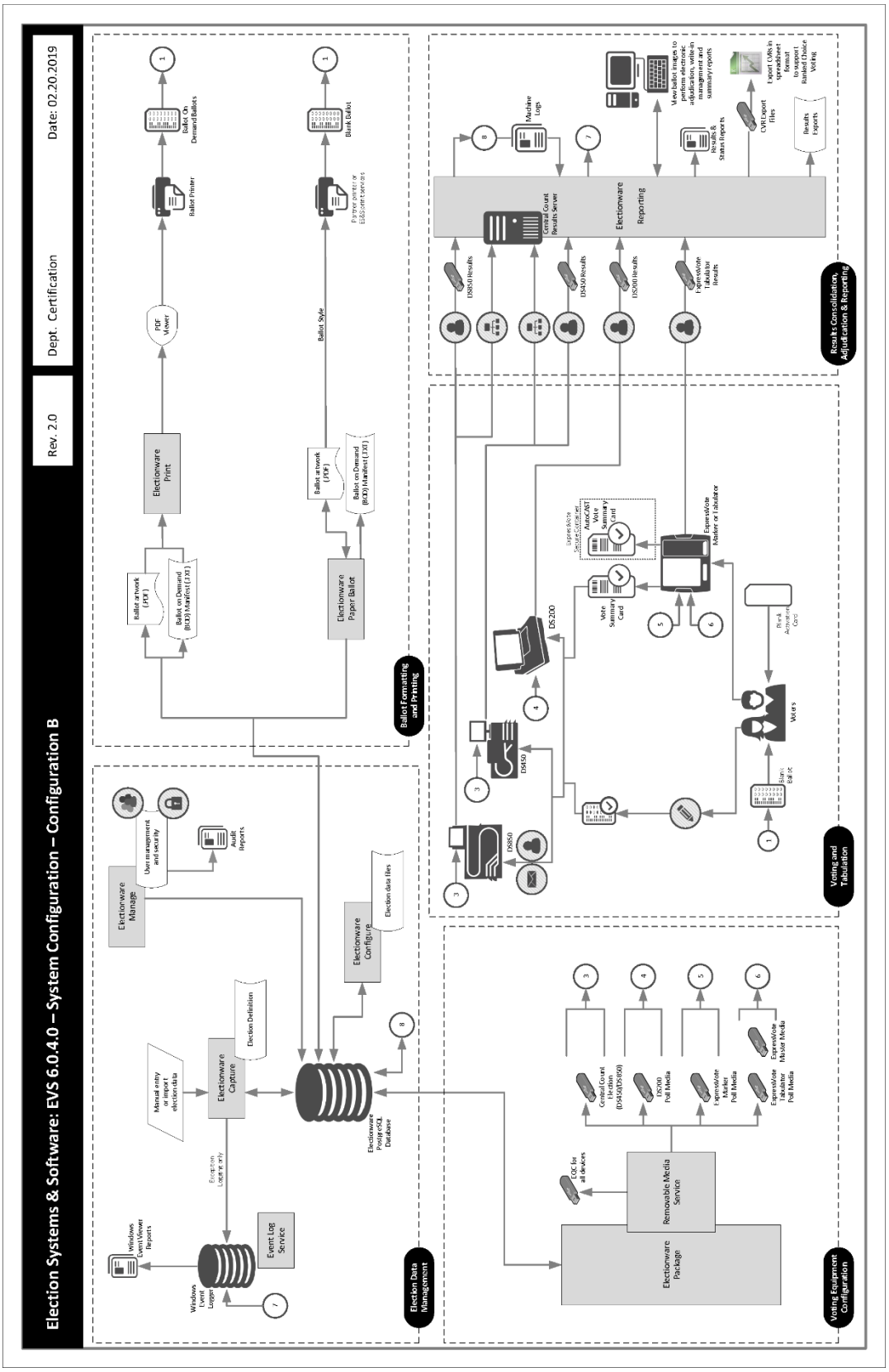

Figure 2: Voting System Overview – Configuration B

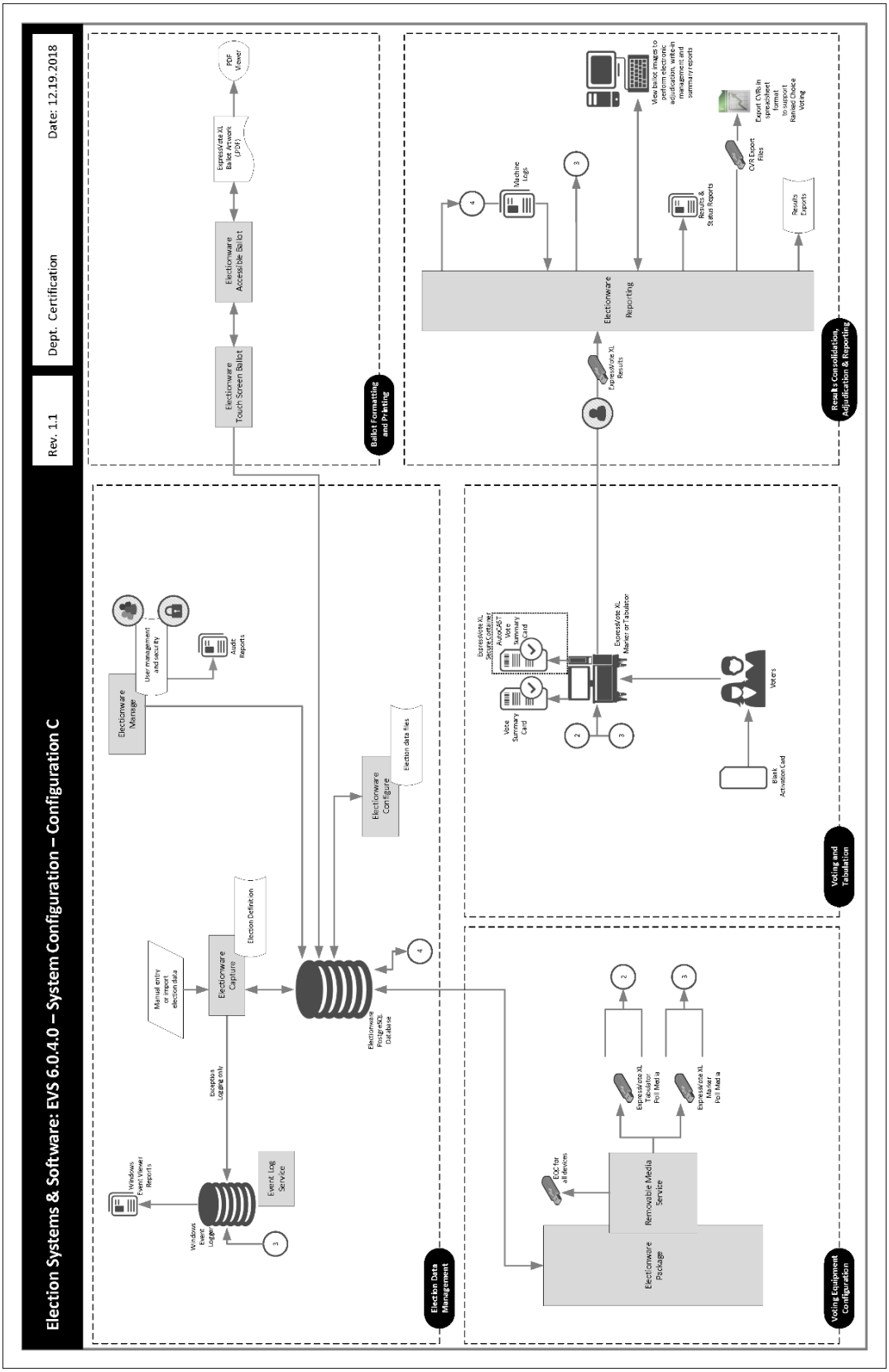

Figure 3: Voting System Overview – Configuration C

1.5 Software and Firmware

All software/firmware to be used by the declared voting system whether directly or indirectly, in a production environment, must be validated during the certification process.

The software and firmware employed by **ES&S EVS 6.0.4.0** consists of two types, custom and commercial off the shelf (COTS). COTS applications were verified to be pristine or were subjected to source code review for analysis of any modifications and verification of meeting the pertinent standards.

1.5.1 Manufacturer Software/Firmware

The **ES&S EVS 6.0.4.0** voting system consists of the following software and firmware components:

- **Electionware** Election database creation, media programming and tally/reporting software
- **DS450** Central Count scanner and tabulator, Central Tabulator firmware
- **DS850** Central Count scanner and tabulator, Central Tabulator firmware
- **DS200** Precinct scanner and tabulator, Precinct Tabulator firmware
- **ExpressVote HW1.0** Precinct ballot marker, Universal Voting System firmware
- **ExpressVote HW2.1** Precinct ballot marker and/or Precinct scanner and tabulator, Universal Voting System firmware
- **ExpressVote HW1.0 Previewer** ballot preview software
- **ExpressVote HW2.1 Previewer** ballot preview software
- **ExpressVote XL** Precinct ballot marker and/or Precinct scanner and tabulator, using a full-face touchscreen and Universal Voting System firmware
- **ExpressTouch** DRE, Electronic Universal Voting System firmware
- **Event Log Service (ELS)** software service monitoring user's interactions with the Election Management System
- **Removable Media Service (RMS)** software service supporting election media programming

Table 1 – ES&S EVS 6.0.4.0 Software/Firmware

Application	Version
Electionware – Client/Server	5.0.4.0
Event Log Service	1.6.0.0
Removable Media Service	1.5.1.0
