

Certification Test Report - Modification

Report Number *HRT-17002-CTR-01*

Hart InterCivic Verity Voting 2.2.1

Modification Certification Test Report version 1.1

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Prepared for:

Vendor Name	<i>Hart InterCivic Inc. (Hart)</i>
Vendor System	<i>Verity Voting 2.2.1</i>
EAC Application No.	<i>HRT 01-17</i>
Vendor Address	<i>15500 Wells Port Drive Austin, TX 78728</i>

Prepared by:



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



Accredited by the National Institute of Standards and Technology (NIST) National Voluntary Lab Accreditation Program (NVLAP), and accredited by the Election Assistance Commission (EAC) for VSTL status.



Revision History

Release	Author	Revisions
v1.0	M. Santos	Initial Release; submitted to EAC for approval
V1.1	M. Santos	Updates for EAC review comments

Disclaimer

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

Opinions and Interpretations

There are no SLI opinions or interpretations included in this report beyond the final recommendation.



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1 Introduction

SLI Compliance is submitting this test report as a summary of the certification testing efforts for the **Hart Verity Voting 2.2.1 system**, a modified system from **Verity Voting 2.2**, as detailed in the section System Identification. This version of **Verity Voting** implements a customization for a particular variation of straight party voting, specifically for the State of Michigan. The purpose of this document is to provide an overview of the certification testing effort and the findings of the testing effort for the **Hart Verity Voting 2.2.1 system**.

This effort included documentation review of the Technical Data Package, source code review, and testing of the **Hart Verity Voting 2.2.1 system**. Testing consisted of the development of a test plan, managing system configurations, component and system level tests prepared by SLI, and analysis of results. The review and testing was performed at SLI's Denver, Colorado facility.

1.1 References

1. Election Assistance Commission Voluntary Voting System Guidelines version 1.0 (EAC VVSG 1.0), Volumes I & II
2. NIST NVLAP Handbook 150: 2006.
3. NIST NVLAP Handbook and 150-22: 2008.
4. EAC Voting System Testing and Certification Program Manual, United States Election Assistance Commission, v 2.0, May 2015
5. EAC Voting System Test Laboratory Program Manual, United States Election Assistance Commission, v 2.0, May 2015
6. SLI VSTL Quality System Manual, v 2.2, prepared by SLI, Sept. 2016

1.2 Document Overview

This document contains:

- The "Introduction", which discusses the applications tested/reviewed
- The "Certification Test Background", which discusses the testing process
- The "System Identification", which identifies hardware and software for the **Hart Verity Voting 2.2.1 system**
- The "System Overview", which discusses the functionality of **Hart Verity Voting 2.2.1 system** software and firmware
- The "Certification Tests Results and Summary", which is a summary of the testing effort
- The "Recommendations" section, which contains the final analysis of the testing effort
- "EAC Certification & Voting System Configuration", which summarizes the voting system configuration



- *Attachments as follows:*
 - Attachment A – Warrant of Change Control for Verity Voting 2.2.1
 - Attachment B - Verity Voting 2.2.1 Attestation of Durability
 - Attachment C - Verity Voting 2.2.1 Attestation of Integrity
 - Attachment D - Attestation of Production Hardware and Software for Verity Voting 2.2.1
 - Attachment E1 - PCA Doc - Software Design_Spec Rev01
 - Attachment E2 - PCA Doc - System Change Notes Rev02
 - Attachment E3 - PCA Doc - System Hardware Spec Rev02
 - Attachment E4 - PCA Doc - System Test_Verification Spec Rev01
 - Attachment F - Record of Trusted Build for Verity Voting 2.2.1
 - Attachment G - Modification of Certified System Analysis Summary Verity 2.2.1 Rev01
 - Attachment H - Hart Discrepancy Report Verity 2.2.1 v2.0
 - Attachment I – As Run Hart Verity 2.2.1 EAC Modification Test Plan v1.1
 - Attachment J1 - HRT_C#_MSAInOneStandard_SCRF
 - Attachment J2 - HRT_C_&_C++_MSAInOneStandard_SCRF
 - Attachment K – List of Source Code Reviewed and Results

2 Certification Test Background

This section provides a brief overview of the EAC Certification Program and the activities involved in order for a voting system to be considered for certification against the VVSG 1.0 and the current EAC program manuals.

2.1 PCA - Document and Source Code Reviews

The Physical Configuration Audit (PCA) review of the **Hart Verity Voting 2.2.1** documentation, submitted in the requisite Technical Data Package (TDP), was performed in order to verify conformance with the VVSG 1.0. Source code was reviewed for each software and firmware application declared within the **Verity Voting 2.2.1** voting system. As this is a modification test campaign, the source code was compared against the final code base of **Verity Voting 2.2**, and changes were subject to review.

All PCA reviews were conducted in accordance with *Volume II Section 2* of the VVSG 1.0, to demonstrate that the system meets the requirements. Results of the PCA documentation review can be found in section 5.2 of this Certification Test Report. Informational issues in the documentation which didn't violate a VVSG 1.0 requirement were identified to Hart for



resolution or comment. This included typos or incorrect labeling of a document (e.g. draft versus official), discrepancies in formatting or versioning, incorrect processes, functionality descriptions and/or missing functionality or descriptions. Additional details of the PCA documentation review can be found in *Attachments E1-E4*.

All PCA source code reviews were conducted in accordance with *Volume I Section 5.2 and Volume II Section 5* of the VVSG 1.0, to demonstrate that the system meets the requirements. Results of the PCA source code reviews can be found in *Attachment K – List of Source Code Reviewed and Results*. Inconsistencies or errors in the source code were identified to Hart for resolution or comment. Additional details of the source code review criteria can be found in *Attachments J1-J2*.

2.2 FCA - Functional & System Testing and Sampling

The Functional Configuration Audit (FCA) review of the test documentation submitted by Hart in the TDP was reviewed in order to verify testing of the voting system.

