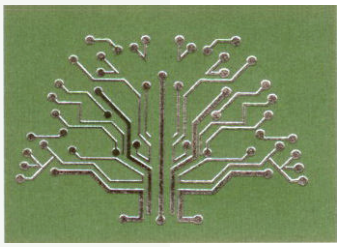

FREEMAN, CRAFT, MCGREGOR GROUP

California Secretary of State Consultant's Report on:

Functional Testing of the ES&S EVS 5.2.1.0 Voting System

And

Supplemental Security and Regression Test of the ES&S EVS 5.2.1.0 CA Voting System

Prepared for the California Secretary of State by:

Paul Craft
Kate McGregor

August 22, 2017
Updated September 26, 2017

Revision history

Version	Change date	Author(s)	Changes to previous version
1.0	2017-07-011	Paul Craft	Initial Draft
1.1	2017-07-024	Kate McGregor	Revised Draft
1.2	2017-08-22	Craft & McGregor	Response to client review Addition of attachments
1.3	2017-09-26	Craft & McGregor	Supplemental testing added to report

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Summary of System Components

The Election Systems & Software (ES&S) EVS 5.2.1.0 CA Voting System Elections voting system submitted for certification testing consisted of the following components:

Software Modules:

- Election Management System (EMS), comprised of
  - Electionware, Version 4.7.1.0
  - Event Log Service, Version 1.5.5.0
  - Removable Media Service, Version 1.4.5.0
  - Election Reporting Manager (ERM), Version 8.12.1.0
  - Voter Assist Terminal (VAT) Previewer, Version 1.8.6.0
  - ExpressVote Previewer, Version 1.4.1.0
  - ExpressLink, Version 1.3.0.0
  - Paper Ballot, Version 4.6.1.0

Hardware Components:

- DS200 Precinct Tabulator, Hardware Version 1.3, Software/Firmware 2.12.1.0
- DS850 Central Tabulator, Hardware Version 1.0, Software/Firmware 2.10.1.0
- AutoMARK Voter Assistance Terminal (VAT), Hardware Versions 1.0, 1.1, 1.3 and 1.31 Software/Firmware 1.8.6.0
- ExpressVote, Hardware Version 1.0, Software/Firmware 1.4.1.0
- ExpressVote Activation Printer

The Initial Red Team Security Report identified multiple vulnerabilities within the EVS 5.2.1.0 environment. The SOS staff identified three vulnerabilities and requested they be mitigated. These patches and updated scripts made changes to the system submitted for certification, so ES&S revised their application to reflect the version number as EVS 5.2.1.0 CA, indicating that these changes are specific to the state of California.

Scope of Work and Reporting

State certification testing for the EVS 5.2.1.0 CA consisted of a series of tests in different locations:

a. System installation and benchmarking, California Secretary of State (SOS) office, Sacramento, CA
b. Phase I, Functional Test, CA SOS office, Sacramento, CA
c. Phase II, Functional Test, CA SOS office, Sacramento, CA
d. Security Audit Test, Coherent Cyber office, San Antonio, TX
e. Source Code Review, atsec information security office, Austin, TX
f. Volume Test, Solano County Registrar of Voters, Vote by Mail Processing Center, Fairfield, CA
g. Accessibility Testing, CA SOS office, Sacramento, CA
h. Supplemental Security and Regression Test, CA SOS office, Sacramento, CA

This report covers the work completed during Phase I and Phase II Functional Tests and the Supplemental Security and Regression Test. Narratives describing the initial Security Audit Test, Source Code Review, Volume Test and Accessibility Test are presented in separate reports.

We are not attorneys and do not offer legal advice. We have assisted the SOS with collecting facts and evidence in order for them to make certification decisions. However, to advise the SOS on the determination of whether the system complies with California's certification requirements would require an interpretation of law. Accordingly we do not provide recommendations or offer any opinion as to whether the system can be certified.

The work we performed and our findings are strictly limited to the specific serial numbered hardware elements and specific software elements exercised during this test. An inventory of those items is included as Attachment A to this report. The results described in this report should be reliable and repeatable for those specific devices. The decision to apply those results to other machines is solely at the discretion and risk of the Secretary of State and election officials who purchase the system. Although Attachment A can be used as part of a baseline to reach conclusions regarding the compliance of other items, anyone who wishes to determine the compliance of newly purchased systems or the compliance of a system that is already in use should conduct appropriate acceptance testing or system validation analysis to support those conclusions.

Description of System Submitted for Certification

ES&S EVS 5.2.1.0 CA is a voting system that utilizes paper ballots. The system is comprised of a suite of software applications that provide end-to-end election management functions. These functions include generating election definitions, creating ballot layout, programming voting devices, collecting and consolidating tabulation data, reporting results and producing audit logs. The applications may be installed on a freestanding workstation or in a client and server configuration. The Election Reporting Manager may be installed as a stand-alone workstation or client workstation. The software applications can be set up to support any of the hardware components described below:

The DS200 is a digital scan tabulator that scans and stores a full-page image of the ballot. During tabulation, the images are processed by proprietary mark recognition software. Ballots may be fed to the machine in any orientation. The DS200 is generally used to tabulate ballots in a polling place, but also may be used as a central count device in small jurisdictions.

The DS850 is a high-speed digital scan ballot counter that scans and stores ballot images. It is used in central count operations. As ballots are tabulated, the images are processed by proprietary mark recognition software. This tabulator can out stack write-in ballots and unreadable ballots into separate batches. Ballots may be fed to the machine in any orientation. It is normally used to tabulate mail-in and provisional ballots.

The AutoMARK Voter Assist Terminal is a ballot-marking instrument that accepts unmarked ballots and, through a Direct Recording Electronic (DRE) style touch screen, allows the voter to select, review and correct their choices before the ballot is marked. Once the voter makes their selections, the AutoMARK prints their choices on the ballot. The ballot is returned to the voter and they take it either to one of the precinct scanners or to a ballot box for central tallying. The VAT includes alternative interfaces for voters with disabilities, including enhanced visual and audio presentations of the ballots and support for alternative assistive devices such as large binary switches and sip and puff mechanisms. A voter may also insert a marked ballot and verify that the ballot is marked properly through either a visual screen or an audio ballot playback.