ExpressVote HW1.0	1.5.2.0
ExpressVote HW1.0 Previewer	1.5.2.0
ExpressVote HW2.1	2.4.5.0
ExpressVote HW2.1 Previewer	2.4.5.0
DS200	2.17.4.0

Application	Version
DS200 Ancillary (used to build the DS200, but no resultant output)	6.0.0.0
DS850	3.1.1.0
DS450	3.1.1.0
ExpressVote XL	1.0.3.0
ExpressTouch	1.0.3.0

Note: The Previewer and DS200 Ancillary file(s) are built during the same build as the respective **ExpressVote** and **DS200** application.

1.5.2 COTS Software/Firmware

This section details the COTS software and firmware utilized within the **ES&S EVS 6.0.4.0** voting system.

Table 2 – COTS Software/Firmware

Manufacturer	Application	Version
Microsoft Corporation	Windows 7 Professional	SP-1 (64-bit)
Microsoft Corporation	Windows Server 2008	R2, SP-1 (64-bit)
Microsoft Corporation	Windows 7 Enterprise	SP-1 (64-bit)
Microsoft Corporation	WSUS Microsoft Windows Offline Update Utility	11.5
Symantec	Symantec Endpoint Protection	14.2.0_MP1 (64-bit)
Symantec	Symantec Endpoint Protection Intelligent Updater (File-Based Protection)	20190122-001-core15sdsv5i64.exe
Symantec	Symantec Endpoint Protection Intelligent Updater (Network-Based Protection)	20190121-062-IPS_IU_SEP_14RU1.exe
Symantec	Symantec Endpoint Protection Intelligent Updater (Behavior-Based Protection)	20190115-001-SONAR_IU_SEP.exe
Gigabyte	WindowsImageTool	B17.1116.01
Cerberus	Cerberus FTP Server - Enterprise	10.0.5 (64-bit)
Adobe	Adobe Acrobat Standard	XI
Microsoft Corporation	Visual C++ Redistributable	en_visual_cpp_2015_redistributable_x86_8487157.exe (32-bit)
RSA Security	RSA BSAFE Crypto-C ME for Windows 32-bit	4.1
OpenSSL	OpenSSL	2.0.12
OpenSSL	OpenSSL	2.0.16
OpenSSL	OpenSSL	1.02d
OpenSSL	OpenSSL	1.02h

Manufacturer	Application	Version
OpenSSL	OpenSSL	1.02k

1.6 Equipment

The following equipment is required for the execution of the hardware, software, telecommunications, and security tests. This includes system hardware, general purpose data processing and communications equipment, and any test instrumentation required.

