

Voting System Examination of Hart InterCivic Verity Voting 2.5

Brian Mechler, Technical Examiner

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1 Background

An examination of the Hart InterCivic Verity Voting 2.5 was conducted at the Hart InterCivic offices in Austin, TX on January 4-8, 2021. Due to the COVID-19 pandemic, the certification exam was spread over five days with limited in-person attendance. When examiners were not physically attending the exam, they were observing and participating remotely via video conference.

Verity Voting 2.5 is a comprehensive voting system which can consist of a subset of the following components [1]:

- Verity Data - Data management software application
- Verity Build - Election definition software application
- Verity Count - Tabulation and reporting software application
- Verity Central - Central scanning software application
- Verity User Management - User management software application
- Verity Election Management - Election management software application
- Verity Desktop - Application for authorized users to manage a very limited set of operating system functions
- Verity Scan - Digital scanning voting device
- Verity Touch Writer with Access - Ballot marking device (BMD), with audio tactile interface (ATI) and external commercial off-the-shelf (COTS) ballot printer
- Verity Controller – Polling place management device for Verity Touch or Touch Writer Duo
- Verity Touch - Direct Recording Electronic (DRE) device
- Verity Touch with Access – Accessible DRE device with an ATI
- Verity Touch Writer Duo – a BMD with internal printed vote record (PVR) printer and optional ATI
- Verity Touch Writer Duo Standalone – a version of the Touch Writer Duo that does not require connection to a Controller

Configuration options are presented in [2].

Through a secure chain of custody, the Texas Secretary of State Elections Division obtained the software and drive images used in the Election Assistance Commission (EAC) certification. Hart personnel used those same files to perform installation under the supervision of the technical examiners. In [3], Hart provides instructions for the identification and verification of the certified products included in Verity Voting 2.5.

The EAC certification includes tables that describe the voting system software components, voting system platforms, hardware components, and system limits [4].

I did not observe the accessibility portion of the exam. ADA compliance will be presented in the legal examiners' reports. A detailed description of the Texas Secretary of State examination including my observations, concerns, and recommendations is presented in the sections that follow.

2 Verity Workstations

Verity workstations run the Data, Build, Central, Count, User Management, Election Management, and Desktop applications. The workstations are COTS HP Z4 G4 Workstation PCs. The HP Z230 and Z240 Workstations are still supported, but only for existing customers. The workstations run Windows 10 Enterprise 2019 LTSC as their OS.

Workstations are delivered pre-imaged with the OS, necessary drivers, and Verity software components appropriate for the particular configuration. Hard drives are physically secured with key locks. The Verity System Administrator's Guide [3] provides best practices for placement of other physical security measures, such as tamper evident seals, on Verity workstations.

Workstations can be stand-alone or setup in a client-server configuration. Workstations are only intended to operate within their own local network (i.e. air-gapped from public and other private networks). The network traffic is encrypted and digitally signed. All wireless capabilities are disabled.

Workstations will only boot up into the Verity desktop environment. Users are not able to access the Windows desktop without intervention from Hart's technical support team. As an additional security measure, only trusted applications are permitted to run on Verity workstations.

General Workstation changes from Verity Voting 2.4 to 2.5 include [5]

- "Windows Embedded Standard 7 OS is replaced with Windows 10 Enterprise 2019 LTSC"
- "Support for Haitian Creole language"
- "Security enhancement: vDrive file and folder names and paths are added to the signed and validated content"
- "SQL Server 2012 is replaced with SQL Server 2017"
- "TPM 2.0 support implemented on Z240 and Z4 G4 workstations"

2.1 Observations

The configuration demonstrated at the exam had one workstation running Data, Build, and Count and another stand-alone workstation running Central. Client-server configurations were not demonstrated.

There were no major concerns with the Verity workstation hardware or configuration. Installation and configuration is always performed by Hart; thus, there is no added burden or opportunity for misconfiguration by the jurisdictions. The COTS components performed adequately during the observed tasks.

The audit logs were detailed; events are tied to both the user and device. Examiners were granted access to the Windows OS and attempted to modify logs, but upon booting back into the Verity environment, a warning regarding log corruption was provided. The corrupted logs files were sequestered and the corruption was noted in a new log file entry preventing malicious users from covering their tracks. Logs can be exported in multiple human-readable formats. They can also be viewed from within Verity. As an added feature, it would be nice to sort or filter log entries from within the Verity UI.

The hash validation process is user-friendly.

