

Test Report

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Verity Voting 1.0 for State of Colorado

Phase I

Test Report Release 1.0

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Prepared for:

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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
1.0	M. Santos	Initial Revision

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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.



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1 Introduction

SLI Global Solutions is submitting this report as a summary of the testing efforts for the Hart Verity Voting State of Colorado Phase I testing. The purpose of this document is to provide an overview of the testing effort and the resultant findings for the Hart Verity Voting State of Colorado Phase I testing. The review and testing was performed at SLI's Denver, Colorado facility.

SLI is a full service third party testing facility, founded in May 1996, from a software test-consulting firm. The specific system testing services offered include:

- Test Planning and Test Management
- eBusiness, Client-Server and Stand-alone Application Functional, Compatibility and Regression Testing
- eBusiness and Client-Server Load and Performance Testing
- Automated Regression Test Development, Consulting, Scripting and Execution
- Complex, Integrated Test Solutions and Automated Test Harnesses
- Independent Verification and Validation
- EAC approved and NIST NVLAP accredited Voting System Test Laboratory

1.1 References

1. SLI Quality System Manual, Revision v1.15, prepared by SLI, dated June 18th, 2013



1.2 Document Overview

This document contains:

- The Introduction which discusses the applications tested/reviewed
- The Test Background which discusses the testing process
- The System Identification which identifies hardware and software for the Hart Verity Voting configuration
- The System Overview which discusses the functionality of Hart Verity Voting configuration software
- The Testing Performed section which is a summary of the testing effort
- The Test Results summary section which contains the final analysis of the testing effort

2 Test Background

2.1 FCA - Functional & System Testing

SLI's standard test suites were customized for the Hart Verity Voting State of Colorado Phase I configuration. Simulations of elections were conducted to demonstrate an integrated business use case process for the Hart Verity Voting configuration.

2.2 Terms and Abbreviations

The following terms and abbreviations will be used throughout this document:

Table 1 – Terms and Abbreviations

Term	Abbreviation	Description
Ballot Marking Device	BMD	An accessible computer-based voting system that produces a marked ballot (usually paper) that is the result of voter interaction with visual or audio prompts.
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.



Term	Abbreviation	Description
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 CompactFlash
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 Management System	EMS	Typically a database management system used to collect 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 layout the ballots, download the election data to the voting devices, upload the results and produce the final results reports.
Independent Test Authority	ITA	This is a test lab that is not connected with the vendor or manufacturer of the voting system.
Chevron	No Abbreviation	Verity components use workflow chevrons. Workflow chevrons, arranged along the top of the screen, identify the function the user is currently viewing.
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.
Precinct Count Scanner	PCS	A precinct-count 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.



Term	Abbreviation	Description
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.
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)

3 System Identification

The Hart Verity Voting State of Colorado Phase I testing was submitted for testing with the hardware and software listed below. No other Hart Verity product was scheduled for review in this test effort.

3.1 Software

The software employed by Hart Verity Voting State of Colorado Phase I testing consists of, Verity Voting Touch Writer, Verity Voting Scan, verity Voting Central and Verity Voting Count and were verification of meeting the pertinent standards.

Table 2 below details each application employed by the Hart Verity Voting State of Colorado Phase I testing

Table 2 – Hart Verity Voting 1.0 Software and Firmware

Manufacturer	Application(s)	Version
Verity Build	EMS software	1.0.3
Verity Central	High speed digital scanner software	1.0.3
Verity Count	Central count location accumulation and tallying software	1.0.3
Verity Scan	Digital scanner firmware	1.0.3
Verity Touch Writer	BMD firmware	1.0.3
Verity Device Microcontroller	Firmware for Verity Devices	V17



Table 3 below details the Commercial Off The Shelf software and firmware utilized within the **Verity Voting 1.0** system.

Table 3 – COTS Software/Firmware

Manufacturer	Application	Version	Verity Voting 1.0 Component
Microsoft	Windows 7 Embedded	Standard	Scan, Touch Writer
Microsoft	Windows 7, Service Pack 1	6.1.7601	Build, Central, Count
Microsoft	SQL Server	6.1	Build, Central, Count
Adobe	Acrobat	10.0	Build, Central, Count

3.2 Equipment

The following equipment was required for the execution of the hardware, software and security tests. This includes system hardware, general purpose data processing and communications equipment, and any test instrumentation required.