1.6.1 ES&S EVS 6.0.4.0 Equipment

The following manufacturer equipment was used in testing:

Table 3 – ES&S EVS 6.0.4.0 Equipment

Hardware	HW Revision	Model
ExpressVote Universal Voting System	1.0	N/A
ExpressVote Universal Voting System	2.1, 2.1.2.0	2.1.2.0 includes display versions 6.4 and 6.8
DS200 Precinct-based Scanner and Tabulator	1.2, 1.3,1.3.11	N/A
DS450 Central Count Scanner and Tabulator	1.0	N/A
DS850 Central Count Scanner and Tabulator	1.0	N/A
ExpressVote XL Full-Faced Universal Voting System	1.0	N/A
ExpressTouch Electronic Universal Voting System	1.0	N/A
ExpressVote Rolling Kiosk	1.0	98-00049
Quad Express Cart	N/A	41404
ExpressVote Voting Booth	N/A	98-00051
MXB ExpressVote Voting Booth	N/A	95000
ExpressVote Single Table	N/A	87033
ExpressVote Double Table	N/A	87032
ExpressVote ADA Table	N/A	87031
DS200 Collapsible Ballot Box	1.0, 1.1	98-00009
DS200 Plastic Ballot Box	1.2, 1.3, 1.4, 1.5	57521
DS200 Tote Bin	1.0	00074
DS450 Cart	N/A	3002
DS850 Cart	N/A	6823
Universal Voting Console	1.0	98-00077
Tabletop Easel	N/A	14040
ExpressTouch Voting Booth	N/A	98-00081

Hardware	HW Revision	Model
Delkin USB Flash Drive	N/A	Bitlocker 32.2 MB

1.6.2 COTS Equipment

The following COTS equipment was used in testing:

Table 4 – COTS Equipment

Manufacturer	Hardware	Model	Operating System
Innodisk	USB EDC H 2SE (1GB)	DEUH1-01GI72AC1SB (for ExpressVote HW1.0)	N/A
Innodisk	USB EDC H 2SE (16GB)	DEUH1-16GI72AC1SB (for ExpressVote HW2.1)	N/A
Delkin Devices	USB Embedded 2.0 Module (16GB)	MY16TNK7A-RA042-D	N/A
Symbol	Scanner (External)	DS9208	N/A
Zebra Technologies	Scanner (Integrated)	DS457-SR20009 DS457-SR20004ZZWW	N/A
OKI	Audit Printer	Microline 420	N/A
Dell	Report Printer	S2810dn	N/A
OKI	Report Printer	B431DN B431D B432DN	N/A
Tripp Lite	Spike Cube	SPIKECUBE	N/A
APC	Backup power supply (Uninterruptible Power Supply)	Back-UPS Pro 1500 Smart-UPS 1500 Back-UPS RS 1500	N/A
Dell (EMS Standalone configuration)	• Processor: Dual Core • RAM: 4 GB, 8 GB recommended • Hard Disk: 150 GB • Keyboard • Mouse • Monitor: 1280x800 resolution • Monitor – ExpressVote XL	Latitude 5580 Latitude E6430	Windows 7 Professional, SP-1 (64-bit) Windows 7 Enterprise, SP-1 (64-bit)

Manufacturer	Hardware	Model	Operating System
	(Monitor needed for programming election for ExpressVote XL) 1920x1080p resolution • CD/DVD reader: 16x min (internal or external) • 2 USB ports: 2.0 min • Report Printer: w/printer control language driver • Trusted Platform Module (TPM)		
Dell (EMS Networked Server and Client configuration)	• Processor: Dual Core or Quad Core • RAM: 4 GB, 8 GB recommended • Hard Disk: 150 GB or 320 GB • Keyboard • Mouse • Monitor: 1280x800 resolution • Monitor – ExpressVote XL Program Your Own: 1920x1080p resolution • CD/DVD reader: 16x min (internal or external) • 2 USB ports: 2.0 min • Report Printer: Network printer w/printer control language driver • Ethernet Port • Backup power supply: 865 Watts /	OptiPlex 5040 OptiPlex 5050 OptiPlex 7020 PowerEdge T420 PowerEdge T630	Windows Server 2008 R2, SP-1 (64-bit) Windows 7 Professional, SP-1 (64-bit) Windows 7 Enterprise, SP-1 (64-bit)

Manufacturer	Hardware	Model	Operating System
	1500 VA output capacity • Network Switch: 1 GB throughput • Trusted Platform Module (TPM)		
Delkin	USB Flash Drive: 512 MB, 1 GB, 2 GB, 4 GB, 8 GB	N/A	N/A
Delkin	USB Flash Drive: 16 GB (Validation only)	N/A	N/A
AVID	Headphones	86002	N/A
Seiko Instruments	Thermal Printer	LTPD-347B	N/A
NCR / Nashua	Paper Roll	2320	N/A
Delkin	Compact Flash Memory Card: 1 GB max	CE0GTFHHK-FD038-D	N/A
Delkin	Compact Flash Memory Card Reader/Writer	6381	N/A
Delkin	CFAST Card, 2 GB, 4 GB	N/A	N/A
Lexar	CFAST Card Reader/Writer	LRWCR1TBNA	N/A
CardLogix	Smart Card, 16 KB	CLXSU128KC7 / AED C7	N/A
SCM Microsystems	Smart Card Writer	SCR3310	N/A
Fujitsu	Thermal Printer	FTP-62GDSL001 FTP-63GMCL153	N/A
TDS	Ink Cartridge	2278	N/A
HP Inkjet	Ink Cartridge	87002	N/A
Dell	Trusted Platform Module (TPM) chip, version 1.2	R9X21	N/A

1.7 Test Materials

The following test materials are required for the performance of testing including, as applicable, test ballot layout and generation materials, test ballot sheets, test ballot cards and control cards, standard and optional output data report formats, and any other materials used in testing.

- Ballots and blank ballot grade paper

- Activation cards
- Smart cards
- Ballot pens
- Printer paper rolls

1.8 ES&S EVS 6.0.4.0 Documentation

The documents that are a part of the **ES&S EVS 6.0.4.0** voting system are detailed in "Attachment C – ES&S EVS6040 TDP Document List".

1.9 Modifications

The following modifications are part of the **ES&S EVS 6.0.4.0** voting system:

New Hardware Configurations

- The MXB ExpressVote Voting Booth accommodates seated voters on one side and standing voters on the other.
- The Quad Express Cart holds up to four ExpressVote units securely in place. Three of the units are positioned for standing voters while the fourth accommodates a seated voter.

