

PRO V&V



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

Test Plan for EAC 2005 VVSG Certification Testing Unisyn Voting Solutions OpenElect 2.2 Voting System

EAC Project Number: UNS10121966-2.2

Version: 01

Date: 10/06/2020

U.S. Election Assistance Commission

VSTL

EAC Lab Code 1501

NVLAP[®]

NVLAP LAB CODE 200908-0

SIGNATURES

Approved by: Michael Walker 10/06/2020
Michael Walker, VSTL Project Manager Date

Approved by: Wendy Owens 10/06/2020
Wendy Owens, VSTL Program Manager Date

REVISIONS

| Revision | Description | Date |
|-----------------|-------------------------|-------------|
| 00 | Initial Release | 09/15/2020 |
| 01 | Update per EAC comments | 10/06/2020 |
| | | |
| | | |
| | | |
| | | |

TABLE OF CONTENTS

| | | |
|------------|---|-----------|
| 1.0 | INTRODUCTION | 1 |
| 1.1 | Description and Overview of EAC Certified System Being Modified | 1 |
| 1.1.1 | Baseline Certified System | 1 |
| 1.1.2 | Description of Modification | 10 |
| 1.1.3 | Initial Assessment | 15 |
| 1.1.4 | Regression Test | 16 |
| 1.2 | References | 16 |
| 1.3 | Terms and Abbreviations..... | 17 |
| 1.4 | Project Schedule | 18 |
| 1.5 | Scope of Testing | 18 |
| 1.5.1 | Block Diagram..... | 20 |
| 1.5.2 | System Limits | 21 |
| 1.5.3 | Supported Languages..... | 23 |
| 1.5.4 | Supported Functionality..... | 23 |
| 1.5.5 | VVSG | 24 |
| 1.5.6 | RFIs..... | 24 |
| 1.5.7 | NOCs | 24 |
| 2.0 | PRE-CERTIFICATION TESTING AND ISSUES | 25 |
| 2.1 | Evaluation of Prior VSTL Testing..... | 25 |
| 2.2 | Evaluation of Prior Non-VSTL Testing..... | 25 |
| 2.3 | Known Field Issues..... | 25 |
| 3.0 | MATERIALS REQUIRED FOR TESTING | 25 |
| 3.1 | Software | 25 |
| 3.2 | Equipment | 25 |
| 3.3 | Test Materials | 26 |
| 3.4 | Deliverable Materials..... | 26 |
| 3.5 | Proprietary Data..... | 27 |
| 4.0 | TEST SPECIFICATIONS | 27 |
| 4.1 | Requirements (Strategy of Evaluation)..... | 27 |
| 4.1.1 | Rational for ‘Not Applicable’ Requirements..... | 30 |

| | | |
|------------|--|------------|
| 4.2 | Hardware Configuration and Design | 30 |
| 4.3 | Software System Functions..... | 30 |
| 4.4 | Test Case Design | 31 |
| 4.4.1 | Hardware Qualitative Design..... | 31 |
| 4.4.2 | Hardware Environmental Test Case Design | 31 |
| 4.4.3 | Software Module Test Case Design and Data | 32 |
| 4.4.4 | Software Functional Test Case Design and Data..... | 32 |
| 4.4.5 | System-Level Test Case Design | 33 |
| 4.5 | TDP Evaluation..... | 33 |
| 4.6 | Source Code Review..... | 34 |
| 4.7 | QA & CM System Review | 35 |
| 4.8 | PCA..... | 35 |
| 4.9 | FCA..... | 35 |
| 4.10 | Accuracy | 36 |
| 4.11 | System Integration | 36 |
| 4.12 | Volume and Stress | 36 |
| 4.12 | Security Functions | 37 |
| 5.0 | TEST DATA | 37 |
| 5.1 | Test Data Recording | 37 |
| 5.2 | Test Data Criteria..... | 37 |
| 5.3 | Test Data Reduction..... | 37 |
| 6.0 | TEST PROCEDURES AND CONDITIONS | 37 |
| 6.1 | Facility Requirements | 38 |
| 6.2 | Test Set-Up | 38 |
| 6.3 | Test Sequence | 38 |
| 6.4 | Test Operations Procedures | 38 |
| | PROJECT SCHEDULE..... | A-1 |

1.0 INTRODUCTION

The purpose of this Test Plan is to document the procedures that Pro V&V, Inc. will follow to perform certification testing during a system modification campaign for the Unisyn Voting Solutions OpenElect Voting System (OVS) Version 2.2 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. Prior to submitting the voting system for testing, Unisyn submitted an application package to the EAC for certification of the OpenElect 2.2 Voting System. The application was accepted by the EAC and the project was assigned the unique Project Number of UNS10121966-2.2.

At test conclusion, the results of all testing performed as part of this test campaign will be submitted to the EAC in the form of a national certification test report.

1.1 Description and Overview of EAC Certified 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 2.1 Voting System. Detailed descriptions of the OVS 2.1 test campaign are contained in Pro V&V Report No.TR-01-01-UNI-005-01.02, which is available for viewing on the EAC's website at www.eac.gov.

OVS 2.1 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 2.1 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)**

The OVO, 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 OVCS is the bulk scanner used for mail-in ballots, provisional ballots, and recounts.

1.1.1 Baseline Certified System

The following subsections describe the baselined OVS 2.1 Voting System.

Open Elect Central Suite (OCS)

The OCS System supports elections on the OVO, 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 be 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.

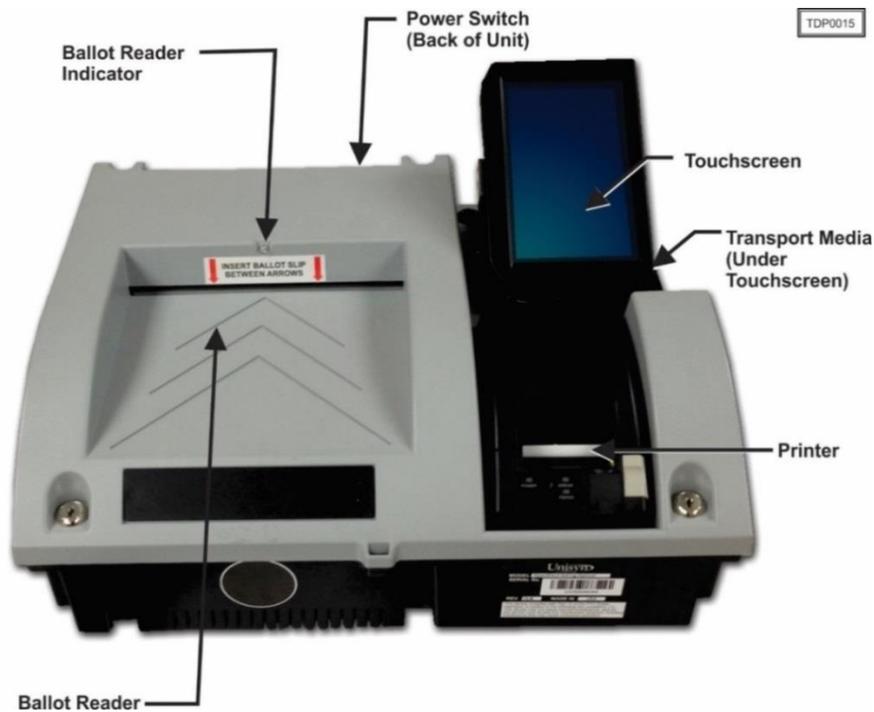


Figure 1-1. OVO

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 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 user interfaces for voting and maintenance. A new election loaded via a Transport Media (TM) sets passwords, parameters, audio, and ballot styles for that election.
- **Transport Media (TM)** - USB device with 1 GB or larger storage provides the means of transporting audit files to the OCS system.
- **Printer** – 82.5 mm thermal receipt printer is 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.



Figure 1-2. OVI-VC

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 (either Canon model DR-M160II or model DR-X10C) that is connected to the PC to scan data from marked ballots.