The ExpressVote is a vote capture device that prints a paper cast vote record of the voter's selections that can be scanned by either a DS200 or a DS850. The paper cast vote record is printed on ES&S proprietary thermal card stock. The paper cast vote record may be blank, or it may be preprinted with bar codes indicating the voter's precinct, ballot style and party. The ExpressVote allows the voter to select, review and correct their choices before their choices are

printed on the paper cast vote record. After the paper cast vote record is printed, it is returned to the voter who carries it to a precinct scanner or deposits it in a ballot box. The ExpressVote also includes alternative interfaces for voters with disabilities.

In addition to using a VAT, voters can mark their ballots manually with a pen or pencil. The ballots and paper records from the ExpressVote are generally tabulated on a scanner, but in the case of an audit, a recount, or a review by ballot resolution boards they can also be counted manually.

Overview of System Operation

EVS 5.2.1.0 CA provides an end-to-end suite of software and voting equipment used to conduct elections. The Electionware software module defines an election and creates the media files used by the ExpressVote, DS200 Tabulator, AutoMARK VAT, DS850 Central Ballot Scanner and the ERM software module. A flow chart illustrating the system configuration can be found in Attachment B.

The Election Reporting Manager accumulates and consolidates election results from the DS200 and DS850 tabulators. It generates both paper and electronic reports and can display election results on monitors.

The Event Log Service runs in the background, recording user access and actions performed in Electionware and Election Reporting Manager. The ExpressVote and VAT Previewer applications allow election administrators to preview and proof ballot layouts and to identify any problems before the election is loaded on those devices.

ExpressLink is an application that prints activation cards for the ExpressVote through the ExpressVote Activation Card Printer. It prints bar codes on the activation card that designate the voter's precinct, ballot style, and party. It can be run in standalone mode or be driven by a voter registration system.

Paper Ballot is a tool found in the design module of the Electionware program. It reads information in the election definition database and converts it into finished ballots for the ballot scanners. It can also produce ballot formats that can be printed by ES&S Ballot Services, other authorized printers or local jurisdictions to print extra ballots.

Federal Certification

The United States Election Assistance Commission, Certification Number ESSEVS5210 was issued for EVS 5.2.1.0 on December 18, 2015. The system is a modification to the previously certified system, EVS 5.2.0.0, Certification Number ESSEVS5200 issued on July 2, 2014.

Approach to Testing

Functional Test

Prior to functional testing, the operating system was installed and benchmarks were established. The test procedures outlined by the California Secretary of State require that the hard drives of all computers used during a test are completely wiped and a fresh installation of the operating system is completed. After the hard drives were wiped, the system software and required supporting utilities were installed from trusted installation media following the documentation provided by the vendor. This work was completed during the week of March 20, 2017. ES&S determined that the configuration of the Dell PowerEdge T630 originally submitted for certification would not adequately serve all California counties. They withdrew that server from the application and replaced it with new configurations of the Dell Power Edge server models T430 and T630 to better serve the diverse population densities among the counties. These machines were built prior to the beginning of Phase II testing.

The functional test was a joint effort shared by consultants, SOS staff and vendor staff. The Freeman, Craft, McGregor Group (FCMG) and SOS jointly managed the test. ES&S provided technical support and witnessed the test. Personnel included:

FCMG:

- Paul Craft
- Kate McGregor
- Jacob Stauffer

SOS

- NaKesha Robinson
- Todd Ross
- Rodney Rodriguez

ES&S

- Brooke Thernes

The functional test was divided into two phases. Phase I included the steps necessary to install the system, develop test elections, provide ES&S with the data they require to print test ballots and prepare equipment for Red Team Penetration Test. This work was completed during the week of April 10, 2017. Phase II exercised the system by staging test elections and documenting the results of those elections in accordance with the California Use Procedures. During Phase II, equipment was also prepared for Red Team Penetration Test and benchmark data was established for use in future forensic validation by the California Secretary of State. This work was completed during the week of May 8, 2017.

Test elections used for functional testing included:

- A Primary election based on a Sacramento County election
- A General election based on a Contra Costa County election
- A Primary election based on a Sacramento County election configured for a countywide voter center
- A Recall election
- A Recall election using a contest type of "Recall Question"
- A Ranked Choice election

Supplemental Security and Regression Test

The SOS began working with ES&S to address multiple vulnerabilities that were identified during the Initial Security Audit Tests of the system. Once the mitigation was determined, a test team was assembled to apply the system patches and perform regression tests. These tests were conducted by FCMG, the SOS and ES&S. FCMG and SOS jointly managed the tests. ES&S provided technical support and witnessed the tests. Personnel included:

FCMG:

- Paul Craft
- Kate McGregor
- Steve Weingart

Coherent Cyber:

- Jacob Stauffer

SOS

- NaKesha Robinson
- Rodney Rodriguez

ES&S

- Chris Grabow
- Brandon Martin
- Brooke Thernes

The servers and workstations have remained in secure storage at the office of the Secretary of State. Two stand-alone workstations were wiped and a fresh installation of the operating system was completed. After the hard drives were wiped, the system software, required supporting COTS and voting system software were installed from trusted media and hardened following the documentation provided by the vendor. The server and client workstations were upgraded and hardened following procedures provided by the vendor.

After system upgrades were completed, security scans were run on all machines. The vulnerabilities mitigated on all machines were the same.