3.2.1 Hart Verity Voting 1.0 Equipment

The following **Hart Verity Voting 1.0** equipment will be used in testing:

Table 4 – Hart Verity Voting 1.0 Custom Equipment

Hardware	Model
Verity Scan (digital scanner)	Revision B
Verity Touch Writer (BMD)	Revision B

3.2.2 COTS Equipment

The following Commercial Off-the-Shelf equipment was used in testing:

- Desktops
- Printers
- High Speed Scanner



Table 5 – COTS Equipment

Manufacturer	Hardware	Model
Various (for Verity Build, Verity Central and Verity Count)	Intel-Windows Workstation (Minimum Requirements) Processor – Intel Celeron D 420 3.06GHz Dual Core Memory – 2GB upgradable to 4GB Hard Drive – 120 GB Removable Storage – 8xDVD+/-RW Slim line USB Ports – 4 ports Video Card - Integrated Graphics Keyboard - USB Keyboard Mouse - USB Mouse	
Various (for 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 60 Hz Contrast Ratio - 1000: 1 Brightness - 250 cd/m2 (typical)	
Canon (for Verity Central)	Ballot Scanner	DR-G1130
OKIDATA (for Verity Central, Verity Touch Writer and Verity Count)	Ballot Printer	431
OKIDATA (for Verity Build)	Ballot Printer	831

3.3 Materials

Items identified in table 4 below reflect materials required to perform software and integrated system testing.

Table 4 –Test Materials

The following test materials were required for the performance of testing including, as applicable, test ballot layout and generation materials, test ballot sheets, test ballot cards and control cards, standard and optional output data report formats, and any other materials used in testing.

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



4 System Overview

4.1 Analysis of the Hart Verity Voting 1.0

An evaluation was performed on the interaction of the existing Hart Verity Voting 1.0 voting system and the requirements prescribed by the State of Colorado, for certification of use within the state.

Based off review of the Colorado Requirements Matrix, which consists of requirements from the 2002 Voting System Standards (VSS) as well as Colorado specific requirements, a list of requirements not verified during the Verity Voting 1.0 federal EAC certification testing, was compiled, as per the “Hart Verity 1 0 Colorado Phase I Test Plan v1.1”. A listing of the requirements can be found in “Appendix A – Requirements Verified”.

5 Testing Performed

5.1 Test Suites Executed

The configuration employed within the Hart Verity Voting State of Colorado Phase I testing test suites included a Verity Build/Count server, Verity Central server, Verity Scan device and Verity Touch Writer device.

The following Test Suites were created for this project:

- Test Suite 1 – Covered the following requirements:
 - 2002 VSS req 2.2.8.2.o
 - Colorado Req. 1-5-404
 - Colorado Req. 1-5-406
 - Colorado Req. 1-5-407(2)
 - Colorado Req. 1-5-407(4.5)
 - Colorado Req. 4.8.2
 - Colorado Req. 1-5-615(1)(e)(III)
 - Colorado Req. 1-5-704(1)(n)(VIII)
 - Colorado Req. 1-8-308(3)(b)
 - Colorado Req. 1-8.5-110(2)
 - Colorado Req. 21.5.2(f)(5)
 - Colorado Req. 21.5.2(f)(6)
 - Colorado Req. 21.5.2(f)(7)
 - Colorado Req. 21.4.5(e)
 - Colorado Req. 21.4.5(e)(3)



The test verified the ordering of candidates on the ballots for partisan and non-partisan contests. Physical and electronic ballots were verified that voters are provided with clear and distinct marking positions for each valid choice.

For contests that have no candidates, either nominated nor write-in option, that the applicable message of “There are no candidates for this office” can be displayed. This was verified on both physical and electronic ballots.

The testing also verified that Touch Writer does not allow a contest to be over voted, as it will allow only the number of choices designated to be marked programmatically. Note that with programmatic restriction enforced by Touch Writer, no audio is present to warn the voter of consequences of over voting a contest, as that situation is not possible.

Testing incorporated verification of reporting results in situations such as when the total number of votes cast and counted in any precinct by early voters' and absentee ballot is less than ten, that then the returns for all such precincts in the political subdivision can be reported together. Also, that when more than 25 provisional ballots are totaled that they can be included in a separate total, or when less than 25 total can be included with mail-in ballot totals.

Testing verified that a recall question can be included that contains 200 words for the demand for recall, as well as 300 words for justification of course of conduct by the recalled officer. The recall can also contain successor candidate names, as well as space for a write-in candidate option. This was verified on both physical and electronic ballots.

Testing verified that 20 “yes/no” contests can be included in a given ballot style.

