

Voting System Examination of Hart InterCivic Verity Voting 2.4

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1 Background

An examination of the Hart InterCivic Verity Voting 2.4 was conducted at the Hart InterCivic offices in Austin, TX on April 13-17, 2020. 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 2.4 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 ballot summary printer and optional ATI

Configuration options are presented in detail 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 2.4.

The EAC certification includes tables that describe in detail 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 PCs (either HP Z240 Workstation or HP Z230 Workstation) that run the 64-bit Windows Embedded Standard 7 OS with Service Pack 1 in kiosk mode.

Each workstation has two hard-drives in a RAID-1 configuration for fail-safe redundancy. The drives 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 whitelisted applications are permitted to run on Verity workstations.

General Workstation changes from Verity Voting 2.3 to 2.4 include [5]

- “Added feature for authorized Hart personnel to change the Certificate Set on devices and workstations. The feature will require a valid Certificate Key and Certificate Key password.”
- “Updated Whitelisting tool, McAfee Application Control for Devices (“Solidifier”), on OS images from version 6.1.1.369 to 8.2.1-143.”
- “Added support for printing a specific range of pages from most reports.”
- “The ‘Enter Access Code’ screen now displays the current date and time and Workstation ID.”

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. Installation was accomplished by extracting and duplicating the drive images sent by the EAC. Hashes of the drive images were checked against those provided by the voting system test laboratory used for the EAC certification.

There were no major concerns with the Verity workstation hardware or configuration. Installation was simple and the COTS components performed adequately during the observed tasks. The audit logs were detailed; events are tied to both the user and device. Logs can be exported in multiple human-readable formats. 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 2.3 and 2.4 include [6]:

- “All newly created polling places are now associated with all parties by default.”

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 digital scanners and Verity Touch Writer BMD 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 which 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 2.3 and 2.4 include [5]:

- “Extended the Device Reports Signature Text maximum length from 300 to 500 characters.”
- “Removed redundant Data Validation screen.”
- “Removed redundant Proof Audio screen.”
- Support added for COTS ballot printers OKI C844dn and OKI C931e “due to manufacturer obsolescence of the existing certified models”
- “New Tally Report Quantity Election Setting in Build for how many copies of the Tally report should automatically print when polls are closed, if the polling place is configured to allow printing of Tally reports.”

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. Central is only capable of scanning paper ballots; i.e. it cannot be used to process the printed vote records (PVRs) produced by Duo devices. Typically, jurisdictions would use Central to process vote-by-mail ballots. Verity Central utilizes COTS scanning hardware in addition to Hart’s ballot processing software.

Changes to Verity Central between 2.3 and 2.4 include [5]:

- “Added support for up to 8 networked clients per server in a high scale configuration”
 - “In this configuration the Server acts as a database Server only, with no access to the Central application. All Client workstations have access to the Central application and Desktop only.”
- Added support for Canon DRG-2110 and Canon DRG-2140 COTS central scanners “due to manufacturer obsolescence of the existing certified models”
- “Changed reporting engine for Scanned Batch Report for consistency. There is no user-facing change to the report.”

5.1 Observations

Examiners observed the use of Verity Central to scan a batch of ballots 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. Jurisdictions using Duo devices will need to reserve a Verity Scan device for central processing of provisional PVRs.

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.”

Changes to Verity Count between 2.3 and 2.4 include [5]:

- “Improved ‘Write-in Candidates’ screen.”
- “Redesigned ‘Write-in Assignment’ workflow”
- “Supports the following write-in assignment features:
 - Reject all write-ins for a contest
 - Revert all assigned or rejected write-ins in a contest”
- “Added a proofing report for Write-in assignments. This report lists each entered write-in for a specific contest, ordered by tabulation time. Each write-in includes the following:
 - The Write-in image snippet
 - The Write-in image ID
 - The Write-in status
 - If assigned to a Write-in Candidate, the Write-in Candidate name”
- “Count will now ask if the user wants to check for additional ballots on the vDrive when a duplicate vDrive is read. The user must enter administrator credentials to add those ballots to the vote totals if additional ballots are found.”
- “Performance improvements to Provisional ballot resolution.”
- “Changed reporting engine for Residual Votes Report for consistency. There is no user-facing change to the report.”

6.1 Observations

During the mock election, examiners observed the tabulation of votes from vDrives and the generation of reports. No major 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 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. CFast cards are never cleared; Hart estimates that CFast memory will fill up after 22 months of elections given typical election schedules.

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 daily-chain network is digitally signed as an additional security measure.