In order to verify that system functionality was not degraded by the increased security, regression tests were performed. A General election based on a Contra Costa County election was run on a stand-alone workstation and a Primary election configured for a countywide voter center in Sacramento County was run on a client/server configuration. Each test involved loading election data and creating programming media for the AutoMARK, ExpressVote, DS200 and DS850. Audio ballots and the ability to review a voted ballot were tested on the AutoMARK and ExpressVote. Ballots were tabulated on the DS200 and the DS850. The results were printed and verified to match expected results. Election data from the scanners was transferred back to the Election Reporting Manager (ERM). Consolidated reports were prepared, printed and verified.

In previous security tests, the tamper evident seals recommended by ES&S were defeated. Tests showed that they could be removed and reapplied without showing any evidence of tampering. ES&S provided six different seals for retesting. Of those six, one could not be defeated during the test.

Scope Limitation

Phase II tests were conducted during the week of May 8, 2017. During that time, it became apparent that ES&S needed to provide additional documentation to set up the system. This documentation included a revised version of the Server Installation Procedures and new appendices to the portions of the Election Programming Guide that deal with Ranked Choice Voting (RCV) Elections, rolling up an election definition from a Primary to a General, and System Limitations. FCMG has reviewed these documents but cannot express an opinion on them. The documentation was not filed with the SOS until June 8, 2017, well after the final round of functional tests was completed. These documents were not available for validation during any phase of the functional test, however, they were subsequently audited and validated by OVSTA staff during the week of August 14, 2017.

Detailed Report on the Phases of Testing

Test servers and workstations that had been previously wiped clean by SOS staff were built during the week of March 20, 2017. The operating system and Commercial Off the Shelf (COTS) software required by the voting system were installed. The machines were configured and hardened according to ES&S specifications and a trusted build of the ES&S EVS 5.2.1.0 CA applications were loaded. After the servers were configured, they were hashed and images of each machine were taken. Firmware from trusted builds was installed on the hardware apparatus, DS850, DS200, AutoMARK and ExpressVote. ES&S system validation procedures were exercised on one of each of the machine models. During this phase, a number of anomalies occurred. Most were a result of documentation errors, poorly seated hard drives and improperly formatted jump drives. After the software was installed and the machines were configured, the incident log was updated to include the documentation errors.

On March 31, 2017, ES&S announced their decision to withdraw the server models and replace them with Dell Power Edge Server models T430 and T630. The new servers arrived May 8th.

During the week of April 10, 2017, Electionware was exercised on a standalone workstation. The test began by creating a recall election. In Electionware, there is a menu for "Contest Types" that includes a setting for a "Question" and another one for a "Recall Question." The documentation was unclear as to the logical difference between a "Question" and a "Recall Question," so a short, simple test election was developed to exercise the logic. The election was tested on an ExpressVote and it was determined that there is no logical difference between a "Recall Question" and a "Question."

Next, the Recall election was defined. This election was modeled after the October 7, 2003 California Gubernatorial Recall election. The election had one hundred thirty-five candidates with ballot positions and one write-in. This election tests the system's ability to handle a contest with one hundred thirty-five candidates. This ballot is also used to test the hardware's ability to read marginal marks and the consistency of the point at which marginal marks are not read. The election was created following system documentation with no anomalies.

The Primary election configured for a countywide vote center was based on the June 5, 2012 Sacramento Presidential Primary Election. The original election definition was modified to support a countywide, all poll vote center, an absentee collection center and an early all poll vote center. This election simulated the procedure in a county that uses ES&S Election Services to create their election definitions. It was created with no anomalies.

The Primary election configured for precinct and polling place voting was also based on the June 5, 2012 Presidential Primary. The election was scaled down, reducing the number of races and the number of candidates in races in order to test the system functionality required by law without necessitating an excessive number of test ballots. This election also simulated the process in a county that uses ES&S Election Services. It was created with no anomalies.

The General election definition was based on the election held in Contra Costa County on November 6, 2012. This test election was also scaled down from the original in order to test the required system functions without using an inordinate number of test ballots. The election was defined using delimited text files based on candidate, contest, and voter registration data in the county. An anomaly was experienced when the system would not load audio ballot files. Empty wave files that were rejected by the system caused this error. The election definition was completed with no other anomalies.

A fictitious Ranked Choice Vote election was created that allowed the voter three choices for each office. The system does not perform RCV tabulation. Rather, it tabulates the number of votes for each candidate in each ranking and produces a "Cast Vote Record" in a spreadsheet file. This file shows the number of votes cast for each candidate for each ranking on every ballot. The cast vote file can be used to manually tabulate the vote following an RCV tabulation algorithm. This election definition was created with no anomalies. Ballots were tabulated. The cast vote file was created, audited against the ballots cast and found to match the ballots cast.

During the week of May 8, 2017, the two new servers arrived. They were wiped and built following the installation procedures provided by ES&S and Phase II of the functional test was completed.

The Recall election was run on the standalone workstation. Media was burned and loaded onto a DS850 and a DS200. A ballot was prepared using a wide range of marks, including five that complied with the instructions on the first page of the ballot. One mark was made with a marker provided by the vendor. Eighty-six marks were potentially unreadable, or marginal, marks. The expectation was that marks that meet the system specifications will be read with accuracy approaching 100% and marks that are unreadable will be consistently not read and that the range of marginal marks, those marks that are sometimes read and sometimes not, should be fairly narrow. The ballot was scanned ten times on a DS200 and ten times on a DS850. An image of the ballot can be found in Attachment C. Hand written notes to the right of each candidate indicate how many times the mark was read by the DS850 and the DS200. All of the marks that were produced with the recommended type of marker and filled the oval or crossed the center of the oval with a solid line were read correctly every time on both scanners.

The RCV election was run on the standalone workstation. Ballots were scanned and the Cast Vote Record file was produced. The file was opened in Microsoft Excel. Each row of the file contained the selections made on a ballot. The file content was audited against the ballots in the test deck and found to be an exact match.