SLI's standard Test Suites were customized for the **Hart Verity Voting 2.2.1** voting system and conducted in accordance with *Volume II Section 6 of the VVSG 1.0*. Simulations of elections were conducted to demonstrate a beginning-to-end business use case process for the **Hart Verity Voting 2.2.1** voting system.

2.2.1 Test Methods

All test methods employed are within the scope of SLI's VSTL accreditation.

The following validated test methods were employed during this test campaign:

Table 1 – Test Methods

SLI VSTL Test Method Name
TM_Audit_Record_Data v1.1
TM_Basic_Election_Components v1.1
TM_Error Message and Recovery v1.3
TM_HW_Integrity v1.2
TM_System_Audit v1.1
TM_Tally_and_Reporting v1.1
TM_Voting_Capabilities v1.3

The above listed test methods are implemented in a complementary fashion: modules are employed from various methods to form suites. Suites included the logical sequence of functionality that was used to validate the requirements addressed by each module within the suite. Please see Table 3 - Terms and Abbreviations below for additional information about Test Modules and Test Suites.



2.2.1.1 Deviations from, additions to, or exclusions from the test methods

The test methods listed in Table 1 above, contain the requirements listed in section 4.6 below. The established and validated test methods did not have any deviations. Test cases utilizing those methods were selected and grouped into test suites to validate the requirements in section 4.6

2.2.2 Terms and Abbreviations

This section details pertinent terms applicable within this report.

Table 2 – Terms and Abbreviations

Term	Abbreviation	Description
Ballot Marking Device	BMD	An accessible computer-based voting system that produces a marked paper ballot that is the result of voter interaction with visual or audio prompts.
Cast Vote Record	CVR	Record of all selections made by a single voter whether in electronic or paper. Also referred to as a ballot image when used to refer to electronic ballots.
Central Count Scanner	CCS	High Speed Digital Scanner is a ballot scanning device typically located at a central count facility and is operated by an automated multi-sheet feeding capability.
Chevron (Arrows at top of current screen)	No Abbreviation	Verity software applications are organized around easy-to-follow workflows, with specific activities associated with “chevrons” or “arrows” in the application user interface.
Compact Flash card	CF	This is a type of flash memory card in a standardized enclosure often used in voting systems to store ballot and/or vote results data.
Compact Flash AST	CFAST	A compact flash media based on the Serial ATA bus rather than the Parallel ATA bus, used by the original Compact Flash
Commercial Off the Shelf	COTS	Commercial, readily available hardware devices (such as card readers, printers or personal computers) or software products (such as operating systems, programming language compilers, or database management systems)
Election Assistance Commission	EAC	An independent, bipartisan commission created by the Help America Vote Act (HAVA) of 2002 that operates the federal government's voting system certification program.



Term	Abbreviation	Description
Election Management System	EMS	Typically utilizes a database management system to enter jurisdiction information (district, precincts, languages, etc.) as well as election specific information (races, candidates, voter groups (parties), etc.). In addition, the EMS is also used to lay out the ballots, download the election data to the voting devices, upload the results and produce the final results reports.
Electromagnetic Compatibility	EMC	The goal of EMC is to validate the correct functioning of different equipment in the same environment and the avoidance of any interference effects between them.
Functional Configuration Audit	FCA	Exhaustive verification of every system function and combination of functions cited in the vendor's documentation. The FCA verifies the accuracy and completeness of the system's Voter Manual, Operations Procedures, Maintenance Procedures, and Diagnostic Testing Procedures.
National Institute of Standards and Technology	NIST	A non-regulatory federal agency within the U.S. Dept. of Commerce. Its mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life.
National Voluntary Laboratory Accreditation Program	NVLAP	A division of NIST that provides third-party accreditation to testing and calibration laboratories.
Physical Configuration Audit	PCA	The testing activities associated with the physical aspects of the system (hardware, documentation, builds, source code, etc.).
Primary – Closed		The Closed Primary election segregates each political party onto its own ballot, along with all pertinent non-political contests and referendums.
Primary - Open		The Open Primary election combines all political parties' contests onto a single ballot, along with all pertinent non-political contests and referendums.
Precinct Count Scanner	PCS	A precinct-count optical scanner is a mark sense-based ballot and vote counting device located at a precinct and is typically operated by scanning one ballot at a time.
Request For Information	RFI	A form used by testing laboratories to request, from the EAC, interpretation of a technical issue related to testing of voting systems.



Term	Abbreviation	Description
Requirements Matrix	N/A	This is the matrix created by the EAC and maintained by SLI that traces the requirements to the various test modules and test methods.
Standard Lab Procedure	SLP	SLI's quality system documentation is made up of standard lab procedures (SLPs), which are procedures required to ensure a systematic, repeatable and accurate approach to voting systems testing and governing the actual performance of SLI's work.
(Verity) Tab	No Abbreviation	Verity software applications are organized around easy-to-follow workflows and activities; a "Tab" provides specific activities associated with "chevron" workflows in the application user interface.
Voting Center		Typically a convenience voting location that manages multiple ballot styles
Technical Data Package	TDP	This is the data package that is supplied by the vendor and includes: Functional Requirements, Specifications, End-user documentation, Procedures, System Overview, Configuration Management Plan, Quality Assurance Program, and manuals for each of the required hardware, software, firmware components of each voting system.
Test Method	No Abbreviation	SLI proprietary documents which are designed to group sets of EAC VVSG requirements in a logical manner that can be utilized to efficiently validate where and how requirements, or portions of a requirement, are met.
Test Module	No Abbreviation	An actionable component of a Test Method, that functionally verifies that a requirement is met within a voting system. Test Modules are at a generic level within the Test Method, and are customized for a particular voting system, within a Test Suite.
Test Suite	No Abbreviation	An actionable grouping of test modules designed to test a set of functions of a voting system or component in a specific way.
Validation	No Abbreviation	Confirmation by examination and through provision of objective evidence that the requirements for a specific intended use or application have been fulfilled (ISO 9000)
Verification	No Abbreviation	Confirmation by examination and through provision of objective evidence that specified requirements have been fulfilled (ISO 9000)



Term	Abbreviation	Description
Voluntary Voting Systems Guidelines Volumes I & II	VVSG	A set of specifications and requirements against which voting systems can be tested to determine if the systems provide all of the basic functionality, accessibility and security capabilities required of these systems.
Voting System Test Lab	VSTL	The accredited lab where the voting system is being tested.
Voting System Under Test	VSUT	The designation for a voting system that is currently being tested.
Voting Test Specialist	VTS	An SLI Compliance employee who has been qualified to perform EAC voting system certification testing.