Restricting access to the Windows OS and enforcing a strict applications whitelist are good security measures. It is recommended that administrators follow the best practices provided by Hart to ensure the security of the workstations.

3 Verity Data

According to [4], “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 is ready for use in Verity Build.”

Changes to Verity Data between 2.4 and 2.5 include [5]:

- “A Party Selector Contest may now be added in an Open Primary election”
- “Keyboard shortcut keys added for usability and convenience”
- “New report, Translation Proofing Report, added to Verity Data and Verity Build.”

3.1 Observations

Use of Verity Data was not directly observed as the data, layout, and audio for the mock election were created prior to the start of the exam. However, no problems were observed during the export to Verity Build or during the mock election.

4 Verity Build

Verity Build is the application where election definitions, election media (known as vDrives), and two-factor authentication dongles (known as Verity Keys) are created. Users can also proof data, view reports, print ballots, and configure settings for Verity voting devices.

vDrives are special purpose USB thumbdrives used to deliver election definitions to voting devices. A unique identifier is written to the vDrive by the voting machine upon the first use of the vDrive in that machine for a particular election.

Verity Keys are USB dongles that provide two-factor authentication for special functions which require extra security. They are used in voting machines to pre-define polling place information, and in Verity Central and Verity Count to import a signed election export from Verity Build. Keys can be configured with different passwords for administrative access, device access, and applications access.

vDrives and Verity Keys must be purchased from Hart; use of other COTS USB devices for the above purposes has not received EAC certification.

Changes to Verity Build between 2.4 and 2.5 include [5]:

- “New option to require voters to view all contests on the ballot before finishing their voting session”
- “New option for automatic duplicate vDrive creation in Verity Scan”
- “Print Queue import now allows write-in text to be defined for each write-in available on the ballot”
- “New report, Translation Proofing Report, added to Verity Data and Verity Build.”

4.1 Observations

Technical examiners observed the import of a signed election export from Verity Build as well as the creation of vDrives and Verity Keys. No issues were observed with the use of the Build application, vDrives, or Verity Keys.

5 Verity Central

Verity Central is a digital ballot scanning system intended for high volume processing of ballots. In Verity 2.5, Central is now capable of scanning paper ballots and printed vote records (PVRs), but only within their own batches. Verity Central utilizes COTS scanning hardware in addition to Hart’s ballot processing software.

Additional changes to Verity Central between 2.4 and 2.5 include [6]:

- “Optimized the archive performance by switching USB device to ‘Better Performance’ during archiving, then back to ‘Quick Removal’ after the archive is complete”

5.1 Observations

Examiners observed the use of Verity Central to scan batches of ballots and PVRs during the mock election. No issues were found with respect to accuracy, speed, paper jams, or interpretation of ballot marks. The quality of the scanned images was good and suitable for the adjudication of ballots.

6 Verity Count

According to [4], “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.”

In Verity 2.4 there was a defect where the application would not save updates to names in the Write-in Candidate UI if the change only affected the alphabet case (i.e. upper- vs lower-case). This has been corrected in Verity 2.5 [5].

6.1 Observations

During the mock election, examiners observed the tabulation of votes from vDrives and the generation of reports. No issues were observed.

7 Verity User Management

Verity User Management is a tool administrators can use to manage user accounts and assign specific roles to users along with the associated permissions. User Management provides a default set of user roles, but administrators are able to create customized roles for users.

7.1 Observations

Use of User Management was not directly observed during this exam. It is strongly recommended that users only be granted the narrow set of roles and permissions necessary to perform their given tasks.

8 Verity Election Management

Per [4], “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.”

8.1 Observations

Though the Election Management application is used throughout the election process, it’s full set of features was not demonstrated during the examination and mock election. Nevertheless, no issues with this application were observed.

9 Verity Devices

Verity Devices include a custom touch screen tablet docked in a base. The tablet, base, and associated cables can be folded into a rugged carrying case. Depending on the configuration, Verity Devices are standalone, paired with a COTS printer, or daisy-chained together to a Verity Controller. Bases and tablets are not interchangeable; i.e. a base configured for Verity Touch must always use a tablet configured for Verity Touch. Unique configuration details will be discussed in the sections that follow.

The device software is loaded with a CFast card. Logs and, if applicable, cast vote records (CVRs) are stored redundantly on the CFast cards and vDrives. All files are digitally signed. A software daemon ensures that the records are kept in sync. Should the two storage devices get out of sync, the vDrive is considered the official record.