Hardware Modifications

- **DS200** (Revision 1.3.11) updated the following components that were certified with previous versions of the system due to end-of-life:
    - Motherboard
    - Display
    - Touch screen controller and drivers
    - Scanner board motor driver
- **DS200 Collapsible Ballot Box.** (Revision 1.1) introduces better ballot box sidewalls and auxiliary slot for product improvement.
- **DS450** added new uninterruptible power supply (UPS) and report printer as alternatives to accommodate end-of-life component replacement.
- Added a new kiosk barcode scanner due to the old version going end-of-life for the **ExpressVote HW1.0** and **ExpressVote HW2.1**.
- The Delkin USB Embedded 2.0 Module and Compact Flash Memory Card COTS hardware components have been updated.
- A Trusted Platform Module (TPM) chip has been introduced to the system configuration. This chip is required to be added to any EMS workstation that doesn't have an integrated TPM when running Windows Enterprise OS with the Bitlocker feature.
- A Delkin 32.2 MB USB Flash Drive has been added to manufacturer equipment for use with the Bitlocker feature.

Software/Firmware Modifications

- Modification for Windows® 7 Enterprise and Windows® Server 2008 Bitlocker configuration. Bitlocker is a full-volume encryption feature included in select Microsoft operating systems.
- Provided support for the Windows® 7 Enterprise operating system to be used for the **EMS**. This operating system includes BitLocker, which is Microsoft's proprietary disk encryption utility. This operating system also includes the optional dual-factor authentication ability, which is a security enhancement that allows you to present two pieces of evidence when logging in to an account. This modification impacts **Electionware**.
- Introduced Marker mode with front eject only for the **ExpressVote XL**. This modification also affects **Electionware**.
- Removed configuration options that allow a voter to cast a vote without the option of first reviewing the printed card. The voter must be able to choose to Review Card or Cast Vote, rather than only providing the option for Cast Vote. This modification is applicable to **Electionware**, **ExpressVote HW1.0, ExpressVote HW2.1**, and **ExpressVote XL**.
- Updated voter-facing screens to increase focus on the Review Card option before the Cast Vote option. This modification is applicable to **Electionware**, **ExpressVote HW1.0, ExpressVote HW2.1**, and **ExpressVote XL**.
- Added an **Electionware** configuration setting to show or hide the Write-Ins icon, which is used to access the onscreen write-in review feature, on the **DS200** Polls Closed screen.
- Updated the copyright date in the startup splash screen. This modification is applicable to the **DS200**, **DS450**, and the **DS850**.
- Provided support for multi-language audio playback of the write-in keyboard on the **ExpressVote HW1.0**, and **ExpressVote HW2.1**.
- Modified the user interface to properly handle manual candidate selection(s) in a contest after the selections made by the straight party selection are automatically deselected in that contest. This modification applies to the **ExpressVote HW1.0, ExpressVote HW2.1**, and **ExpressVote XL**.
- Modified the **ExpressVote HW1.0** and **ExpressVote HW2.1** firmware/software to accommodate a new version of the kiosk barcode scanner due to the old version going end-of-life.
- Enhanced support for kiosk barcode scanner in "low light" mode for the **ExpressVote HW1.0** and **ExpressVote HW2.1**.
- Modified the **DS200** firmware to accommodate end-of-life component replacement.
- Modified the **DS450** firmware to support an alternative UPS and report printer.
- Modified the **DS850** firmware to support an alternative UPS and report printer. The alternative UPS and report printer are not included in the hardware configuration of the **DS850** for this system and is intended to be used in a future release.
- Removed support in **Electionware** for Adjudication Status Controls (i.e. "Approve Ballot" and "Put On-Hold") for vote summary cards generated from the **ExpressVote HW1.0**, **ExpressVote HW2.1**, and **ExpressVote XL**.

- Enhanced the Reporting Admin Settings in **Electionware** for the Precinct Summary Report to suppress results on a contest-by-contest basis rather than by ballots cast in the precinct.
- Added the ability in **Electionware** to recognize and load media burned from an election restored on any instance of **Electionware** when loading results.
- Updated Users.xml to ensure the most up-to-date version is utilized in **Electionware**.
- Incremented the **ExpressTouch** firmware version to remain synchronized with common code changes in the **ExpressVote XL**.
- Removed **DS200** Status from **ExpressVote HW1.0** System Readiness Report since "tethered mode" will not be supported.
- Removed Ballot Online (BOL) scanner setup functionality from the Maintenance Menu for the **ExpressVote HW1.0**.
- Modified the user interface for the **ExpressVote XL** to properly handle write-in entry for a multiple Vote-For contest.
- Corrected straight party audio inconsistency for the **ExpressVote XL** when changing selection(s).
- Resolved a scenario where the cast button was displayed after the vote session timed out for the **ExpressVote XL**.
- Enhanced the **ExpressVote XL** user interface to display a warning corresponding to the media door being opened.
- Added the ability to automatically print a test deck from tabulation mode for the **ExpressVote XL**. Test deck cards include the word "Test" when printed.
- Added a configuration setting to the **ExpressVote XL** to control on screen selection presentation. Options include show the borders around the selection checkmark, show only the selection checkmark or show nothing.
- Improved latest version of **RMS** to ensure media packaging remains consistent.
- Changes have been made to all COTS software components as listed in Table 2.
- Updates made to SecureSetup.exe hardening script.

2 Certification Test Background

This section provides a brief overview of the EAC Certification Program and the activities involved for a voting system to be considered for certification against the EAC VVSG and the EAC program manual.

2.1 System Revision History

ES&S EVS 6.0.4.0 is a modification of the **ES&S EVS 6.0.2.0** voting system, certified by the EAC on October 4th, 2018. Specific engineering changes are listed in section 1.8 of this report.

2.2 Implementation Statement

The **ES&S EVS 6.0.4.0** voting system incorporates all software and hardware, as well as supporting documentation, as declared in the **ES&S**'s implementation statement, as

provided to the EAC. Please refer to "Attachment B – ES&S EVS6040 Implementation Statement".