General changes related to Verity Devices between 2.3 and 2.4 include [5][6][7]:

- “Ballot unique identifiers are now shown in both base-36 (13 digit) and base-10 (19 digit).”
 - “Affects both standard paper ballots and Printed Vote Records”
 - “Previously only base-36 (13-digit) representation was shown.”
 - “The contents of the barcode have not changed. The barcode has always contained the unique identifier in base-10 (19 digit + 1 random checksum digit at the end).”
- “New ‘Ballots Issued Report’ on Touch Writer, Controller (when used with Duo), and Print that lists every unique ID issued from the device, with unique IDs reordered so the order cannot be reconstructed.”
- “Improved fast-speed audio playback.”
- “Ballots issued report for Print, Touch Writer, and Duo listing the unique IDs issued.”
- “Devices now display a ‘Canceling’ screen when the user requests that a report be canceled.”
- “Removed Help button when unnecessary within device menu screens, such as device tests screen, administrator menu screen.”
- “Included a new ‘Additional Functions’ menu on all devices at boot up, activated using the blue Validation button. Menu includes the following functions:
 - ‘Validate’, to produce device hash files
 - ‘Change Certificate Set’”
- “The device keyboard used on the Precinct selection screen now includes a hyphen (-) key. This screen is used on Controller, Touch Writer, and Print.”

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 9.5 for more detail on Verity Scan). The Touch Writer with Access includes an ATI which provides accessibility features.

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.

9.4 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.

9.5 Verity Scan

Per [4], “Verity Scan is a digital scanning device (tabulator) that is used in conjunction with an external ballot box. The unit is designed to scan marked paper ballots or Verity Touch Writer Duo printed vote records, interpret and record voter marks on the marked paper ballot or record voter selections on the printed vote records, and deposit into the secure ballot box.” Verity Scan can only be configured to accept marked ballots (by hand or from the Touch Writer) or PVRs from the Touch Writer Duo, but not both.

9.6 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.

Daisy chain cables are 15-ft long which should allow for social distancing at the polling booth if necessary. The touchscreen of all devices could be controlled using the tip of a cotton swab, pencil eraser, or any sufficiently stiff stylus-type implement. The touchscreen was also responsive to touch from a gloved hand.

The Touch Writer with Access is slow to print and activating sessions for voters requires too much poll worker intervention for it to be used as the only voting option in a polling place. If the Touch Writer’s COTS printer is disconnected prior to a voting session, the user will be stuck on the “activating voter”

screen. The only resolution involves poll worker intervention to press the poll worker button on the back of the base. This issue was also noted in my report on Verity Voting 2.3 [7]

The Touch Writer Duo in use at the exam had paper feed issues which resulted in spoiled ballots. This was due to the paper feed mechanism not sitting flush with the rest of the device. Figure 1 depicts the issue. Hart indicated this was a known issue, that existing customers had already received field service to resolve the problem, and that additional QC procedures have been put in place at the manufacturing facility to prevent further delivery of devices with this fault. Any jurisdictions that have or receive a Touch Writer Duo with this defect should contact Hart for an RMA.

The Touch Writer Duo's printed vote record 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. My report on Verity Voting 2.3 contains an image of such a spoiled ballot [7].

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 Duo or 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.

The updated scheme for generating unique identifiers printed on ballots and PVRs satisfies the Texas ballot numbering requirement. Data is stored and logged in a manner to protect the secrecy of the ballot.

In order to fully comply with the EAC Voluntary Voting System Guidelines (VVSG) Vol 1.0, Hart needs to ensure that their documentation recommends hash verification software that uses a FIPS 140-2 level 1 or higher validated cryptographic module [8].



Figure 1: Touch Writer Duo Paper Feed Mechanical Issue

10 Conclusions

While some concerns arose during the examination, none were disqualifying. For the next revision of Verity Voting, Hart should consider improving the readability of the Touch Writer Duo's PVR and fixing the Touch Writer's buggy behavior when the COTS printer is disconnected. Hart should also ensure that their hash verification documentation fully complies with the VVSG.

Overall, Verity Voting 2.4 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 2.4.

11 References

- [1] Application for Texas Certification of Voting System – Form 100, Verity Voting 2.4, Feb-26 2020
- [2] Hart InterCivic Verity Voting 2.4 Configurations, Required materials submitted with Voting System Certification Form 100
- [3] Verity System Administrator’s Guide, Version 2.4, Document Number 6641-035 A02
- [4] United States Election Assistance Commission Certificate of Conformance Hart Verity Voting 2.4, EAC Certification Number HRT-VERITY-2.4, Feb-21 2020,
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- [5] Verity Voting 2.4 Change Notes, Revision A.05, Document Number 4005653
- [6] Release Notes: Hart InterCivic Verity Voting 2.4, Doc # 6674-005 A
- [7] B. Mechler, “Voting System Examination of Hart InterCivic Verity Voting 2.3”, June-21 2019,
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