Test Report for EAC 2005 VVSG Certification Testing MicroVote EMS 4.2 Voting System

EAC Project Number: MVT1601

Version: Rev.C

Date: 9/27/2018

EAC Lab Code 1501

NVLAP LAB CODE 200908-0

SIGNATURES

Approved by: _Jack call_   _9-27-18_

For   Michael Walker, VSTL Project Manager   Date

Approved by: _Wendy Owens_   _9/27/18_

Wendy Owens, VSTL Program Manager   Date

REVISIONS

Revision	Description	Date
NR	Initial Release	7/27/2018
A	Update per EAC Comments	9/5/2018
B	Update per EAC Comments	9/20/2018
C	Final version with all highlights removed	9/27/2018

TABLE OF CONTENTS

1.0   INTRODUCTION

The purpose of this Test Report is to document the procedures that Pro V&V, Inc. followed while performing certification testing of the MicroVote EMS 4.2 Voting System modification campaign per the requirements set forth by voting systems in the U.S. Election Assistance Commission (EAC) 2005 Voluntary Voting System Guidelines (VVSG), Version 1.0. Certification testing of EMS 4.2 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, MicroVote submitted an application package to the EAC for certification of the EMS 4.2 Voting System modification to the previously certified EMS 4.1 Voting System (Certification Number: MVTEMS41). The application was accepted by the EAC and the project was assigned the unique Project Number of MVT1601.

1.1   Description and Overview of EAC Certified System Being Modified

The MicroVote EMS 4.2 software functionality is divided by activity, based on each stage of the election. These activities are further divided into five modes, all building on each other to complete the election process: Administration, Election Setup, Ballot Setup, Programming & Printing, and Vote Tabulation. Combined, these modes allow for:

- Creating and maintaining default preferences and settings for a specific jurisdiction.

- Creating and maintaining preferences and settings for an election.

- Creating and maintaining security clearances for all users of EMS.

- Creating primary, general or both types of elections or municipal elections.

- Creating offices and filing candidates.

- Creating and maintaining all objects appearing on the ballot.

- Printing ballots.

- Programming voting devices.

- Printing reports of election data.

- Tallying election results.

- Generating reports of election results for state reporting systems, media displays, or printing.

- Creating and restoring backup files of election databases for archival purposes

Administration

The Administration mode is the system setup stage. This mode includes: Preferences, Political Parties, Vote Types, Precincts, Ballot Text, Ballot Graphics, Equipment, Equipment Assignment, and Security. Election Setup Reports reflecting each form are also available.

Election Setup

The Election Setup mode is a mode for pre-election activities. It includes entering offices, filing candidates, creating secondary vote lockouts.

Ballot Setup

The Ballot Setup mode is a mode for pre-election activities. In Ballot Setup, users create and edit ballots, build activations, and assign precincts.

Programming & Printing

The Programming & printing mode is a mode for pre-election activities. Programming & Printing includes programming voting machines and Smart Cards, and previewing and printing ballots

Vote Tabulation

The Vote Tabulation mode is the final mode during which all tabulations and final results are produced. Reports for Vote Tabulation mode reflect the results as they are reported

The EMS software supports the MicroVote Infinity voting panel. This panel is a direct recording electronic (DRE) device, and is connected to EMS via a serial port. Data/Vote tabulations exchange between the EMS and the Infinity machine is done directly through the serial port or via a Smart Card programmed for each election. OMR Ballot Cards, sometimes referred to as Absentee Cards, are optically scanned by a Chatsworth ACP 2200 reader.

Several COTS hardware items and software are used with the EMS software. EMS is designed to be used with Microsoft Windows 10 Pro X86/X64, and is installed on a Dell computer desktop and/or laptop. The database software is SQL Server 2016 Express. AVG Free anti-virus protection software has been installed. There is a COTS DOUBLETALK LT text-to-speech converter box attached to the Infinity machine. There are also COTS Smart Cards and Smart Card readers/writers. All OMR/Absentee ballot cards are optically scanned by the ACP 2200 reader.