3 System Overview

3.1 Scope of the Hart Verity Voting 2.2.1 Voting System

This section provides a description of the scope of **Hart Verity Voting 2.2.1** voting system components:

- The **Hart Verity Voting 2.2.1** voting system represents a set of software applications for pre-voting, voting and post-voting election project activities for jurisdictions of various sizes and political division complexities. **Verity Voting 2.2.1** functions include:
 - Defining the political divisioning of the jurisdiction and organizing the election with its hierarchical structure, attributes and associations.
 - Defining the election events with their attributes such as the election name, date and type, as well as contests, candidates, referendum questions, voting locations and their attributes.
 - Preparing and producing ballots for polling place and absentee voting.
 - Preparing media for precinct voting devices and central count devices.
 - Configuring and programming the **Verity Scan** digital scanners.
 - Configuring and programming the **Verity Touch Writer** BMD devices
 - Transmission of election results via **Verity Relay**
 - Producing the election definition and auditing reports.
 - Providing administrative management functions for user, database, networking and system management.
 - Import of the Cast Vote Records from **Verity Scan** devices and **Verity Central**.
 - Preview and validation of the election results.



- Producing election results tally according to voting variations and election system rules.
 - Producing a variety of reports of the election results in the desired format.
 - Publishing of the official election results.
 - Auditing of election results including ballot images and log files.
-
- The **Verity Scan** is a digital scan precinct ballot counter (tabulator) that is used in conjunction with an external ballot box. The unit is designed to scan marked paper ballots, interpret and record voter marks on the paper ballot and deposit the ballots into the secure ballot box. **Verity Scan** also has the capability of utilizing an optional cellular modem.
 - **Verity Relay** provides a remote transmission capability to the **Verity Voting 2.2.1** system. Utilizing an optional modem on **Verity Scan**, at close of polls, results are transmitted from the polling place device to the **Verity Relay** station.
 - The **Verity Touch Writer** is a standalone precinct level Ballot Marking Device (BMD) which also includes an Audio Tactile Interface (ATI), which allows voters who cannot complete a paper ballot to generate a machine-readable and human readable paper ballot, based on vote selections made, using the ATI.
 - **Verity Print** is an on-demand ballot production device for unmarked paper ballots.
 - **Verity Election Management** allows users with the Administrator role to import and manage election definitions. Imported election definitions are available through the Elections chevron in Build. Users can also delete, archive, and manage the election definitions.
 - **Verity User Manager** enables users with the correct role and permissions to create and manage user accounts within the **Verity Voting** system for the local workstation in a standalone configuration, or for the network in a networked configuration.
 - **Verity Desktop** enables users, with the correct roles, to set the workstations' date and time, gather **Verity** application hash codes (in order to validate the correctness of the installed applications), and access to Windows desktop.
 - **Verity Data** provides the user with controls for entering and proofing data and audio. **Verity Data** also performs validation on the exported information to ensure that it will successfully import into **Verity Build**.
 - **Verity Build** opens the election to proof data, view reports, and print ballots, and allows for configuring and programming the **Verity Scan** digital scanners, and **Verity Touch Writer** BMD devices, as well as producing the election definition and auditing reports.
 - **Verity Central** is a high-speed, central digital ballot scanning system used for high-volume processing of ballots (such as vote by mail). The unit is based on COTS scanning hardware coupled with custom **Hart**-developed ballot processing application software which resides on an attached work-station.
 - **Verity Count** is an application that tabulates election results and generates reports. **Verity Count** can be used to collect and store all election logs from every **Verity** component/device used in the election, allowing for complete election audit log reviews.



3.1.1 Supported Languages

The **Hart Verity Voting 2.2.1** voting system supports English and Spanish.

3.2 Changes from Verity 2.2 to Verity 2.2.1

3.2.1 Modifications new to Verity 2.2.1

The sole modification to **Verity Voting 2.2.1** addresses how Straight Party voting is handled.

In an <n of m> race (e.g., Vote for Two, Vote for Three), in addition to counting valid individual marks, if unmarked choices affiliated with the Straight Party selection can be counted without ambiguity, up to the total “m” number of valid choices, then those votes are also counted, in addition to the marked choice. However, if there would be ambiguity about which one of the “leftover” choices would be assigned to the Straight Party affiliation, then no Straight Party votes are counted.

For example:

- Vote for four Township Trustee, Straight Party vote Democrat, four Democrats are running, a direct vote is made for one Republican. Only the Republican vote is counted. No straight party votes would be awarded to any of the Democrats because it cannot be determined which three of the four Democrats running should get the remaining votes allowed.
- Vote for four Township Trustee, Straight Party vote Democrat, three Democrats are running, a direct vote is made for one Republican. The Republican vote is counted, and each of the three (unmarked) Democrats running for township trustee would also receive a vote based on the Straight Party vote, because there is no ambiguity about which Democratic candidates should get votes – there are three Democratic slots remaining, and 3 unmarked Democratic slots + 1 direct vote marked Republican is within the limit of “vote for four.”

