6705 Odyssey Dr. Suite C
Huntsville, AL 35806
Phone (256)713-1111
Fax (256)713-1112

Test Report for EAC 2005 VVSG Certification Testing
Unisyn Voting Solutions OpenElect 2.2.3 Voting System

EAC Project Number: UNS10121966-2.2.3

Version: 06

Date: 08/03/2023

U.S. Election Assistance Commission
VSTL

EAC Lab Code 1501

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SIGNATURES

Approved by: Michael L. Walker — 08/03/2023

Michael Walker, VSTL Project Manager — Date

Approved by: Wendy Owens — 08/03/2023

Wendy Owens, VSTL Program Manager — Date

Approved by: Stacey Glover — 08/03/2023

Stacey Glover, QA Manager — Date

Pro V&V attests to the following: 1) all testing prescribed by the approved and published test plan or amended test plan was performed as identified or the divergence from the test plan was properly documented in this test report, 2) all identified voting system anomalies or failures were reported and resolved, and 3) this test report is accurate and complete. There are no opinions or interpretations included in this report, except as noted under Recommendations.

REVISIONS

Revision	Description	Date
00	Initial Release	04/28/2023
01	Updated to address EAC Comments	05/12/2023
02	Updated OVS System Overview version in Table 3-1	05/30/2023
03	Updated OVS System Hardware Specification version in Table 3-1	05/31/2023
04	Updated to address EAC Comments for items in Table 3-1, corrected multiple version numbers in Table 3-1, and corrected a document number in Table 3-1	06/06/2023
05	Updated Table 3-1 to correct the version numbers of the 04-00510 System Verification, 04-00617 EOS Linux Installation Guide and 04-00512 Technical Data Package documents. Updated Appendix B to include OCS Applications and Hashes.	07/25/2023
06	Corrected typos	08/03/2023

TABLE OF CONTENTS

1.0 INTRODUCTION

The purpose of this Test Report is to document the procedures that Pro V&V, Inc. followed to perform certification testing during a system modification campaign for the Unisyn Voting Solutions OpenElect Voting System (OVS) Version 2.2.3 to the requirements set forth for voting systems in the U.S. Election Assistance Commission (EAC) 2005 Voluntary Voting System Guidelines (VVSG), Version 1.0. Certification testing of OpenElect 2.2.3 was performed to ensure the applicable requirements of the EAC VVSG 1.0 and the EAC Testing and Certification Program Manual, Version 2.0 were met. Additionally, all EAC Request for Interpretations (RFI) and Notices of Clarification (NOC) relevant to the system under test were incorporated in the test campaign.

Prior to submitting the voting system for testing, Unisyn submitted an application package to the EAC for certification of the OpenElect 2.2.3 Voting System. The application was accepted by the EAC and the project was assigned the unique Project Number of UNS10121966-2.2.3.

The OpenElect 2.2.3 EAC-approved test plan (TP-01-01-UNI-07-01.01), as published on the EAC's website at www.eac.gov, was utilized as the guiding document during test performance. Since test plan approval, and as testing progressed, minor system modifications, such as revised system documentation, were incorporated. This test report reflects all testing completed and details the final versions of all technical documentation and system components and supersedes the approved test plan.

1.1 Description and Overview of EAC System Being Modified

The EAC Certified System that is the baseline for the submitted modification is described in the following subsections. All information presented was derived from the previous Certification Test Report, the EAC Certificate of Conformance and/or the System Overview.

The baseline system for this modification is the OVS 2.2 Voting System. Detailed descriptions of the OVS 2.2 test campaign are contained in Pro V&V Report No. TR-01-01-UNI-06-01.03, which is available for viewing on the EAC's website at www.eac.gov.

OVS 2.2.3 is a paper ballot voting system using touch screen and scan technology to scan and validate ballots, provide voter assisted ballots to accommodate voters with special needs, and tabulate results. OVS 2.2.3 consists of the following major components: **OpenElect Central Suite (OCS), OpenElect Voting Optical (OVO), OpenElect Voting Interface – Vote Center (OVI-VC), FreedomVote Tablet (FVT), OpenElect Voting Central Scan (OVCS), and FreedomVote Scan (FVS).**

The OVO, FVS, FVT, and OVI-VC are the OVS components designed to accept voter input. The FVT and OVI-VC are the OVS ballot marking devices (BMDs). The OVO can collect and tally precinct votes, generate reports, and store election data internally. The FVS is a full-page dual-sided optical scan system. It scans and validates BMD ballots produced on the FVT and OVI-VC, as well as full-page ballots. The OVCS is the bulk scanner used for mail-in ballots, provisional ballots, and recounts.

1.1.1 Baseline Certified System

The following paragraphs provide a product description and an overview of the design methodology of the OVS 2.2.3 Voting System, as taken from the Unisyn technical documentation.

OpenElect Central Suite (OCS)

The OCS System supports elections on the OVO, FVS, OVI-VC, FVT, and OVCS systems. The Election Management System (EMS) consists of the following components running as either a front-end/client application or as a back-end/server application:

Ballot Layout Manager (BLM) – uses a database to create and store precinct and district information and an interface to create, check, translate, and produce the ballot styles needed by a jurisdiction for an election. The BLM output is printer ready artwork of all ballots in all languages and the Unisyn election definition file.

Election Manager (EM) – converts the Unisyn election definition file to a Unisyn-specific XML format and prepares compressed, encrypted election files for output to CD or USB. The EM allows the jurisdiction to add voting device specific options for elections, i.e. whether to check the contests for undervotes, and whether to allow or disallow certain features such as sounds, party icons, reports, etc. The EM also creates and manages Supervisor and Maintenance technician logins and passwords.

Tabulator Client (TC) – retrieves vote files and ballot images from a Transport Media (TM) device (USB), stores them on its disk, and transfers the files to the Tabulator and notifies the Tabulator that a new file is present.

Tabulator (TAB) – receives and validates uploaded voting data and provides a status of uploaded files as well as handling Rank Choice Voting (RCV) functionality. It also updates the database with adjudicated ballots from the Auditor application. The Tabulator maintains the Tabulator database, which stores the results from all precincts.

Auditor – accesses ballot images and data from the OVCS and TC PCs to allow jurisdiction personnel to evaluate ballots with questionable or erroneous marks and change votes in accordance to the voter's perceived intent. The Auditor can also be used to process write-in votes. All changes uploaded to the Tabulator database and actions are password controlled.

Tabulator Reports (TR) – accesses data from the Tabulator database to generate the necessary reports.

OpenElect Voting Optical (OVO)

The OVO is a full-page dual-sided optical scan precinct scanner that scans and validates voter ballot pages and provides a summary of all ballot pages cast. The election is loaded from an Election TM. On Election Day, an OVO at each poll location scans and validates voters' ballots and provides precinct tabulation and reporting. The OVO runs Logic Tests and Training Elections in addition to General and Primary Elections.

The OVO unit can also paired with OVI-VC and FVT units for early voting to scan and tabulate early voting ballots and election support at voting centers. Additionally, OVO units can be used at election headquarters to read absentee, provisional or recount ballots in smaller jurisdictions.

The OVO consists of the following components:

- **Personal Computer (PC) -** Computer component (with a touch panel display) has the OVO application installed that manages data and provides a user interface for voting and maintenance. A new election loaded via a Transport Media (TM) sets passwords, parameters, and ballot styles for that election. (Valid ballots for a poll location are reinitialized or set on Election Day startup by scanning a ballot header card).
- **Transport Media (TM)** – 1 GB or larger USB thumb drive that provides the means of transporting audit, optional ballot page images and results files from the precinct on Election Night to Election Headquarters where the central count system resides.
- **Ballot Reader -** Dual-sided scanner connected to the PC to scan data from marked ballot pages. The Ballot Reader ejects accepted ballot pages into an attached ballot box or rejects unaccepted ballot pages back out to the voter.
- **Printer -** 58 mm thermal receipt printer connected to the PC to print voter receipts and reports at the OVO.
- **UPS** - Uninterruptible power supply is provided as part of the system.

OpenElect Voting Interface – Vote Center (OVI-VC)

The OVI-VC is a ballot marking device (BMD) that supports both ADA and Regional Early Voting requirements. The OVI-VC has a 15-inch display and is equipped to assist voters, with varying abilities, to prepare their ballots independently and privately. It presents each contest on the correct ballot to the voter in visual and, if needed, audio formats. The OVI-VC gives voters the option to use an audio ballot, ADA keypad, sip and puff binary device, and touchscreen with varying font sizes to make their selections. Once the voter has made their selections, they are prompted to review their ballot selections. After the validation process is complete, the OVI-VC then prints the ballot and the voter inserts it into the OVO/FVS to cast their vote. When authorized, the OVI-VC provides for write-in candidates. Each OVI-VC can support multiple languages for both visual and audio ballots, allowing the voter to choose their preferred language.