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.

1.1.1 Baseline Certified System

The baseline system for this modification is the EMS 4.1 Voting System. The tables below describe the certified equipment and firmware versions. Detailed descriptions of the EMS 4.1 test campaign are contained in NTS Report No. PR029488-01, Rev. B, which is available for viewing on the EAC's website at www.eac.gov.

Table 1-1. Baseline (EMS 4.1) Software Components

Firmware/Software	Version
Proprietary	
EMS	4.1.20.0
COTS	
Microsoft .Net Framework	3.5
Microsoft Windows 7	SP1
ComponentOne Ultimate 2013	3.1
Microsoft SQL Server 2012 Express	N/A

Table 1-2. Baseline (EMS 4.1) Hardware Components

Component	Model	Hardware Version	Firmware Version
Proprietary			
Infinity Voting Panel	VP-01	Rev. D.05	4.10-983
COTS			
Central Count Scanner	Chatsworth ACP 2200	605000-190	N/A
Text-to-speech Device	Double Talk LT	LT RC8650	BIOS 0212
Voting Panel Printer	Seiko	Models DPU-414 and DPU-3445	---
Smartcard Reader	GemPlus	IDBridge CT30 Smart	---
EMS Report Printer	Dell	Dell 0P0137	---
EMS Desktop	Dell	Dell Optiplex 3010	---
EMS Laptop	Dell	Dell Latitude E5440	---

1.2 References

- Election Assistance Commission 2005 Voluntary Voting System Guidelines (VVSG) Version 1.0, Volume I, "Voting System Performance Guidelines"

- Election Assistance Commission 2005 Voluntary Voting System Guidelines (VVSG) Version 1.0, 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, "NVLAP Procedures and General Requirements (NIST Handbook 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

- Election Assistance Commission "Approval of Voting System Testing Application Package" letter dated November 12, 2015

- EAC Requests for Interpretation (RFI) (listed on www.eac.gov)

- EAC Notices of Clarification (NOC) (listed on www.eac.gov)

- MicroVote EMS 4.2 Technical Data Package *(A listing of the EMS 4.2 documents submitted for this test campaign is listed in Section 3.1 of this Test Report)*

- MicroVote TDP Section 2.13 System Change Notes, Election Management System, Version 1.13, dated 03/16/2017

- NTS Report No. PR029488-01, Rev. B

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

"CM" – Configuration Management

"COTS" – Commercial Off-The-Shelf

"DRE" – Direct Record Electronic

"EAC" – United States Election Assistance Commission

"ECO" – Engineering Change Order

"EMS" – Election Management System

"FCA" – Functional Configuration Audit

"HAVA" – Help America Vote Act

"NIST" – National Institute of Standards and Technology

"NOC" – Notice of Clarification

"NVLAP" – National Voluntary Laboratory Accreditation Program

"OMR" – Optical Mark Recognition

"PCA" – Physical Configuration Audit

"QA" – Quality Assurance

"RAM" – Random Access Memory

"RFI" – Request for Interpretation

"SCAP" – Security Content Automation Protocol

"SQL" – Structured Query Language

"TDP" – Technical Data Package

"UPS" – Uninterruptible Power Supply

"VSTL" – Voting System Test Laboratory

"VVSG" – Voluntary Voting System Guidelines

2.0 CERTIFICATION TEST BACKGROUND

The MicroVote EMS 4.2 is a modification of a previously certified system (EMS 4.1). Pro V&V performed an evaluation of results from the previous test campaign along with the submitted changes made to the system to determine the scope of testing required for certification of the EMS 4.2. Based on this evaluation, Pro V&V determined that testing from the previous test campaigns 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 EMS 4.2:

Table 2.1. EMS 4.2 System Revision History

System Version	Certification Type	Baseline System	Certification Number
EMS 4.0	New System	--- (Original System)	MVTEMS4
EMS 4.0B	Modification	EMS 4.0	MVTEMS40B
EMS 4.1	Modification	EMS 4.0B	MVTEMS41
EMS 4.2	Modification	EMS 4.1	MVTEMS42*

*Upon grant of certification by the EAC

2.2 Scope of Testing

The scope of testing focused on evaluating the modifications detailed in the following sections. The following tasks were required to verify compliance of the submitted modifications:

- Technical Data Package (TDP) Review

  A limited TDP Review was performed to ensure that all submitted modifications were accurately documented and that the documents meet the requirements of the EAC 2005 VVSG.