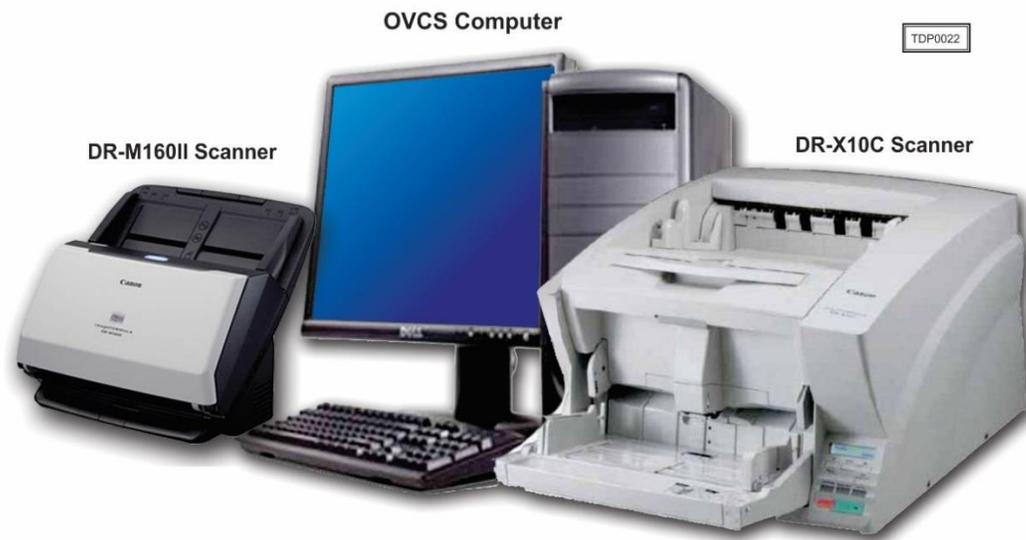


Figure 1-3. OVCS

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 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 Sip and Puff Interface, Headphones, Sip and Puff Device.



Figure 1-4. FVT

The proprietary and COTS software to be provided by the manufacturer as part of the test campaign are detailed in the following tables.

Table 1-1. OVS 2.1 COTS Software Components

| FVT, OVO and OVI-VC Device Software | Version |
|--|----------------|
| CentOS Linux (OVO and OVI-VC) | 6.3 |
| Java JRE + Unlimited Cryptographic Extension | 1.6.0_02 |
| Android OS (FVT) | 4.4.4 |

Table 1-2. OCS and OVCS COTS Software Components

| OCS and OVCS Device Software | Version |
|--|---------------------|
| CentOS Linux | 6.5, 6.8, and 7.6 |
| Java JRE + Unlimited Cryptographic Extension | 1.6.0_02 |
| Apache-Tomcat Application Server | 6.0.13 |
| MySQL Database (BLM, EM, A, and Tab only) | 5.0.45-7 |
| JasperReports | 2.0.5 |
| OpenVPN | 2.4.4 |
| OpenSSL | 1.0.1f |
| OpenSSL FIPS Object Module | 2.0.10 (cert #1747) |

Table 1-3. Voting System COTS Hardware

| Hardware | Make | Model |
|-----------------------------------|---------------------------|------------------------|
| OVO | | |
| <i>Duplex Ballot Scanner</i> | | |
| Duplex Ballot Scanner | PDI Scan | Pagescan III |
| Scanner Power Adapter | eUrasia Power | uA36-1024 |
| <i>58 mm Thermal Printer</i> | | |
| 58 mm Thermal Printer | Citizen Printer | CT-5281 |
| Printer Power Adapter | Citizen Printer | 28AD4 |
| <i>Computer</i> | | |
| Chassis | Morex | Morex 2699 |
| Power Adapter | DC/DC converter | MX-0608F |
| Motherboard | Jetway | JNF9D-2550 |
| Chassis Fans | Young Lin Tech | DFB404012M |
| Memory | SuperTalent - Onboard RAM | W1333SA2GV |
| Hard Drive | Western Digital | WD5000AZLX |
| Adapter | EDAC | EA 10951c-120 |
| <i>1 GB USB TM</i> | | |
| Innodisk | 1 GB USB | DEUA1-01G172AC1SB-B088 |
| Delkin | 1 GB USB | UY0GTFLSY-XN000-D |
| <i>7" LCD Touchscreen Display</i> | | |
| 7" LCD Touchscreen Display | Xenarc Technologies | 700TSV |

Table 1-3. Voting System COTS Hardware (continued)

| Hardware | Make | Model |
|--------------------------------------|---------------------------|--------------------------------|
| <i>AC Power In Module</i> | | |
| AC Power In Module | Delta | Emi 10BEEG3G |
| OVI-VC | | |
| <i>Sip and Puff (Optional)</i> | | |
| Sip and Puff (Optional) | Origin Instruments | AirVoter |
| <i>Headphone (Optional)</i> | | |
| Headphone (Optional) | Koss On-Ear Headphones | KPH5 |
| <i>15 in LCD Touchscreen Display</i> | | |
| 15 in LCD Touchscreen Display | GVision | P15BX-OB-4690 |
| <i>82.5 mm Thermal Printer</i> | | |
| 82.5 mm Thermal Printer | Star | TSP743IID-24, serial interface |
| Printer Adapter | Star | PS60A-24B 1 |
| <i>Computer</i> | | |
| Power Adapter Kit | DC-DC Converter | MX-0608F |
| Motherboard | Jetway | JNF9D-2550 |
| Memory | SuperTalent - Onboard RAM | 3120-21282 |
| | | |
| Hard Drive | Western Digital | WD5000AZLX |
| Adapter | EDAC | EA 10951c-120 |
| <i>1 GB USB TM</i> | | |
| Innodisk | 1 GB USB | DEUA1-01G172AC1SB-B088 |
| Delkin | 1 GB USB | UY0GTFLSY-XN000-D |
| <i>AC Power In Module</i> | | |
| AC Power In Module | Delta | Emi 10BEEG3G |
| OVCS | | |
| <i>Large Volume Scanner</i> | | |
| Large Volume Scanner | Canon | DR-X10C DR-G2140 |
| <i>Desktop Scanner</i> | | |
| Desktop Scanner | Canon | DR-M160II |
| FVT | | |
| <i>13.3 in Touchscreen Tablet</i> | | |
| 13.3 in Touchscreen Tablet | Android Tablet | GVision - T13 |
| Tablets Battery Charger | Sager Power System | GC30B-4P1J |
| <i>82.5 mm Thermal Printer</i> | | |
| 82.5 mm Thermal Printer | Star | TSP743IIU-24 |
| Printer Adapter | Star | PS60A-24B 1 |
| <i>Barcode Reader 1D,2D series</i> | | |
| Barcode Reader 1D,2D series | Newland | FM420 |