The OVI-VC consists of the following components:

- **Personal Computer (PC) -** Computer component (with a touch panel display) has the OVI-VC application installed that manages data and provides a user interface for voting and maintenance. A new election loaded via a Transport Media (TM) sets passwords, parameters, and ballot styles for that election.
- **Transport Media (TM)** – 1 GB or larger USB thumb drive that provides the means of transporting audit files to the OCS system.
- **Ballot Reader -** Dual-sided scanner connected to the PC to scan data from marked ballot pages. The Ballot Reader ejects accepted ballot pages into an attached ballot box or rejects unaccepted ballot pages back out to the voter.
- **Printer –** 82.5 mm thermal receipt printer connected to the PC to print BMD Ballots and reports at the OVI-VC.

- **UPS** - Uninterruptible power supply is provided as part of the system.

OpenElect Voting Central Scan (OVCS)

The OVCS units reside at election headquarters designated to read absentee, provisional or recount ballots in large jurisdictions or read the entire election's ballots at a central count location in smaller jurisdictions. The OVCS also captures Write-In data images and produces a Write-In image report for manual processing upon request. The OVCS system consists of the following components:

- **PC Desktop -** A desktop PC configuration with the following minimum characteristics:
  - PC: 1.8 GHz Processor, 2 GB RAM, 250GB (or larger) Hard Drive, USB Ports, Network Interface Port (Ethernet), CDRW/DVD, Video Port
  - 16:9 LCD
  - Keyboard and Mouse
- **Bulk Scanner** – A dual-sided scanner (Canon model DR-M160II, model DR0G2140 or model DR-X10C) that is connected to the PC to scan data from marked ballots.

Freedom Vote Tablet (FVT)

The FVT is a tablet ballot marking device that enables voters to make their vote selections and to print their voted ballot. It can be used on Election Day or during an early voting period. Like the OVI-VC, the FVT is ADA compliant. It assists voters, with varying levels of ability, through the voting process, ballot review, and printing functions. The FVT presents each contest of the ballot style to the voter in visual and/or audio formats. It facilitates special needs voters through a variety of methods including wheelchair access, sip and puff, zoom-in ballot function and audio assistance for the visually impaired. The voter with limited vision can navigate through the ballot using an audio ballot and the ADA keypad or touchscreen to input their selections. Once the ballot is printed, it is taken to the OVO/FVS to be cast. Each FVT can support multiple languages for both visual and audio ballots, allowing the voter to choose their preferred language.

The FVT consists of the following components:

- **Tablet –** The Android tablet has a 13.3 in. touchscreen and comes with pre-installed software that provides user interfaces for voting and maintenance. Election files generated by the EM are loaded manually via a USB. The election files will allow the jurisdiction to determine the FVT's mode such as early voting or training, sets passwords, parameters, audio, and ballot styles for that election.
- **Barcode Reader -** 2D USB Barcode reader will read the 2D barcodes produced by the EM such as the initialize barcode and administrative/maintenance barcodes. It will also read the 'populate' barcode produced by other qualified systems.
- **USB Hub –** A four port USB hub is installed in the FVT case to connect the printer, barcode scanner, and keypad to the tablet.
- **Printer –** 82.5 mm thermal receipt printer is connected to the Tablet to print BMD ballots and reports.

- **Optional ADA Devices –** 10-key keypad with a Sip and Puff Interface, Headphones, Sip and Puff Device.

OpenElect Freedom Vote Scan (FVS)

The FVS is a full-page dual-sided optical scan precinct scanner that scans and validates voter ballot pages and provides a summary of all ballot pages cast. The election is loaded from an Election TM. On Election Day, an FVS at each poll location scans and validates voters' ballots and provides precinct tabulation and reporting. The FVS runs Logic Tests and Training Elections in addition to General and Primary Elections. The FVS unit can also be paired with FVT units for early voting to scan and tabulate early voting ballots and election support at voting centers. Additionally, FVS units can be used at election headquarters to read absentee, provisional, or recount ballots in smaller jurisdictions.

The FVS consists of the following components:

- **Personal Computer (PC) –** The internal computer with Solid State storage has the FVS application installed that manages data and provides a user interface for voting and maintenance. A new election loaded via a Transport Media (TM) sets passwords, parameters, and ballot styles for that election. (Valid ballots for a poll location are reinitialized or set on Election Day startup by scanning a ballot header card.
- **Touchscreen Display –** The 10.1" TFT LCD has a resolution of 1280x800. The display is used to interact with the system application, and provides all functionality needed to deploy, conduct, and tally an election.
- **Transport Media (TM) –** 1 GB or larger USB thumb drive that provides the means of transporting audit, optional ballot page images and results files from the precinct on Election Night to Election Headquarters where the central count system resides.
- **Ballot Reader -** Dual-sided scanner connected to the PC to scan data from marked ballot pages. The Ballot Reader ejects accepted ballot pages into an attached ballot box or rejects unaccepted ballot pages back out to the voter.
- **Printer** - 80 mm thermal receipt printer connected to the PC to print voter receipts and reports at the FVS.
- **Internal Battery Backup** – An internal battery powers the system in the event of a power interruption. The battery allows for continued, and uninterrupted, use of the system if wall power is lost during a voting session

1.2 References

- Election Assistance Commission 2005 Voluntary Voting System Guidelines (VVSG) Version 1.0, Volume I, "Voting System Performance Guidelines", and Volume II, "National Certification Testing Guidelines"
- Election Assistance Commission Testing and Certification Program Manual, Version 2.0
- Election Assistance Commission Voting System Test Laboratory Program Manual, Version 2.0

- National Voluntary Laboratory Accreditation Program NIST Handbook 150, 2020 Edition, "NVLAP Procedures and General Requirements (NIST Handbook 150)", dated July 2020
- National Voluntary Laboratory Accreditation Program NIST Handbook 150-22, 2021 Edition, "Voting System Testing (NIST Handbook 150-22)", dated October 2021
- United States 107th Congress Help America Vote Act (HAVA) of 2002 (Public Law 107-252), dated October 2002
- Pro V&V, Inc. Quality Assurance Manual, Revision 9.0
- Election Assistance Commission "Approval of Unisyn OpenElect 2.2.3 Voting System Testing Application Package" letter dated November 10, 2022
- EAC Requests for Interpretation (RFI) and Notices of Clarification (NOC) (listed on www.eac.gov)
- Pro V&V Test Report No. TR-01-01-UNI-06-01.03, "Test Report for EAC 2005 VVSG Certification Testing Unisyn Voting Solutions OpenElect 2.2 Voting System"
- Unisyn Voting Solutions Technical Data Package *(A listing of the OpenElect 2.2.3 documents submitted for this test campaign is listed in Section 3.1 of this Test Report)*

1.3 Terms and Abbreviations

This subsection lists terms and abbreviations relevant to the hardware, the software, or this Test Report.

"ADA" – Americans with Disabilities Act 1990

"BLM" – Ballot Layout Manager

"BMD" – Ballot Marking Device

"CM" – Configuration Management

"COTS" – Commercial Off-The-Shelf

"EAC" – United States Election Assistance Commission

"EM" – Election Manager

"EMS" – Election Management System

"EOS" - Election Operating System

"FCA" – Functional Configuration Audit

"FVS" – FreedomVote Scan

"FVT" – FreedomVote Tablet

"LAT" – Logic and Accuracy Test

"NOC" – Notice of Clarification

"OCS" – OpenElect Central Suite

"OVCS" – OpenElect Voting Central Scan

"OVI-VC" – OpenElect Voting Interface – Vote Center

"OVO" – OpenElect Voting Optical

"OVS" – OpenElect Voting System

"PC" – Personal Computer

"PCA" – Physical Configuration Audit

"QA" – Quality Assurance

"RFI" – Request for Interpretation

"RCV" – Rank Choice Voting

"TAB" – Tabulator

"TC" – Tabulator Client

"TDP" – Technical Data Package

"TM" – Transport Media (USB Thumb Drive)

"TR" – Tabulator Reports

"UPS" – Uninterruptible Power Supply

"VSTL" – Voting System Test Laboratory

"VVSG" – Voluntary Voting System Guidelines

2.0 CERTIFICATION TEST BACKGROUND

OVS 2.2.3 is a modification of a previously certified system (OVS 2.2). Pro V&V performed an evaluation of results from the previous test campaign to determine the scope of testing required for certification of the OVS 2.2.3. Based on this evaluation, Pro V&V determined that testing from the previous test campaign would establish the baseline and that the focus of this test campaign would be on the documented system updates.

