ClearVote 2.1

ClearVote System Overview

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Document history

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Preface

This document describes each ClearVote product and shows how they interact to provide a complete end-to-end election solution. In addition, it provides information about data flows, security and encryption, and other important program features.

Audience for this document

This document is intended for election officials and voting system test laboratory (VSTL) staff, as well as for informed citizens with an interest in election technology.

For more information

For more information about the ClearVote system, visit our website at clearballot.com, or contact us at info@clearballot.com.

Chapter 1. The ClearVote product family

The ClearVote system consists of four products that are certified as an integrated application, as well as an independent, automated election audit system.

Figure 1-1. The ClearVote product family

Table 1-1. ClearVote products by election phase

Election phase	Products
Pre-election	ClearDesign
Vote capture	ClearAccess, ClearCast, ClearCount
Postelection	ClearCast, ClearCount
Independent election audit	ClearAudit

Chapter 2. ClearVote: An end-to-end solution

Clear Ballot offers a flexible, cost-effective election technology solution that streamlines election management; accelerates adjudication and tabulation; and ensures timely, accurate, transparent reporting. Since 2009, Clear Ballot has pursued the answer to two questions:

- How can we apply modern technology to improve election administration in America?
- Can we harness technology to build trust in the results, especially in the closest of elections?

With these questions in mind, we built a team of technology experts and seasoned election industry professionals, and put them to work to build a solution. The result is the ClearVote suite of products.

The ClearVote system consists of five independent systems:

- ClearDesign—election management system (EMS)
- ClearAccess—in-person accessible-voting station
- ClearCast—in-person precinct-scan voting station
- ClearCount—central scan and tabulation, results consolidation and reporting system
- ClearAudit—independent, automated audit system

The diagram below shows the simple relationship between the independent products. The ClearVote products exchange data in fully documented, zipped, plain text comma-separated values (CSV) files. These files are digitally signed and encrypted for protection against tampering.

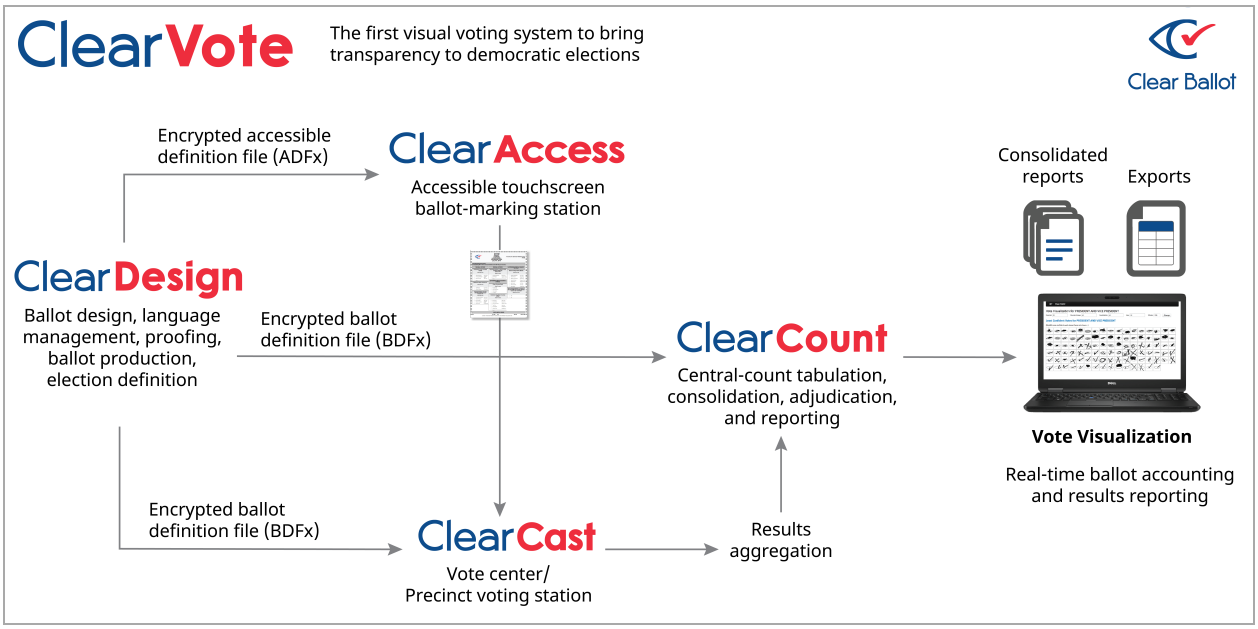

Figure 2-1. Relationship between ClearVote products

System limits

The following table summarizes the testing of ClearVote system limits by Clear Ballot.