Similar to Verity Workstations, Verity Devices enforce a strict applications whitelist. USB ports for vDrives and other peripherals are secured underneath locked covers. The CFast slot is also sealed underneath a locked cover which includes a hasp for additional tamper prevention during long term storage. USB cables used to connect the daisy-chain are keyed and custom wired to prevent malicious access to those ports which are not physically secured. Data that flows across the daisy-chain network is digitally signed as an additional security measure.

General changes related to Verity Devices between 2.4 and 2.5 include [5][6]:

- “A user may now create a recovery vDrive and export temporary logs (these are logs when a vDrive for the currently loaded election is not present) to a USB stick during a system alert”
- “Backup data may now be deleted”
- “SQL Server 2012 is replaced with SQLite 3.29”
- “Added battery state debouncing to prevent a reading of temporary zero value”

9.1 Verity Touch and Touch with Access

Verity Touch and Touch with Access are interoperable Direct Recording Electronic (DRE) devices. They are networked to other Verity Touch devices and the Verity Controller via a daisy-chain network. The Touch with Access includes an ATI which provides accessibility features. Voters are issued an access code from the Controller and use the touchscreen to mark and review their ballot which is then cast electronically.

9.2 Verity Touch Writer with Access

Verity Touch Writer with Access is a standalone Ballot Marking Device (BMD) that is paired with a COTS printer. Unlike the Verity Touch and Touch Writer Duo, the Touch Writer with Access is not daisy-chained with other devices or a Verity Controller. Instead, a poll worker must be in-the-loop to initiate each voting session for voters. The Touch Writer with Access is designed to act an accessibility device in a jurisdiction where voters would normally fill out paper ballots by hand at the polling place.

Voters use the touchscreen to mark and review their choices and subsequently print a marked ballot. The marked ballot is then taken to the Verity Scan device where it is scanned and deposited into a ballot

box (see Section 9.7 for more detail on Verity Scan). The Touch Writer with Access includes an ATI which provides accessibility features.

Changes to Verity Touch Writer with Access between 2.4 and 2.5 include [5]:

- “If only one precinct-split will appear on the Select Precinct screen, the system shall automatically select it and not present the Select Precinct screen”
- “If only one party will appear on the Select Party screen, the system shall automatically select it and not present the Select Party screen”
- “Device Tests menu function to send a test page to the thermal roll printer is renamed ‘Test report printer’”

9.3 Verity Touch Writer Duo

The Touch Writer Duo is a BMD with an integrated thermal printer that creates a printed vote record (PVR) that is both human- and machine-readable. It is configured for use in a daisy-chained network with Verity Controller similar to the Verity Touch. Voters are issued an access code from the Controller and use the touchscreen to mark and review their choices. They are instructed to insert as many pages of thermal paper as needed into the on-board printer. The printed output contains a summary of their choices. Voters then take the PVR to the Verity Scan where it is scanned and deposited into a ballot box. The Touch Writer Duo can include an ATI which provides accessibility features.

Changes to Verity Touch Writer Duo between 2.4 and 2.5 include [5]:

- “Device Tests menu function to send a test page to the full sheet thermal printer is renamed ‘Test vote record printer’”

9.4 Verity Touch Writer Duo Standalone

The Duo Standalone is a new voting device introduced in Verity 2.5. As the name implies, it is a standalone version of the Touch Writer Duo and does not require or interface with a Verity controller. A poll worker must be in-the-loop to initiate each voting session for voters. Otherwise, the interface presented to the voter is identical to that of the Touch Writer Duo.

9.5 Verity Duo Go

The Duo Go is not within the scope of the EAC certification; however, it was demonstrated during the exam and jurisdictions may find the device useful. The Duo Go is a carrier for use with Touch Writer Duo or Touch Writer Duo Standalone that enables curbside voting. The carrier includes a thermal printer for creating PVRs. The poll worker loads the Duo tablet and thermal paper into the Duo Go for the voter to use. This eliminates the need to transport the bulky base station out of the polling place for curbside voting.

9.6 Verity Controller

Verity Controller is used by the poll worker to create access codes for Verity Touch, Touch with Access, and Touch Writer Duo systems. Access codes are used by the voter to initiate their voting session. The Verity Controller can manage up to 12 devices connected via a daisy-chain network. The Verity Controller touchscreen gives the poll worker the current status of each device in the daisy-chain. The Verity Controller base also has an integrated on-board thermal printer for printing reports. The daisy-chain network can only be used to control one type of Verity device, i.e. only Verity Touch or Verity Touch Writer Duo.