2.3 PCA - Document and Source Code Reviews

The Physical Configuration Audit (PCA) review of the **ES&S EVS 6.0.4.0** voting system documentation, submitted in the requisite Technical Data Package (TDP), was performed in order to verify conformance with the Election Assistance Commission Voluntary Voting System Guidelines 1.0 (EAC VVSG 1.0). Source code was reviewed for each software and firmware application modified from **ES&S EVS 6.0.2.0** for the **ES&S EVS 6.0.4.0** voting system. Source code was not reviewed for firmware or software applications that were not modified for **ES&S EVS 6.0.4.0.**

All PCA reviews were conducted in accordance with *Volume 2 Section 2* of the EAC VVSG 1.0, to demonstrate that the system meets the requirements. Results of the PCA documentation review can be found in section 3.2 of this Certification Test Report. Inconsistencies or errors in documentation were identified to **ES&S** for resolution or comment.

All PCA source code reviews were conducted in accordance with *Volume 1 Section 5.2 and Volume 2 Section 5* of the EAC VVSG 1.0, to demonstrate that the system meets the requirements. Results of the PCA source code reviews can be found in section 3.1 of this Certification Test Report.

2.4 FCA - Functional & System Testing

The Functional Configuration Audit (FCA) review of the test documentation submitted by **ES&S** in the TDP was executed to verify testing of the voting system requirements defined in *Volume 1 Sections 2, 6, 7,* and *9* of the EAC VVSG 1.0. Changes made to the TDP from **ES&S EVS 6.0.2.0** to the TDP submitted with **ES&S EVS 6.0.4.0** were reviewed in detail. In addition, the **ES&S** System Development program was reviewed to ensure processes and procedures are properly documented and in agreement with observations by the VSTL through the duration of this test campaign.

SLI's standard Test Suites were customized for the **ES&S EVS 6.0.4.0** voting system and conducted in accordance with *Volume 2 Section 6,* in conjunction with the source code review, TDP review, integration, accuracy, security, modification, and regression tests. Simulations of elections were conducted to demonstrate a beginning-to-end business use case process for the **ES&S EVS 6.0.4.0** voting system.

2.4.1 Test Methods

All test methods employed are within the scope of SLI's VSTL accreditation. The following validated test methods were employed during this test campaign:

Table 6 – Test Methods

SLI VSTL Test Method Name
TM_Accuracy v1.1

SLI VSTL Test Method Name
TM_Basic_Election_Components v1.0
TM_Tally_and_Reporting v1.0
TM_Ballot_Counter v1.1
TM_Accumulating_and_Transmitting_Results v1.1
TM_Pre-Voting_Capabilities v1.2
TM_Voting_Capabilities v1.3
TM_Closing_the_Polls v 1.1
TM_Security_Access_Control v1.1
TM_Security_Software_Security v1.1
TM_Security_Physical_Security_Measures v1.1
TM_Voting_Vote_for_N_of_M v1.1
TM_Voting_Straight_Party v1.2

The above listed test methods are implemented in a complementary fashion: modules are employed from various methods to form suites. Suites include a logical sequence of functionality that is used to validate the requirement addressed by each module within the suite. Please see the Terms and Abbreviations table for additional information about Test Modules and Test Suites.

2.4.2 3rd Party Hardware Testing

Hardware testing was conducted by 3rd Party certified hardware test laboratories to verify the voting system devices that have been modified in the **ES&S EVS 6.0.4.0** voting system are in compliance with the EAC VVSG 1.0 hardware requirements.

SLI Compliance is responsible for all core voting system tests as identified in the NIST NVLAP Handbook 150-22 (2017). Regarding non-core hardware testing for this certification test campaign, this report contains data that were produced under subcontract by the following lab(s):

Table 3 – Labs Performing Hardware Testing

Laboratory	Address	Test(s)	Date(s)
NTS – EMI / EMC	1736 Vista View Drive Longmont, CO 80504	**EMC / EMI Tests:** Radiated Emissions, Conducted Emissions, ESD, Electromagnetic Susceptibility, Electrical Fast Transient, Lightning Surge, Conducted RF Immunity, Magnetic Fields Immunity, Electrical Power Disturbance	10/17/2018 – 10/23/2018 11/27/2018 1/7/19 – 1/14/19

Laboratory	Address	Test(s)	Date(s)
NTS – Environmental / Dynamic	1601 Dry Creek Drive Suite 200 Longmont, CO 80503	**MIL-STD-810D Tests:** Bench Handling, Vibration, Low Temperature, High Temperature, Humidity, Temperature/Power Variation	10/16/2018 – 10/31/2018 12/11/18 – 12/14/18 1/8/19 – 1/11/19

3 Certification Test Results Summary

3.1 Source Code Review Summary

SLI has reviewed the modified software source code for each application in the **ES&S EVS 6.0.4.0** voting system to determine the code's compliance with the EAC VVSG 1.0, *Volume 1 Sections 5, 9* and *Volume 2 Section 5.4* and for compliance with **ES&S'**s internally developed coding standards. **ES&S EVS 6.0.4.0** is implemented with the C, C++, C#, Java, VB and VB.net languages.

Evaluation of Source Code

No discrepancies were observed during the review of delivered source code. All code has successfully passed all reviews.

3.2 Technical Data Package Review Summary

SLI reviewed the **ES&S EVS 6.0.4.0** TDP for compliance with the EAC VVSG 1.0 according to *Volume 2 Section 2*. The documents that are a part of the **ES&S EVS 6.0.4.0** voting system are detailed in "Attachment C – ES&S EVS6040 TDP Document List".

Evaluation of TDP

Twenty four documentation issues were written during the PCA and FCA documentation review phases. The issues were related to either incorrect or missing information. Details can be found in "Attachment H – ES&S EVS6040 Discrepancy Report".

In all instances, the issues were addressed and resolved with updated documentation prior to the writing of this report. Once all identified discrepancies were resolved, the Technical Data Package for the **ES&S EVS 6.0.4.0** voting system was found to comply with all applicable standards.

3.3 Hardware Testing Summary

SLI and their third-party certified hardware test laboratory, National Technical Systems (NTS), performed an analysis and review of the modified **ES&S EVS 6.0.4.0** voting system hardware components. During execution of testing performed at NTS, an SLI representative was present to oversee the testing.

The test methodologies for all tests are identified in the hardware test plans and hardware test reports, as listed in section 1.1 “Certification Test Report Attachments”.