Characteristic	Tested Limit	Characteristic	Tested Limit
Election parameters			
Precincts per election	3200	Card styles per election	3200
Splits per election	3200	Contests per ballot style	60
District categories per election	100	Card styles per precinct	50
Districts per single category	3200	Parties per election	50
Districts per election	3200	Counter groups per election	7
Contests per election	3200	"Vote for" per contest	50
Choices per election	3200	Languages per election	15
Choices per contest	300	Cards per ballot (per language)	5
Vote positions per side	420	Write-ins per contest	50
Reporting name parameters*			
Election name (characters)	60	Contest name (characters)	60
Jurisdiction name (characters)	60	Candidate name (characters)	60
Precinct name (characters)	60	Party name (characters)	60
Vote center name (characters)	60	Write-in length (characters)	60
System parameters			
Central-count scanners per network	10	Cards per central-count device	4,000,000
Cards per precinct-voting device	10,000		

*These limits are for reports only.

Security and encryption

Security is built in to the ClearVote system design and informs every technical decision. All networked systems operate solely on closed, wired Ethernet connections. No component is ever connected to the Internet.

The ballot design system (ClearDesign) and the tabulating and reporting system (ClearCount) undergo a thorough hardening process to prevent unauthorized access. The accessible voter terminals (ClearAccess) and the precinct voting station (ClearCast) are also hardened with a focus on the threat model associated with polling place deployment. The role-based security model establishes the minimum level of access (least privilege) that individual users are granted so that the jurisdiction can maintain control and accountability over system use.

When data is in motion in the ClearDesign and the ClearCount systems, which operate on closed, wired networks, it is encrypted to guard against interception, unauthorized viewing of the data traffic, and tampering with that data.

Safety, reliability, and maintainability

The ClearVote system runs on commercial, off-the-shelf (COTS) scanning and computing hardware, and printers. Developed for a broad market, these products are robust, reliable, and well-supported.

All COTS hardware used in the system has been tested by a Nationally Recognized Testing Laboratory (NRTL) and is marked with a UL or other safety mark.

Chapter 3. ClearDesign: Election management system

Jurisdictions use the ClearDesign election management system (EMS) for these tasks:

- Creating and importing jurisdiction data
- Laying out, proofing, and producing both paper and accessible ballots in supported languages
- Programming the other ClearVote products

Election department staff can design ballots independently, proof their design (including accessible ballots), lay out and review one or all ballot styles (including HTML-based accessible ballots), generate PDFs for ballot-printing companies and ballot-on-demand printers, and generate the election definition files that program the other ClearVote products.