Table 1-3. Voting System COTS Hardware (continued)

| Hardware | Make | Model |
|--|-------------------------|------------------------|
| <i>USB Hub</i> | | |
| USB Hub | D-Link | DUB-H4 |
| Hub Adapter | Mean Well | PSD-15A-05 |
| <i>1 GB USB TM</i> | | |
| Innodisk | 1 GB USB | DEUA1-01G172AC1SB-B088 |
| Delkin | 1 GB USB | UY0GTFLSY-XN000-D |
| <i>Micro SD</i> | | |
| Micro SD | San Disk | 4 GB Edge |
| <i>Battery</i> | | |
| Battery Pack 12 V 6.0 AH | Power Sonic | PSH-1255-FR |
| Adapter | Mean Well | GC30B-4PIL |
| <i>AC Power In Module</i> | | |
| AC Power In Module | Delta | Emi 10BEEG3G |
| <i>Sip and Puff (Optional)</i> | | |
| Sip and Puff | Origin Instruments | AirVoter |
| <i>Headphone (Optional)</i> | | |
| Headphone | Koss On-Ear Headphones | KPH7 |
| <i>USB to Ethernet RJ45 Adapter (Optional)</i> | | |
| USB to Ethernet RJ45 Adapter | D-Link | DUB-E100 |
| FVS | | |
| <i>Computer</i> | | |
| CPU w/Fan | Intel | G5400-LGA1151 |
| Motherboard | Jetway | JNC8H-IH310 |
| Memory | Crucial | CT4G48F8824A |
| SSD 250GB | Crucial | CT250MX500SSD1 |
| <i>Printer</i> | | |
| 80mm Thermal Printer | SNBC | BTS-S80 |
| <i>Scanner</i> | | |
| Duplex Ballot Scanner | PDI Scan | Pagescan V |
| <i>Battery</i> | | |
| Battery. | RRC Power Solutions Inc | RRC2040-2 |
| Power Management Module | RRC Power Solutions Inc | RRC-PMM240 |
| Power Supply 15VDC AC/DC | Mean Well | UHD-200-15 |
| Power Supply 12/12VDC | Mean Well | RSD-60G-12 |
| Power Supply 12/24VDC | Mean Well | RSD-60G-24 |
| <i>AC Inlet Module</i> | | |
| AC Inlet Module | Schurter | 4303.5013 |
| <i>Fuse Drawer 1P</i> | | |
| Fuse Drawer 1P | Schurter | 4303.2406 |
| <i>Switch Power On/Off DPDT</i> | | |
| Switch On/Off DPDT | Switchcraft | EHRRSLBPKG |
| UPS | | |
| Minuteman Power Technologies | Para Systems, Inc. | Entrepid Series |

Table 1-4. 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-G2140, DR-M160II, or DR-X10C |
| Laptop | Dell Latitude E5500, E5540, E5570, E5590, E5500 v2, Dell XPS m1530, HP 2000 |

1.1.2 Description of Modification

The OVS 2.2 Voting System is a modified voting system configuration that contains updates to various components of the OpenElect Voting System as well as the addition of the OpenElect FreedomVote Scan (FVS) and the Canon DR-G2140 (OVCS) central count tabulator. The FVT has end of life electrical components that are being replaced within this release, as well as an internal battery backup unit installed. This release incorporates specific enhancement requests primarily centered on improving the end user experience.

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.



Figure 1-5. FVS

OpenElect Voting Central Scan (OVCS)

A new mid-tier OVCS unit is being added to the list of units supported. The OVCS system consists of the following components:

- PC Desktop – A certified PC and configuration.
- Bulk Scanner –Canon model G-2140 that is connected to the PC to scan data from marked ballots.

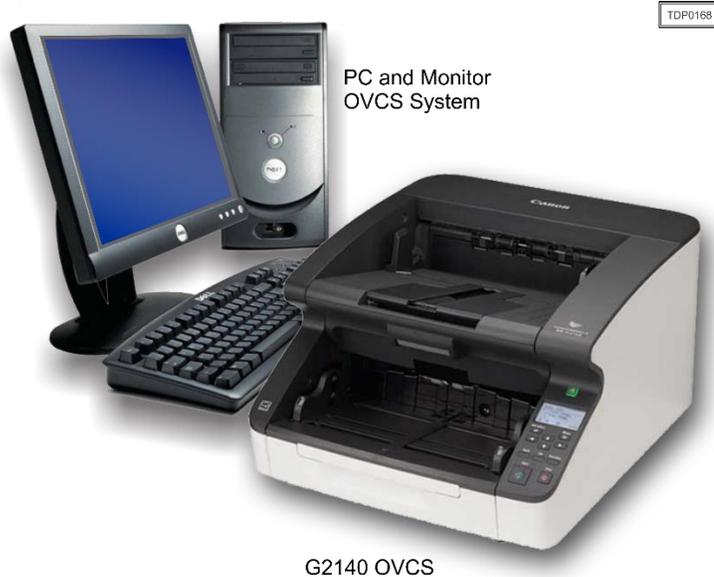


Figure 1-6. OVCS PC and G2140 OVC Scanner

The list below includes the submitted software changes between the OVS 2.2 system and the baseline of the OVS 2.1 Voting System as derived from the OpenElect Voting System Release Notes, System 2.1 to 2.2, Version 1.0:

Auditor (A)

- *Reference Number 2.2-1:* Add ability for operator to swap left/right images.

Ballot Layout Manager (BLM)

- *Reference Number 2.2-2:* Adjust BMD length calculation to accommodate voting options and font sizes.
- *Reference Number 2.2-3:* Increase speed of backup/restore UDB process.
- *Reference Number 2.2-4:* Enforce type limitation on precinct splits. (Normal precincts must have at least one normal split, absentee etc. precincts can only have splits of same type.)
- *Reference Number 2.2-5:* Improvements to speed and balancing of proportional rotation function. Ignore absentee precincts in counts.
- *Reference Number 2.2-6:* Add ability to move groups of contests in contest reorder interface.
- *Reference Number 2.2-7:* Show dynamically generated IDs for contest/candidate in interface.

- *Reference Number 2.2-8:* Export and import rotation point in precinct interface.
- *Reference Number 2.2-9:* Add alignment option (left or center) to BLM interface.

Election Manager (EM)

- *Reference Number 2.2-10:* Add FVS machine type and specific FVS options.
- *Reference Number 2.2-11:* Add option for type of write report (compressed or expanded) to be selected at EM, and not on close in OVO/FVS.
- *Reference Number 2.2-12:* Add support for encrypted USB.
- *Reference Number 2.2-28:* Allow operator to set default number of open / close reports to print.

FreedomVote Tablet (FVT)

- *Reference Number 2.2-9:* Add alignment option (left or center) to BLM interface.
- *Reference Number 2.2-14:* Make training mode on FVT function more like election-day for training purposes.
- *Reference Number 2.2-15:* Remove user confirmation when USB is inserted in FVT.
- *Reference Number 2.2-16:* Ensure the ballots look consistent (font, format, etc.) from ballot to screen.
- *Reference Number 2.2-17:* Support multiple cross party endorsements for a single candidate.
- *Reference Number 2.2-18:* Allow multipage retraction/cast by adding page number to Retraction ID.
- *Reference Number 2.2-19:* Only one vote assigned to each write-in in Test Deck generation, no longer part of the sequence.
- *Reference Number 2.2-20:* When a contest does not have enough candidates to fulfill the vote for value, the second chance validation will not flag them as undervotes.

OpenElect Voting Interface (OVI-VC)

- *Reference Number 2.2-12:* Add support for encrypted USB.
- *Reference Number 2.2-20:* When a contest does not have enough candidates to fulfill the vote for value, the second chance validation will not flag them as undervotes.

OpenElect Voting Central Scan (OVCS)

- *Reference Number 2.2-20:* When a contest does not have enough candidates to fulfill the vote for value, the second chance validation will not flag them as undervotes.
- *Reference Number 2.2-21:* Add Canon G2140 to OVCS.
- *Reference Number 2.2-22:* Add Ballot Count to OVCS upload screen.

OpenElect Voting Optical Scan (OVO)

- *Reference Number 2.2-11:* Add option for type of write-in report (compressed or expanded) to be selected at EM, and not on close in OVO/FVS.
- *Reference Number 2.2-12:* Add support for encrypted USB.
- *Reference Number 2.2-23:* Prevent ballot hang at back of OVO.
- *Reference Number 2.2-24:* Write-in extraction improvement (in line with OVCS.)
- *Reference Number 2.2-25:* Speed up closing process (background thread to sign images and extract write-ins) and efficiency improvements.
- *Reference Number 2.2-26:* Updated jam after cast handling. If jammed after cast, a voter message will display telling them to request poll worker assistance. When the 'Continue' button is selected, the next screen requires the Election password screen input by the poll worker.

Then the system will then attempt to eject to the ballot box again, if not successful, it will eject the ballot to the front with a screen messaging telling the poll worker that special handling is required.