2.1 Revision History

The table below details the version history of the OVS 2.2.3 System:

Table 2-1. OpenElect 2.2.3 System Revision History

System Version	Certification Type	Baseline System	Certification Number
OVS 2.0	New System	--- (Original System)---	UNS10121966-2.0
OVS 2.0.A	Modification	OVS 2.0	UNS10121966-2.0.A
OVS 2.1	Modification	OVS 2.0.A	UNS10121966-2.1
OVS 2.2	Modification	OVS 2.1	UNS10121966-2.2
OVS 2.2.3	Modification	OVS 2.2	UNS10121966-2.2.3*

*Upon grant of certification by the EAC

2.2 Scope of Testing

The scope of testing focused on evaluating the modifications detailed in Section 2.2.1 of this Test Report. To determine the OVS 2.2.3 test requirements, the submitted modifications were evaluated against each section of the EAC VVSG 1.0 to determine the applicable tests to be performed. Based on this assessment, it was determined that multiple areas within the EAC VVSG 1.0 would be evaluated to encompass the required tests. Additionally, it was determined that Regression Testing would consist of executing the System Integration Test and the Accuracy Test.

A breakdown of the areas and associated tests is listed below:

- EAC VVSG 1.0 Volume I, Section 2: Functional Requirements
  - System Integration Testing
  - Functional Configuration Audit (FCA)
  - Physical Configuration Audit (PCA), including System Loads & Hardening
  - Technical Documentation Package (TDP) Review
  - Accuracy Testing
- EAC VVSG 1.0 Volume I, Section 4: Hardware Requirements
  - Environmental Requirements
    - Electrical Tests
    - Environmental Tests
    - Technical Documentation Package (TDP) Review
- EAC VVSG 1.0 Volume I, Section 5: Software Requirements
  - Source Code Review, Compliance Build, Trusted Build, and Build Document Review
  - Technical Documentation Package (TDP) Review
  - Functional Configuration Audit (FCA)

Note: Section 6 (Telecommunications Requirements) of the VVSG 1.0 is not applicable to OVS 2.2.3, therefore, it was not included in testing. Additionally, Section 3 (Usability & Accessibility),

Section 7 (Security Requirements), Section 8 (Quality Assurance Requirements), and Section 9 (Configuration Management Requirements) were reviewed in previous test campaigns and were not impacted by the submitted modifications.

2.2.1 Modification Overview

The submitted modifications to the OVS 2.2.3 System consist of both software and hardware changes. The currently certified FVT tablet has reached its end of life and is being replaced.

To verify the modifications were successfully addressed throughout the test campaign, each modification was tracked and verified to be addressed during the execution of the relevant test area. For example, source code changes were verified during the source code review. Modifications requiring functional test verification were evaluated by executing the standard Accuracy Test, the System Integration Test, or during performance of the FCA. Modifications that were not adequately evaluated during the performance of these tests were subjected to specifically designed test cases. Additionally, Pro V&V functionally verified that any corrected issues from the baseline system were not present in the modified system and that all enhancements implemented did not adversely impact system performance.

2.2.1.1 List of Changes

The submitted modifications include the following changes from OVS version 2.2 to 2.2.3, as taken from the *OpenElect 2.2.3 Release Notes*:

<u>FreedomVote Tablet - Battery Backup (FVT-B)</u>

- Reference Number 2.2.3-1: Upgraded the Processor and RAM for the FVT tablet.
- Reference Number 2.2.3-2: Diagnostic Printer Test updated to prevent Print Test interruption during EMP testing.

<u>Tabulator Reports</u>

- Reference Number 2.2.3-3: When determining the number of ballots cast in an election with multiple page ballots base the number of ballots cast on the first page.

<u>Tabulator</u>

- Reference Number 2.2.3-4: When determining the number of ballots cast in an election with multiple page ballots base the number of ballots cast on the first page.
- Reference Number 2.2.3-5: Create Desktop Shortcut to Reports directory when new "Run" is created.

<u>Freedom Vote Tablet (FVT)</u>

- Reference Number 2.2.3-6: Make the Close with Barcode process on FVT match the Close with Button process, so that they have the same end point.

2.2.2 Block Diagram

The system overview of the submitted voting system is depicted in Figure 2-1.

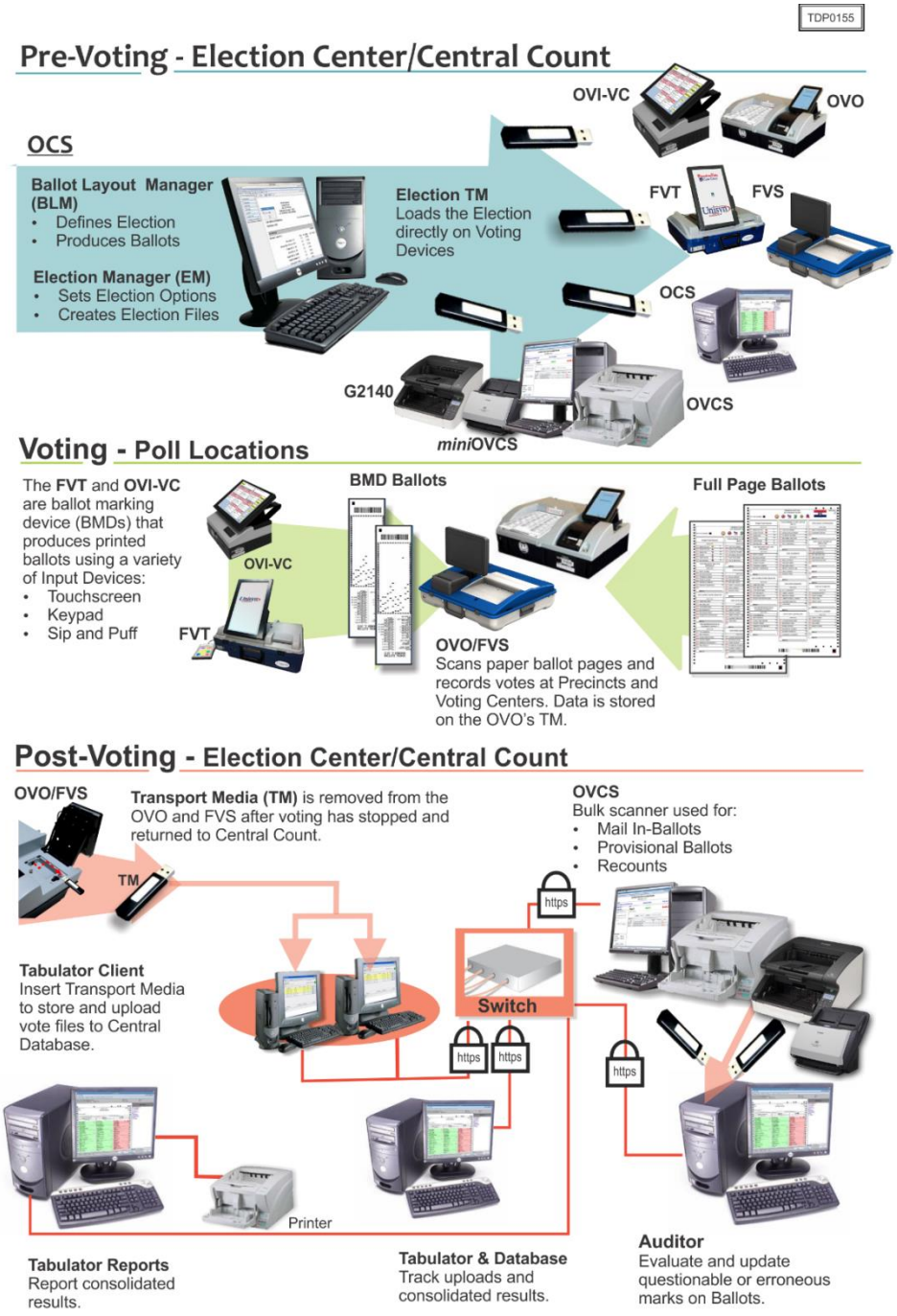

Figure 2-1. OVS 2.2.3 System Components Overview

2.2.3 System Limits

Unisyn has defined the following system performance characteristic limits for the OVS 2.2.3:

- The OCS and OVCS Software are intended for use by a single jurisdiction with one set of districts, voting centers, and precincts at any given time.
- The OCS and OVCS are designed for handling up to 20 consecutive elections.
- Ten elections may be stored in the OCS database simultaneously.
- The system allows 400 ballot styles for an election.
- One OVO and FVS can be initialized for use with ballots from 1-50 precincts, or all precincts.
- An OVI-VC and FVT can present all precincts to the voter.
- The system allows voting by precinct and split precinct.
- The OVO and FVS provides several voting sessions to accommodate different ballot counting purposes. Only one session can be used at a time:
  - **Election Day** voting at the polls and voting centers
  - **Training Election** voting for training or sales purposes
  - **Logic Test** voting to test data and tabulation
  - **Absentee** session
  - **Recount** session
  - **Provisional** session
  - **Regional Early Voting** session
- The OVO/FVS provides the following System Performance:
  - Expected speed (per ballot page) 4 seconds to ballot page confirm
  - Throughput capacity (per ballot page) 6 ballot pages per minute
  - Maximum Volume 5,000 ballot pages
  - Ballot Pages
    - 11" ballot page:
      - Maximum number of voting positions per ballot page (11 inch ballot pages, without Rank Choice Voting): 228
      - Maximum number of voting positions per ballot page (11 inch ballot pages, with Rank Choice Voting): 456
    - 14" ballot page:
      - Maximum number of voting positions per ballot page (14 inch ballot pages, without Rank Choice Voting): 300
      - Maximum number of voting positions per ballot page (14 inch ballot pages, with Rank Choice Voting): 600

- 17” ballot page:
    - Maximum number of voting positions per ballot page (17 inch ballot pages, without Rank Choice Voting): 372
    - Maximum number of voting positions per ballot page (17 inch ballot pages, with Rank Choice Voting): 744
- 19” ballot page:
    - Maximum number of voting positions per ballot page (19 inch ballot pages, without Rank Choice Voting): 420
    - Maximum number of voting positions per ballot page (19 inch ballot pages, with Rank Choice Voting): 840

- Maximum number of ballot styles: 50 ballot styles per OVO session if individually entered with a maximum of 400 ballot style choices. For All Precinct sessions, all ballot styles are accepted by the OVO/FVS.
- The OVCS provides several voting sessions to accommodate different ballot counting purposes. Only one session can be used at a time:
    - Normal - Election Day Tabulation
        - Election Day Tabulation
        - Recount
        - Training
    - LAT - Logic and Accuracy Test (LAT) voting to test data and tabulation
    - Absentee session
    - Provisional session
    - Write-In only session
- The OVCS Large scanners provide the following System Performance:
    - Max Ballot pages per batch 500
    - Max Ballot pages per session 5,000
    - Expected speed (ballot pages per hour) 2,100 ballot pages per hour
    - Maximum number of ballot styles: 400 ballot style choices
- The mini OVCS scanner provides the following System Performance:
    - Max Ballot pages per batch 50
    - Max Ballot pages per session 5,000
    - Expected speed (ballot pages per hour) 350 ballot pages per hour
    - Maximum number of ballot styles: 400 ballot style choices

In the end-to-end OVS, a single election is limited to:

- Up to 10 political parties (including non-partisan) voting their own ballot in a Primary Election. Up to 10 political parties (including non-partisan) voting in a General Straight Ticket Election. 50 parties may appear on the ballot for candidates.

- Up to 2,000 precincts.
- Up to 160 candidates per contest, with a limit of 3,000 combined count of candidates and contests.
- Up to 10 language translations (applies to ballot pages).
- Up to 3 ballot pages per ballot.
- Up to 5,000 ballot pages processed (cast votes) at an OVO/FVS during a single voting session.

2.2.4 Supported Languages

The submitted voting system supports:

- Hindi
- Chinese
- English
- Japanese
- Korean
- Navajo
- Spanish
- Thai

Due to the limited scope of testing, only English and Spanish language ballots were cast during the performance of functional testing. Additionally, one character-based language (Chinese) was tested during System Integration Testing.

For the character-based language, the ballot was created by Pro V&V and voted utilizing both paper ballots and ADA voting devices along with all applicable peripherals. The Chinese language for the ballot was created using a readily available online translation tool. The translated language text was entered into the Ballot Layout Manager Application. A ballot preview was generated in the Ballot Layout Manager application. The Chinese characters displayed in the ballot preview were compared to the characters generated by the online translation tool, to ensure that the characters matched. The ballots were then generated and printed, and the election loaded onto the tabulators and the BMD units. The Chinese characters displayed on both the printed ballots and displayed on the BMD units were compared to the original Chinese characters generated by the online translation tool to verify that the characters matched.

2.2.5 Supported Functionality

The OVS 2.2.3 was verified to support the following voting variations:

- General Election
- Primary Election (Open and Closed)
- Modified Open Primary
- Early Voting
- Partisan/Non-Partisan Offices

- Write-In Voting
- Primary Presidential Delegation Nominations
- Straight Ticket Voting (*including Pennsylvania and Indiana Rules*)
- Presidential-only Voting
- Split Precincts
- Multiple Selection Contests: Vote for N of M
- Ballot Rotation
- Cross Party Endorsement
- Multi-Page Ballots
- Multi-Party Candidate Endorsements
- Provisional or Challenged Ballots
- Absentee Ballots
- Recount Tabulation
- Ranked Choice Voting (RCV)

2.2.6 VVSG

The OVS 2.2.3 was evaluated against the relevant requirements contained in the EAC VVSG 1.0. To evaluate the OVS 2.2.3 test requirements, the submitted modifications were evaluated against each section of the EAC VVSG 1.0 to determine the applicable tests to be performed. Additionally, all requirements that were excluded from the previous test campaign (OVS 2.2) were also deemed not applicable to this test campaign. The submitted modifications did not require the evaluation of any requirements that were not included in the baseline system.

2.2.7 RFIs

There are no RFIs released by the EAC as of the date of this Test Report that pertain to this test campaign that were not in effect at the time of the baseline system certification.

2.2.8 NOCs

There are no NOCs released by the EAC as of the date of this Test Report that pertain to this test campaign that were not in effect at the time of the baseline system certification.

3.0 TEST FINDINGS AND RECOMMENDATION

The OVS 2.2.3 Voting System was evaluated against the relevant requirements contained in the EAC 2005 VVSG, Volumes I and II. The focus of this test campaign was on the modifications made to the baseline certified system. The summary findings and recommendations for each area of testing are provided in the following sections.

3.1 Summary Findings and Recommendation

Summary findings for the System Level Testing (System Integration, Accuracy, and FCA), Hardware Testing, and Source Code Review are detailed in the relevant sections of this report. In addition to these areas of testing, a PCA and a limited TDP Review were performed, as described below.

TDP Review

In order to determine compliance of the modified TDP documents with the EAC 2005 VVSG, a limited TDP review was conducted. This review focused on TDP documents that have been modified since the certification of the baseline system. The review consisted of a compliance review to determine if each regulatory, state, or manufacturer-stated requirement had been met based on the context of each requirement. Results of the review of each document were entered into the TDP Review Checklist and reported to the manufacturer for resolution of any anomalies. This process continued until all anomalies were addressed. Any revised documents during the TDP review process were compared with the previous document revision to determine changes made, and the document was re-reviewed to determine whether subject requirements had been met.

Summary Findings

The submitted TDP was determined to be in compliance with the requirements set forth in the EAC 2005 VVSG. A listing of all documents contained in the OVS 2.2.3 TDP is provided in Table 3-1.

Table 3-1. OVS 2.2.3 TDP Documents

Document Number	Description	Version	Release
04-00512	Technical Data Package-Document List and Version Control	1.5	2.2.3
04-00446	OVS System Overview	1.5	2.2.3
04-00444	System Functionality Description	1.0	2.2.3
04-00458	System Hardware Specification	1.6	2.2.3
04-00464	Software Design and Specification	1.1	2.2
04-00447	System Security Specification	1.1	2.2
04-00453	System Test and Verification Plan	1.0	2.2
04-00460	Systems Operations Procedure: Warehouse Technician's Guide	1.0	2.2.2
04-00459	System Maintenance Procedures	1.2	2.2
04-00445	Personnel Training and Deployment Requirements	1.0	2.2

Table 3-1. OVS 2.2.3 TDP Documents *(continued)*

Document Number	Description	Version	Release
04-00448	Configuration Management Plan	1.1	2.2
04-00454	Quality Assurance Plan	1.1	2.2
04-00469	Final QA Report	1.0	2.2.2
04-00427	Election Manager User Guide	1.1	2.2
04-00428	Ballot Layout Manager User Guide	1.1	2.2
04-00431	Tabulator Client User Guide	1.0	2.2
04-00432	Tabulator User Guide	1.0	2.2.3
04-00433	Tabulator Reports User Guide	1.0	2.2.3
04-00495	OVCS User Guide	1.4	2.2
04-00530	Auditor Users Guide	1.2	2.2
04-00549	EOS Linux and OCS Installation Guide	1.1	2.2
04-00449	System Coding Standards	1.0	2.2
04-00462	Election Day Troubleshooter's Guide	1.1	2.2.3
04-00463	Election Day Poll Worker's Guide	1.0	2.2.3
04-00494	OVS Acronyms	1.1	2.2
04-00503	OVS Paper Specification	1.0	2.2
04-00513	Hardware Verification	1.2	2.2.3
04-00452	Requirements of the 2005 VVSG Trace To Vendor Testing and Technical Data Package	1.0	2.2
04-00594	OpenElect Voting System Release Notes, 2.2 to 2.2.3	1.5	2.2.3
04-00510	System Verification	1.3	2.2.3
04-00553	Trusted Build – Applications 2.2	2.10	2.2
04-00602	FVS Trusted Build 1.0	1.4	1.0
04-00606	Write-in Utility User Guide	1.1	2.2
04-00607	Cast Vote Record User Guide	1.0	2.2
04-00617	EOS Linux Installation Guide	1.0	2.2.3