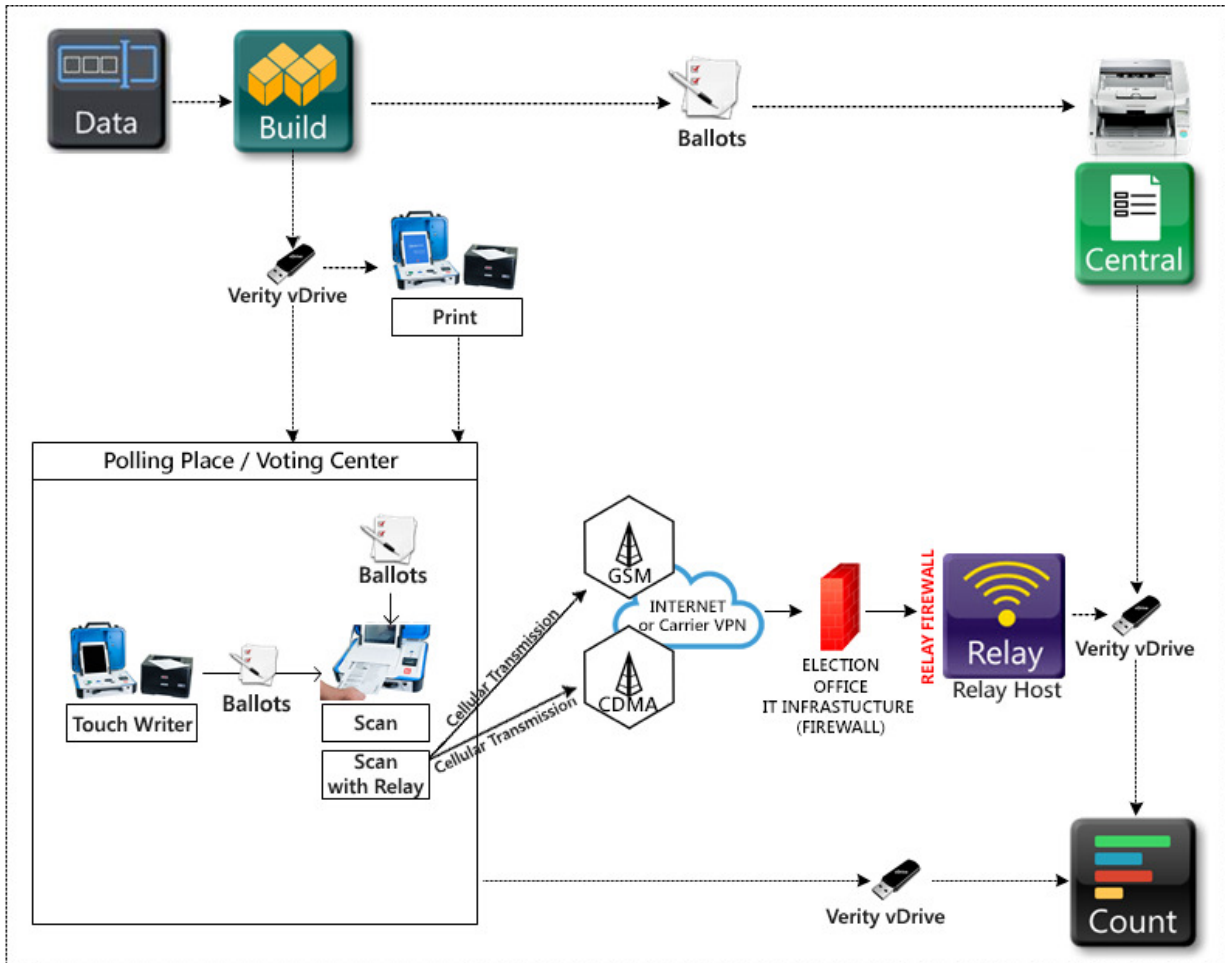
Verity Voting 2.2.1 implements this modification with updates to the following components:

1. **Verity Scan** – support for the new implementation of Straight Party voting
2. **Verity Central** – support for the new implementation of Straight Party voting
3. **Verity Count** – support for the new implementation of Straight Party voting

4 System Identification

The **Hart Verity Voting 2.2.1** voting system was submitted for certification testing with the documentation, hardware and software listed below. No other Hart product was included in this test effort.

4.1 System Topology Diagram



Overview of the diagram:

- The components are displayed as touch points of data access, transfers, and verification.
- Dotted lines show the flow of data and air gaps using **Verity vDrives**.
- **Verity vDrive** is media used for transportation of voting system data.
- **Verity Print** is a ballot production device that provides unmarked printed ballots.



- **Verity Touch Writer** and **Verity Scan** (**Verity Voting** devices) are used in any polling location.
- **Verity Key** (not shown) is required for user access into components to load election elections, use features, and generate reports. Feature access depends on the roles applied to user accounts.
- **Verity Relay** is a transmission option within the Verity Voting system.

4.2 Documentation

The TDP User/Owner manuals that are deliverables of the certified system delivered to a purchaser of the system are as follows:

- Verity Build Technical Reference Manual
- Verity Central Technical Reference Manual
- Verity Count Technical Reference Manual
- Verity Data Technical Reference Manual
- Verity Polling Place Operations Technical Reference Manual
- Verity Print Technical Reference Manual
- Verity Relay Technical Reference Manual
- Verity Service and Maintenance Operations Technical Reference Manual
- Verity Operational Guide
- Verity Count Technical Reference Supplement
- Verity Scan with Relay Technical Reference Supplement

4.3 Software and Firmware

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

The software and firmware employed by **Hart Verity Voting 2.2.1** consists of 2 types, custom and commercial off the shelf (COTS). COTS applications were verified to be pristine, or were subjected to source code review for analysis of any modifications and verification of meeting the pertinent standards. The COTS software and firmware was either obtained directly from the 3rd party manufacturer, or was verified against digital signatures obtained from the 3rd party manufacturer. No modified COTS were implemented. For Hardware, the hardware was either shipped directly from the 3rd party manufacturer, or the equipment was inspected to verify conformance to the 3rd party manufacturer's specifications.



Tables 4 and 5 below detail each application employed by the **Hart Verity Voting 2.2.1** voting system.