- *Reference Number 2.2-27:* On full review screen: Cast and Return buttons are always enabled.
- *Reference Number 2.2-28:* Allow operator to set default number of open / close reports to print.
- *Reference Number 2.2-29:* If write-in report is cancelled, do not print signature lines, instead print that report was cancelled.
- *Reference Number 2.2-30:* Add ability to support scaling of ballot image on paper down to 95%.

Tabulator (TAB)

- *Reference Number 2.2-31:* Allow VR totals by party to be input for all defined parties.

- *Reference Number 2.2-32:* Aggregate party VR totals when validating ballot counts on upload.
- *Reference Number 2.2-33:* Support for RCV Single Transferable Vote.
- *Reference Number 2.2-34:* Add option to allow RCV tally to continue beyond minimum winning threshold.
- *Reference Number 2.2-35:* Add show splits button on upload interface to make it easier to determine which splits have not reported.
- *Reference Number 2.2-36:* Improve handling of write-ins for RCV. See Tabulator User Guide, Section 5.3.2 (pg. 5-25) for details.
- *Reference Number 2.2-37:* On export, RCV contests only export the first rank contests.
- *Reference Number 2.2-38:* Add support for FVS devices.

Tabulator Reports (TR)

- *Reference Number 2.2-39:* Choose all precincts and contests by default when generating reports.
- *Reference Number 2.2-40:* Filter SOVC report so that a contest only shows precincts that it is assigned to.

Tabulator Client (TC)

- *Reference Number 2.2-38:* Add support for FVS devices.

FreedomVote Scan (FVS)

- *Reference Number 2.2-13:* Add FreedomVote Scan.

1.1.3 Initial Assessment

Testing from the previous test campaign was used to establish the baseline. The focus of this test campaign is on the updates to various components of the OpenElect Voting System, the introduction of the end user enhancements, the addition of the Canon G2140 scanner for the OpenElect Voting Central Scan (OVCS), and the addition of the FreedomVote Scan (FVS).

Based on the submitted modifications, it was determined the following tasks would be required to verify compliance of the modifications:

- Source Code Review, Compliance Build, Trusted Build, and Build Document Review
- System Level Testing
 - System Integration

- Accuracy
- Volume and Stress
- Technical Documentation Package (TDP) Review
- Physical Configuration Audit (PCA), including System Loads and Hardening
- Functional Configuration Audit (FCA)
- Regression Testing
- Usability, Accessibility, and Maintainability Testing
- Security Testing
- Hardware Testing (Electrical and Environmental)

1.1.4 Regression Test

Regression testing for this test campaign will consist of the execution of the System Integration Testing.

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, 2016 Edition, “NVLAP Procedures and General Requirements (NIST HB 150-2016)”, dated July 2016
- National Voluntary Laboratory Accreditation Program NIST Handbook 150-22, 2008 Edition, “Voting System Testing (NIST Handbook 150-22)”, dated May 2008
- 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 7.0
- EAC Requests for Interpretation (RFI) (listed on www.eac.gov)
- EAC Notices of Clarification (NOC) (listed on www.eac.gov)

- Pro V&V Test Report No. TR-01-01-UNI-005-01.02, “Test Report for EAC 2005 VVSG Certification Testing Unisyn Voting Solutions OpenElect 2.1 Voting System”
- OpenElect Voting System Release Notes, System 2.1 to 2.2, Version 1.0
- Unisyn Voting Solutions Technical Data Package (*A listing of the OpenElect 2.2 documents submitted for this test campaign is listed in Section 4.5 of this Test Plan*)

1.3 Terms and Abbreviations

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

“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

“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

1.4 Project Schedule

The Project Schedule for the test campaign is located in Appendix A. The dates on the schedule are not firm dates but planned estimates based on the anticipated project workflow.

1.5 Scope of Testing

The scope of testing is limited to the modifications/enhancements implemented since the certification of the baseline system. These modifications include updates to various components of the OpenElect Voting System, the introduction of the end user enhancements, and the addition of the FreedomVote Scan (FVS) and the new OVCS scanner, the Canon DR-G2140.

Based on this assessment, it was determined that multiple areas within the EAC 2005 VVSG would be evaluated to encompass the required tests. A breakdown of the areas and associated tests is listed below:

- EAC 2005 VVSG Volume 1, Section 2: Functional Requirements
 - System Integration Testing
 - Functional Configuration Audit (FCA)
 - Physical Configuration Audit (PCA), including System Loads & Hardening
 - Technical Documentation Package (TDP) Review
 - Volume & Stress Testing
 - Accuracy Testing

- EAC 2005 VVSG Volume 1, Section 3: Usability & Accessibility
 - Usability & Accessibility Testing
 - Technical Documentation Package (TDP) Review
- EAC 2005 VVSG Volume 1, Section 4: Hardware Requirements
 - Hardware Testing
 - Technical Documentation Package (TDP) Review
- EAC 2005 VVSG Volume 1, Section 5: Software Requirements
 - Source Code Review, Compliance Build, Trusted Build, and Build Document Review
 - Technical Documentation Package (TDP) Review
 - Functional Configuration Audit (FCA)
- EAC 2005 VVSG Volume 1, Section 7: Security Requirements
 - Security Testing
 - Technical Documentation Package (TDP) Review
 - Functional Configuration Audit (FCA)