- Physical Configuration Audit (PCA), including Security Testing and SCAP Checklist

  A PCA was performed to compare the voting system submitted for certification testing to the manufacturer's technical documentation. The purpose of the PCA was to verify that the submitted hardware was unmodified from the previously certified voting system.

- Source Code Review, Compliance Build, Trusted Build, and Build Document Review

  The source code review was based on the source code changes made since the previous system was certified. Build document review was performed to ensure that all required equipment and software were current during the building process. A compliance build was created after the reviews. Once the integrity of the compliance build was verified, the trusted build was created.

- System Level Testing

  System Level Testing included the FCA, Accuracy, and System Integration tests. The FCA for this test campaign included an assessment of the submitted modifications and tests designed to verify that the modifications were implemented as intended and did not adversely affect system performance. The System Integration tests were performed to ensure the EMS 4.2 functioned as a complete system. The Accuracy Test was performed to ensure the EMS 4.2 correctly captured, stored, consolidated, and reported the specific ballot selections, and absence of selections, for each ballot position.

- EMS And System Functional Regression Testing

  Regression testing was conducted on the EMS to establish assurance that the modifications had no adverse impact on the compliance, integrity, or performance of the system.

- ECO assessment of baseline system (EMS 4.1) modifications

  Since certification of the EMS 4.1 system, MicroVote has implemented various Engineering Change Orders (ECOs), each of which were evaluated and determined to be De Minimis in nature. Although testing was not warranted during implementation of these ECOs, they are included as part of the EMS 4.2 system test campaign. A listing of De Minims changes made to EMS 4.1are provided in Section 2.2.1.1 of this report.

2.2.1 Modification Overview

The submitted modifications for the EMS 4.2 test campaign included modifications to the baseline EMS 4.1 system. These modifications consisted of various enhancements and updates to add support and improve voting functions, correct identified defects, one system addition and

replacements of end-of-life components. No hardware modifications were submitted. *Note: Defects D-05 to D-08 were not included in the EMS 4.2 Change Notes as they pertained to a Windows 7 based operating system; therefore, the numbering of the defects listed below is not sequential.*

2.2.1.1 Detailed List of Changes

Descriptions of the submitted modifications are described below:

Enhancements

1. E-01-(EMS/Infinity) – Added support for a third language within an election (in addition to English and Spanish). The optional third language, including pictographic, must be included within the Windows environment.

2. E-02-(EMS) – Modified entry method for ballot style precinct assignment to allow multiple precinct selection (shift-click and control-click).

3. E-03-(EMS) – Improved office-candidate report sorting and ballot sequence number display.

4. E-04-(EMS) – Improved ballot designer functionality when removing last item on a ballot page.

5. E-05-(Infinity) – Added the precinct name to the consolidated tally tape when more than one precinct was programmed to an Infinity panel.

6. E-06-(Infinity) – Improved "No Vote" location appearance and added build number in version display.

7. E-07-(EMS) – Modified All Precincts report to display precinct straight party totals for each precinct rather than county totals to match individual precinct report format.