Table 3 – Hart Verity Voting 2.2.1 Software and Firmware

Manufacturer	Application(s)	Version
Verity Data	Ballot setup software – new build	2.2.1
Verity Build	EMS software – new build	2.2.1
Verity Central	High speed digital scanner software	2.2.1
Verity Count	Central count location accumulation, tallying and reporting software – new build	2.2.1
Verity Relay (Host)	Data transmission software (receiving station)	2.2.0
Verity Scan	Digital scanner firmware – new build	2.2.1
Verity Touch Writer	BMD firmware	2.0.3
Verity Print	Printer firmware	2.0.3
Verity Device Microcontroller	Firmware for Verity Devices	V17

Table 4 – COTS Software

Manufacturer	Application	Version	Verity Voting 2.2.1 Component
Microsoft	Microsoft Windows Embedded Standard 7 with Service Pack 1 – 64bit	6.1.7601	Data/Build, Data/Build + Count, Central, Count, Print, Relay, Scan, Touch Writer
Microsoft	Microsoft SQL Server 2012 for Embedded Systems	11.00.2100	Data/Build, Data/Build + Count, Relay, Central, Count
Microsoft	Microsoft SQL Server 2012 Express	11.00.2100	Print, Scan, Touch Writer,
McAfee	McAfee Application Control for Devices	6.1.1.369	Data/Build, Data/Build + Count, Central, Count, Relay, Print, Scan, Touch Writer
Microsoft	Windows Communication Foundation (WCF)	4.5	Relay host, Scan
Canon	DR-G1100 Scanner Driver	1.0.0.1	Verity Central
Canon	DR-G1130 Scanner Driver	1.0.0.1	Verity Central



Manufacturer	Application	Version	Verity Voting 2.2.1 Component
OKIDATA	Universal Printer Driver	1.6.4.0	Verity Data, Verity Build, Verity Print, Verity Central, Verity Touch Writer and Verity Count)
OKIDATA	B431d Printer Driver	1.2.0.0	Verity Data, Verity Build, Verity Print, Verity Central, Verity Touch Writer and Verity Count)
OKIDATA	C831dn Printer Driver	1.0.0.0	Verity Print, Verity Build
OKIDATA	C911dn Printer Driver	1.0.3.0	Verity Print, Verity Build
MultiTech	MTD Series Modem Driver	8.00.04	Verity Scan with modem
TWAIN Working Group	Twacker 32 Scanner Driver	2.0.1	Verity Central

4.4 Equipment (Hardware)

The hardware employed by **Hart Verity Voting 2.2.1** consists of 2 types, custom and commercial off the shelf (COTS). COTS hardware was verified to be unmodified, or was subjected to review for analysis of any modifications and verification of meeting the pertinent standards.

Tables 6 and 7 below detail each device employed by the **Hart Verity Voting 2.2.1** voting system.

Table 5 – Hart Verity Voting 2.2.1 Custom Voting Equipment

Hardware	Use	Model	Revision
Verity Scan (digital scanner)	Precinct polling place digital scanner	3005368	Revision B
Verity Touch Writer (BMD)	Precinct polling place Ballot Marking Device	2005352	Revision C
Verity Print	Ballot production device	3005356	Revision C
Verity Key	Security key used within the voting system	N/A	N/A
Verity vDrive	Media used for transportation of voting system data	N/A	N/A



Table 6 – Hart Verity Voting 2.2.1 COTS Equipment

Manufacturer	Hardware	Model
OKIDATA (for Verity Data, Verity Build, Verity Print, Verity Central, Verity Touch Writer and Verity Count)	Ballot and Report Printer	B431d
OKIDATA (for Verity Print, Verity Build)	Ballot Printer	C831dn
OKIDATA (for Verity Print, Verity Build)	Ballot Printer	C911dn
OKIDATA (for Verity Count)	Ballot Printer	ML-1121
Eaton	UPS for Verity Touch Writer printer	5P1500
PC Workstation - Various (for Verity Data, Verity Build, Verity Central and Verity Count)	Processor – Intel Core i7-4790 3.6 8M GT2 4C CPU Memory – 32GB DDR3-1600 nECC (4x8GB) RAM Hard Drive – 2x1 TB RAID-Level 1, Removable w/ key lock USB Ports – 4 ports Video Card - Integrated Graphics Keyboard - USB Keyboard Mouse - USB Mouse	
PC Display - Various (for Verity Data, Verity Build, Verity Central and Verity Count)	Monitor (Minimum Requirements) Panel Size - 50.8 cm Aspect Ratio - Widescreen (16:9) Optimal Resolution - 1600 x 900 at 60Hz Contrast Ratio - 1000: 1 Brightness - 250 cd/m2 (typical)	
Canon (for Verity Central)	Ballot Scanner	DR-G1100
Canon (for Verity Central)	Ballot Scanner	DR-G1130
QuickCarrier® USB-D by MultiTech Systems cellular modem	Aeris cellular modem	MTD-EV3- N16
QuickCarrier® USB-D by MultiTech Systems cellular modem	Sprint cellular modem	MTD-EV3- N2
QuickCarrier® USB-D by MultiTech Systems cellular modem	Verizon cellular modem	MTD-EV3- N3
QuickCarrier® USB-D by MultiTech Systems cellular modem	Global (AT&T, T-Mobile, etc...) cellular modem	MTD-H5-2.0



4.5 Materials

The following test materials are required for the performance of testing including, as applicable, test ballot layout and generation materials, test ballot sheets, and any other materials used in testing.

- Ballots & Blank Ballot grade paper
- Thumb Drives
- Ballot marking pens
- Printer paper rolls

4.6 Requirements

4.6.1 VVSG Requirements

The **Verity Voting 2.2.1** modifications were tested to applicable 2005 VVSG 1.0 requirements. This section details the requirements reviewed for **Verity Voting 2.2.1**.

Verity Scan's modification to provide the capability to accept and record votes for a Straight Party, in a given manner, as detailed in section "1.1.2 Modifications".