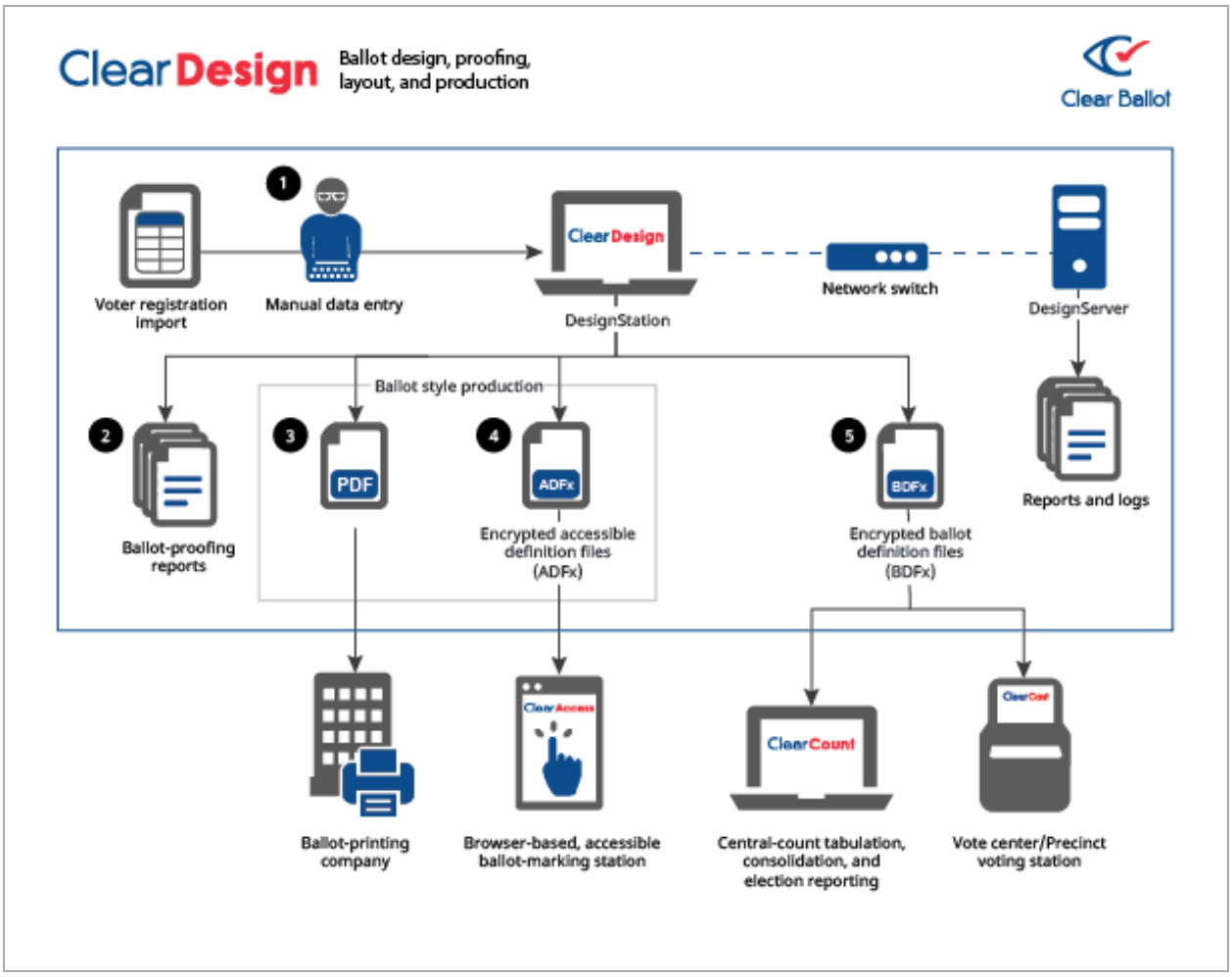

Figure 3-1. ClearDesign data flow

With the ClearDesign EMS, a jurisdiction can create ballots in many lengths between 8.5" by 5" and 8.5" by 22" in the same election. The number of possible vote positions per side depends upon the length of the ballot. The following table shows the values for common card lengths.

Length (inches)	Vote positions
5	60
11	180
14	240
17	300
19	360
22	420

The ClearDesign EMS allows the user to define the various parameters required for accurate vote casting and records, such as:

- The number to vote for in a contest
- The party a contest is associated with
- The district a contest runs in
- Contest rotation
- Special contests, such as straight-party voting

The ClearDesign EMS validates all data entered by the user to ensure it conforms to the system requirements and is consistent. It also supports a variety of import formats that allow election definitions to be directly imported from other applications, such as voter registration systems. These data imports are validated using the same logic as manually entered data to ensure data accuracy and integrity.

The ClearDesign EMS provides over 90 reports for validating and proofing the election definition to ensure that the election is defined correctly.

The ClearDesign system consists of the following physical components—all of which are unmodified COTS hardware and are connected via closed, wired Ethernet connections:

- **DesignServer**—A computer that runs the ClearDesign software on Linux, and hosts its election database and the web server that serves its election reports. The DesignServer computer is an appliance and cannot be interacted with directly. All user access (including administration) occurs via a DesignStation computer by a user with the proper credentials.
- **DesignStations**—One or more computers running the Microsoft Windows operating system with a browser-based user interface. The DesignStation computer connects to the DesignServer computer and is used to create the ballots and the election definition.
- **Network switch**—Connects the DesignStation computers to the DesignServer computer via a closed, wired Ethernet.

Chapter 4. ClearAccess: Accessible-voting station

The ClearAccess system is an in-person ballot-marking station designed to ensure access for all voters by incorporating best practices recommended by the disability community, such as use of the Anywhere Ballot.