Testing also verified that voting location devices have the capability to print reports with all Colorado prescribed information. One exception was noted here, please see “Section 6.1 – Functional Testing Summary”.

- Test Suite 2 – Covered the following requirements:
 - 2002 VSS req 2.2.7.1.c-f
 - 2002 VSS req 2.2.7.2.e.2&3
 - 2002 VSS req 2.4.3.3.a-h
 - 2002 VSS req 2.2.8.2.o
 - Colorado req 21.5.2(e)(2)
 - Colorado req 21.5.2(e)(4)
 - Colorado req 1-5-404
 - Colorado req 1-5-406
 - Colorado req 1-8.5-110(2)

Testing verified that positioning of the Touch Writer ballot marking device (BMD) is in line with accessibility requirements, including interactions related to casting votes



and ballots. The Touch Writer BMD also permits the voter to adjust color settings, as applicable, and adjust the size of text as prescribed.

Testing verified that the Touch Writer BMD prohibits voter access to any unauthorized information or functionality.

Testing verified that requirements for ballot layout and order of candidates in various election types are performed as expected.

Testing also verified that the prescribed types of reporting are implemented.

- Test Suite 3 – Covered the following requirements:
 - Colorado Req. 21.5.2(d)

This test incorporated 119 ballots, utilizing Hart specified paper as well as common printer paper for the ballots.

Marks included fully filled boxes, left and right oriented slashes, “X” markings, check marks, horizontal single line marks, and circles of various sizes. Marks also included vertical lines within the marking position that fill approximately five percent of the designated space.

The Verity specifications specify that only blue or black ink is to be utilized in the marking of ballot positions. These ink colors had no issues. Additional inks were also tested, as well as #2 pencil lead.

The colors purple, green and the pencil lead were read on both Verity Scan and Verity Central. The ink color red was tested and was able to be read on Verity Central, but were not detected on Verity Scan. The results on Verity Scan were not unexpected as the scanner employs a LED light source. As Verity Scan is a polling place device, the governance of marking utensils should be able to prevent issues with these ink colors. This test covered Verity Scan, Verity Central as well as Verity Count. Vote counts were accumulated from both Verity Central and Verity Scan into Verity Count.

6 Test Results Summary

6.1 Functional Testing Summary

SLI executed the three test suites as identified in Section 5.1. The testing incorporated three different election scenarios testing the functionality supported by the Hart Verity Voting 1.0 voting system.

All requirements were tested, with all meeting the requirements expectations, with the exception of requirement 21.4.5(e)(3)(L). This requirement states:



*Ability to print a report which must contain:
An election judge's certificate with an area for judges' signatures with the words
similar to: "Certified by us", and "Election Judges". Space must allow for a minimum of
two signatures.*

The issue here is that the Verity Voting 1.0 implementation displays, "Official Signatures", which is incorporated as a static field within the code base of the voting system. A code change would be required in order to modify that label, to "Certified by us" and "Election Judges". The portion of the requirement for allowing space for a minimum of two signatures is met by the system.

6.2 Deficiencies

SLI has determined that the only deficiencies in the Hart Verity Voting 1.0 voting system as per the State of Colorado Phase I testing requirement, is that related to requirement 21.4.5(e)(3)(L), as discussed above, in section 6.1.



7 Appendix A - Requirements Verified

2002 VSS	Requirement	Rules and Statutes	Colorado Additional Requirements
2.2.7.1	Common Standards		
c.	The position of any operable control is determined with respect to a vertical plane that is 48 inches in length, centered on the operable control, and at the maximum protrusion of the product within the 48-inch length.	21.4.2	All voting systems must meet the 2002 Voting System Standards.
d.	Where any operable control is 10 inches or less behind the reference plane, have a height that is between 15 inches and 54 inches above the floor.	21.4.2	All voting systems must meet the 2002 Voting System Standards.
e.	Where any operable control is more than 10 inches and not more than 24 inches behind the reference plane, have a height between 15 inches and 46 inches above the floor.	21.4.2	All voting systems must meet the 2002 Voting System Standards.
f.	Have operable controls that are not more than 24 inches behind the reference plane.	21.4.2	All voting systems must meet the 2002 Voting System Standards.
2.2.7.2	DRE Standards		
e. 2)	Adjust the color settings, when color is used.	21.4.2	All voting systems must meet the 2002 Voting System Standards.
e. 3)	Adjust the size of the text so that the height of capital letters varies over a range of 3 to 6.3 millimeters.	21.4.2	All voting systems must meet the 2002 Voting System Standards.
2.2.8.2	Voting Variation		
o.	Provisional or challenged ballots.	21.4.2	All voting systems must meet the 2002 Voting System Standards.
2.4.3.3	DRE Systems Standards		