Pertinent VVSG requirements are:

- 2.1.2.c
- 2.1.5.1.b.i
- 2.1.7.1.c
- 2.1.7.2.h
- 2.3.3.1.c
- 2.3.3.2.e,f,g

Verity Central's modification to provide the capability to accept and record votes for a Straight Party, in a given manner, as detailed in section "1.1.2 Modifications".

Pertinent VVSG requirements are:

- 2.1.2.c
- 2.1.7.1.c
- 2.1.7.2.h
- 2.3.3.1.c



Verity Count's modification to provide the capability to accept and record votes for a Straight Party, in a given manner, as detailed in section "1.1.2 Modifications".

Pertinent VVSG requirements are:

- 2.1.2.c
- 2.1.7.1.c
- 2.1.7.2.h
- 2.3.3.1.c
- 2.4.3.d

4.7 Hart State Specific Modification Requirements

The following requirements represent Hart internally developed specifications designed to satisfy the jurisdictional request of the State of Michigan, for whom this voting system version is intended..

Pertinent Hart requirements, with Hart internal numbering, for the update to Straight Party voting logic are:

3.2.1 Straight party marking rules shall be applied when the following criteria are all met:

- The contest is included in straight party logic
- The straight party selector is marked for a single party ("P")
- Number of Valid Choices ("N") is greater than 1
- The voter has made "M" manual selections in this contest, and $M < N$
- The number of remaining available choices (N minus M) is greater than or equal to the number of contest choices that are associated with party P

Note: In prior versions of Verity, this scenario resulted in only the voter's manual selections being counted. Automatic straight party marking was not applied.

3.2.2 Requirement 3.2.1 shall apply to scanned paper ballots.

Note: Based on existing behavior, the logic from 3.2.1 will never be triggered on an electronic ballot because all marks in straight-party connected contests are cleared when a selection is made in the straight party selector, prior to applying straight party marking logic. So, no behavior change will be seen on electronic ballots.

3.2.3 All other straight party behavior shall remain unchanged.

3.2.4 There shall NOT be a configuration setting for the new straight party logic.



5 Certification Test Results Summary

5.1 Source Code Review Summary

SLI has reviewed the software source code for each application in the **Hart Verity Voting 2.2.1** voting system to determine the code's compliance with Volume I Sections 5, 9 and Volume II Section 5.4 of the VVSG 1.0 and for compliance with **Hart's** internally developed coding standards. **Verity Voting 2.2.1** is implemented with the C, C++ and C# languages. Results of the source code review are detailed in *Attachment K. – List of Source Code Reviewed and Results.*

5.1.1 Evaluation of Source Code

The source code was reviewed for compliance per the guidelines defined in *Volume II, Section 5.4* of the VVSG 1.0. As a modification project, the **Verity Voting 2.2.1** code base was reviewed using the final **Verity Voting 2.2** code base as the initial drop, to which the initial **Verity Voting 2.2.1** code base was compared. The differences found between those two code bases served as the starting point of the code review. The source code was found to be in compliance with the terms of the VVSG 1.0, and Hart declared industry standards.

5.2 Technical Data Package Review Summary

SLI reviewed the **Hart Verity Voting 2.2.1** TDP, as detailed in sections 3.1 and 3.4, for compliance according to *Volume II Section 2* of the VVSG 1.0.

The review was conducted for the required content and format of:

- **Software Design and Specification:** (Attachment E1) Purpose and scope, applicable documents, software overview, software standards and conventions, software operating environment, software functional specification, programming specifications, system database, interfaces and appendices.
- **System Change Notes:** (Attachment E2) Changes to a previously certified system (**Verity Voting 2.2**).
- **System Hardware Specification:** (Attachment E3) System Hardware Characteristics, Design and Construction.
- **System Test and Verification Specifications:** (Attachment E4) Development and certification test specifications that **Hart** applied to their testing efforts.

5.2.1 Evaluation of TDP

All the TDP discrepancies were resolved. The Technical Data Package for the **Hart Verity Voting 2.2.1** voting system was found to comply with the standards. A jurisdiction would be able to deploy the **Hart Verity Voting 2.2.1** voting system using the TDP. Results of the PCA documentation review are detailed in *Attachments E1-E4.*



5.3 Hardware Testing

No hardware testing was conducted for this test campaign.

5.4 Known Vulnerabilities Testing

Hart Verity Voting 2.2.1 is a modification of the **Verity Voting 2.2**, which has had only limited exposure in the field.

There are no known vulnerabilities to the **Verity Voting** system family (**Verity Voting 1.0**, **Verity Voting 2.0**, **Verity Voting 2.2** and **Verity Voting 2.2.1**), at this time.

Review of the “Known Vulnerabilities” database, maintained by SLI, has provided 14 known vulnerabilities to previous Hart (non-Verity, rather HVS 6.2.1) systems already accounted for in SLI’s Test Methods.

5.5 Functional Testing Summary

Functionality was tested as identified below for the **Verity Voting 2.2.1** system.

5.5.1 How Each Device was Tested

5.5.1.1 Verity Scan

- **Verity Scan** is a standalone precinct level scanning device. It accepts and records votes from voter hand marked ballots, as well as from **Verity Touch Writer** marked ballots. Data from the votes cast is stored in a **Verity vDrive** and transported to central count locations for accumulation and tallying in **Verity Count**. In this release, **Verity Scan** with modem provides the capability to also transmit election results data over a cellular modem, to the Relay workstation.
- **Verity Scan** was tested first as an individual component in order to verify that all declared functionality is present and working as documented, with media and data produced by **Verity Build**. All documented features were tested, and all functional features were verified to be documented. This included election data being stored on the **Verity vDrive**, as well as being transmitted to **Verity Relay**.
- **Verity Scan** was also tested as an integrated piece of the voting system in several different system level test suites, where it inputs media and data produced in **Verity Build**, then accepts user marked ballots as well as **Verity Touch Writer** machine marked ballots within the polling place, prior to producing all defined output media.