8. E-08-(EMS) – Enhancement to prevent candidate wrapping when assigning party to candidate record in referendum office.

9. E-09-(EMS) – Improved automatic display of Vote Limit Text when vote for > 35.

10. E-10-(EMS) – Enhanced warning notifications during OMR card reading.

11. E-11-(EMS) – Added more info to precinct lookup window during OMR card reading.

12. E-12-(EMS) – Added equipment programmed/reported to Election Summary report.

Defects

1. D-01-(EMS) – Corrected overwriting of election backup file in database utilities.

   The newer replacement version of Visual Studio needs the full path of a file in order to kill (delete) it. When creating a backup file, the routine in EMS checked for an existing file with the same name and killed it prior to the backup, otherwise the backup ADDED a backup set

to the current file which is not the intended behavior. The old kill routine didn't use the full file path so a line was added to retrieve the full path so the routine would correctly delete the previous backup prior to creating a new one rather than appending to the existing one.

2. D-02-(Infinity) – Corrected an issue related to an unanticipated ballot layout configuration.

    Indiana changed a law regarding ballot layout which sometimes requires several pages of long referendums to be placed on the ballot before the straight party selectors. In the past, straight party selectors always appeared before any other voter selections and on the first page of the ballot. The modification allows the straight party selectors to appear further down on the ballot.

3. D-03-(Infinity) – Corrected an issue related to bypassing presentation of the correct ballot when voter card was inserted in a specific manner.

    If a Vote card was quickly "dipped" and caused a rare incomplete read of the data on the card the firmware would still activate the panel for voting and bring up the previously activated ballot style instead of allowing the poll worker to choose the ballot style. The firmware was modified to improve the error trapping for an incomplete read to prevent the condition.

4. D-04-(Infinity) – Corrected a condition which could cause multiple copies of the consolidated tally tape to print.

    Duplicate consolidated tally reports would print if a ballot setup file correction was detected and successfully recovered (rebuilt) when consolidated report order is defined for the ballots. This caused appending of duplicate data in a consolidated report tally collection file with each recovery instance.

Replacement of End-Of-Life Components

1. R-01-(EMS) – Replaced Windows 7 Pro operating system with Windows 10 Pro Build 1709. (Removed dependence on AVG Free because Windows Defender built-in).

2. R-02-(EMS) – Replaced Advanced Installer 11.1 with Advanced Installer 14.8.

    New version of installer supports Windows 10 and newer versions of SQL Server.

3. R-03-(EMS) – Replaced SQL Server Express 2012 SP1 with SQL Server Express 2016.

    SQL Server Express 2012 SP1 is not supported under Windows 10. SQL Server Express 2016 mainstream support is predicted to continue until October 12, 2021.

4. R-04-(EMS) – Replaced .Net Framework 3.5 SP1 target with .Net Framework 4.6.1.

    While .Net Framework 3.5 SP1 is still available for Windows 10, it is not natively installed. V4.6 is the latest version and included within the operating system.

5. R-05-(EMS) – Replaced Visual Studio Pro 2013 with Visual Studio Pro 2017.

Engineering Change Orders

Engineering Change Orders (ECOs) were implemented into the system as part of the submitted modifications and were included as part of this test campaign, as detailed below:

Enhancements

1. E-04-(Infinity) – To simplify tally data collection for write-in candidates the precinct name was added to the consolidated tally tape when more than one precinct was programmed to an Infinity panel. *Reference MicroVote ECO Carson 1609.*

Defects

1. D-09-(Infinity) – A 2016 Indiana state law changed the ballot layout creating an unanticipated ballot configuration. Placing vote locations before straight party selectors caused the firmware to miscalculate the undervote for these locations. *Reference MicroVote ECO Carson 1605.*

   a. Changed version number displayed or printed.

   - Revision header source file – for recording changes and defining revision text.
   - Added 2 comment lines – description of change.
   - Changed 1 code line – revision number constant.

   b. Changed tally processing of undervotes treating straight party activator locations the same as no-vote locations.

   - Tally processing source file – undervote calculation function.
   - Added 3 comment lines – description of change.
   - Changed 2 code lines – moved straight party activator treatment during undervote count to same as no-vote.

2. D-10-(Infinity) – Microvote's internal testing revealed a defect in which it was possible to consistently bypass presentation of the correct ballot by quickly dipping" a vote card into a panel with just the right angle and force. *Reference MicroVote ECO Carson 1604.*

   a. Changed version number displayed or printed.