Reminder of this page intentionally left blank

1.5.1 Block Diagram

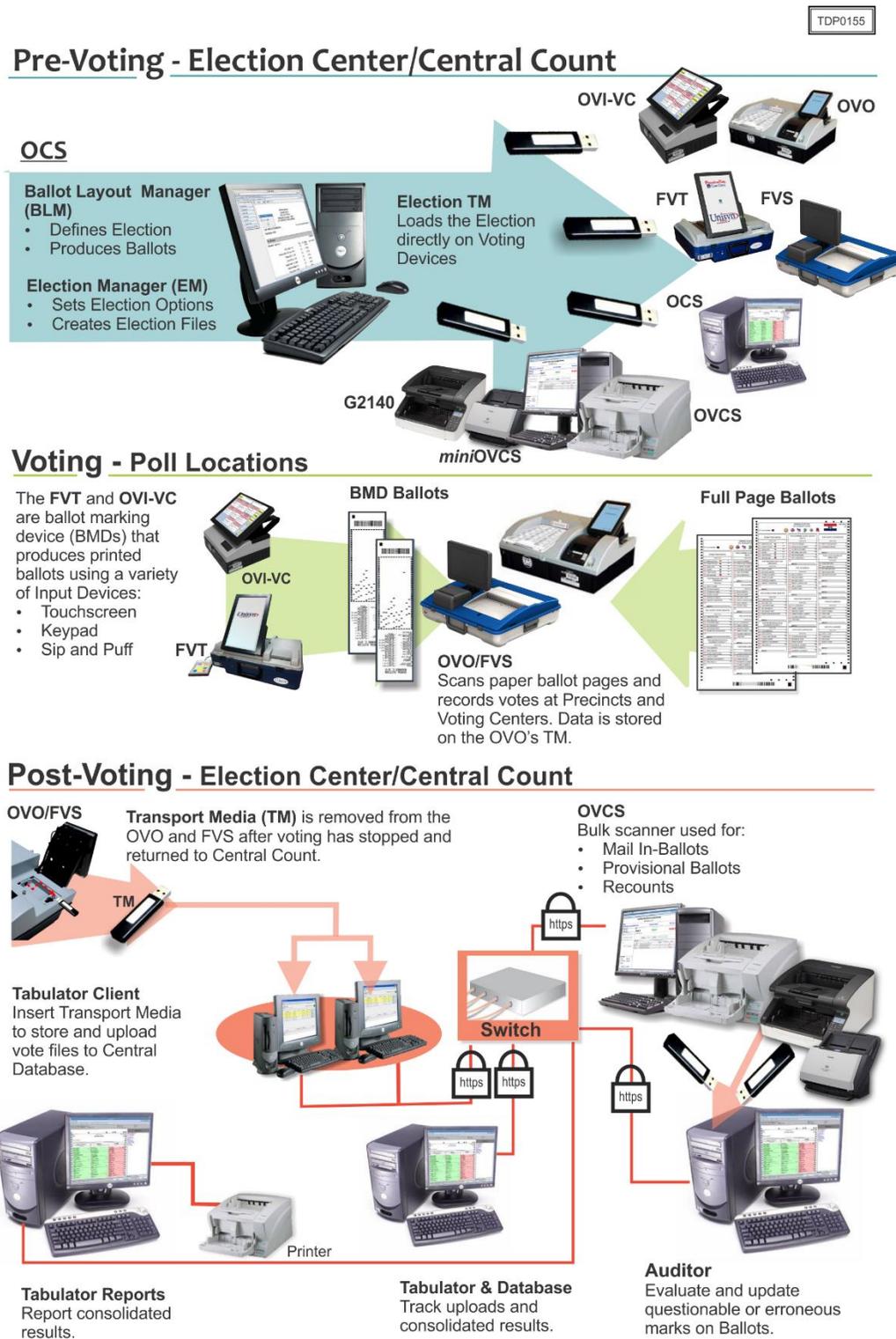


Figure 1-5. OVS 2.2 System Components Overview

1.5.2 System Limits

Unisyn has defined the following system performance characteristic limits for the OVS 2.2:

- 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 designed for handling up to 20 consecutive elections.
- Ten elections may be stored in the OCS database simultaneously.
- The system allows 2000 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 2000 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: 2000 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: 2000 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.

1.5.3 Supported Languages

The submitted voting system supports:

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

Support for all stated languages will be verified; however, only English and Spanish language ballots will be cast during the performance of functional testing. Additionally, one character based language (Chinese) will be tested during System Integration Testing.

1.5.4 Supported Functionality

The OVS 2.2 is designed to support the following voting variations:

- General Election
- Closed Primary
- 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)

1.5.5 VVSG

The OVS 2.2 shall be evaluated against the relevant requirements contained in the EAC 2005 VVSG, Volumes I and II.

1.5.6 RFIs

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

1.5.7 NOCs

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

2.0 PRE-CERTIFICATION TESTING AND ISSUES

This section describes previous testing performed prior to submitting the voting system to the EAC.

2.1 Evaluation of Prior VSTL Testing

Pro V&V evaluated to the published Final Test Report for the OVS 2.1 System in order to baseline the current system under test.

2.2 Evaluation of Prior Non-VSTL Testing

No prior non-VSTL testing of the OVS 2.2 modifications were considered for this test campaign.

2.3 Known Field Issues

There are no known field issues with the baseline system OVS 2.1. OVS 2.2 is a modification to the previously certified OVS 2.1 system and has not been fielded.

3.0 MATERIALS REQUIRED FOR TESTING

The following sections list all materials needed to enable the test engagement to occur.

The materials required for testing of the OVS 2.2 System include all materials to enable the test campaign to occur. This includes the applicable hardware and software as well as the TDP, test support materials, and deliverable materials, as described in the following subsections.

3.1 Software

This subsection lists the proprietary and COTS software to be provided by the manufacturer as part of the test campaign.

All software required for testing is identified in Section 1.1 of this test plan.

To verify that no source code was changed to implement the updated FIPS modules/libraries, which are called upon in the build process and included in the compile, Pro V&V will perform a comparison on the submitted source code.

3.2 Equipment

This subsection lists the proprietary and COTS equipment to be provided by the manufacturer as part of the test campaign.

For COTS equipment, every effort will be made to verify that the COTS equipment has not been modified for use. This will be accomplished by performing research using the COTS equipment manufacturer's websites based on the serial numbers and service tag numbers for each piece of equipment. Assigned test personnel will evaluate COTS hardware, system software and communications components for proven performance in commercial applications other than voting.

For PCs, laptops, and servers, the service tag information will be compared to the system information found on each machine. Physical external and internal examination will also be performed when the equipment is easily accessible without the possibility of damage. Hard drives, RAM memory, and other components will be examined to verify that the components match the information found on the COTS equipment manufacturer’s websites.

All hardware required for testing is identified in Section 1.1 of this test plan.

3.3 Test Materials

This subsection lists the test materials required to execute the required tests throughout the test campaign.

The materials required for certification testing of the OVS 2.2 include all previously identified software, hardware and test materials, as well as the deliverable materials listed below.

3.4 Deliverable Materials

This subsection lists the materials identified by the manufacturer as materials deliverable to the end user for the system being tested.

Table 3-1. Voting System Deliverables

| Material | Software Version | Hardware Version | Description |
|---|------------------|--|----------------------------|
| OpenElect Voting Optical (OVO) | 2.2 | Rev. E | Precinct Ballot Scanner |
| OpenElect Voting Interface (OVI-VC) | 2.2 | --- | Ballot Marking Device |
| OVCS | 2.2 | Hardware, Canon DR-X10C, DR-G-2140 and Canon M160-II | Central Count Scanner |
| Freedom Vote Tablet (FVT) Ballot Marking Device | 2.2 | Rev. F | Ballot Marking Device |
| Freedom Vote Scanner (FVS) | 2.2 | Rev. A | Precinct Ballot Scanner |
| Ballot Box – Plastic (OVO) | 1.0 | --- | OVO Ballot Box |
| Ballot Box – Plastic (OVO) | 2.0 | --- | OVO Ballot Box |
| Ballot Box – Plastic (FVS) | 2.2 | --- | FVS Ballot Box |
| Open Elect Central Suite (OCS) | 2.2 | --- | |
| Transport Media | 1 GB | -- | USB Flash Drive |
| Minuteman UPS | --- | EP1500 LCD | UPS |
| Surgecube | --- | Belkin F9H100-CW | Surge Protector |
| Headphones (optional) | --- | Koss KPH7 | Stereo headphones |
| Sip and Puff (optional) | | Origin AirVoter | Binary Input Device |
| OVS 2.2 TDP* | --- | --- | OVS Technical Data Package |

* Listed in Section 4.5

3.5 Proprietary Data

All data and documentation considered by the manufacturer to be proprietary will be identified and documented in an independent submission along with a Notice of Protected Information.

4.0 TEST SPECIFICATIONS

Certification testing of the OVS 2.2 System submitted for evaluation will be performed to ensure the applicable requirements of the EAC 2005 VVSG and the EAC Testing and Certification Program Manual, Version 2.0, are met. Additionally, all EAC Request for Interpretations (RFI) and Notices of Clarification (NOC) relevant to the system under test will be incorporated in the test campaign. A complete listing of the EAC RFIs and NOCs is available on the EAC website.

4.1 Requirements (Strategy of Evaluation)

To evaluate the OVS 2.2 test requirements, the submitted modifications were evaluated against each section of the EAC 2005 VVSG to determine the applicable tests to be performed. Based on this assessment, it was determined the following evaluations would be required to verify compliance of the modifications:

Technical Documentation Package (TDP) Review

A TDP Review will be performed to ensure that all submitted modifications are accurately documented and that the documents meet the requirements of the EAC VVSG 1.0. The preliminary TDP review is performed to gather information concerning the system under test and its capabilities or design intentions. Additionally, a TDP review will be performed throughout the test campaign. The TDP Review includes the Initial Review, the Regulatory/Compliance Review, and the Final Review. This review is conducted to determine if the submitted technical documentation meets the regulatory, customer-stated, or end-user requirements and includes reviewing the documents for stated functionality and verification.

Section 2: Functional Requirements

The requirements in this section shall be tested during the FCA, Accuracy Test, and System Integration Test. This evaluation will utilize baseline test cases as well as specifically designed test cases and will include predefined election definitions for the input data.