The ExpressVote does not display the three RCV selections for each contest. Instead, the ExpressVote presents a single page for each ranked choice in a given contest. On an ExpressVote, voting all three rankings in one race requires the voter to navigate through three separate screens

The Primary election was run on the standalone workstation. Media was burned and installed on the hardware. A Logic and Accuracy test was conducted on the DS850 and the DS200 and verified against expected results. When the results from the DS200 were verified, the result for under votes in multiple vote-for contests was reported as the number of votes lost. An unvoted vote for three contest was reported as three under votes. This differed from the results that were reported by the DS850, where the race was counted as one under vote. An erroneous setting in Electionware caused this anomaly. After this issue was resolved, the Primary election was run. Test ballots were tabulated on the DS200 and DS850 scanners and the polls were closed. Media was transferred to, and consolidated in, ERM and results reports were prepared. The results were audited and matched the expected results.

The Vote Center Primary was run on the client/server with the T630 server. Media was burned for the Vote Center Primary election. The documented limitation for both the ExpressVote and the AutoMARK is 6,400 ballot styles. The test election included 5,284 ballot styles. The object of this test was to verify that Electionware, the precinct and the central count devices could support an election that incorporated a number of ballot styles approaching the maximum without an adverse effect on their performance. The election was run with no anomalies.

The General election was run on the client/server with the T430 server. Media was burned and installed on the hardware. This test was conducted in a manner similar to that of the Primary election. No anomalies occurred. The results were audited and matched the expected results.

AutoMARK and ExpressVote Functionality

In the Primary and General test elections, ballots voted on the AutoMARK and ExpressVote devices were added to the test decks. The AutoMARK ballots included selections that were located near the corners of the ballots, where the machine is most likely to mark outside of the target area if the ballot gets skewed. The expected results for the elections were adjusted to include these ballots. All of the marks produced by the devices matched the voter's input and

were read accurately by the scanners. One ballot that was voted on an AutoMARK was mismarked by the machine, which caused the machine to error out. When the anomaly was investigated, the ballot turned out to be defective. One of the timing marks on the side of the ballot had a white space within the mark. This defective timing mark was adjacent to where the ballot was mismarked. The audio ballots were also exercised during voting. The Primary election included three languages, English, Spanish and Chinese. All three languages were incorporated in both the audio and video ballots.

Exercise of the AutoMARK and ExpressVote Accessibility Functions

The AutoMARK and ExpressVote have similar accessible voter interfaces. Both machines offer a touch screen display that is capable of high contrast and magnified displays. The volume and speed at which the audio files are played can be adjusted on each device. Both machines use keypads that provide all of the functions available on the touch screen. The keypad on the AutoMARK is built into the body of the machine to the right of the touchscreen. The keypad on the ExpressVote is on a stretch cord that can be held by the voter, placed in their lap or placed on an adjacent table. The keypad can also be stowed in a compartment located behind the privacy screen. The touch screen and the keypad for either machine can be operated with one hand, including a closed fist. However, a voter who operates the ExpressVote keypad with one hand may need a poll worker to hold it steady.

Both machines can be operated using accessible binary switches such as a sip and puff device or large paddle switches. They also offer a standard pin plug where a voter may plug in their own binary switch.

The audio ballot and video ballot can work both separately and simultaneously. When the ballot comes up the video ballot is displayed and the audio ballot is running. The keypad includes a “Screen Button” which turns the video ballot on and off. Each time the button is pushed the audio stream notifies the voter whether the screen has been turned on or off.

After the initial instructions are given to the voter and the poll worker has selected the correct precinct and party, the voter is able to operate both devices independently. They can mark their ballot, confirm its content and cast the ballot without assistance. The audio ballot is silent when the poll worker is selecting the precinct and party, as well as during any other actions that are completed by a poll worker. Separate instructions are provided for the audio and video ballots. The instructions shown on the touch screen describe how to vote with the touch screen and the instructions provided by the audio ballot are specific to voting with the accessible keypad. Neither set of instructions provides instructions for a sip and puff device or

other binary switches. A voter who uses the video ballot and a binary switch can view the screen, see how the system responds to the switch and learn how to navigate the ballot. It is more difficult for a voter who does not see the screen and relies on only the audio ballot and a binary switch. Although the use of binary switches is infrequent, supplemental instructions should be provided to voters who do use them.

The voter is able to determine the races for which they are eligible to vote, which candidates are in each race and how many candidates may be selected in each race. The voter can review which candidates they have selected at any time by using the review screen or returning to a specific race. The voter may change any selection previously made and confirm the new choice prior to printing the ballot. The system communicates to the voter if they have failed to vote the allowable number of candidates in any race to prevent an unintentional under vote and it prevents the voter from over voting any race.

A voter can use the accessible devices to write in a candidate's name for any contest that allows write-ins. However, if a voter uses the binary switches, this may prove to be time consuming. Both devices allow the voter to proceed through the alphabet as well as use space, backspace, cancel and OK buttons, but these actions are in a continuous string and operate in only one direction. For example, to enter "ZEBRA" using one of these devices requires three rounds through the alphabet, the first to get to Z, and then go back to the beginning so they can select E. In order to get back to B the voter must pass through the remainder of the alphabet and the buttons at the end. Once the B is selected they can proceed down to R, but must go through the remainder of the string to get back to A. This results in a total of 115 button presses or sip and puff motions. After the write-in is complete, the voter can review their input, edit it and confirm that the edits meet their intent.

The voter has to take a clear, identifiable action in order to cast the ballot. The system clearly instructs the voter through this process. Once the ballot is cast, the system confirms that the action occurred and that the process of voting is complete.

Once the ballot is printed, the voter can rescan it and review their selections through either the audio or video option and the system will notify them of any under voted contests. However, if the voter wants to change their printed ballot they must spoil that ballot, get another ballot from a poll worker and re-vote. The AutoMARK instructions instruct the voter to get another ballot from a poll worker. The ExpressVote does not.