SLI also conducted a review on the **ES&S EVS 6.0.4.0** Safety Report, no issues were found, all components were found to be compliant according to EAC VVSG 1.0 *Volume 1 Section 4.3.8.*

Hardware testing conducted specifically for this test campaign involved the **DS200** and **DS450**. The testing consisted of:

- Electromagnetic Emissions / Immunity Tests:
    - Radiated Emissions – FCC, Part 15 Class B ANSI C63.4.
    - Conducted Emissions – FCC, Part 15 Class B ANSI C63.4.
    - ESD – IEC 61000-4-2 (2008) Ed. 2.0.
    - Electromagnetic Susceptibility – IEC 61000-4-3 (1996).
    - Electrical Fast Transient – IEC 61000-4-4 (2004-07) Ed. 2.0.
    - Lightning Surge – IEC 61000-4-5 (1995-02).
    - Conducted RF Immunity – IEC 61000-4-6 (1996-04).
    - Magnetic Fields Immunity – IEC 61000-4-8 (1993-06).
    - Electrical Power Disturbance – IEC 61000-4-11 (1996-06).
- Non-Operating Environmental Tests:
    - Bench Handling - MIL-STD-810D, Method 516.3, Procedure VI
    - Vibration - MIL-STD-810D, Method 514.3, Category 1- Basic Transportation, Common Carrier.
    - Low Temperature - MIL-STD-810D, Methods 502.2, Procedure I-Storage.
    - High Temperature - MIL-STD-810D, Methods 501.2, Procedure I-Storage.
    - Humidity (85%) Soak - MIL-STD-810D, Method 507.2, Procedure I-Natural Hot-Humid.
- Operating Environmental Tests:
    - Temperature/Power Variation - similar to the low temperature and high temperature tests of MIL-STD-810-D, Method 502.2 and Method 501.2.
    - Reliability – Vol. 1, Section 4 for the acceptable Mean Time Between Failure (MBTF).

Evaluation of Hardware Testing

As this test campaign was a modification of an EAC certified voting system, only modified hardware components of the **ES&S EVS 6.0.4.0** voting system were evaluated against applicable hardware requirements.

Seven hardware discrepancies were written during this test campaign for issues encountered during hardware testing. Details can be found in “Attachment H – ES&S EVS6040 Discrepancy Report”. **ES&S** appropriately resolved each issue and subsequently passed all hardware tests.

3.4 Functional Testing Summary

SLI performed tests designed to functionally verify the modifications listed in section 1.8 of this report. The testing incorporated end-to-end election scenarios testing the functionality supported by **ES&S**. The following sections detail the test suites that were executed.

3.4.1 Accuracy Test Suite

Accuracy testing was performed to verify the ability of the system to capture, record, store, consolidate and report the specific selections and absence of selections, made by the voter for each ballot position, without error. Additionally, the system was exercised to validate that the accumulation, tallying and reporting mechanisms at the system level accurately perform their functions.

Accuracy testing was conducted at both the device level and the system level. The **ExpressVote HW1.0, ExpressVote HW2.1,** and **ExpressVote XL** were utilized to mark and print vote summary cards, which were then scanned into the **DS200, DS450,** and **DS850** devices. Vote counts were tabulated from **DS450, DS850, ExpressVote HW2.1, ExpressTouch, ExpressVote XL,** and **DS200**. Results were processed through **Electionware** and examined for completeness and correctness.

3.4.2 Integration Test Suite

An Integration Test Suite designed to verify proper integration of system components was conducted using General and Open Primary elections. These elections were utilized multiple times to ensure each EMS operating system, standalone, and server-client configuration was covered.

- The General election definition focused on N of M voting, Partisan offices, Non-Partisan Offices, precincts and districts, write-ins, tally, results loading, and reporting functionality.
- The Open Primary election definition utilized three partisan parties.

Integration testing was conducted at both the device level and the system level. The **ExpressVote HW1.0**, **ExpressVote HW2.1,** and **ExpressVote XL** were utilized to mark and print vote summary cards, which were then scanned into the **DS200, DS450,** and **DS850** devices. Vote counts were tabulated from **DS450, DS850, ExpressVote HW2.1, ExpressTouch, ExpressVote XL,** and **DS200**. Results were processed through **Electionware** and examined for completeness and correctness.

3.4.3 Modification Test Suite

Modification test cases were executed to focus on the specific changes incorporated into the system at the device level, and in conjunction with the **EMS** as applicable. Various elections were used to exercise the **EMS** and devices such that each specific modification was functionally verified, with an appropriate quantity of regression testing performed as determined by analysis of the modifications.

3.4.4 Pennsylvania Straight Party Method Test Suite

A General Election designed to test all variations of the Pennsylvania Straight Party Method was performed to ensure all modifications and performance related enhancements are working correctly as documented, and in accordance with the VVSG 1.0 requirements.

3.4.5 Security Test Suite

A Security Test Suite was designed and executed to examine all the various security related modifications to the system configuration. Included in the assessment was a comprehensive examination of the in-place physical security mitigation measures of the new **DS200** collapsible ballot box. The physical examination comprised of verification of security seal placement and the ability to quickly detect tampering. Attempts to easily bypass ballot box design to introduce untallied ballots or access internal contents of the ballot box were included in the physical examination.

The Security examination also included review of a new version of the endpoint protection software. Utilizing industry defined Anti-virus and Malware test definitions, alongside vulnerability assessment to determine if the machines were susceptible to malicious software and network attacks.

A review of a new EMS configuration Windows® 7 Enterprise operating system, including BitLocker drive encryption, was performed. This configuration was examined to determine if BitLocker drive encryption was successfully implemented utilizing a TPM 1.2 chip and required security keys. In addition, testing confirmed that the BitLocker drive encryption was properly configured and that all storage drives were successfully encrypted utilizing AES-256-bit encryption.

Evaluation of Functional Testing

In this test campaign, **ES&S EVS 6.0.4.0** was subjected to examination for changes, updates, and modifications made from the previously certified system, **ES&S EVS 6.0.2.0**, against applicable requirements within the EAC VVSG 1.0.

Through the duration of testing, six functional issues were written. Details can be found in “Attachment H – ES&S EVS6040 Discrepancy Report”. Issues found were reported, resolved, and re-tested as applicable. Once all discrepancies have been addressed, no violation of conformance to EAC VVSG 1.0 requirements was observed. All components of the **ES&S EVS 6.0.4.0** voting system have successfully passed all tests.