Physical Configuration Audit (PCA)

The physical configuration audit compares the voting system components submitted for qualification to the manufacturer's technical documentation, and included the following activities:

- Establish a configuration baseline of software and hardware to be tested; confirm whether manufacturer's documentation is sufficient for the user to install, validate, operate, and maintain the voting system
- Verify software conforms to the manufacturer's specifications; inspect all records of manufacturer's release control system; if changes have been made to the baseline version, verify manufacturer's engineering and test data are for the software version submitted for certification
- If the hardware is non-COTS, review drawings, specifications, technical data, and test data associated with system hardware to establish system hardware baseline associated with software baseline

- Review manufacturer's documents of user acceptance test procedures and data against system's functional specifications; resolve any discrepancy or inadequacy in manufacturer's plan or data prior to beginning system integration functional and performance tests
- Subsequent changes to baseline software configuration made during testing, as well as system hardware changes that may produce a change in software operation are subject to re-examination

Summary Findings

During execution of the PCA, the components of the OVS 2.2.3 were documented by component name, model, serial number, major component, and any other relevant information needed to identify the component. For COTS equipment, every effort was made to verify that the COTS equipment had not been modified for use. Additionally, each technical document submitted in the TDP was recorded by document name, description, document number, revision number, and date of release. At the conclusion of the test campaign, test personnel verified that any changes made to the software, hardware, or documentation during the test process were fully and properly documented.

3.1.1 Source Code Review, Compliance Build, Trusted build, and Build Documentation Review

Pro V&V evaluated the submitted source code for the FVT against the EAC 2005 VVSG and the manufacturer-submitted coding standards using both Automated Source Code Review and Manual Review methods. Prior to initiating the software review, Pro V&V verified that the submitted documentation was sufficient to enable Pro V&V to: (1) a review of the source code and (2) Pro V&V to design and conduct tests at every level of the software structure to verify that design specifications and performance guidelines are met.

Summary Findings

- Automated Source Code Review: The Automated Source Code Review was performed to review the changes in the source code from the previously certified OVS 2.2 voting system. No source code issues were found during the Automated Source Code review.
- Manual Source Code Review: The Manual Source Code review was performed on 10% of the comments for compliance to VVSG Volume I, Section 5.2.7. No source code issues were found during the Manual Source Code review.
- Compliance Build: The compliance build was performed following the compliance review. Once the compliance review was performed and the source was deemed stable enough to proceed with testing, the source code and all additional packages were compiled into a Compliance Build.
- Trusted Build: The Trusted Build consisted of inspecting proprietary source code, COTS software, and third-party software products and combining them to create the executable code. This inspection followed the documented process from the "United States Election Assistance Commission Voting System Test Laboratory Program Manual Version 2.0" Section 5.5 – 5.7. Completion of the trusted build included the build documentation review. The Trusted Build was performed following the completion of the Functional Configuration Audit.

3.1.2 System Level Testing

System Level testing was implemented to evaluate the complete system. This testing included all proprietary components and COTS components (software, hardware, and peripherals) in a configuration of the system's intended use. For software system tests, the tests were designed according to the stated design objective without consideration of its functional specification. The

system level hardware and software test cases were prepared independently to assess the response of the hardware and software to a range of conditions.

Pro V&V reviewed the manufacturer's program analysis, documentation, and module test case design and evaluated the test cases for each module with respect to flow control parameters and entry/exit data.

The software system functions for the previously certified voting system (OVS 2.2) remained unchanged for the submitted modifications. The OCS/OVO/FVS/OVI-VC/OVCS software is a set of Java applications that utilize open source libraries and run on a customized Linux operating system to take advantage of that platform's security and performance. The OVO, FVS, and OVCS use the Java Native Interface (JNI) classes, which are C++ classes, to communicate with the native drivers (also C++) provided by the hardware manufacturer. This is required by the Optical Scanner in the OVO, FVS and the OVCS. The OpenElect system is designed for use in two distinct locales: Central Processing and In-Precinct Systems. The FreedomVote Tablet (FVT) product is also written in Java, but compiled for use on the Google Android operating system, using different core libraries.

System Level Testing included the evaluations of the following test areas: FCA, Accuracy Testing, and System Integration Testing. Each of these areas is reported in detail in the subsections that follow.

Summary Findings

Component Level Testing was implemented during the FCA for each component and subcomponent. During the source code review, compliance builds, and security testing, Pro V&V utilized limited structural-based techniques (white-box testing). Additionally, specification-based techniques (black-box testing) were utilized for the individual software components.

Pro V&V defined the expected result for each test and the ACCEPT/REJECT criteria for certification. If the system performed as expected, the results were accepted. If the system did not perform as expected, an analysis was performed to determine the cause. If needed, the test was repeated in an attempt to reproduce the results. If the failure could be reproduced and the expected results were not met, the system was determined to have failed the test. If the results could not be reproduced, the test continued. Any errors encountered were documented and tracked through resolution.

To verify the modifications were successfully addressed throughout the test campaign, each modification was tracked and verified to be addressed during the execution of the relevant test area. For example, source code changes were verified during the source code review. Modifications requiring functional test verification were evaluated by executing the standard Accuracy Test, the System Integration Test, or during performance of the FCA. Modifications that were not adequately evaluated during the performance of these tests were subjected to specifically designed test cases.

3.1.2.1 Functional Configuration Audit (FCA)

The functional configuration audit encompasses an examination of manufacturer's tests, and the conduct of additional tests, to verify that the system hardware and software perform all the functions described in the manufacturer's documentation submitted in the TDP. In addition to functioning according to the manufacturer's documentation, tests are conducted to ensure all applicable EAC 2005 VVSG requirements are met.

For this campaign FCA testing included several exhaustive paths applied in concert:

- FCA-VVSG Testing: Each component of the system was evaluated against a standardized test-case suite centered upon requirements stated in the VVSG and administered through a test-management software tool. All applicable test-cases were performed while any non-applicable test-cases were logged as "n/a" for substantiation. The system operations and functional capabilities were categorized in the tool as follows by the phase of election activity in which they are required:
    - Pre-voting Capabilities: These functional capabilities are used to prepare the voting system for voting. They include ballot preparation, the preparation of election-specific software (including firmware), the production of ballots, the installation of ballots and ballot counting software (including firmware), and system and equipment tests.
    - Voting System Capabilities: These functional capabilities include all operations conducted at the polling place by voters and officials including the generation of status messages.
    - Post-voting Capabilities: These functional capabilities apply after all votes have been cast. They include closing the polling place; obtaining reports by voting machine, polling place, and precinct; obtaining consolidated reports; and obtaining reports of audit trails.
- FCA-Claims Testing: System user instructions and procedures found in the TDP were followed to verify their accuracy and completeness. In addition any functional claims discovered in the TDP that were not specifically examined in other areas or that were items of interest were also tested.
- FCA-Mapping: Any modified functional paths (buttons, dropdowns, etc.) were mapped by qualified VSTL personnel, to help ensure all functional options had been noted and exercised. Any items of interest were examined and/or tested.

All issues (if any) found during these efforts are detailed in Section 3.3. Any issues noted were tracked using an issue tracking software program and issue tracking spreadsheets.

Summary Findings

All functional tests were successfully executed. During execution of the test procedure, it was verified that the OVS 2.2.3 System successfully completed the system level integration tests with all actual results obtained during test execution matching the expected results. At the conclusion of the test campaign, it was determined that all issues communicated to Unisyn had been successfully reconciled.

The functional configuration audit also included Regression Testing. OVS 2.2.3 is a modified voting system configuration that includes functional upgrades and modifications to the baseline system. Modified system testing is an abbreviated testing campaign built upon a regression review of the modifications against the baseline system and requirements. Modifications, alone and collectively, are reviewed (tested) to see if they fall under any requirement(s), or functionally impact the ability of the modified system to continue to meet requirements. Regression reviews consist of targeted investigations to determine if further testing is necessary based on the nature and scope of the communicated modifications (whether activated or deactivated), and any other submitted information.

The objective of regression testing was to establish assurance that the modifications have no adverse impact on the compliance, integrity, or performance of the system. All functional regression tests were successfully completed.