   - Revision header source file – for recording changes and defining revision text.
   - Added 2 comment lines – description of change.
   - Changed 1 code line – revision number constant.

   b. Changed vote card file read error processing.

   - Vote card processing source file – vote card file read function.
   - Added 3 comment lines – description of change.

- Changed 1 code line – default file read error condition

3. D-11-(Infinity) – Correct condition which could cause multiple copies of the consolidated tally tape to print. *Reference MicroVote ECO Carson 1611.*

   a. Changed version number displayed or printed.

   - Revision header source file – for recording changes and defining revision text.

   - Added 2 comment lines – description of change.

   - Changed 1 code line – revision number constant.

   b. Added proper re-building of consolidated tally data file in the event of setup data recovery.

   - Ballot setup processing source file – consolidated tally re-build function.

   - Added 4 comment lines – description of change.

   - Changed 1 comment line – header info.

   - Added 1 code line – re-tally if consolidated tally file re-built.

   c. Added proper erasure of consolidated tally data file in the event of setup data recovery.

   - Initialization processing source file – consolidated tally creation function.

   - Added 11 comment lines – description of change and new function header.

   - Changed 4 comment line – header info.

   - Added 6 code lines – new function to erase and create file.

   - Changed 1 code line – call to erase and create file

Additions

1. A-02-(EMS) – Added a Dell Latitude E5570 laptop as an alternate component. *Reference MicroVote ECO ECN119.*

To verify the submitted 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:

- All defects discovered in the baseline system were not present or able to be duplicated in the modified system.

- All enhancements implemented did not adversely impact system performance.

2.2.2 Block Diagram

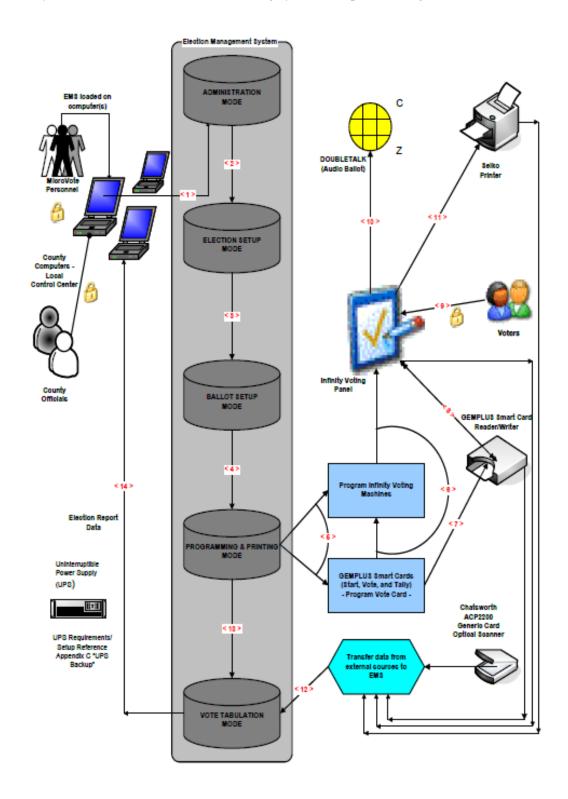The system overview of the submitted voting system is depicted in Figure 1-1.

Figure 1-1. EMS 4.2 System Overview

2.2.3   System Limits

There were no changes made to the system limits. The system limitations remain the same as the previously certified version.

2.2.4   Supported Languages

The submitted voting system supports:

- English
- Spanish

Support for each stated languages was verified. Both 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. Testing of the Chinese language was accomplished through the creation and execution of both a primary and general election verifying the translations can be used by Chinese minority language voters. The translations themselves came from an online translator (Google Translate). The translations were then copied and pasted into the qualified EMS ballot text fields using Windows Notepad. In order for the Infinity Panel to recognize the Chinese characters, a number of special reserved ballot text objects needed to be activated. These are covered in Appendix B: Third Language Support of the EMS User Manual.