4 Recommendations

SLI has successfully completed the testing of the **ES&S EVS 6.0.4.0** voting system. It has been determined that the **ES&S EVS 6.0.4.0** voting system meets the required acceptance criteria of the Election Assistance Commission Voluntary Voting System Guidelines, version 1.0.

This recommendation reflects the opinion of SLI Compliance based on testing scope and results. It is SLI’s recommendation based on this testing effort that the EAC grant certification of the **ES&S EVS 6.0.4.0** voting system.

5 APPROVAL SIGNATURES

SLI:

Traci Mapps
VSTL Director
April 26th, 2019

6 Appendix A – Ancillary Products

Ancillary systems represent products and utilities that are not part of the EAC certified configuration, however, they may be used to facilitate testing.

Ancillary systems include:

- Ballot Production
  - **Balotar** is a product that receives ballot artwork PDFs and ballot on demand files from **Electionware**. **Balotar** is specifically designed to automatically generate and print ad hoc ballots.
- Ranked Choice Voting
  - **ExpressRunoff** is a software utility for automating ranked choice voting for single-seat contests. Ranked Choice Voting (RCV) is an electoral system used to elect a single winner from a field of more than two candidates, where voters rank the candidates in order of preference. After results have been loaded into **Electionware**, **ExpressRunoff** uses the Cast Vote Record (CVR) data exported from **Electionware** to create RCV rounds, and produces customizable reports showing the outcome of each round.
- Electronic Pollbook
  - **ExpressPoll** electronic pollbook stores registered voter information for precincts, districts, or entire jurisdictions. The voter registration data can be shared with the **ExpressLink** application to print a voter's activation card for use in an **ExpressVote** or **ExpressVote XL**.
- **ExpressLink** System
  - **ExpressLink** is a Windows PC application that can run in either a standalone mode, or in a monitor mode, where the application monitors requests from a voter registration (VR) system over a shared network folder. The application imports an election definition from **Electionware**, accepts requests to print a voter's activation card for use in an **ExpressVote** or **ExpressVote XL**, determines the voter's ballot style and then prints the activation card on the **ExpressVote Activation Card Printer**. Separately, this application is used to program vote session activator cards for use with **ExpressTouch**.

  - **ExpressVote Activation Card Printer**, a thermal, on demand printer, is used to print the ballot activation code on the activation card for use with **ExpressVote** or **ExpressVote XL**.
  - **ExpressTouch Smart Card Writer** is a device used to program the ballot activation code on the **ExpressTouch** vote session activator card.

- **Electionware Toolbox** is a set of utilities that can be integrated into the **Electionware** EMS to enhance the software usability experience and streamline various processes. These add-on utilities include **Test Deck**, **Text to Speech** and **Media Restore**.
  - **Test Deck** provides a means for the election official to test the election on each machine that will be used for voting. Vote patterns can be created with automatic ballot marking, and then the ballots can be printed and scanned through the **ES&S** ballot tabulators to test logic and accuracy of the counting. Additionally, a test pattern file can be created for the **ExpressTouch**, **ExpressVote** or **ExpressVote XL** that allows automated logic and accuracy testing on the universal voting machine.
  - **Text to Speech** provides a simplified method for creating the audio wave files that make up the audible ballot.
  - **Media Restore** is used to prepare ES&S-certified USB media flash drives for use with **Electionware** by securely clearing all data and then restoring to the FAT32 format.

End of Certification Test Report

EXHIBIT 18

COMMONWEALTH OF PENNSYLVANIA

DEPARTMENT OF STATE

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

Issued By:

Robert Torres

Robert Torres
Acting Secretary of the Commonwealth
November 30, 2018

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

I. INTRODUCTION

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

Upon the request of Election Systems and Software (ES&S), the Department of State's Bureau of Commissions, Elections and Legislation (Department) scheduled an examination for June 25, 2018 of EVS 6.0.0.0 (EVS 6000). The system presented for certification in Pennsylvania included the following components - Electionware® (Electionware) election management software used in conjunction with the following components: 1) the ExpressVote XL™ (ExpressVote XL) hybrid paper-based polling place voting device; 2) the ExpressVote® Hardware 2.1 (ExpressVote 2.1) a hybrid paper-based polling place voting device that provides touch screen vote capture that can be configured as a ballot marking device (BMD) or a BMD and tabulation unit; 3) DS200® (DS200) precinct scanner; 4) DS450®(DS450) central scanner; and 5) DS850® high speed central scanner.

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

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

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

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

II. THE EVS 6021 VOTING SYSTEM

EVS 6021 is a paper-based voting system that provides end-to-end election support; from defining an election to generating final reports. The system is comprised of both precinct and central count tabulators and Universal Voting System and/or Ballot Marking Devices as ADA component. The system hardware components include: ExpressVote XL™ Full-Faced Universal Voting System, ExpressVote Universal Voting System hardware 2.1, DS450 High-Throughput Central Tabulator, DS850 High-Speed Central Tabulator and DS200 Precinct-Based Tabulator[1].

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

[1] The EAC certified system also includes ExpressTouch Electronic Universal Voting System and ExpressVote Universal Voting System hardware 1.0, but those components are not part of the system presented for certification in Pennsylvania.

Electionware®

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

ExpressVote XL™

ExpressVote XL is a hybrid paper-based polling place voting device that provides touch screen vote capture that incorporates the printing of the voter's selections as a cast vote record (CVR), and tabulation scanning into a single unit. The screen provides a display of the full ballot. This device can serve all voters, including those with special needs, allowing all voters to cast vote summary cards autonomously. Voters navigate ballot selections using the touch screen, detachable UVC keypad or ADA support peripherals, such as a sip and puff device. ExpressVote XL guides voters through the ballot selection process with screen prompts, symbols and ballot audio. The voter can print the vote summary card once they are ready to cast the vote. Once printed, the ExpressVote XL internally processes the vote summary card for tabulation. The tabulated vote summary card is deposited into a removable, secure card container attached to the ExpressVote XL cart.

ExpressVote® Hardware 2.1

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

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

DS200®

DS200 is a polling place paper-based system, specifically a digital scanner and tabulator that simultaneously scans the front and back of a paper ballot and/or vote summary card in any of four orientations for conversion of voter selection marks to electronic CVR's to be saved on USB media. DS200 scans and tabulates hand marked paper ballots and ballot cards produced from ExpressVote 2.1. It also has a touch screen for voter communication, an integrated thermal printer for printing reports and internal battery backup.