3.1.2.2 Accuracy

The Accuracy Test ensures that each component of the voting system can each process at least 1,549,703 consecutive ballot positions correctly within the allowable target error rate. The Accuracy Test is designed to test the ability of the system to "capture, record, store, consolidate and report" specific selections and absences of a selection. The required accuracy is defined as an error rate. This rate is the maximum number of errors allowed while processing a specified volume of data. For paper-based voting systems the ballot positions on a paper ballot must be scanned to detect selections for individual candidates and contests, and those selections converted into digital data.

Summary Findings

To verify the proper functionality of the units under test, the following methods were used to test the components of the OVS 2.2.3 voting system:

The OVO, FVS, and OVCS were tested by utilizing a combination of hand marked (70%) and pre-marked (30%) ballots to achieve accuracy rate greater than 1,549,703 correct ballot positions. The OVI-VC and FVT were utilized to create ballots that were implemented as part of the pre-marked test deck.

The OVS 2.2.3 System successfully passed the Accuracy Test. Two deficiencies were encountered during test performance (ID#'s 544 and 545 detailed in Table 3-4). All issues noted were successfully resolved during test performance. During execution of the test procedure, it was verified that the OVS 2.2.3 System successfully completed the test with all actual results obtained during test execution matching the expected results.

3.1.2.3 System Integration

System Integration is a system level test for the integrated operation of both hardware and software. System Integration evaluates the compatibility of the voting system software components or subsystems with one another, and with other components of the voting system environment. This compatibility was determined through functional tests integrating the voting system software with the remainder of the system. During test performance, the system was configured exactly as it would be for normal field use. This included connecting all supporting equipment and peripherals including ballot boxes, voting booths (regular and accessible), and any physical security equipment such as locks and ties.

Summary Findings

During System Integration testing, two General Elections and two Primary Elections were exercised on the voting system, as described below:

Two general elections with the following breakdowns:

- General Election GEN-01: A General Election with Straight Party held in four precincts, one of which is a split precinct. This election contains nineteen contests compiled into four ballot styles. Five of the contests are in all four ballot styles. The other fourteen contests are split between at least two of the precincts with a maximum of four different contest spread across the four precincts.
- General Election GEN-03: A General Election held in two precincts. This election contains eight contests compiled into two ballot styles. Four of the contests are in both ballot styles. The other four contests are split between the two precincts. This election is designed to functionally test the handling of multiple ballot styles, support for at least three languages including a character-based language, support for common voting variations, and audio support for at least three languages and an ADA binary input device.

Two primary elections with the following breakdowns:

- Primary Election PRIM-01: This election is designed to functionally test a Closed Primary Election with multiple ballots and support for common voting variations. This election contains thirty-one contests and six parties compiled into eighteen ballot styles, each ballot containing six contests.
- Primary Election PRIM-03: A Closed Primary Election held in two precincts. This election contains ten contests and is compiled into two ballot styles. Two of the contests are in both ballot styles. The other eight contests are split between the two parties' ballots. This election is designed to functionally test the handling of multiple ballot styles, support for at least three languages including a character-based language, support for common voting variations, and audio support for at least three languages and an ADA binary input device.

The OVS 2.2.3 System successfully passed the System Integration Test. Any deficiencies encountered during the System Integration test are detailed in Section 3.3. All issues noted were successfully resolved. During execution of the test procedure, it was verified that the OVS 2.2.3 System successfully completed the system level integration tests with all actual results obtained during test execution matching the expected results.

3.1.3 Hardware Testing

OVS 2.2.3 consists of the following major components: the OCS software suite, OVO precinct scanner, FVS precinct scanner, OVI-VC precinct voting interface, OVCS central count scanner, and FVT precinct voting tablet. All components of the OVO, excluding the case, are COTS. All components of the OVI-VC, excluding the case and keypad, are COTS. All components of the FVT, excluding the case, tablet enclosure, and keypad, are COTS. All OVCS components are COTS. All components of the FVS, excluding the case, are COTS. All OCS functions are handled by proprietary software running on COTS PS/laptop/servers

Previous hardware examinations were performed on certified versions of the baseline system (OVS 2.2). The addition of the new FVT to the modified system (OVS 2.2.3) required the tests listed below to be performed on the FVT only:

Electrical Tests:

- Electrical Power Disturbance
- Electromagnetic Radiation (Radiated & Conducted)
- Electrostatic Disruption
- Electromagnetic Susceptibility
- Electrical Fast Transient
- Lightning Surge
- Conducted RF Immunity
- Magnetic Fields Immunity
- Electrical Supply

Environmental Tests:

- Temperature Power Variation
- Bench Handling

- Transportation Vibration
- Low Temperature
- High Temperature
- Humidity

Pro V&V utilized third party testing during the performance of hardware testing. Testing was performed by personnel verified by Pro V&V to be qualified to perform the test. Pro V&V utilized third-party test facilities for performance of the electrical and environmental tests. Environmental testing was performed at the NTS Longmont facility located in Longmont, Colorado. Electrical testing was performed at the Nemko facility located in Carlsbad, California. All pre and post operational status checks were conducted by Pro V&V personnel.

Summary Findings

Electrical Testing was performed on the FVT component of the OVS 2.2.3. The procedures and results for this testing are included in the following report:

- Nemko Engineering Summary Report REP0026405SRFEMC, Version 1.0, presented in Appendix A-1

The test results from this testing are summarized below:

Table 3-2. Electrical Hardware Test Results

Standard/Method	Description	Criteria	Class/Level	Result
FCC 15.107 ICES-003 VVSG Vol. 1 4.1.2.9	Power Line Conducted Emissions	Normal Operation & No Data Loss	Class B	Pass
FCC 15.109 ICES-003 VVSG Vol. 1 4.1.2.9	Radiated Emissions	Normal Operation & No Data Loss	Class B	Pass
EN61000-4-11 VVSG Vol. 1 4.1.2.5	Electrical Power Disturbance	Normal Operation & No Data Loss	Various	Pass
EN61000-4-4 VVSG Vol. 1 4.1.2.6	Electrical Fast Transient	Normal Operation & No Data Loss	±2kV - Mains	Pass
EN61000-4-5 VVSG Vol. 1 4.1.2.7	Lightning Surge	Normal Operation & No Data Loss	±2kV Line - Line ±2kV Line - Ground	Pass
EN61000-4-2 VVSG Vol. 1 4.1.2.8	Electrostatic Disruption	Normal Operation & No Data Loss	±8kV Contact ±15kV Air	Pass
EN61000-4-3 VVSG Vol. 1 4.1.2.10	Electromagnetic Susceptibility	Normal Operation & No Data Loss	10 V/m, 80 MHz – 1 GHz	Pass
EN61000-4-6 VVSG Vol. 1 4.1.2.11	Conducted RF Immunity	Normal Operation & No Data Loss	10 Vrms, 150 kHz – 80 MHz	Pass
EN61000-4-8 VVSG Vol. 1 4.1.2.12	Magnetic Immunity	Normal Operation & No Data Loss	30 A/m	Pass

Three deficiencies were noted during performance of the Electrical Hardware Testing (ID#'s 541, 542, and 543 detailed in Table 3-4). All deficiencies were successfully resolved during testing.

Environmental Testing was performed on the FVT component of the OVS 2.2.3. The procedures and results for this testing are included in the following report:

- TR-PR167218, Revision 1, presented in Appendix A-1

The test results from this testing are summarized in Table 3-3:

Table 3-3. Environmental Hardware Test Results

Standard/Method	Description	Criteria	Result
MIL-STD-810D, 501.2/502.2 VVSG Vol 2 4.7.1	Reliability, Temperature-Power Variation Testing	Normal Operation & No Data Loss	Pass
MIL-STD-810D Method 507.2 VVSG Vol 2 4.6.6	Humidity	Successful Post-Test Operation	Pass
MIL-STD-810D Method 502.2 VVSG Vol 2 4.6.4	Low Temp	Successful Post-Test Operation	Pass
MIL-STD-810D Method 501.2 VVSG Vol 2 4.6.5	High Temp	Successful Post-Test Operation	Pass
MIL-STD-810D Method 516.3 VVSG Vol 2 4.6.2	Bench Handling	Successful Post-Test Operation	Pass
MIL-STD-810D Method 514.3 VVSG Vol 2 4.6.3	Transportation Vibration	Successful Post-Test Operation	Pass

All Environmental Hardware Testing was completed successfully without issue.

3.2 Anomalies and Resolutions

When a result is encountered during test performance that deviates from what is standard or expected, a root cause analysis is performed. Pro V&V considers it an anomaly if no root cause can be determined. In instances in which a root cause is established, the results are then considered deficiencies.

Summary Findings

There were no anomalies encountered during this test campaign.