The ClearAccess system runs on a COTS touchscreen computer. The voter can privately and independently indicate his or her choices on the touchscreen, review the selections, make corrections as necessary, print a machine-marked ballot, and cast it into a ballot receptacle. The ClearAccess software logs all transactions without compromising voter privacy, and stores no results data because its output is a marked paper ballot.

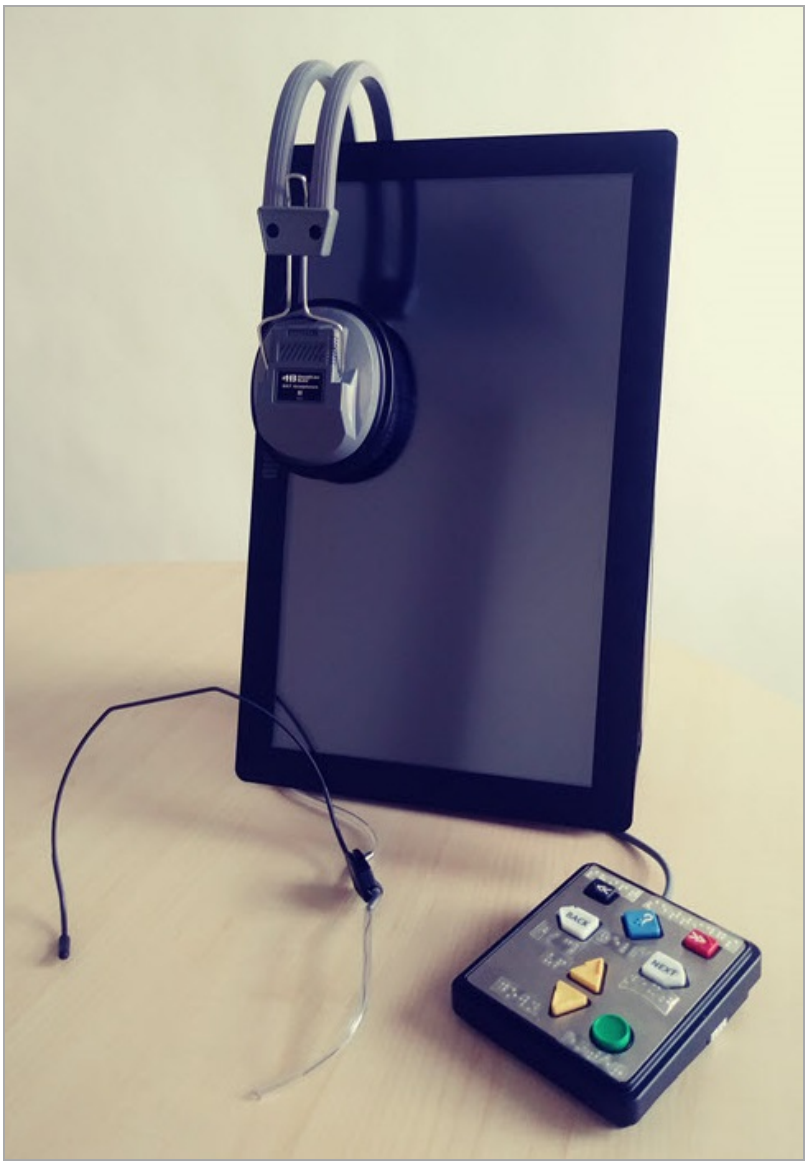

Figure 4-1. A sample ClearAccess setup

The ClearAccess ballot-marking system consists of one or more ballot-marking stations having the following physical components (all of which consist of standalone, unconnected, unmodified COTS hardware):

- **Ballot-marking device (BMD)**—A Microsoft Windows touchscreen computer running the ClearAccess software as a browser application in kiosk mode. At each ballot-marking station, a web server provides HTML pages for voting and administration.
- **Privacy screen**—A folding screen to ensure privacy for the voter during ballot marking.
- **Personal assistive technology (PAT) devices**—Each ballot-marking station includes these assistive input devices:
  - Sip-and-puff headset
  - Accessible keypad
  - Headphones
- **Ballot style transfer device**—USB drive
- **Printer**—A printer capable of printing two-sided ballots. Jurisdictions will find that the superior mark-recognition algorithms in the ClearCast and the ClearCount software allows the use of less expensive printers to produce the ballots. Because the traditionally tight tolerances, for example, for front-to-back registration, are relaxed in the ClearVote system, a wider variety of printers can be used to print the voted ballots.