The FCA targets the specific functionality claimed by the manufacturer to ensure the product functions as documented. This testing uses both positive and negative test data to test the robustness of the system. The FCA encompasses an examination of manufacturer 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 (such as system operations, voter manual, maintenance, and diagnostic testing manuals). It includes a test of system operations in the sequence in which they would normally be performed. These system operations and functional capabilities are categorized as follows by the phase of election activity in which they are required:

- Overall System Capabilities: These functional capabilities apply throughout the election process. They include security, accuracy, integrity, system audit ability, election management system, vote tabulation, ballot counters, telecommunications, and data retention.
- 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.
- Maintenance, Transportation and Storage Capabilities: These capabilities are necessary to maintain, transport, and store voting system equipment.

The system integration testing addresses the integration of the hardware and software. This testing focuses on the compatibility of the voting system software components and subsystems with one another and with other components of the voting system. During test performance, the system is configured as would be for normal field use.

The accuracy test ensures that each component of the voting system can each process 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.

The FCA for this test campaign will include an assessment of the submitted modifications and will include inputs of both normal and abnormal data during test performance. This evaluation will utilize baseline test cases as well as specifically designed test cases and will include predefined election definitions for the input data. As part of the FCA, one primary and one general election will be executed to verify that each of the submitted modifications have been successfully implemented

Section 3: Usability and Accessibility Requirements

The requirements in this section shall be tested during the Usability and Accessibility Testing. This evaluation will utilize baseline test cases as well as specifically designed test cases and will include predefined election definitions for the input data.

The usability testing focuses on the usability of the system being tested. Usability is defined generally as a measure of the effectiveness, efficiency, and satisfaction achieved by a specified set of users with a given product in the performance of specified tasks.

In the context of voting, the primary user is the voter, the product is the voting system, and the task is the correct recording of the voter ballot selections. Additional requirements for task performance are independence and privacy: the voter should normally be able to complete the voting task without assistance from others, and the voter selections should be private. Accessibility evaluates the requirements for accessibility. These requirements are intended to address HAVA 301 (a) (3) (B).

Section 4: Hardware Requirements

The hardware tests specified in the VVSG are divided into two categories: non-operating and operating. The non-operating tests apply to the elements of the system that are intended for use at poll site locations and are intended to simulate the storage and transport of equipment between the storage facility and the polling location. The Operating tests apply to the entire system, including hardware components that are used as part of the voting system telecommunications capability, and are intended to simulate conditions that the voting system may encounter during operation. Prior to and immediately following each required non-operating and operating test, the system shall be subjected to an operational status check.

The requirements in this section shall be tested and/or evaluated by personnel verified by Pro V&V to be qualified to perform the testing.

Section 5: Software Requirements

The requirements in this section shall be tested utilizing a combination of review and functional testing during the source code review, TDP review, and FCA.

To perform the source code review, Pro V&V will review the submitted source code to the EAC VVSG 1.0 and the manufacturer-submitted coding standards. Prior to initiating the software review, Pro V&V shall verify that the submitted documentation is sufficient to enable: (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. The source code review includes a compliance build and a trusted build of the submitted source code.

Section 7: Security Requirements

The requirements in this section shall be tested during the source code review, security tests, and FCA.

To evaluate the integrity of the system, Pro V&V will develop specifically designed test cases in an attempt to defeat the access controls and security measures documented in the system TDP as well verifying compliance to EAC RFI 2012-05. A threat matrix will be created to determine the risks and vulnerabilities. An evaluation of the system will be accomplished by utilizing a combination of functional testing, source code review, and static code analyzers.

During the security testing, the system shall be inspected for various controls and measures that are in place to meet the objectives of the security standards which include: protection of the critical elements of the voting system; establishing and maintaining controls to minimize errors; protection from intentional manipulation, fraud and malicious mischief; identifying fraudulent or erroneous changes to the voting system; and protecting the secrecy in the voting process.

4.1.1 Rationale for ‘Not Applicable’ Requirements

The OVS 2.2 is a paper-based system that supports a closed network. Therefore, all EAC 2005 VVSG requirements, with the exceptions listed below, will be evaluated as part of this test campaign.

- Volume I, Section 7.7 (Wireless Communications)
- Volume I, Section 7.9 (Voter Verifiable Paper Audit Trail Requirements)

The rationale for not evaluating the OVS 2.2 to the indicated sections is described in following table.

Table 4-1. Not Applicable Requirements

| EAC 2005 VVSG Version 1 Volume I, Section | Rationale for ‘Not Applicable’ |
|--|---|
| 7.7 | No wireless technology is present in the Unisyn OVS 2.2 |
| 7.9 | The Unisyn OVS 2.2 is a paper-based system |

4.2 Hardware Configuration and Design

The Unisyn OVS 2.2 is a paper-based optical scan voting system. The OVS 2.2 consists of the following major components: the OCS, 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.

4.3 Software System Functions

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.

4.4 Test Case Design

Test cases are designed based on the manufacturer’s design specifications and the relevant technical requirements set forth by the VVSG. Test cases shall be based on the following aspects of the voting system:

- Hardware qualitative examination design
- Hardware environmental test case design
- Software module test case design and data
- Software functional test case design
- System level test case design

Test cases shall provide information regarding the sequence of actions to be performed for the execution of a test, the requirements being met, the test objective, test configuration, equipment needed, special requirements, assumptions, and pass/fail criteria. Once the test cases are finalized, they will be validated and published for use in the test campaign. The validation of the test case will be accomplished by technical review and approval. This validation will include the following: confirmation of adequate test coverage of all requirements; confirmation that test case results are not ambiguous and gave objective pass/fail criteria; and confirmation that any automated test suites will produce valid results.

4.4.1 Hardware Qualitative Design

Previous hardware examinations were performed on the certified baseline system (OVS 2.1). The addition of the FVS to the modified system will require the full suite of hardware and electrical testing as detailed in the 2005 VVSG. The addition of the Canon DR-G2140 COTS central count device will require it to undergo temperature power variation only. In addition to the FVS testing, the FVT has end of life electrical components being replaced in this release. Based on these changes, the FVT will undergo the full suite of electrical testing and temperature power variation testing. These tests are listed below and marked as applicable:

Table 4-2. Hardware Test Requirements

| Test | System Component | | |
|--------------------------------|------------------|-----|------|
| | FVS | FVT | OVCS |
| <i>Electrical Tests</i> | | | |
| Electrical Power Disturbance | X | X | N/A |
| Electromagnetic Radiation | X | X | N/A |
| Electrostatic Disruption | X | X | N/A |
| Electromagnetic Susceptibility | X | X | N/A |
| Electrical Fast Transient | X | X | N/A |
| Lightning Surge | X | X | N/A |
| Conducted RF Immunity | X | X | N/A |

Table 4-2. Hardware Test Requirements *(continued)*

| Test | System Component | | |
|-----------------------------|------------------|-----|------|
| | FVS | FVT | OVCS |
| Magnetic Fields Immunity | X | X | N/A |
| Electrical Supply | X | X | X |
| <i>Environmental Tests</i> | | | |
| Bench Handling | X | N/A | N/A |
| Vibration | X | N/A | N/A |
| Low Temperature | X | N/A | N/A |
| High Temperature | X | N/A | N/A |
| Humidity | X | N/A | N/A |
| Temperature Power Variation | X | X | X |

4.4.2 Hardware Environmental Test Case Design

The voting system hardware shall be subjected to the tests specified in Section 4.4.1. Testing will be performed by personnel verified by Pro V&V to be qualified to perform the test. Pro V&V will utilize third-party test facilities for performance of the electrical and environmental tests. Environmental and Electrical will be performed at the NTS Longmont facility located in Longmont, Colorado. All pre and post operational status checks shall be conducted by Pro V&V personnel.

4.4.3 Software Module Test Case Design

Pro V&V shall review the manufacturer’s program analysis, documentation, and module test case design and shall evaluate the test cases for each module with respect to flow control parameters and entry/exit data. As needed, Pro V&V shall design additional test cases to satisfy the coverage criteria specified in Volume II, Section 7.2.1.

Component Level Testing will be implemented during the FCA for each component and subcomponent. During the source code review, compliance builds, and security testing, Pro V&V will utilize limited structural-based techniques (white-box testing).