3.3 Deficiencies and Resolutions

Any violation of the specified requirement or a result encountered during test performance that deviates from what is standard or expected in which a root cause is established was considered to be a deficiency. When a root cause can be determined, instances of nonstandard or unexpected results are considered deficiencies, rather than anomalies. Throughout the test campaign, any deficiencies encountered were logged in the Pro V&V tracking system (Mantis) for disposition and resolution. In each instance, if applicable, the resolution was verified to be resolved through all required means of testing (regression testing, source code review, and TDP update) as needed.

The noted deficiencies are listed in Table 3-4.

Table 3-4. Noted Deficiencies

ID#	Test Category	Deficiency	Resolution
541	Hardware	FVT-B Failed Radiated Immunity Test	The determined cause of the issue was due to unshielded USB cables with a different part number being used in construction of the FVT-B units being tested. After determining this to be the cause, Unisyn disposed of the unshielded cables, and the correctly shielded USB cables were installed in the units and the test was performed successfully. In addition to disposal of the incorrect cables, Unisyn will introduce supplemental and refresher training for manufacturing personnel to ensure additional checks when requisitioning parts for a device build. *The applicable Root Cause Analysis for this issue is OE2.2.3 FVT-B Radiated Immunity Testing.*
542	Hardware	FVT-B Failed Electrical Fast Transient Test	The test failure was limited to FVT-B S/N UVS218211. This unit was removed from testing and replaced with FVT-B S/N UVS218212, which successfully performed the test without issue. The affected unit was then sent to the manufacturer of the Tablet for analysis. The determined cause was a decrease in the insulation resistance between the copper core via the screen connecting wire and the metal frame, which caused screen flashing during testing. This was caused due to excessive break point testing of the affected unit. *The applicable Root Cause Analysis for this issue is OE2.2.3 FVT-B Fast Transient Testing.*
543	Hardware	FVT-B Failed Electrostatic Discharge Test	The determined cause of the issue was due to internal brackets within the unit being completely painted which had an insulating effect and prevented the FVT-B from redirecting the electricity to ground. To address this, paint was removed from key areas of the FVT-B internal brackets to improve grounding and additional error correction was implemented in the FVT-B software to automatically restart the printing process if an error is detected. Unisyn also provided new drawings to the vendor providing the FVT chassis to mask off key areas so that they will not be painted and improve grounding. *The applicable Root Cause Analysis for this issue is OE2.2.3 FVT-B Electrostatic Discharge Testing v2.*

Table 3-4. Noted Deficiencies *(continued)*

ID#	Test Category	Deficiency	Resolution
544	Accuracy	Accuracy Test Attempt #1, halted on FVT-B due to unit not cutting the last ballot printed when a Low Paper error occurs	To address this issue a new Trusted Build of the FVT software was performed. FVT 2.2.3 Trusted Build 3 was then installed on the FVT which allowed the system to print FVT Test Decks without issues with ballots being cut when a Low Paper error occurs.
545	Accuracy	Accuracy Test Attempt #2, halted on FVT-B due to unit attempting to reprint the last ballot printed when a Low Paper error occurs but the reprinted ballot had the barcode cut	To address this issue a new Trusted Build of the FVT software was performed. FVT 2.2.3 Trusted Build 3 was then installed on the FVT which allowed the system to print FVT Test Decks without issues with ballots being cut when a Low Paper error occurs.

4.0 RECOMMENDATION FOR CERTIFICATION

The OVS 2.2.3 Voting System, as presented for testing, successfully met the requirements set forth for voting systems in the U.S. Election Assistance Commission (EAC) 2005 Voluntary Voting System Guidelines (VVSG), Version 1.0. Additionally, Pro V&V, Inc. has determined that the OVS 2.2.3 functioned as a complete system during System Integration Testing. Based on the test findings, Pro V&V recommends the EAC grant the OVS 2.2.3 system, as identified in Tables 4-1 through 4-4, certification to the EAC 2005 VVSG.

Table 4-1. OVS 2.2.3 COTS Software Components

FVT, FVS, OVO and OVI-VC Device Software	Version
Cent OS Linux	
OVO1 and OVI-VC1	5.0
OVO2 and OVI-VC2	6.3
FVS	8.0
Java JRE + Unlimited Cryptographic Extension	
OVO and OVI-VC	1.6.0_02
FVS	1.6.0_45
Android OS	
FVT	4.4.4

Table 4-2. OCS and OVCS COTS Software Components

OCS and OVCS Device Software	Version
CentOS Linux	6.5, 6.8, 7.6, and 7.9
Java JRE + Unlimited Cryptographic Extension	1.6.0_02
Apache-Tomcat Application Server	6.0.13

Table 4-2. OCS and OVCS COTS Software Components *(continued)*

OCS and OVCS Device Software	Version
MySQL Database (BLM, EM, A, and Tab only)	5.0.45-7, 5.7 (on CentOS 7.6 and 7.9)
JasperReports	2.0.5
OpenVPN	2.4.4
OpenSSL	1.0.1f-fips

Table 4-3. OVS 2.2.3 COTS Hardware

Hardware	Make	Model
OVO		
Duplex Ballot Scanner		
Duplex Ballot Scanner	PDI Scan	Pagescan III
Scanner Power Adapter	eUrasia Power	uA36-1024
58 mm Thermal Printer		
58 mm Thermal Printer	Citizen Printer	CT-5281
Printer Power Adapter	Citizen Printer	28AD4
Computer		
Chassis	Morex	Morex 2699
DC/DC converter	Morex	MX-0608F
Chassis Fans	Young Lin Tech	DFB404012M
Motherboard	Jetway	JNF9D-2550
Memory	SuperTalent - Onboard RAM	W1333SA2GV
Hard Drive	Western Digital	WD5000AZLX
AC Adapter	EDAC	EA 10951C-120
1 Gb USB TM		
1 Gb USB	Innodisk	DEUA1-01GI72AC1SB-B88
1 Gb USB	Delkin	UY0GTFLSY-XN000-D
7” LCD Touchscreen Display		
7” LCD Touchscreen Display	Xenarc Technologies	700TSV
Hardware	**Make**	**Model**
AC Power In Module		
AC Power In Module	Delta	Emi 10BEEG3G
FVS		
Computer		
CPU w/ Fan	Intel	G5400-LGA1151
Motherboard	Jetway	JNC8H-IH310
Memory	Crucial	CT4G48F8824A
SSD 250GB	Crucial	CT250MX500SSD1
80mm Thermal Printer		
80mm Thermal Printer	SNBC	BTS-S80
Duplex Ballot Scanner		
Duplex Ballot Scanner	PDI Scan	Pagescan V
Battery		
Battery	RRC Power Solutions Inc.	RRC2040-2
Power Management Module	RRC Power Solutions Inc.	RRC-PMM240
Power Supply 15VDC AC/DC	Meanwell	UHD-200-15

Table 4-3. OVS 2.2.3 COTS Hardware *(continued)*

Hardware	Make	Model
Power Supply 12/12VDC	Meanwell	RSD-60G-12
Power Supply 12/24VDC	Meanwell	RSD-60G-24
AC Inlet Module		
AC Inlet Module	Schurter	4303.5013
Fuse Drawer 1P		
Fuse Drawer 1P	Schurter	4303.2406
Switch On/Off DPDT		
Switch On/Off DPDT	Switchcraft	EHRRSLBPKG
1 Gb USB TM		
1 Gb USB	Innodisk	DEUA1-01GI72AC1SB-B88
1 Gb USB	Delkin	UY0GTFLSY-XN000-D
OVI-VC		
Sip and Puff (Optional)		
Sip and Puff (Optional)	Origin Instruments	AirVoter
Headphone (Optional)		
Headphone (Optional)	Koss On-Ear Headphones	KPH7
15 in LCD Touchscreen Display		
15 in LCD Touchscreen Display	GVision	P15BX-OB-4690
82.5 mm Thermal Printer		
82.5 mm Thermal Printer	Star	TSP743IID-24, serial interface
Printer Adapter	Star	PS60A-24B 1
Computer		
Power Adapter Kit	DC-DC Converter	MX-0608F
Motherboard	Jetway	JNF9D-2550
Hard Drive	Western Digital	WD5000AZLX
Adapter	EDAC	EA 10951c-120
Memory	SuperTalent	W1333SA2GV
1 Gb USB TM		
Hardware	**Make**	**Model**
1 Gb USB	Innodisk	DEUA1-01GI72AC1SB-B88
1 Gb USB	Delkin	UY0GTFLSY-XN000-D
AC Power In Module		
AC Power In Module	Delta	Emi 10BEEG3G
OVCS		
Large Volume Scanner		
Large Volume Scanner	Canon	DR-X10C, DR-G2140
Desktop Scanner		
Desktop Scanner	Canon	DR-M160II
Laptop		
Laptop	Dell	Dell Precision
Desktop PC		
Desktop PC	Dell	Dell OptiPlex