Ballots voted on the ClearAccess system are scanned by the ClearCast precinct-voting station or the ClearCount central-count system.

Chapter 5. ClearCast: Precinct-voting station

The ClearCast precinct-count, optical-scan voting system is built with modern software tools. Its hardware and software design eliminates the need to separate ballots mechanically when they are unreadable, overvoted, undervoted, or have write-in entries.

Figure 5-1. A ClearCast voting station

For precinct voting, the ClearCast system maintains three copies of election data: one on its internal solid-state storage drive, and two on removable USB drives.

Along with in-person precinct ballots, the ClearCast voting station can process the paper ballots that are printed on the ClearAccess ballot-marking station.

The ClearCast voting station is built from COTS parts. The lightweight station sits on a tabletop or its collapsible ballot box. With its small footprint, can be transported by passenger car or truck.

The ClearCast ballot bag is collapsible and produced from ripstop canvas. Translucent strips on two sides of the bag allow election officials to see that the bag is filling and anticipate the need to change or empty it. A collapsible ballot box is also available.

When polls close, the ClearCast voting station produces a results tape either by precinct or as a summary report of all results. An additional tape showing the images from marked write-in contests is also available. Ballots scanned on the ClearCast system are aggregated to the ClearCount central-count system via one of the redundant USB drives.

Chapter 6. ClearCount: Central tabulation, consolidation, and reporting system

The ClearCount tabulation system captures voter intent and retains ballot provenance to improve election reporting and administration. It handles four important functions:

- Central-count tabulation
- Consolidating results imported from ClearCast precinct-voting stations
- Generating operational reports and contest reports
- Logging the activities and data required for independent audits

The system consists of the following physical components (all of which are unmodified COTS hardware and are connected via closed, wired Ethernet connections):

- **ScanServer**—A computer running the ClearCount software that hosts the election database and the web server that serves the election reports. The ScanServer computer runs a Linux operating system (a configured version of which is installed with the ClearCount software).
- **ScanStations**—One or more computers with attached scanners that scan and adjudicate ballots. The ScanStation computers run the Microsoft Windows operating system.
- **Election administration stations**—One or more Microsoft Windows computers installed with browser software. Election officials use this computer to manage elections and users, to monitor and interact with election reports, to assign write-in choices, and to adjudicate unreadable cards. System administrators use it to monitor the ClearCount system.
- **Network switch**—Connects the ScanStation computers and the election administration station computers to the ScanServer computer via a closed, wired Ethernet.

Ballot inventory and control

The ClearCount technology allows for ballot control. Ballot batches are identified by a target card, which contains a barcode and is the first card scanned in a batch. By combining the value of the barcode with a sequence number assigned by the scanning software, each ballot card is assigned a unique identifier when it is scanned.

This card ID eliminates the need for physical sorting and tracking of ballots for inventory, reporting, and recounts, but it is not possible to tie this card ID back to a voter. The Card Inventory report summarizes every batch scanned in the election. Officials can view the image of every card in every batch in the order it appears in the physical box.

With the ClearCount central-count system, election-specific data, including card image files and log entries, can be backed up and archived, and restored if needed.

The Dashboard

The Dashboard is the ClearCount information center. This real-time summary of election operations allows officials to monitor the progress of tabulation, such as the number of precincts scanned and the number of ballots that were automatically tabulated.