5.5.1.2 Verity Print

- **Verity Print** is a standalone ballot production device for poll worker use. Once the ballot is printed and marked, the voter can cast the ballot through **Verity Scan** or through **Verity Central**.
- **Verity Print** was tested as an integrated piece of the voting system, in several different system level test suites, where it accepted user input instructions, prior to producing ballots which were then marked and cast through both **Verity Scan** and **Verity Central**.

5.5.1.3 Verity Touch Writer

- **Verity Touch Writer** is a standalone precinct level ballot marking device. It assists voters in marking their ballot and prints it out for them. Once the ballot is printed, **Verity Touch Writer** erases all memory components of that session.
- **Verity Touch Writer** was tested as an integrated piece of the voting system, in several different system level test suites. The tests verified that it accepted voter selections, and produced marked ballots that mirrored the voter's intent.

5.5.1.4 Verity vDrive

- **Verity vDrive** is a Verity memory device. It carries information from **Verity Build** to each of the components within the **Verity** system during the pre-voting phase of an election. On Election Day data from the votes cast in **Verity Scan**, and **Verity Central** as well as those transmitted to **Verity Relay**, and are stored in a **Verity vDrive** and transported to **Verity Count** for accumulation and tallying.
- **Verity vDrive** was tested as an integrated piece of the voting system where it inputs **Verity Build** produced media and data, then accepts and transports cast vote record data and ballot images from the polling place to **Verity Count**.

5.5.1.5 Verity Key

- **Verity Key** is a **Verity** security device. It carries security information from **Verity Build** to each of the components within the **Verity** system.
- **Verity Key** was tested as an integrated piece of the voting system, where it is utilized for authorizing loading election information onto **Verity Touch Writer**, **Verity Print**, **Verity Relay**, **Verity Scan** and **Verity Central**, as well as accumulating vote data into **Verity Count**.



5.5.2 How each Application was tested

5.5.2.1 Verity Relay

- **Verity Relay** provides a remote transmission capability to the **Verity Voting 2.2.1** system. Utilizing an optional modem on **Verity Scan**, at close of polls, results are transmitted from the polling place device to the **Verity Relay** workstation.
- **Verity Relay** was tested as an integrated piece of the voting system where it inputs media and data produced in **Verity Build**, then accepts transmitted data from **Verity Scan** devices, transferring data to **Verity vDrives**, which are input into **Verity Count** for accumulation and tallying.

5.5.2.2 Verity Data

- **Verity Data** accepts imported election data and produces contests, choices, precincts, districts, ballots, and all other data needed to accept an election in **Verity Build**.
- **Verity Data** was also tested as an integrated piece of the voting system where it outputs election data to be used by **Verity Build**.

5.5.2.3 Verity Build

- **Verity Build** accepts imported election information and produces ballots, election information, **Verity vDrives** and **Verity Keys**.
- **Verity Build** was tested as an integrated piece of the voting system where it outputs media and data (via **Verity Key** and **Verity vDrive**), which feed into **Verity Print**, **Verity Touch Writer**, **Verity Scan**, **Verity Relay**, **Verity Central** and **Verity Count**.

5.5.2.4 Verity Central

- **Verity Central** is a central count location system that utilizes high speed scanners to scan large volumes of voted ballots, which are recorded onto a **Verity vDrive** for transportation to **Verity Count** for accumulation and tallying.
- **Verity Central** was tested first as an individual component in order to verify that all declared functionality is present and working as documented. All functional features were tested and verified to be correctly documented.
- **Verity Central** was tested as an integrated piece of the voting system where it inputs media and data produced in **Verity Build**, then accepts user marked ballots as well as **Verity Print**, **Verity Touch Writer** ballots, prior to producing all defined output medias.



5.5.2.5 Verity Count

- **Verity Count** is the **Verity** application used for accumulation and tallying of voted ballots, transported via **Verity vDrive**, from **Verity Scan** and **Verity Central**.
- **Verity Count** was tested first as an individual component in order to verify that all declared functionality is present and working as documented. All functional features were tested and verified to be correctly documented.
- **Verity Count** was also tested as an integrated piece of the voting system where it inputs media and data produced in **Verity Build**, then accepts **Verity vDrive** data from **Verity Scan** and **Verity Central**, prior to tabulating results and producing all defined output reports.

5.5.2.6 Verity Election Management

- **Verity Election Management** is the **Verity** application used for importing, exporting, archiving and restoring elections into and from **Verity Build, Central and Count**.
- **Verity Election Management** was also tested as an integrated piece of the larger voting applications where it resides (**Verity Build, Central and Count**), verifying that it performed the appropriate functions for the parent application.

5.5.3 Test Suites Utilized

The following test suites were executed:

5.5.3.1 Verity Count test suite

All functionality present in **Verity Count** was verified to work as documented, and all functionality is appropriately documented.

This test covered **Verity Count** and focused on all functionality within the application, including the straight party modification in a general election.

This test was completed without issue, and each device and application passed the tests in this suite.

5.5.3.2 Verity Central test suite

All functionality present in **Verity Central** was verified to work as documented, and all functionality is appropriately documented.

This test covered **Verity Central** and focused on all functionality within the application, including the straight party modification in a general election..

This test was completed without issue, and each device and application passed the tests in this suite.



5.5.3.3 Verity Scan with optional modem test suite

All functionality, including administrative, and maintenance options, present in **Verity Scan with optional modem**, including the straight party modification in a general election, was verified to work as documented, and all functionality is appropriately documented.

This test was completed without issue, and each device and application passed the tests in this suite.

5.5.3.4 General Election test suite

The focus of this suite was validating N of M voting, Partisan offices, Non-Partisan Offices, Ballot Rotations, Write-Ins, Ballot Formatting, precincts and split precincts, Tally and Reporting functionality, as well as including the straight party modification in a general election.