Functional Findings

Within the test, the ES&S EVS 5.2.1.0 CA Voting System performed with no tabulation or reporting errors. Three of the test elections were designed to verify that the system is able to support the types of elections currently held in in California: a Primary, General and Recall. Two additional test elections were designed to verify that the system is able to support elections using countywide, all precinct vote centers and a RCV election.

The system does not perform RCV tabulation, but it creates a Cast Vote Records spreadsheet file. This file can be used to manually tabulate the results or incorporate other software products outside of the system to determine the results. ExpressVote does not display the RCV columns on its touchscreen. Instead, each ranked choice is presented as a single column ballot with one page for each choice so, in a single contest voting each choice requires three screens. This makes the usability less user friendly since, in an election with numerous contests, navigating through multiple pages becomes more complicated and could confuse a voter.

There were a number of errors found in the documentation. The errors were reported to ES&S and they were asked to make the necessary corrections. The revised documentation was received from ES&S on June 8, 2017, and the corrections were subsequently verified.

A new set of instructions was required to configure the Dell servers. In addition, the Election Programming Guide needed new appendices to cover RCV elections, rolling up an election definition from a Primary to a General and System Limitations. These documents were also received on June 8, 2017. The documents were reviewed and they address the subject areas. As stated in the Scope Limitations, these documents arrived after the functional tests were concluded so they were not validated during the functional test. However, they were audited and verified by OVSTA staff during the week of August 14, 2017.

ES&S provided procedures using scripts run in a Linux environment to verify the software and firmware on the AutoMARK, DS200, DS850, ExpressVote and EMS. These procedures were exercised during the functional tests. The scripts are designed to verify ES&S specific files. These scripts are not suitable for a forensic system validation. A confidential analysis and specific recommendations for improving these procedures has been provided to the SOS and ES&S.

Supplemental Security Test Findings

The Initial Red Team Security Report identified multiple vulnerabilities within the EVS 5.2.1.0 environment. The SOS staff identified three vulnerabilities and requested they be mitigated. Each is listed below along with the mitigation. From September 19 to September 22, 2017, SOS staff, ES&S and FCMG applied security patches and updated scripts, then conducted functional regression tests. These patches and updated scripts made changes to the system submitted for certification, so ES&S revised their application to reflect the version number as EVS 5.2.1.0 CA, indicating that these changes are specific to the state of California. These changes include:

Multiple operating system patches—Microsoft patches were applied to each hardware component, the T630 and T430 servers and four Dell OptiPlex 5040 workstations. The patches are up-to-date as of September 2017.

Unquoted Service Path, found on servers and clients--ES&S developed a visual basic script that was applied to the environment to address this vulnerability. The first version was not successful, but a second script was developed and, when applied, it mitigated the issue.

Hardware Encryption --Full hardware encryption including server, workstation, and auxiliary hardware such as DS 200, DS 850, and ExpressVote will be addressed in future ES&S releases.

Additional Vulnerabilities Addressed

During the regression test, Dell released a patch addressing the Active Management Technology (AMT) vulnerability. The patch was applied to the Dell servers and the AMT vulnerability was mitigated.

Six new security seals were tested on the plastic case top of a DS 200, and the surface of the Dell servers. Of those six seals, only one—the “red and white seal”, showed evidence of tampering. Images of this seal and its tamper evidence are provided in Attachment D.

Regression Test Findings

Regression tests involved a General and Primary election in order to exercise the functionality of ballot configurations, tabulation, results reporting, ballot marking and restoring election definitions. One potentially fatal error occurred while attempting to finalize ballots for the Primary election. However, it was determined to be a coding error in the ballot layout. Once this error was corrected the Primary election was restored and run without incident.

Attachment A

Inventory of Components

EMS Small Server

Vendor	Model	Serial# or Service Tag#
Dell	PowerEdge T430	HZ8SJH2
Dell	Dell 23" Monitor E2316H	CN-0YDPKC-74445-4BI-AXU8
	Wired USB Keyboard and Mouse	

COTS Software

Vendor	Product	Version
Microsoft	Windows Server 2008	R2 /SP1
Microsoft	WSUS Offline Updates	11.0.1
Microsoft	Security Update	KB4038777
Microsoft	Security and Quality Update for .NET Framework	KB4041083
Symantec	Endpoint Protection 64 Bit	14.0.0
Symantec	Endpoint Protection Update	20170904-005-SONAR_IU_SEP.exe
Symantec	Endpoint Protection Update	20170911-021-IPS_IU_SEP_14.exe
Symantec	Endpoint Protection Update	20170912-001-CORE3SDSV5I64.EXE

ES&S Software

Vendor	Product	Version
ES&S	Electionware – Server Installation	4.7.1.0

EMS Large Server

Vendor	Model	Serial# or Service Tag#
Dell	PowerEdge T630	86KVHH2
Dell	Dell 23" Monitor E2316H	CN-0YDPKC-74445-4BI-AXU8
	Wired USB Keyboard and Mouse	

COTS Software

Vendor	Product	Version
Microsoft	Windows Server 2008	R2 /SP1
Microsoft	WSUS Offline Updates	11.0.1
Microsoft	Security Update	KB4038777
Microsoft	Security and Quality Update for .NET Framework	KB4041083
Symantec	Endpoint Protection 64 Bit	14.0.0
Symantec	Endpoint Protection Update	20170904-005-SONAR_IU_SEP.exe
Symantec	Endpoint Protection Update	20170911-021-IPS_IU_SEP_14.exe
Symantec	Endpoint Protection Update	20170912-001-CORE3SDSV5I64.EXE

ES&S Software

Vendor	Product	Version
ES&S	Electionware – Server Installation	4.7.1.0

ERM Standalone Workstation Client 1

Vendor	Model	Serial# or Service Tag#
Dell	Optiplex 5040	14NDC3C2
Dell	Dell 23" Monitor E2316H Wired USB Keyboard and Mouse USB Printer and Drivers	CN-0X0Y40-72872-6AQ-A67L-A00