Changes to Verity Controller between 2.4 and 2.5 include [5]:

- “Device Tests menu function to send a test page to the thermal roll printer is renamed ‘Test report printer’”

9.7 Verity Scan

Verity Scan is a digital scanning device used in the polling place in conjunction with an external ballot box. In Verity 2.5, Verity Scan can now be configured to accept both marked ballots (by hand or from the Touch Writer) and PVRs.

Other changes to Verity Scan between 2.4 and 2.5 include [5]:

- “Device Tests menu function to send a test page to the thermal roll printer is renamed ‘Test report printer’”
- “New option for an automatic duplicate vDrive when two vDrives are inserted. This option is set in Verity Build.”
- “Increase single sheet ballot limit per vDrive to 25,000 to support long early voting events. The Ballot Box limit is unchanged and must be emptied every 4000 sheets.”

9.8 Observations

Examiners were given the opportunity to interact with all of the above devices. The UI was consistent across all devices and easy to use.

The ballot box provided with Verity Scan provided sufficient security measures.

The Touch Writer with Access is slow to print and may reduce voter throughput if it is the only voting method available in the polling place.

The Touch Writer with Access and Touch Writer Duo Standalone require poll worker intervention to initiate sessions for voters which may place a burden on larger polling sites if they are the only methods available.

The Touch Writer Duo’s printed vote record still has potential readability issues; the font is small and the whitespace between the contests and the selected candidates’ names is too wide. Some voters may have a hard time reviewing their PVR. One might be tempted to draw lines on the PVR to connect the contest to the candidate. This action will likely spoil the ballot.

If an election requires a two-page PVR, voters may experience some confusion with the Touch Writer Duo since they have to insert and print each page one-at-a-time. In the event of such an election, poll workers would require extra training on procedures for spoiling a single page of a multi-page PVR.

For curbside voting with the Touch Writer with Access, the entire assembly would have to be brought out to the voter on a cart. This is different from the Touch DRE where only the tablet needs to be brought to the voter. Duo device tablets can be hand-carried within the Duo Go harness. Jurisdictions will need to establish procedures to streamline operation since the Duo Go will have to be unlocked and reloaded between each voting session. Two-page PVRs will complicate the process even further.

The exported audit logs were sufficiently detailed.

The hash export and validation process was user-friendly and no issues were observed. Verity software determines which files to verify and computes their hashes. This may be at odds with Voluntary Voting System Guidelines (VVSG) Version 1.0, Volume 1, Guideline 7.4.6(b)(i), "The process used to verify software should be possible to perform without using software installed on the voting system." The Secretary of State's office has reached out to the EAC and VSTL to better understand this guideline and the VSTL's procedure for validation of the vendor's solution. As of the report date, no response has been received. It is not within the scope of the Texas certification exam to recreate the work of the VSTL, and I'm not inclined to second-guess them absent any obvious or major deficiencies.

10 Conclusions

While some concerns arose during the examination, none were disqualifying. Overall, Verity Voting 2.5 is a comprehensive voting system that is secure, accurate, and user-friendly. Hart's responses to Voting System Certification Form 101 are truthful and adequate. The system tallied votes accurately during the mock election portion of the exam. Hart personnel provided clear and knowledgeable answers to the examiners' questions.

I recommend certification of Verity Voting 2.5.

11 References

- [1] Application for Texas Certification of Voting System – Form 100, Verity Voting 2.5
- [2] Hart InterCivic Verity Voting 2.5 Configurations, Required materials submitted with Voting System Certification Form 100
- [3] Verity System Administrator’s Guide, Version 2.5, Document Number 6641-043 A01
- [4] United States Election Assistance Commission Certificate of Conformance, Hart Verity Voting 2.5, EAC Certification Number HRT-VERITY-2.5, Sep-09 2020,
URL: <https://www.eac.gov/voting-equipment/hart-verity-voting-25>
- [5] Verity Voting 2.5 Change Notes, Revision A.01, Document Number 4005669
- [6] Verity Voting 2.5 Change Notes: Update from 2.5.0 to 2.5.1, Revision A.00, Document Number 4005680
- [7] United States Election Assistance Commission Voluntary Voting System Guidelines, Volume 1, Version 1.0, 2005,
URL: https://www.eac.gov/sites/default/files/eac_assets/1/28/VVSG.1.0_Volume_1.PDF