DS450®

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

DS850®

DS850 is a central scanner and tabulator that simultaneously scans the front and back of hand marked paper ballots and/or vote summary cards from ExpressVote and ExpressVote XL in any of four orientations for conversion of voter selection marks to

electronic CVR's. The tabulation results can be physically transported using USB drives or the device may be configured to transmit tabulation results to the results server through a closed network connection. DS850 provides higher throughput than DS450.

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

Manufacturer Software/Firmware

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

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

- **Electionware** Election database creation, media programming and tally/reporting software
- **DS450** Central Count scanner and tabulator, Central Tabulator firmware
- **DS850** Central Count scanner and tabulator, Central Tabulator firmware
- **DS200** Precinct scanner and tabulator, Precinct Tabulator firmware
- **ExpressVote HW2.1** Precinct ballot marker and/or Precinct scanner and tabulator, Universal Voting System firmware
- **ExpressVote XL** Precinct ballot marker and/or Precinct scanner and tabulator, using a full-face touchscreen and Universal Voting System firmware
- **ExpressLink™** standalone application that interfaces with voter registration (e.g. electronic Pollbook) systems and the ExpressVote Activation Card Printer to print the ballot activation code on an ExpressVote and ExpressVote XLcards

- **Electionware Toolbox** set of utilities that can be integrated into the Electionware EMS to enhance the software usability experience and streamline various processes. These add-on utilities include Test Deck and Text to Speech.

COTS Software/Firmware

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

Hardware

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

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

Test Materials

Test support materials utilized during the examination included:

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

III. EXAMINATION APPROACH, PROCEDURES AND RESULTS

A. Examination Approach

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

EVS 6000 Examination Approach

Functional Examination

The test protocols separated the requirements of Article XI-A of the Pennsylvania Election Code, Sections 1101-A to 1122-A, 25 P.S. §§ 3031.1 - 3031.22, into six main areas of test execution: (1) Source Code Review; (2) Documentation Review; (3) System Level Testing; (4) Security/Penetration Testing; (5) Privacy Analysis; and (6) Usability Analysis.

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

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

- 1105-A(a), 25 P.S. § 3031.5(a), requiring that an electronic voting system has been examined and approved by a federally recognized ITA;
- 1107-A(11), 25 P.S. § 3031.7(11), requiring an electronic voting system to be suitably designed in terms of usability and durability, and capable of absolute accuracy;
- 1107-A(13), 25 P.S. § 3031.7(13), requiring an electronic voting system to correctly tabulate every vote;
- 1107-A(14), 25 P.S. § 3031.7(14), requiring an electronic voting system to be safely transportable; and
- 1107-A(15), 25 P.S. § 3031.7(15), requiring an electronic voting system to be designed so voters may readily understand how it is operated.

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

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

All components of the EVS 6000 system were exercised to verify that they meet all pertinent requirements of the Pennsylvania Election Code. The test cases were designed to ascertain compliance to the following sections of the Election Code:

- 1101-A, 25 P.S. § 3031.1, requiring an electronic voting system to provide for a permanent physical record of all votes cast;
- 1107-A(2), 25 P.S. § 3031.7(2), requiring an electronic voting system to permit voting on both candidates and ballot questions, according to the official ballot;
- 1107-A(3), 25 P.S. § 3031.7(3), requiring an electronic voting system to permit straight party voting, including the "Pennsylvania method" of straight party voting;
- 1107-A(4), 25 P.S. § 3031.7(4), requiring an electronic voting system to permit a voter to vote for candidates of all different parties, and write-in candidates;
- 1107-A(5), 25 P.S. § 3031.7(5), requiring an electronic voting system to permit a voter to enter write-in votes;
- 1107-A(6), 25 P.S. § 3031.7(6), requiring an electronic voting system to permit a voter to cast votes for candidates and ballot questions he or she is entitled to vote for, and prevents a voter from casting votes the voter is not entitled to vote on;
- 1107-A(7), 25 P.S. § 3031.7(7), requiring an electronic voting system to prevent over-votes;
- 1107-A(8), 25 P.S. § 3031.7(8), requiring an electronic voting system to prevent a person from casting more than one vote for a candidate or question, except where this type of cumulative voting is permitted by law;
- 1107-A(9), 25 P.S. § 3031.7(9), requiring an electronic voting system to permit

voters to vote in their own parties' primaries, and prevents them from voting in other parties' primaries, while also permitting voters to vote for any nonpartisan nomination or ballot question they are qualified to vote on; and

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

- Parts of 1107-A(16), 25 P.S. § 3031.7(16), requiring an electronic voting system which provides for district-level tabulation to include (i) a public counter to register how many ballots are submitted to be counted; (iv) will not tabulate an over-vote, with an option to notify a voter of an over-vote if used during voting hours; and (v) generates a printed record that counters are set to zero before voting commences; and

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

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

The Security/Penetration Analysis examined the voting system's compliance with the requirements of the Pennsylvania Election Code by analyzing physical security procedures and impoundment of ballots. Precinct tabulation devices were installed for delivery to the precinct, and the Functional Examiner analyzed the pertinent security procedures performed on each device to ascertain compliance to Section 1107-A(12), 25 P.S. § 3031.7(12), requiring an electronic voting system to provide acceptable ballot security procedures and impoundment of ballots to prevent tampering with or substitution of any ballots or ballot cards. The Functional Examiner also used the security analysis phase of testing to validate

compliance to parts of Sections 1107-A(16) and (17), 25 P.S. §§ 3031.7(16) & (17) that relate to system security.

The Privacy Analysis examined the voting system's compliance to Section 1107-A(l) of the Election Code, 25 P.S. § 3031.7(1), requiring that an electronic voting system provide for absolute secrecy of the vote, by analyzing how the polling place devices met the pertinent privacy requirements.

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

Accessibility Examination

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

- **Expert review** by the Accessibility Examiner, using scenarios based on personas of people with disabilities from National Institute of Standards and Technology (NIST) and their professional experience.

- **Voters with disabilities used** the system voting a reasonable length PA ballot and completed a questionnaire about their experience. The Accessibility Examiner observed and made notes.

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

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

Security Testing

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

EVS 6021 Examination Approach

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

Functional Examination

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