COTS Software

Vendor	Product	Version
Microsoft	Windows 7 Professional	64-Bit SP1
Microsoft	WSUS Offline Updates	11.0.1
Microsoft	Security Update	KB4038777
Microsoft	Security and Quality Update for .NET Framework	KB4041083
Symantec	Endpoint Protection 64 Bit	14.0.0
Symantec	Endpoint Protection Update	20170904-005-SONAR_IU_SEP.exe
Symantec	Endpoint Protection Update	20170911-021-IPS_IU_SEP_14.exe
Symantec	Endpoint Protection Update	20170912-001-CORE3SDSV5I64.EXE
Adobe	Adobe Acrobat Standard	11
Micro Focus	RM COBOL Runtime	12.06

ES&S Software

Vendor	Product	Version
ES&S	Event Log Service (ELS)	1.5.5.0
ES&S	Removable Media Service (RMS)	1.4.5.0
ES&S	Election Reporting Manager (ERM)	8.12.1.0

EMS Standalone Workstation Client 2

Vendor	Model	Serial# or Service Tag#
Dell	Optiplex 5040	5KMD3C2
Dell	Dell 23" Monitor E2316H Wired USB Keyboard and Mouse USB Printer and Drivers	CN-0X0Y40-72872-6AQ-AC1L-A00

COTS Software

Vendor	Product	Version
Microsoft	Windows 7 Professional	64-Bit SP1
Microsoft	WSUS Offline Updates	11.0.1
Microsoft	Security Update	KB4038777
Microsoft	Security and Quality Update for .NET Framework	KB4041083
Symantec	Endpoint Protection 64 Bit	14.0.0
Symantec	Endpoint Protection Update	20170904-005-SONAR_IU_SEP.exe
Symantec	Endpoint Protection Update	20170911-021-IPS_IU_SEP_14.exe
Symantec	Endpoint Protection Update	20170912-001-CORE3SDSV5I64.EXE
Adobe	Adobe Acrobat Standard	11
Micro Focus	RM COBOL Runtime	12.06

ES&S Software

Vendor	Product	Version
ES&S	Event Log Service (ELS)	1.5.5.0
ES&S	Removable Media Service (RMS)	1.4.5.0
ES&S	Election Reporting Manager (ERM)	8.12.1.0
ES&S	VAT Previewer	1.8.6.0
ES&S	ExpressVote Previewer	1.4.1.0
ES&S	Electionware - All Components	4.7.1.0

EMS Client Workstation Client 3

Vendor	Model	Serial# or Service Tag#
Dell	Optiplex 5040	5QMD3C2
Dell	Dell 23" Monitor E2316H Wired USB Keyboard and Mouse USB Printer and Drivers	CN-0X0Y40-72872-6AQ-A6EL-A00

COTS Software

Vendor	Product	Version
Microsoft	Windows 7 Professional	64-Bit SP1
Microsoft	WSUS Offline Updates	11.0.1
Microsoft	Security Update	KB4038777
Microsoft	Security and Quality Update for .NET Framework	KB4041083
Symantec	Endpoint Protection 64 Bit	14.0.0
Symantec	Endpoint Protection Update	20170904-005-SONAR_IU_SEP.exe
Symantec	Endpoint Protection Update	20170911-021-IPS_IU_SEP_14.exe
Symantec	Endpoint Protection Update	20170912-001-CORE3SDSV5I64.EXE
Adobe	Adobe Acrobat Standard	11

Micro Focus	RM COBOL Runtime	12.06

ES&S Software

Vendor	Product	Version
ES&S	Event Log Service (ELS)	1.5.5.0
ES&S	Removable Media Service (RMS)	1.4.5.0
ES&S	Election Reporting Manager (ERM)	8.12.1.0
ES&S	VAT Previewer	1.8.6.0
ES&S	ExpressVote Previewer	1.4.1.0
ES&S	Electionware - Client Installation	4.7.1.0

EMS Client Workstation Client 4

Vendor	Model	Serial# or Service Tag#
Dell	Dell Optiplex 5040	GMQKD82
Dell	Dell 23" Monitor E2316H	Not Recorded
	Wired USB Keyboard and Mouse	
	USB Printer and Drivers	

COTS Software

Vendor	Product	Version
Microsoft	Windows 7 Professional	64-Bit SP1
Microsoft	WSUS Offline Updates	11.0.1
Microsoft	Security Update	KB4038777
Microsoft	Security and Quality Update for .NET Framework	KB4041083
Symantec	Endpoint Protection 64 Bit	14.0.0
Symantec	Endpoint Protection Update	20170904-005-SONAR_IU_SEP.exe
Symantec	Endpoint Protection Update	20170911-021-IPS_IU_SEP_14.exe
Symantec	Endpoint Protection Update	20170912-001-CORE3SDSV5I64.EXE
Adobe	Adobe Acrobat Standard	11
Micro Focus	RM COBOL Runtime	12.06

ES&S Software

Vendor	Product	Version
ES&S	Event Log Service (ELS)	1.5.5.0
ES&S	Removable Media Service (RMS)	1.4.5.0
ES&S	Election Reporting Manager (ERM)	8.12.1.0
ES&S	VAT Previewer	1.8.6.0
ES&S	ExpressVote Previewer	1.4.1.0
ES&S	Electionware - Client Installation	4.7.1.0

AutoMARK (VAT)

Vendor	Model/Hardware Version/Firmware	Serial#
ES&S	Model A100/HW1.0/1.8.6.0	AM0106431423
ES&S	Model A300/HW 1.3.0/1.8.6.0	AM0308421582
ES&S	Model A200/HW1.1/1.8.6.0	AM02006461961
ES&S	Model A300/HW 1.3.1/1.8.6.0	AM0208490407