This test covered **Verity Election Management, Verity Data, Verity Build, Verity Print, Touch Writer, Verity Scan with optional modem, Verity Relay, Verity Central** as well as **Verity Count**. Vote counts were accumulated from both **Verity Central** and **Verity Scan** into **Verity Count**.

This test was completed without issue, and each device and application passed the tests in this suite.

5.5.3.5 Open Primary test suite

The focus of this suite was an election designed to conform to an Open Primary election with focus on validating primary presidential delegation nominations, N of M voting, Partisan offices, Non-Partisan Offices, Ballot Formatting, precincts and split precincts, as well as Tally and Reporting functionality.

This test covered **Verity Election Management, Verity Data, Verity Build, Verity Scan, Verity Central** as well as **Verity Count**. Vote counts were accumulated from both **Verity Central** and **Verity Scan** into **Verity Count**.

This test was completed without issue, and each device and application passed the tests in this suite.

5.5.3.6 Closed Primary test suite

The focus of this suite was an election designed to conform to a Closed Primary election with N of M voting, Partisan offices, Non-Partisan Offices, Ballot Formatting, precincts and split precincts, Tally and Reporting functionality.

This test covered **Verity Election Management, Verity Data, Verity Build, Verity Print, Verity Scan, Verity Central** as well as **Verity Count**. Vote counts were accumulated from **Verity Scan** into **Verity Count**.

This test was completed without issue, and each device and application passed the tests in this suite.



5.5.3.7 Error Messaging and Recovery test suite

Testing in this suite focused on Error Messaging and Recovery in key areas of the system modified within this release. **Verity Scan, Verity Central** and **Verity Count** were focused on in order to validate that the recoveries were completed correctly, that the system and election audit logs recorded the recovery activities correctly, and that any downstream process were not negatively affected by errors.

This test covered **Verity Scan, Verity Central** as well as **Verity Count**.

This test was completed without issue, and each device and application passed the tests in this suite.

5.5.3.8 Audit test suite

Audit records are used to track what system functions were executed, what data was modified, as well as by whom and when. Election audit trails provide the supporting documentation for verifying the accuracy of reported election results. They present a concrete, archival record of all system activity related to the vote tally, and are essential for public confidence in the accuracy of the tally, for recounts, and for evidence in the event of criminal or civil litigation. Additionally, audit record data content can be a key factor in identifying system anomalies and provide assistance in troubleshooting system errors.

Testing in this suite focused on audit logging on **Verity Scan, Verity Central** and **Verity Count**, in order to validate that the audit logging was adequate.

This test covered **Verity Scan, Verity Central** as well as **Verity Count**.

This test was completed without issue, and each device and application passed the tests in this suite.

5.6 Evaluation of Testing

The above tests were successfully conducted using the executables created in the final Trusted Build, in association with the appropriate hardware versions as declared in this Test Report for the **Hart Verity Voting 2.2.1** voting system.

No issues were found during functional testing. This resulted in only 1 Trusted Build being required.

5.7 Quality Assurance and Configuration Management Audits

The review processes employed verified that the manufacturer not only has written processes and procedures in both the Quality Assurance and Configuration Management arenas, but that those processes and procedures were actually implemented within the software development life cycle that is used to produce the **Hart Verity Voting 2.2.1** version that is submitted for certification.

Coverage of tests employed by **Hart** was deemed satisfactory for meeting the requirements of the VVSG 1.0, as well Hart internal requirements for state specific feature implementations.



The CM portion of the review focused on the organization's understanding and implementation of the declared configuration management processes, procedures and policies. Deliverables were reviewed against all pertinent CM processes employed by **Hart**.

Implementation of the **Hart** configuration processes was adequately documented and followed throughout the course of the **Verity Voting 2.2.1** project, and no issues were encountered.

5.8 Deficiencies Found During Testing

Discrepancies found fall into 4 major categories, Hardware, Documentation, Source Code, and Functional. Hardware discrepancies are issues that occur specifically in the hardware arena, and are usually found during the hardware testing phase. Documentation discrepancies are issues that occur during the PCA documentation (TDP) review phase and are issues that are resolved by updates to the documentation. Source Code discrepancies are issues that occur during source code review and are issues that must be fixed in the source code prior to the Trusted Build. Functional discrepancies are issues that occur during functional testing and can be related to any software or firmware within the system. Functional discrepancies often lead to source code modifications, additional source code review and an additional Trusted Build.

5.8.1 Documentation Discrepancies and Informationals

Discrepancy issues included:

- System change notes did not encompass documentation changes (#1,2)
- Outdated information included (#3)

5.8.2 Source Code Discrepancies

No source code discrepancies were written during this campaign

5.8.3 Hardware Discrepancies

No hardware discrepancies were written during this campaign.

5.8.4 Functional Discrepancies

No functional discrepancies were encountered during this campaign.

5.8.5 Hardware Anomalies

Hardware Anomalies

No hardware anomalies were written during this campaign.

5.8.6 Functional Anomalies

No functional anomalies were encountered during this campaign.



5.9 Deficiencies Resolution

SLI has determined that there are no remaining unresolved deficiencies against the requirements tested.

6 Recommendations

SLI has successfully completed the testing of the **Hart Verity Voting 2.2.1** voting system. It has been determined that the **Verity Voting 2.2.1** voting system meets the required acceptance criteria of the Election Assistance Commission Voluntary Voting System Guidelines 1.0 (2005).

It is SLI's recommendation that the EAC grant certification of **Hart Verity Voting 2.2.1** voting system. This recommendation reflects the opinion of SLI Compliance based on the testing scope and results.

SLI:

A handwritten signature in blue ink, appearing to read 'Traci Mapps'.

Traci Mapps
VSTL Director/Director of Operations
March 6th, 2017

7 EAC Certification & Voting System Configuration

This report has been submitted to the Election Assistance Commission on February 23rd, 2017. Upon acceptance of this report by the EAC technical committee, a certification number will be issued for this modification.

This certification is for the **Hart Verity Voting 2.2.1** voting system, configured as detailed in section 3 of this document.

End of Certification Test Report