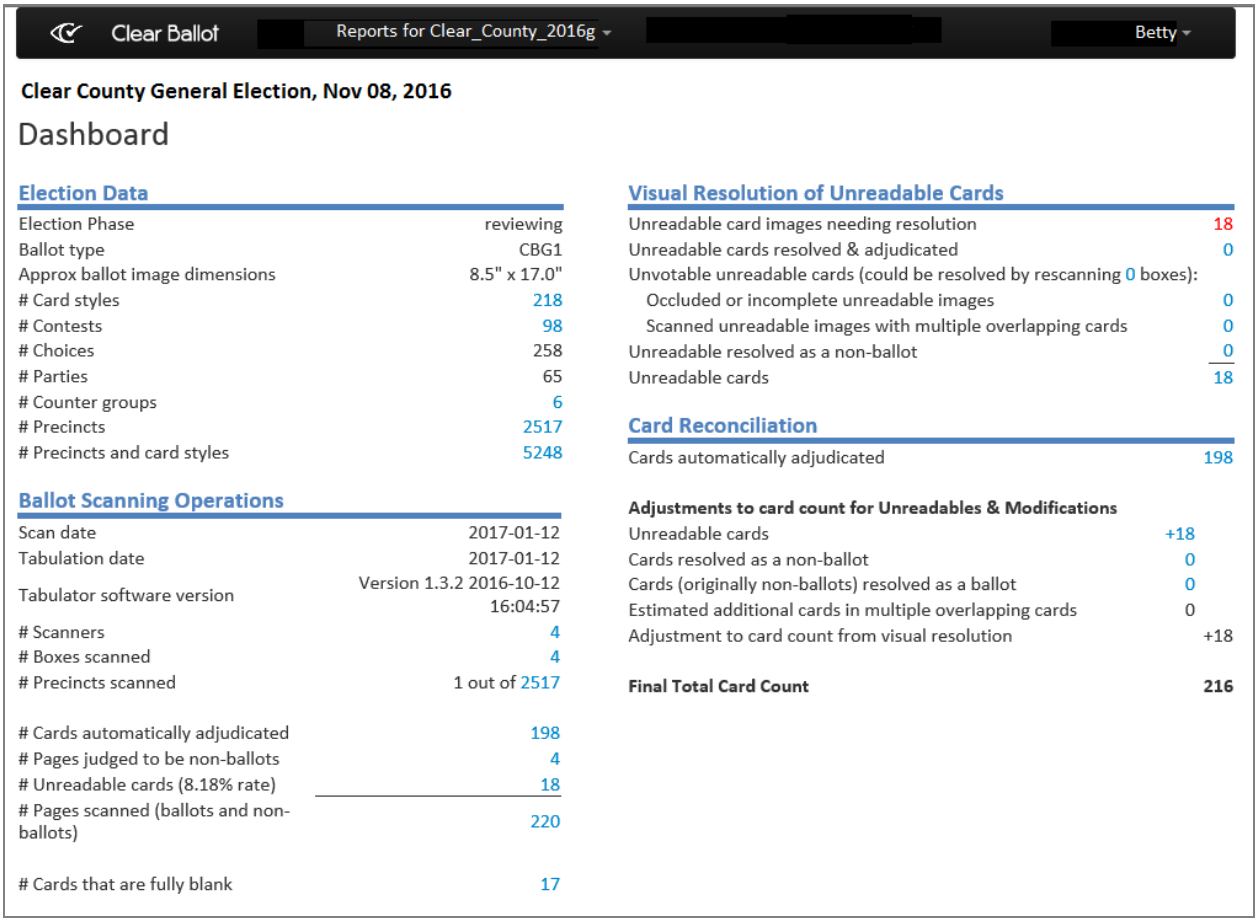

Figure 6-1. The ClearCount Dashboard

From the Dashboard, election officials can examine operations in detail, such as the performance of individual ScanStation computers, and can access and adjudicate unreadable cards. All election and contest data is updated as each ballot card is scanned. When tabulation is complete, election officials generate the reports required to complete the canvass and certify the election.

Vote Visualization

The ClearCount voting system includes Clear Ballot's Vote Visualization™ technology. This technology provides images of scanned ballots to allow click-through examination of every vote on every card. The ClearCount (and ClearCast) system uses white-light, grayscale scanning to make the highest quality card images. The following image shows voted ovals for a contest. Each oval links to a high-resolution card image.