Additionally, specification-based techniques (black-box testing) will be utilized for the individual software components.

Pro V&V shall define the expected result for each test and the ACCEPT/REJECT criteria for certification. If the system performs as expected, the results will be accepted.

If the system does not perform as expected, an analysis will be performed to determine the cause. The test will be repeated in an attempt to reproduce the results. If the failure can be reproduced and the expected results are not met, the system will have failed the test. If the results cannot be reproduced, the test will continue. All errors encountered will be documented and tracked through resolution.

4.4.4 Software Functional Test Case Design

Pro V&V shall review the manufacturer-submitted test plans and data to verify that the individual performance requirements specified in the EAC 2005 VVSG and the TDP are reflected in the software. As part of this process, Pro V&V shall review the manufacturer's test case design and prepare a detailed matrix of system functions and the test cases that exercise them.

Pro V&V shall also prepare a test procedure describing all test ballots, operator procedures, and the data content of output reports. Pro V&V shall define abnormal input data and operator actions and then design test cases to verify that the system is able to handle and recover from these abnormal conditions. During this review, emphasis shall be placed on those functions where the manufacturer data on module development, such as the system release notes and comments within the source code, reflects significant debugging problems, and on functional tests that resulted in high error rates.

Pro V&V shall define the expected result for each test and the ACCEPT/REJECT criteria for certification. If the system performs as expected, the results will be accepted. If the system does not perform as expected, an analysis will be performed to determine the cause. The test will be repeated in an attempt to reproduce the results. If the failure can be reproduced and the expected results are not met, the system will have failed the test. If the results cannot be reproduced, the test will continue. All errors encountered will be documented and tracked through resolution.

4.4.5 System-Level Test Case Design

System Level testing will be implemented to evaluate the complete system. This testing will include 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 shall be designed according to the stated design objective without consideration of its functional specification. The system level hardware and software test cases shall be prepared independently to assess the response of the hardware and software to a range of conditions.

4.5 TDP Evaluation

In order to determine compliance of the modified TDP documents with the EAC 2005 VVSG, a limited TDP review shall be conducted. This review will focus on TDP documents that have been modified since the certification of the baseline system. The review will consist of a compliance review to determine if each regulatory, state, or manufacturer-stated requirement has been met based on the context of each requirement. Results of the review of each document will be entered on the TDP Review Checklist and reported to the manufacturer for disposition of any anomalies. This process will be ongoing until all anomalies are resolved.

Any revised documents during the TDP review process will be compared with the previous document revision to determine changes made, and the document will be re-reviewed to determine whether subject requirements have been met.

A listing of all documents contained in OVS 2.2 TDP is provided in Table 4-3.

Table 4-3. TDP Documents

| Document Number | Description | Version | Release |
|------------------------|--|----------------|----------------|
| 04-00512 | Technical Data Package-Document List and Version Control | 1.0 | 2.2 |
| 04-00446 | OVS System Overview | 1.0 | 2.2 |
| 04-00444 | System Functionality Description | 1.0 | 2.2 |
| 04-00458 | System Hardware Specification | 1.0 | 2.2 |
| 04-00464 | Software Design and Specification | 1.0 | 2.2 |
| 04-00447 | System Security Specification | 1.0 | 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 |
| 04-00459 | System Maintenance Procedures | 1.0 | 2.2 |
| 04-00445 | Personnel Training and Deployment Requirements | 1.0 | 2.2 |
| 04-00448 | Configuration Management Plan | 1.0 | 2.2 |
| 04-00454 | Quality Assurance Plan | 1.0 | 2.2 |
| 04-00469 | Final QA Report | 1.0 | 2.2 |
| 04-00427 | Election Manager User Guide | 1.0 | 2.2 |
| 04-00428 | Ballot Layout Manager User Guide | 1.0 | 2.2 |
| 04-00431 | Tabulator Client User Guide | 1.0 | 2.2 |
| 04-00432 | Tabulator User Guide | 1.0 | 2.2 |
| 04-00433 | Tabulator Reports User Guide | 1.0 | 2.2 |
| 04-00495 | OVCS User Guide | 1.0 | 2.2 |
| 04-00530 | Auditor Users Guide | 1.0 | 2.2 |
| 04-00549 | EOS Linux and OCS Installation Guide | 1.0 | 2.2 |
| 04-00449 | System Coding Standards | 1.0 | 2.2 |
| 04-00462 | Election Day Troubleshooter's Guide | 1.0 | 2.2 |
| 04-00463 | Election Day Poll Worker's Guide | 1.0 | 2.2 |
| 04-00494 | OVS Acronyms | 1.0 | 2.2 |
| 04-00503 | OVS Paper Specification | 1.0 | 2.2 |
| 04-00513 | Hardware Verification | 1.0 | 2.2 |
| 04-00542 | Requirements of the 2005 VVSG Trace To Vendor Testing and Technical Data Package | 1.0 | 2.2 |
| 04-00594 | OpenElect Voting System Release Notes, 2.1 to 2.2 | 1.0 | 2.2 |

4.6 Source Code Review

Pro V&V will review the submitted source code to the EAC 2005 VVSG and the manufacturer-submitted coding standards.

Prior to initiating the software review, Pro V&V shall verify that the submitted documentation is sufficient to enable: (1) a review of the modified 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.

A combination of Automated Source Code Review and Manual Source Code Review methods will be used to review the changes in the source code from the previously certified system. In addition, 10% of the source code comments will be manually reviewed.

4.7 QA and CM System Review

The Unisyn Quality and Configuration Management Manuals shall be reviewed for their fulfillment of Volume I, Sections 8 and 9, and the requirements specified in Volume II, Section 2.

The requirements for these sections establish the quality assurance and configuration standards for voting systems to which manufacturers must conform and require voting system manufacturers to implement a quality assurance and configuration management program that is conformant with recognized ISO standards. As part of the review process, the Unisyn TDP documents will be reviewed to determine if the stated policies are being followed.

4.8 PCA

The physical configuration audit compares the voting system components submitted for qualification to the manufacturer's technical documentation, and shall include 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, Pro V&V shall 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

4.9 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 will be conducted to insure all applicable EAC 2005 VVSG requirements are met.

4.10 Accuracy

The accuracy test ensures that each component of the voting system can each process 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 the conversion of those selections detected on the paper ballot converted into digital data.

In an effort to achieve this and to verify the proper functionality of the units under test, the following methods will be used to test components of the voting system:

The OVO, FVS, and OVCS shall be 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 shall be utilized to create ballots that will be implemented as part of the pre-marked test deck.

4.11 System Integration

System Level test for the integrated operation of both hardware and software. Compatibility of the voting system software components or subsystems with one another, and with other components of the voting system environment, shall be determined through functional tests integrating the voting system software with the remainder of the system.

Additionally, the system shall be configured exactly as it would for normal field use. This includes connecting all supporting equipment and peripherals including ballot boxes, voting booths (regular and accessible), and any physical security equipment such as locks and ties.

Pro V&V personnel shall properly configure and test the system by following the procedures detailed in the OVS 2.2 voting system technical documentation.

4.12 Volume & Stress

Tests to investigate the system’s response to conditions that tend to overload the system’s capacity to process, store, and report data. The test parameters will focus on the system’s stated limits and the ballot logic for areas such as the maximum number of active voting positions, maximum number of ballot styles, maximum candidates, maximum contests, and stated limits within the EMS. This test will be utilized to ensure the system can achieve the manufacturer’s TDP claims of what the system can support. Testing will be performed by exercising an election definition and test cases developed specifically to test for volume and stress conditions of the system being tested.

4.13 Security Functions

The objective of the security testing is to evaluate the effectiveness of the voting system in detecting, preventing, recording, reporting, and recovering from security threats. To evaluate the integrity of the system, Pro V&V shall develop specifically designed test cases in an attempt to defeat the access controls and security measures documented in the system TDP.