Table 4-3. OVS 2.2.3 COTS Hardware *(continued)*

Hardware	Make	Model
FVT		
13.3 in Touchscreen Tablet		
13.3 in Touchscreen Tablet	Android Tablet	GVision - T13
Tablets Battery Charger	Sager Power System	GC30B-4P1J
82.5 mm Thermal Printer		
82.5 mm Thermal Printer	Star	TSP743IIU-24
Printer Adapter	Star	PS60A-24B 1
Barcode Reader 1D,2D series		
Barcode Reader 1D,2D series	Newland	FM420 & FM430
USB Hub		
USB Hub	D-Link	DUB-H4
Hub Adapter	Meanwell	PSD-15A-05
1 Gb USB TM		
1 Gb USB	Innodisk	DEUA1-01GI72AC1SB-B88
1 Gb USB	Delkin	UY0GTFLSY-XN000-D
Micro SD		
Micro SD	San Disk	4 GB Edge
AC Power In Module		
AC Power In Module	Delta	Emi 10BEEG3G
Sip and Puff (Optional)		
Sip and Puff	Origin Instruments	AirVoter
Headphone (Optional)		
Headphone	Koss On-Ear Headphones	KPH7
USB to Ethernet RJ45 Adapter (Optional)		
USB to Ethernet RJ45 Adapter	D-Link	DUB-E100
FVT-B (Includes items listed for the FVT above)		
Battery		
Battery	RRC Power Solutions Inc.	RRC2040-2
Power Management Module	RRC Power Solutions Inc.	RRC-PMM240
Power Supply 15VDC AC/DC	Meanwell	UHD-200-15
Power Supply 12/12VDC	Meanwell	RSD-60G-12
Power Supply 12/24VDC	Meanwell	RSD-60G-24
UPS		
UPS System – Minuteman Power Technologies	Para Systems, Inc.	Entrepid Series EP1500 LCD
Surgecube – Surge Protector	Belkin	F9H100-CW

Table 4-4. OVCS System COTS Software Components

OVS Hardware	Version
Desktop for non-redundant solutions	Dell OptiPlex 360, 755, 7010, D075/XE2
Desktop for redundant solutions	Dell PrecisionT3500, T3600, T5810, T5820, 3420
Canon Scanner (OVCS)	Canon DR-M160II, DR-G2140, or DR-X10C
Laptop	Dell Latitude E5500, E5540, E5570, E5590, E5500 v2, E5520, Dell XPS m1530,HP 2000

APPENDIX A

Hardware Test Reports

(Provided Separately)

Electrical Test Report

REP0026405SRFEMC, Version 1.0

Environmental Test Report

TR-PR167218, Revision 1

APPENDIX B

Trusted Builds

Trusted Builds

The OVS 2.2.3 Voting System Trusted Build was performed using the steps described in section 5.5 of the EAC Voting System Testing and Certification Program Manual, Version 2.0. The Trusted Build yielded the following software outputs which are described below along with their associated Filenames and Hash Values in SHA 256 format:

FreedomVote Tablet (FVT) Version 2.2.3 – The FreedomVote Tablet trusted build was performed using the "Trusted Build – Applications 2.2" document Version 2.10, dated 07/20/2021, provided by Unisyn Voting Solutions. The trusted build yielded the following output file and the associated Hash Value:

- fvt.apk
  SHA256: 7337cc83ca9c0247160ebb61b985abb5d6b746bca3ea845816c2eb5b15544691

OpenElect Central Suite (OCS) Version 2.2.3 – The OCS Applications trusted build was performed using the "Trusted Build – Applications 2.2" document Version 2.10, dated 07/20/2021, provided by Unisyn Voting Solutions. The applications built for version 2.2.3 were the Tabulator, Tabulator Reports, and OCSInstaller applications. The trusted build yielded the following output files and the associated Hash Values:

- OCSInstaller\OCSInstaller.jar
  SHA256: 788f42160fb49cd36b5a2b33f43ae4e472ec1ee24d008905ecd4bee338ccd499
- OCSInstaller\TOC
  SHA256: 71530f3abd7c7019d8961e575ce2c650e85009518a541c6a7ec8c731a424e80e
- OCSInstaller\TOC.sig
  SHA256: 93826114f9bbd83f0fa24d79a52d443b079698da63c9edc7af2bca779a6d501b
- OCSInstaller\fonts\Arial-Unicode-Bold-Italic.ttf
  SHA256: 0c9d28a03ae39d32ff038398778a6c3a3e7e49966d255ad98c49dee3d93f707b
- OCSInstaller\fonts\Arial-Unicode-Bold.ttf
  SHA256: 131fd02506275cd2ae56ca966c6de086eb5b7b27e9e2d38d4ca4d955193d4530
- OCSInstaller\fonts\Arial-Unicode-Italic.ttf
  SHA256: 83f0db76359b5ec294c880e7fe358b95ca50f164c2bf267e12bf2df544566e21
- OCSInstaller\fonts\arial.ttf
  SHA256: 1906a771ed879a5de75a3ff552fbad533827fe7b39e18319ce9d9ae134c346c7
- OCSInstaller\fonts\arialbd.ttf
  SHA256: f8f19c2bc7205605e2cdf28725b98c818d7079a4a33a654facffc74a67b4294c
- OCSInstaller\fonts\arialbi.ttf
  SHA256: 722c61a99c1af1413d762d0a3b185dd497fe55b873c8672a0c3c4bfe05d29d92
- OCSInstaller\fonts\ariali.ttf
  SHA256: c8dec6540df60f41c5d571b66146d331b2583c952a89a0f224c396f0aeabb117

- OCSInstaller\lib\bcpkix-jdk15on-154.jar
  SHA256: d618dcfbf0337b91015b21d4b398175ae96382a82c7e1d6e8c657fcd236463c7

- OCSInstaller\lib\bcprov-jdk15on-154.jar
  SHA256: d0ae14598f9c528d2ab7bb8ed00e785a5440f692712cd362d69328aba25efb57

- OCSInstaller\lib\commons-httpclient-3.0.jar
  SHA256: 7afd18f30e98c92bf873b64bafeea43b4abdeaba62a4e50e1b6b2d00405ef7ef

- OCSInstaller\lib\mysql-connector-java-5.1.7-bin.jar
  SHA256: a0120d89696ee43a2d7ccacc9a2bd8bf2a2c3da4fbf38c1541e84b23e49bf3fe

- OCSInstaller\lib\pdfhelp.jar
  SHA256: 401043f54a9b111b269b2f8bcdb3243e2d0e2fd37653899b2b15c13f1c3f5a43

- OCSInstaller\preinstall\clean_tm.zip
  SHA256: 856b4dec42d1bef7e2380e2d709e0d8b16905bb76bb97a16f626d1c4ba4488e1

- OCSInstaller\preinstall\clean_tm_install.sh
  SHA256: 64610baa00402e571133ccefe4852979588bc2b3b346a4b68cca99291224bf5b

- OCSInstaller\preinstall\increase_heap.sh
  SHA256: c3df95855b88a346c780c0bd5671b4450fbdc58fa34adaaac3432c94114c0066

- OCSInstaller\preinstall\java.security
  SHA256: a75ba699f9996fc23ef8d0b74319068c67ee65a20a9817254f4d3ad51134e9f7

- OCSInstaller\preinstall\openvpn_install.sh
  SHA256: 209ce89b379bf0b33724d17d9825bb18b58142fe5194968f798349b543a86232

- OCSInstaller\preinstall\setup-openvpn.zip
  SHA256: 5f39e5a2e787669b8910fdad0cec03f0e8c3d77bf8f2ad6f4df5d349289ebb8e

- OCSInstaller\preinstall\set_permissions.sh
  SHA256: a42616896118b9afd4d65b7bd4563fe1cc2da6c1aaeba4ead2a389725b1fdb0f

- OCSInstaller\preinstall\update
  SHA256: 4b161f53d48126f3103350362eea45c3d03c9a4bada33b8fa4c632a542aea521

- Release\TabulatorMonitor.zip
  SHA256: 873a927b7684596475315be3eb2c4ff2a24bf530b0a294949a7b28ef983dd194

- Release\TabulatorReports.zip
  SHA256: 7deae2e6c0971ecf1556e97c3e59e10fe0b8326f65f896947e09cac838abb064

- Release\TOC
  SHA256: 9a63236fc045bcc45ae4b0f42852977429f0264c2c9631bb01a2611bc48f156b

- Release\TOC.sig
  SHA256: f5a266ee967e5ad44245f616f50a0e8f136d07d491ab6e17c19649591fd4f2f6