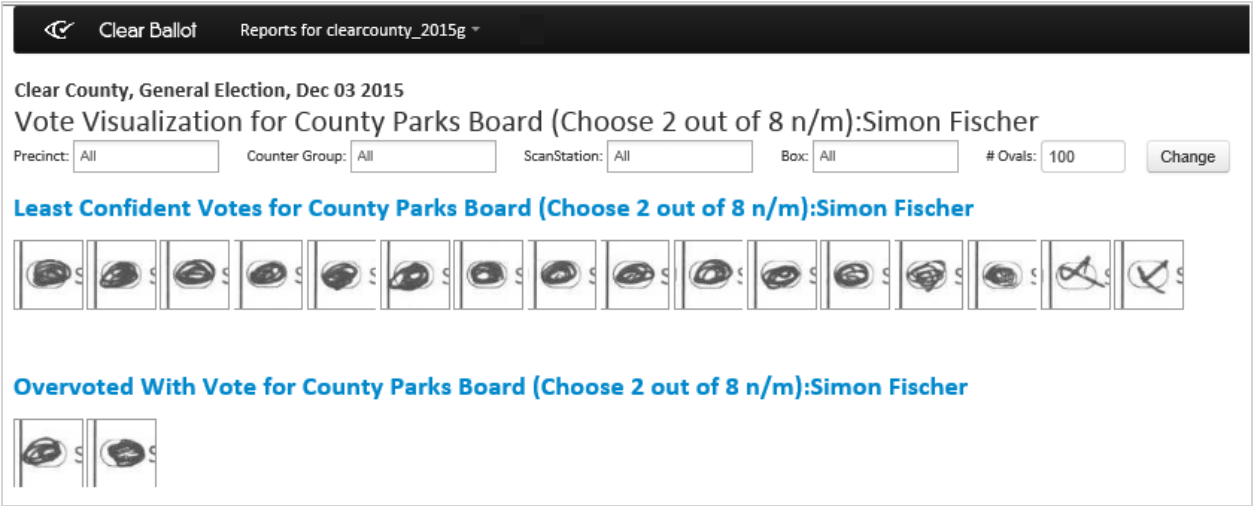

Figure 6-2. ClearCount's Vote Visualization

Write-in Assignments tool

The ClearCount system captures write-in images for all contests that have write-in choice zones associated with them in an election's BDF.

Election officials can use the Write-in Assignments tool to assign candidate names to write-in images. Those assigned write-in choices can then appear in key ClearCount election results reports, such as the Statement of Votes Cast reports. The assigned write-in choices can also be exported as a CSV file.

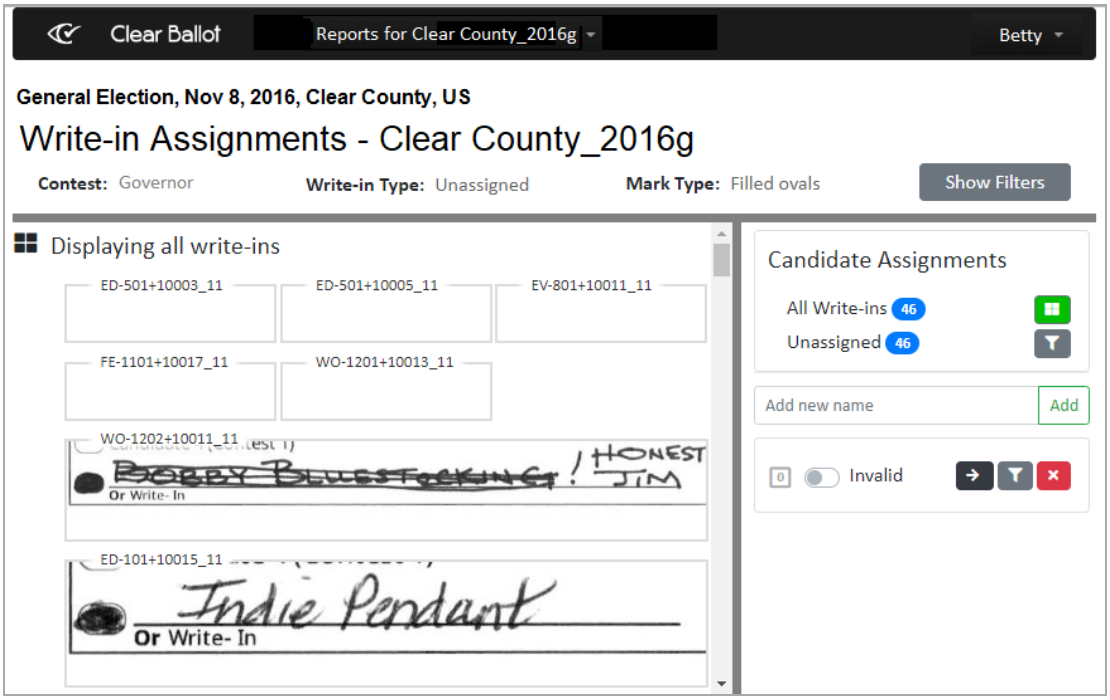

Figure 6-3. The Write-in Assignments tool

Chapter 7. ClearAudit: Independent, automated election audit system

In addition to providing products that cover each phase of an election, Clear Ballot offers an independent, automated election audit system—ClearAudit.