a.	Prohibit the voter from accessing or viewing any information on the display screen that has not been authorized by election officials and preprogrammed into the voting system (i.e., no potential for display of external information or linking to other information sources).	21.4.2	All voting systems must meet the 2002 Voting System Standards.
b.	Enable the voter to easily identify the selection button or switch, or the active area of the ballot display that is associated with each candidate or ballot measure response.	21.4.2	All voting systems must meet the 2002 Voting System Standards.
c.	Allow the voter to select his or her preferences on the ballot in any legal number and combination.	21.4.2	All voting systems must meet the 2002 Voting System Standards.
d.	Indicate that a selection has been made or canceled.	21.4.2	All voting systems must meet the 2002 Voting System Standards.
e.	Indicate to the voter when no selection, or an insufficient number of selections, has been made in a contest.	21.4.2	All voting systems must meet the 2002 Voting System Standards.
f.	Prevent the voter from overvoting.	21.4.2	All voting systems must meet the 2002 Voting System Standards.
g.	Notify the voter when the selection of candidates and measures is completed.	21.4.2	All voting systems must meet the 2002 Voting System Standards.
h.	Allow the voter, before the ballot is cast, to review his or her choices and, if the voter desires, to delete or change his or her choices before the ballot is cast.	21.4.2	All voting systems must meet the 2002 Voting System Standards.
		1-5-404 1-5-406	Requirements for the order of candidate names with contests for both partisan (1-5-404) and nonpartisan (1-5-406) elections
		1-5-407(2)	The ballots shall be printed so as to give to each eligible elector a clear opportunity to designate his or her choice of candidates, joint candidates, ballot issues, and ballot questions by a mark as instructed. On the ballot may be printed words that will aid the elector, such as "vote for not more than one".
		1-5-407(4.5)	If no candidate has been duly nominated and no person has properly filed an affidavit of intent of write-in candidate for an office, the following text shall appear under the designation of the office: "There are no candidates for this office."



	Provide the voter with the opportunity to correct the ballot before the ballot is cast and counted.	21.4.2; 1-5-615(1)(e)(II)	All voting systems must meet the 2002 Voting System Standards. No electronic or electromechanical voting system shall be certified by the Secretary of State unless such system: If the elector overvotes it gives the elector the opportunity to correct the ballot before the ballot is cast.
		1-5-704(1)(n)(VIII)	The voting system shall warn the elector of the consequences of overvoting for an office.
		1-8-308(3)(b)	If the total number of votes cast and counted in any precinct by early voters' and absentee ballot is less than ten, the returns for all such precincts in the political subdivision shall be reported together.
		1-8.5-110(2)	Voting systems shall provide a means for reporting the results of provisional ballots as a separate total when more than 25 or inclusion with mail in ballots when less than 25.
		4.8.2	If there is no candidate for an office, the ballot must state, "There are no candidates for this office."
		21.5.2(d)	For mark-sense or optical scan devices, the Secretary of State or the VSTL will prepare 100 or more test ballots with marking devices of various color, weight and consistency to determine the range of marks that can be read and the range and consistency of reading marginal marks.
		21.5.2(e)(2)	Polling location / DRE = 500;
		21.5.2(e)(4)	Provisional = 500.
		21.5.2(f)(5)	Allow for programming to accommodate Colorado recall questions as prescribed in Article 12 of Title 1, C.R.S.;
		21.5.2(f)(6)	A minimum of 20 pairs of "yes" and "no" positions for voting on ballot issues; and
		21.5.2(f)(7)	Ability to contain a ballot question or issue of at least 200 words.



		21.4.5(e)(3)	Ability to print a report which must contain: (A) Names of the offices; (B) Names of the candidates and party, when applicable; (C) A tabulation of votes from ballots of different political parties at the same voting location in a primary election; (D) Ballot titles; (E) Submission clauses of all initiated, referred or other ballot issues or questions; (F) The number of votes counted for or against each candidate or ballot issue; (G) Date of election (day, month and year); (H) Precinct number (ten digit format); (I) County or jurisdiction name; (J) "State of Colorado"; (K) Count of votes for each contest; and (L) An election judge's certificate with an area for judges' signatures with the words similar to: "Certified by us", and "Election Judges". Space must allow for a minimum of two signatures.
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End of Test Report