2.2.5   Supported Functionality

There were no changes made to the supported functionality of the voting system. The supported functionality for the submitted voting system remains unchanged from the previously certified version.

2.2.6   VVSG

The EMS 4.2 Voting System shall be evaluated against the relevant requirements contained in the EAC 2005 VVSG, Volumes I and II.

2.2.7   RFIs

All RFIs released by the EAC that pertain to this test campaign and were not in effect at the time of the baseline system certification are listed in the table below.

Table 1-3. Applicable RFIs

RFI ID	Name
RFI 2013-04	EAC Decision on Usability Testing
RFI 2015-05	EAC Decision on Touchscreen Technology

2.2.8 NOCs

All NOCs released by the EAC that pertain to this test campaign and were not in effect at the time of the baseline system certification are listed in the table below.

Table 1-4. Applicable NOCs

NOC ID	Name
NOC 15-01	Test Readiness Review
NOC 16-01	Test Readiness Review
NOC 16-02	Trusted Build
NOC 16-03	Test Case Upload

3.0 TEST FINDINGS AND RECOMMENDATION

The EMS 4.2 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 to the voting system configuration that included various enhancements and updates to add support and improve voting functions, correct identified defects, and replacements of end-of-life components to the baselined 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 Testing, Accuracy, and FCA), PCA (including Security Review and SCAP Checklist), and Source Code Review are detailed in the relevant sections of this report. In addition to these areas of testing, a limited TDP Review was performed, as described below.

Technical Documentation Package (TDP) Review

In order to determine compliance of the modified TDP documents with the EAC VVSG 1.0, 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 verify that each regulatory, state, or manufacturer-stated requirement had been met based on the context of each requirement.

A listing of all documents contained in the EMS 4.2 TDP is provided in Table 3-1.

Table 3-1. EMS 4.2 TDP Documents

Section	Description	Version
---	Technical Data Package (TDP) TABLE OF CONTENTS Election Management System	1.1
2.1	SCOPE Election Management System	1.1

Table 3-1. EMS 4.2 TDP Documents *(continued)*

Section	Description	Version
2.2	SYSTEM OVERVIEW Election Management System	1.14
2.3	SYSTEM FUNCTIONALITY DESCRIPTION Election Management System	1.2
2.4	SYSTEM HARDWARE SPECIFICATION Election Management System	1.3
2.5	SOFTWARE DESIGN AND SPECIFICATION Election Management System	2.8
2.6	SYSTEM SECURITY SPECIFICATION Election Management System	1.8
2.7	SYSTEM TEST AND VERIFICATION SPECIFICATION Election Management System	1.2
2.8	SYSTEM OPERATION PROCEDURES Election Management System	1.3
2.9	SYSTEM MAINTENACE PROCEDURES Election Management System	1.3
2.10	PERSONNEL DEPOYMENT AND TRAINING REQUIREMENTS Election Management System	1.1
2.11	CONFIGURATION MANAGEMENT PLAN Election Management System	1.6
2.12	QUALITY ASSURANCE PROGRAM Election Management System	1.3
2.13	SYSTEM CHANGE NOTES Election Management System	1.14
---	Appendices TABLE OF CONTENTS Election Management System	1.7

Additionally, the requirements for the QA and CM system review were evaluated throughout the test campaign, as described below:

QA and CM System Review

This testing utilized the TDP Review in conjunction with the PCA to determine compliance to the EAC 2005 VVSG requirements and the requirements stated in the MicroVote technical documentation. The review of the Quality Assurance and Configuration Management documentation focused on MicroVote's adherence to its stated QA and CM processes. No discrepancies were noted during the reviews.

3.1.1 Source Code Review

Pro V&V reviewed 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 verified 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 was based on the source code changes made since the previous system was certified

A combination of Automated Source Code Review and Manual Source Code Review methods were used to review the changes in the source code from the previously certified EMS 4.1 voting system. In addition, 10% of the source code comments were manually reviewed.