The ClearAudit system completely verifies an election. The election definition from the primary voting system is selected from the library of PDFs produced by a jurisdiction's EMS. Every card image is captured using COTS scanners. The ClearAudit software then independently tabulates the vote and compares the detailed results to those of the official tally produced by the primary voting system. Any differences—especially results that could change the outcome—are instantly highlighted and can be analyzed by election officials. Clear Ballot uses intelligent technology to interpret voter marks, to confirm the accuracy of the results, to identify any errors, and to build public confidence in the election system itself.

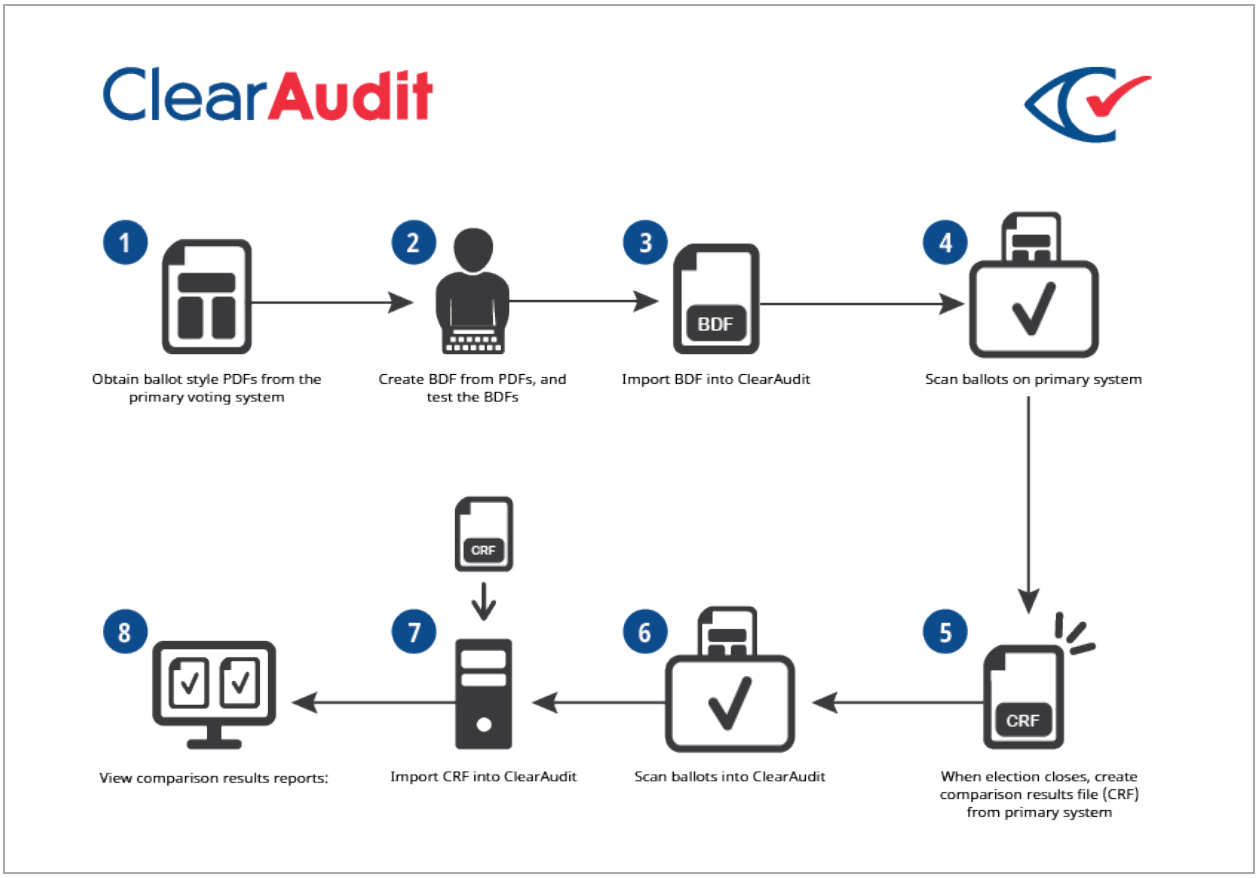

Figure 7-1. ClearAudit operational flow

The ClearAudit system shares a code base with the ClearCount system and its physical setup is similar. The ClearAudit hardware consists of one or more computers connected to COTS scanners, connected by a network switch to a single ScanServer computer.