DS200 Ballot Scanner

Vendor	Hardware Version/Firmware Version	Serial#
ES&S	1.3/2.12.1.0	DS0316371033
ES&S	1.3/2.12.1.0	DS0315380813
ES&S	1.3/2.12.1.0	DS0315381002
ES&S	1.3/2.12.1.0	DS0315380937
ES&S	1.3/2.12.1.0	DS0315380974
ES&S	1.3/2.12.1.0	DS0316370810

ExpressVote UVD

Vendor	Hardware Version/Firmware Version	Serial#
ES&S	1.0/1.4.1.0	EV0115412606
ES&S	1.0/1.4.1.0	EV0115370012
ES&S	1.0/1.4.1.0	EV0115412382

DS850 Ballot Scanner

Vendor	Hardware Version/Firmware Version	Serial#
ES&S	HW 1.0/2.10.1.0	DS8509420014

Hardware Devices used in the Regression Test included:

AutoMARK (VAT)

Vendor	Model/Hardware Version/Firmware	Serial#
ES&S	Model A200/HW1.3.1/1.8.6.0	AM0208490407

DS200 Ballot Scanner

Vendor	Hardware Version/Firmware Version	Serial#
ES&S	1.3/2.12.1.0	DS0315380974

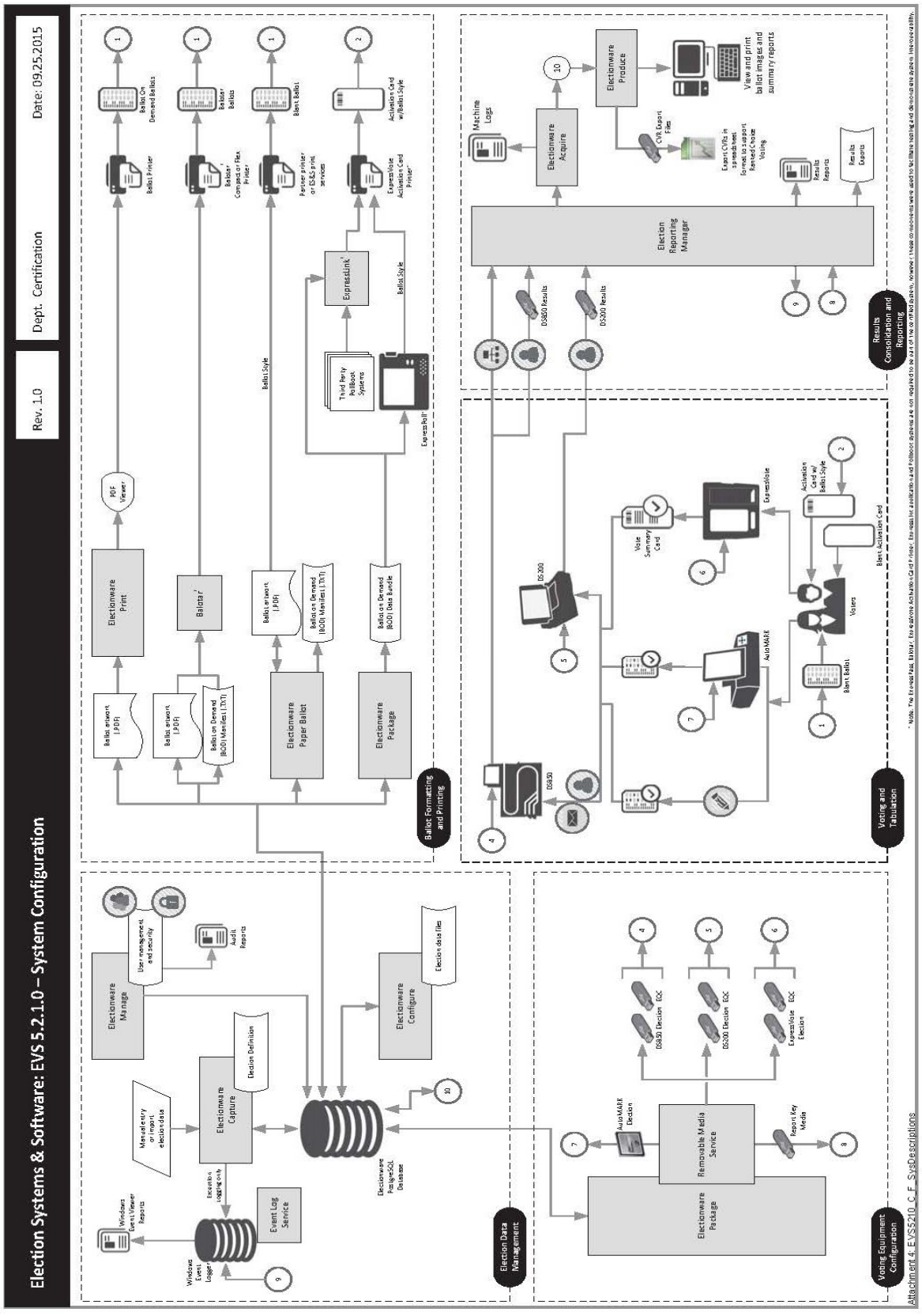
ExpressVote UVD

Vendor	Hardware Version/Firmware Version	Serial#
ES&S	1.0/1.4.1.0	KO115350052

DS850 Ballot Scanner

Vendor	Hardware Version/Firmware Version	Serial#
ES&S	HW 1.0/2.10.1.0	DS8509420014

Attachment B



Attachment C

EVS 5.2.1.0 Certification
Marginal Mark Test

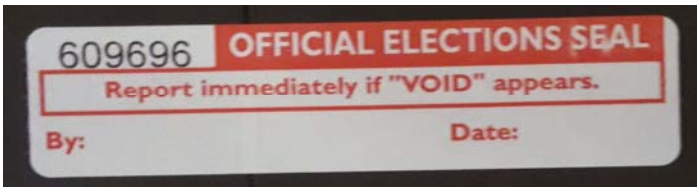
Question
Shall Gravy Davis be recalled from the office of Governor?
Yes ○ No ○