Summary Findings

- Automated Source Code Review: The Automated Source Code Review was performed during the EMS 4.2 Compliance and Trusted Builds. 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 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 customer submitted source code, COTS, 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" Section 5.5 – 5.7. Performance of the trusted build includes the build documentation review. The Trusted Build was performed following the completion of the Functional Configuration Audit.

3.1.2 Physical Configuration Audit (PCA)

The Physical Configuration Audit (PCA) compares the voting system components submitted for certification testing to the manufacturer's technical documentation. The purpose of the PCA was to verify that the submitted hardware is unmodified from the previously certified voting system. The PCA 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, Pro V&V reviewed drawings, specifications, technical data, and test data associated with system hardware to establish a system hardware baseline associated with the 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 test procedure, the components of the EMS 4.2 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.

3.1.3 Security Testing

The objective of the security testing was to evaluate the security posture of the system that may have been affected by the changes implemented in this modification. The evaluation of the system was accomplished by utilizing a combination of documentation review, functional testing, and manual inspection.

Since the modification included an upgrade to the operating system and database server engine, configuration compliance and cryptography were reevaluated to establish a new security baseline.

The system was evaluated for secure configuration utilizing the CIS Microsoft Windows 10 Enterprise (Release 1607) Benchmark v1.2.0 – 06-28-2017. Testing methods were manual confirmation that all recommended settings were implemented.

An analysis was performed to verify the systems cryptographic functions protecting telecommunications were compliant to EAC RFI 2012-05. Data transfer between system components are limited to crossing two boundaries (EMS to Database and EMS to Infinity Panel). Communication across these boundaries are never conducted via public, private, or closed network at the recommendation of the manufacturer detailed in the TDP. All communication is performed via three distinct methods. Communication boundaries and methods utilized are as follows:

The first communication boundary is between the EMS application and supporting database layer which communicate via the TCP/IP protocol over port 1433. Manufacturer recommendation, found in the TPD, specifies that these two layers are deployed on a single physical computer.

The second communication boundary is between the EMS and the Infinity panel. Both ballot definition data needed in the programming of Infinity Panel and voted data are transferred across this boundary. One method of communication between these two components is performed via

EMS Cable (serial to RJ-45) and a discretionary USB to Serial converter cable. The remaining method of voted data transfer is via smart card.

Summary Findings

Configuration Compliance Checking:

No issues were encountered during the SCAP review.

FIPS 140-2 / EAC RFI 2012-05 Compliance – Cryptography:

The system was found to not implement telecommunication functionality that required compliance with this RFI.

3.1.4 System Level Testing

System Level Testing included the Limited Functional Configuration Audit (FCA), the Accuracy Test, and the System Integration Tests. The Accuracy Test and the System Integration tests were performed as part of the regression test requirements for this campaign. System Level testing was implemented to evaluate the complete system. This testing included all proprietary components and COTS components (software, hardware, and peripherals). 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.

The FCA for this test campaign included an assessment of the submitted modifications and included inputs of both normal and abnormal data during test performance. This evaluation utilized baseline test cases as well as specifically designed test cases and included predefined election definitions for the input data. As part of the FCA, one primary and one general election were executed to verify that each of the submitted modifications had been successfully implemented. The System Integration Tests were performed to verify the EMS 4.2 functioned as a complete system.

During System Level Testing, the system was configured exactly as it would for normal field use per the procedures detailed in the EMS 4.2 technical documentation. This included connecting all supporting equipment and peripherals as well as any physical security equipment such as locks and ties.

3.1.4.1 Functional Configuration Audit (FCA)

The Functional Configuration Audit (FCA) 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 were conducted to ensure all applicable EAC VVSG 1.0 requirements were met.

All functional tests were successfully executed.