The test methods for performing the security testing are execution and review. Prior to performance of security testing, the examiner will verify that security hardening scripts have been properly applied to system components per the system documentation. The examiner will review the submitted TDP to verify that documented access and physical controls are in place. Following the documented procedures, the examiner will configure the voting system for use and functionality to verify that the documented controls are in place and adequate and meet the stated requirements.

Physical security will be tested by setting up the system as described in the TDP and then examining the effectiveness and comprehensiveness of physical security measures. Administrative Security will be tested by examining the system's documented security instructions and procedures for effectiveness and breadth.

5.0 TEST DATA

The following subsections provide information concerning test data recording, criteria, and reduction.

5.1 Test Data Recording

All equipment utilized for test data recording shall be identified in the test data package. The output test data shall be recorded in an appropriate manner as to allow for data analysis. For source code and TDP reviews, results shall be compiled in reports and submitted to Unisyn for resolution.

5.2 Test Data Criteria

The OVS 2.2 shall be evaluated against all applicable requirements contained in the EAC 2005 VVSG. The acceptable range for system performance and the expected results for each test case shall be derived from the manufacturer-submitted technical documentation and the EAC 2005 VVSG.

5.3 Test Data Reduction

Test data shall be processed and recorded in the test log book and the relevant Test Cases.

6.0 TEST PROCEDURE AND CONDITIONS

The following subsections detail the facility requirements, test setup conditions, and sequence of testing.

6.1 Facility Requirements

Unless otherwise annotated, all testing shall be conducted at the Pro V&V test facility located in Huntsville, AL, by personnel verified by Pro V&V to be qualified to perform the test. Unless otherwise specified herein, testing shall be performed at the following standard ambient conditions and tolerances:

- Temperature: 68-75° F ($\pm 3.6^\circ\text{F}$)
- Relative Humidity: Local Site Humidity
- Atmospheric Pressure: Local Site Pressure
- Time Allowable Tolerance: $\pm 5\%$

Testing performed at third-party laboratories will be subject to the test parameters and tolerances defined by VVSG. If not specified in VVSG, the test facilities' standard parameters and tolerances will be used. These shall be reported in the final Test Report.

6.2 Test Set-up

All voting system equipment shall be received and documented using Pro V&V proper QA procedures. Upon receipt of all hardware, an inspection will be performed to verify that the equipment received is free from obvious signs of damage and/or degradation that may have occurred during transit. If present, this damage shall be recorded, photographed, and reported to the Unisyn Representative. Additionally, a comparison shall be made between the recorded serial numbers/part numbers and those listed on shipper's manifest and any discrepancies shall be reported to the Unisyn Representative. TDP items and all source code received shall be inventoried and maintained by Pro V&V during the test campaign.

During test performance, the system shall be configured as it would be for normal field use. This includes connecting all supporting equipment and peripherals.

6.3 Test Sequence

The OVS 2.2 will be evaluated against all applicable requirements in the EAC 2005 VVSG. There is no required sequence for test performance.

6.4 Test Operations Procedure

Pro V&V will identify PASS/FAIL criteria for each executed test case. The PASS/FAIL criteria will be based on the specific expected results of the system. In the case of an unexpected result that deviates from what is considered standard, normal, or expected, a root cause analysis will be performed. Pro V&V will evaluate every EAC 2005 VVSG requirement applicable to the OVS 2.2 voting system. Any deficiencies noted will be reported to the EAC and the manufacturer. If it is determined that there is insufficient data to determine compliance, this test plan will be altered and additional testing will be performed.

APPENDIX A
PROJECT SCHEDULE

| Task Name | Start Date | End Date | Assigned To | Duration |
|---|-------------------|-----------------|--------------------|-----------------|
| EAC Application & TRR | 08/27/20 | 09/01/20 | | 4d |
| Application Submitted to EAC | 08/27/20 | 08/28/20 | Walker | 2d |
| TRR | 08/31/20 | 08/31/20 | Walker | 1d |
| Application Approval from EAC | 09/01/20 | 09/01/20 | Walker | 1d |
| TDP | 08/31/20 | 01/20/21 | | 94d |
| Initial Review | 08/31/20 | 09/01/20 | Stacey | 2d |
| Compliance Review | 09/02/20 | 01/14/21 | Stacey | 88d |
| Final review | 01/15/21 | 01/20/21 | Stacey | 4d |
| Test Plan | 09/01/20 | 11/04/20 | | 46d |
| Test Plan Creation | 09/01/20 | 09/08/20 | Wendy | 5d |
| Vendor Review & Comments | 09/09/20 | 09/10/20 | Wendy | 2d |
| EAC Submission and Review | 09/11/20 | 10/08/20 | Wendy | 20d |
| VSTL Comment Review & Update | 10/09/20 | 10/14/20 | Wendy | 4d |
| EAC Submission & Review of Revision | 10/15/20 | 10/28/20 | Wendy | 10d |
| EAC Approved Test Plan | 10/29/20 | 10/30/20 | Wendy | 2d |
| Source Code | 09/02/20 | 09/09/20 | | 5d |
| Automated Review | 09/02/20 | 09/02/20 | Jack | 1d |
| Source Code Review | 09/02/20 | 09/03/20 | Jack | 2d |
| Source Code Re-Review | 09/03/20 | 09/03/20 | Jack | 1d |
| Document Review | 09/04/20 | 09/04/20 | Jack | 1d |
| Compliance Build | 09/08/20 | 09/09/20 | Jack | 2d |
| System Delivery & Setup | 08/31/20 | 10/09/20 | | 29d |
| PCA | 08/31/20 | 10/05/20 | Ryan | 25d |
| System Setup | 10/06/20 | 10/07/20 | Ryan | 2d |
| System Loads & Hardening | 10/08/20 | 10/09/20 | Ryan | 2d |
| Hardware Testing | 09/09/20 | 10/09/20 | | 23d |
| Electrical Testing (2 configs full testing suite) | 09/14/20 | 09/25/20 | Walker | 10d |
| Environmental Testing (1 configuration) | 09/09/20 | 09/25/20 | Walker | 13d |
| Temp Power (85 hours based on 2 each of the configurations total of 6 units under test) | 09/28/20 | 10/02/20 | Walker | 5d |
| Electrical Supply (3 configs) | 10/05/20 | 10/07/20 | Ryan | 3d |
| Maintainability | 10/08/20 | 10/09/20 | Ryan | 2d |
| System Level Testing | 10/12/20 | 12/11/20 | | 42d |
| FCA | 10/12/20 | 11/06/20 | Ryan | 20d |
| Security | 11/09/20 | 11/10/20 | Ryan | 2d |
| Usability | 11/11/20 | 11/12/20 | Ryan | 2d |
| Accessibility | 11/13/20 | 11/13/20 | Ryan | 1d |
| Volume & Stress | 11/16/20 | 11/18/20 | Ryan | 3d |
| Accuracy | 11/19/20 | 11/24/20 | Ryan | 4d |
| Regression Testing | 11/30/20 | 11/30/20 | Ryan | 1d |
| Trusted Build | 12/01/20 | 12/02/20 | Ryan | 2d |
| System Loads & Hardening | 12/03/20 | 12/04/20 | Ryan | 2d |

| | | | | |
|-------------------------------------|-----------------|-----------------|-------|------------|
| System Integration | 12/07/20 | 12/11/20 | Ryan | 5d |
| Test Report | 12/07/20 | 02/15/21 | | 46d |
| Test Report Creation | 12/07/20 | 12/18/20 | Wendy | 10d |
| Vendor Review & Comments | 12/21/20 | 12/22/20 | Wendy | 2d |
| EAC Submission & Review | 12/28/20 | 01/26/21 | Wendy | 20d |
| VSTL Comment Review & Update | 01/27/21 | 01/29/21 | Wendy | 3d |
| EAC Submission & Review of Revision | 02/01/21 | 02/12/21 | Wendy | 10d |
| EAC Approved Test Report | 02/15/21 | 02/15/21 | Wendy | 1d |