Governor
Vote for no more than Eighty
850 200

Iris Adams Republican	10	10
Brooke Adams Democratic	10	10
Alex-St James American Independant	10	10
Douglas Anderson Peace and Freedom	10	10
Angelyne Green	10	10
Arif Mohammed Libertarian	0	0
Badi Badiozamani NONPARTISAN	0	0
Vik S. Bajwa Republican	0	0
John W. Beard Democratic	0	0
Ed Beyer American Independant	0	0
Vip Bhola Peace and Freedom	0	0
Cheryl Bly-Chester Green	10	10
Audie Bock Libertarian	10	10
Joel Britton NONPARTISAN ←No	0	0
Art Brown Republican	10	9
John Christopher Burton Democratic	1	0
Cruz M Bustamante American Independant	0	0
Peter Miguel Camejo Peace and Freedom	0	0
Todd Carson Green	0	0
William "Bill" S. Chambers Libertarian	0	0
Michael Cheli NONPARTISAN	10	10
(Logan Darrow) W Clements Republican	0	0
Gary Coleman Democratic	0	0
Mary "Mary Carey" Cook American Independant	9	10
Robert Cullenbine Peace and Freedom	0	0
Scott Davis Green	0	0
Robert "Butch" Dole Libertarian	10	10
Bob Lynn Edwards NONPARTISAN	10	10
Warren Farrell Republican	10	10
Dan Feinstein Democratic	10	10
Larry Flynt American Independant	0	0
Lorraine (Abner Zurd) Fontanes/ Peace and Freedom	0	10
Gene Forte Green	10	10
Diana Foss Libertarian	0	0
Ronald J. Friedman NONPARTISAN	0	0
Leo Gallagher Republican	0	0
Gerald Lee Gorman Democratic	10	10
Rich Gosse American Independant	10	10
James H. Green Peace and Freedom	0	0
Jack Lloyd Grisham Green	0	0
Garrett Gruener Libertarian	0	0
Joe Guzzardi NONPARTISAN	0	0
Ivan A. Hall Republican	0	0
Ken Hamidi Democratic	10	10
Sara Ann Hanlon American Independant	0	10
Stephen C. Henderson Peace and Freedom	0	0
Ralph A. Hernandez Green	0	0
John J. "Jack" Hickey Libertarian	0	0
Jim Hoffmann NONPARTISAN	0	10
Ariana Huffington Republican	0	0
S. Issa Democratic	0	0
Michael Jackso American Independant	10	10
Trek Thunder Kelly Peace and Freedom	10	10
Edward (Ed) Kennedy Green	10	10
D. E. Kessinger Libertarian	10	7
Kelly P. Kimball NONPARTISAN	0	0
Stephen L. Knapp Republican	0	0
Eric Korevaar Democratic	10	10
Jerry Kunzman American Independant	0	0
Dick Lane Peace and Freedom	0	0
Gary Leonard Green	10	10
Todd Richard Lewis Libertarian	0	10
Calvin Y. Louie NONPARTISAN	0	0
Frank A. Jr. Macaluso Republican	10	10
Paul "Chip" Mailander Democratic	3	1
Robert C. Mannheim American Independant	0	0
Bruce Margolin Peace and Freedom	10	10
Paul Mariano Green	1	6
Gino Martorana Libertarian	0	0
Mike P. McCarthy NONPARTISAN	0	0
Bob McLean Republican	0	0
Tom McClintock Democratic	10	10
Dennis Duggan McMahon American Independant	10	10
Mike McNeilly Peace and Freedom	10	10
Scott A. Mednick Green	0	0
Carl A. Mehr Libertarian	10	10
Johnathan Miller NONPARTISAN	10	10
Darryl L. Mobley Republican		
Jeffrey L. Mock Democratic		
John "Jack" Mortensen American Independant		
Dorene Musilli Peace and Freedom		
Paul Nave Green		
Robert C. II Newman Libertarian		
Leonard Padilla NONPARTISAN		
Ronald Jason Palmieri Republican		
Gregory J. Pawlik Democratic		
Heather Peters American Independant		
Charles "Chuck" Jr. Pineda Peace and Freedom		
Bill Prady Green		
Darin Price Libertarian		
Brooke Thernes Democratic		
Paul Craft Republican		
Bruce McDannold Democratic		
Steve Freeman Republican		
Kate McGregor Peace and Freedom		
Todd Ross American Independant		
Alex Padilla Democratic		
Ryan Macias Republican		
Jeff Rodencil Democratic		
Ben Swartz Republican		
NaKesha Robinson Peace and Freedom		
Jacob Stauffer Republican		
Rodney Rodriguez Democratic		
Susan Lapsley Green		
Steve Pearson Republican		
Tom Burt Republican		
John Galt Libertarian		
Micky Mouse American Independant		
Donald Duck Peace and Freedom		
Daisy Duck Democratic		
Scrooge McDuck Green		
Winnie "the" Pooh Peace and Freedom		
Snow White NONPARTISAN		
Prince Charming Republican		
Sleeping Beauty American Independant		
Evil Queen Democratic		
Bambi Deer American Independant		
Thumper Rabbit Peace and Freedom		
Shrek Ogre Libertarian		
Fiona Ogre Democratic		
Fiona Pattinson Republican		
Steve Weingart Democratic		
Herb Deutsch Libertarian		
Tucker Omell American Independant		
Mark Manganaro Peace and Freedom		
Gregg Mendenhall Green		
Ana Queveda Peace and Freedom		
Ronald Regan Democratic		
Richard Nixon Libertarian		
John Kennedy Republican		
Gerald Ford Green		
Jerry Brown Green		
Pete Wilson Democratic		
Pat Brown NONPARTISAN		
Write-in		

Attachment D

The Red and White Seal



All of the tamper evidence labels tested are designed to leave a residue, making it evident if they are removed. For example, the above label looks like the picture below after removal.

A corresponding remnant is left on the surface, as depicted below.