3.1.4.2 Accuracy

The Accuracy Test ensured that each component of the voting system could 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 were used to test components of the voting system:

The accuracy requirements for the EMS 4.1.20.0 were met as part of the previous EMS 4.1 test campaign. Only the EMS 4.2 (firmware version 4.2.11.0) was subjected to the Accuracy Test as part of this test campaign. Testing of the EMS 4.2 was accomplished by the execution of the standard accuracy test utilizing contests created within the EMS. These were then transported to and voted on the Infinity Voting Panel (firmware version 4.20-005).

Summary Findings

The EMS 4.2 software successfully passed the Accuracy Test without issue. A total of 1,549,800 voting positions were voted on the Infinity Voting Panel with all actual results obtained during test execution matching the expected results.

3.1.4.3 System Integration

System Integration is a system level test that evaluates the integrated operation of both hardware and software. System Integration tests the compatibility of the voting system software components, or subsystems, with one another and with other components of the voting system environment. This functional test evaluates the integration of the voting system software with the remainder of the system.

Summary Findings

During test performance, the system was configured as it would be for normal field use. Pro V&V personnel properly configured and tested the system by following the procedures detailed in the EMS 4.2 technical documentation.

A General Election and a Primary Election were successfully exercised on the voting system, as described below:

General election with the following breakdown:

— General Election GEN-03: A basic election held in two precincts. This election contains eight contests and is 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 two languages (English and Spanish).

Primary election with the following breakdown:

— Primary Election PRIM-03: A basic 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 Primary 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 two languages (English and Spanish).

The EMS 4.2 successfully passed the System Integration Test. During execution of the test procedure, it was verified that the EMS 4.2 successfully completed the system level integration tests with all actual results obtained during test execution matching the expected results.

3.1.4.4 Regression Testing

Regression testing was conducted on the EMS to establish assurance that the modifications had no adverse impact on the compliance, integrity, or performance of the system. No new faults or issues were found during regression testing. All aforementioned enhancements in Section 2.2.1.1 of this Test Report were verified. This included

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. No anomalies occurred during the testing of the EMS 4.2.

3.3 Deficiencies and Resolutions

Any violation of the specified requirement or a result is encountered during test performance that deviates from what is standard or expected in which a root cause is established is considered to be a deficiency. Upon occurrence, deficiencies are logged throughout the test campaign for disposition and resolution. No deficiencies were encountered during testing of the EMS 4.2.

4.0 RECOMMENDATION FOR CERTIFICATION

The EMS 4.2, 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 EMS 4.2

functioned as a complete system during System Integration Testing. Based on the test findings, Pro V&V recommends the EAC grant the EMS 4.2, as identified in Table 4-1, certification to the EAC VVSG 1.0.

Table 4-1. EMS 4.2 System Components

EMS 4.2 SYSTEM SOFTWARE	
Firmware/Software	**Version**
Proprietary	
Election Management Software (EMS)	4.2
COTS	
Microsoft Windows 10 Professional	1709
Microsoft Visual Studio 2017 Professional	15.5
ComponentOne Ultimate 2014	1
EMS 4.2 SYSTEM HARDWARE	
Component	**Serial Number**
Proprietary	
Infinity Voting Panel (VP-1 Rev: D05) w/Power Supply	11588
Infinity Voting Panel (VP-1 Rev: C) w/Power Supply	04689
COTS	
Dell OptiPlex 3020 w/Power Cord, Keyboard, & Mouse	BSNNK52
Dell OptiPlex 3020 w/Power Cord, Keyboard, & Mouse	FVNNK52
Dell Latitude EMS Computer	Model E5440 or E5570
Dell 15" Monitor (E153FPb)	CN-0D5421-46633-4B8-0GVU T
Seiko Instruments Printer (DPU-3445) w/Power Supply	2008922A
EMS Download Cable	CC06789-06
USB Smart Card Reader (PC USB TR PIV) w/Stand (HWP109380 B)	113101316600170
DoubleTalk LT w/Radio Shack Headphones	[MVT-001]
Gearmo USB to RS-232 Converter (FTDI-LED)	USA000106043

Appendix A

MicroVote EMS 4.2 As-Run Test Plan

(submitted separately)