ClearVote 2.3

ClearCount System Overview

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Preface

This section defines the purpose of this document.

About this document

This document describes:

- The functional and physical components of the ClearCount system
- How the components are structured
- The interfaces between components
- System-performance characteristics

This document responds to the requirement for the technical data package (TDP) described in the *Voluntary Voting System Guidelines 2005, Volume 2, Section 2*.

Scope of this document

This document contains the following sections:

- Chapter 1. High-level system description
- Chapter 2. Operational environment of the system
- Chapter 3. COTS components
- Chapter 4. Interfaces among internal components
- Chapter 5. Performance characteristics
- Chapter 6. Quality attributes

Intended audience

The document is for state and federal election officials and their voting system test laboratories as part of the Technical Data Package (TDP) required to certify the ClearVote system for use. Clear Ballot personnel also use this document to support election officials and staff.

Conventions

This section describes conventions used in this document.

References to ClearVote products

A ClearVote® system can comprise the ClearAccess®, ClearCast®, ClearCount®, and ClearDesign® products. Jurisdictions are not required to purchase all products. You can ignore references to any ClearVote products that are not part of your voting system. Also ignore implementation options that are not relevant to your policies and procedures.

BDF and ADF

ClearAccess imports an election definition contained in an accessible definition file (ADF) created by ClearDesign. ClearCount and ClearCast import an election definition contained in a ballot definition file (BDF) created by ClearDesign.

Versions of ClearDesign earlier than 2.0 created unencrypted ADFs and BDFs. ClearDesign 2.0 and later versions produce encrypted ADFs and BDFs. You can distinguish between unencrypted and encrypted ADFs and BDFs by the ending of the filename.

File type	Filename ends in
Unencrypted accessible definition file	adf.zip
Encrypted accessible definition file	adfx.zip
Unencrypted ballot definition file	bdf.zip
Encrypted ballot definition file	bdfx.zip

In this document, the general terms ADF and BDF can refer to both the unencrypted and encrypted versions of these files.

For the specifics of the ADF and BDF file formats, see the following:

- *ClearDesign Accessible Definition File Guide*
- *ClearDesign Ballot Definition File Guide*

Chapter 1. High-level system description

ClearCount is an optical-scanning and central-count system for tabulating votes. The components of ClearCount run on commercial off-the-shelf computers.

Note: ClearCount is not a precinct-count system and is not intended for direct voter interaction.

To set up an election, ClearCount imports a ballot definition file (BDF). Jurisdictions can create an election definition and generate the BDF in ClearDesign. Jurisdictions that do not use ClearDesign can request Clear Ballot to generate BDFs from the ballot style PDF files created by another vendor.

After importing the BDF, ClearCount creates an election database to tabulate and store ballot-scanning results. ClearCount produces reports that elections officials use to track and analyze election results. ClearCount can also print the results or export them in a variety of formats, including comma-separated values (CSV) files.

1.1 ClearCount hardware

The ClearCount system contains the physical components listed in Table 1-1. All these components are unmodified COTS hardware and are connected over a closed, wired Ethernet.

Table 1-1. ClearCount hardware components

Component	Description
CountServer	A computer running the ClearCount software and hosting the election database and the web server that serves the election reports. The CountServer computer runs the Ubuntu Linux operating system. A configured version of Ubuntu Linux is installed with the ClearCount software.
ScanStations	One or more Microsoft Windows computers linked over a closed, wired Ethernet connection to the CountServer computer through the network switch. Each ScanStation computer is paired to an individual scanner. The computer and scanner pairs are used to scan and adjudicate ballots.
Scanners	Each scanner is connected to a single ScanStation computer with a USB cable.
CountStations	One or more Microsoft Windows computers installed with browser software, linked by a wired Ethernet connection to the CountServer computer by the network switch. Election officials use this computer to create election reports. The election administrator also uses this computer to monitor the system and manage databases and users.

Table 1-1. ClearCount hardware components (continued)

Component	Description
Network switch	Connects the ScanStation and CountStation computers to the CountServer computer over a wired, closed Ethernet.
Uninterruptible power supply (UPS)	Used to ensure that the CountServer computer or other desktop computer is available if a power outage occurs.
External hard drive	Used to back up and restore elections. The external hard drive connects to the CountServer computer. Clear Ballot recommends an encrypted external hard drive. See the *ClearVote Approved Parts List* for approved devices.

The minimum hardware configuration for ClearCount contains:

- One CountServer
- One ScanStation with an attached scanner
- One CountStation

All these components are connected by Ethernet cables to a single network switch.

It is possible to expand a ClearCount configuration to include multiple ScanStations and CountStations with a single CountServer computer.

All connections between devices in the ClearCount system are closed and wired. The ClearCount system does not use wireless connectivity or connect to any other network. Wireless capabilities on any hardware used with the ClearCount system must be disabled.

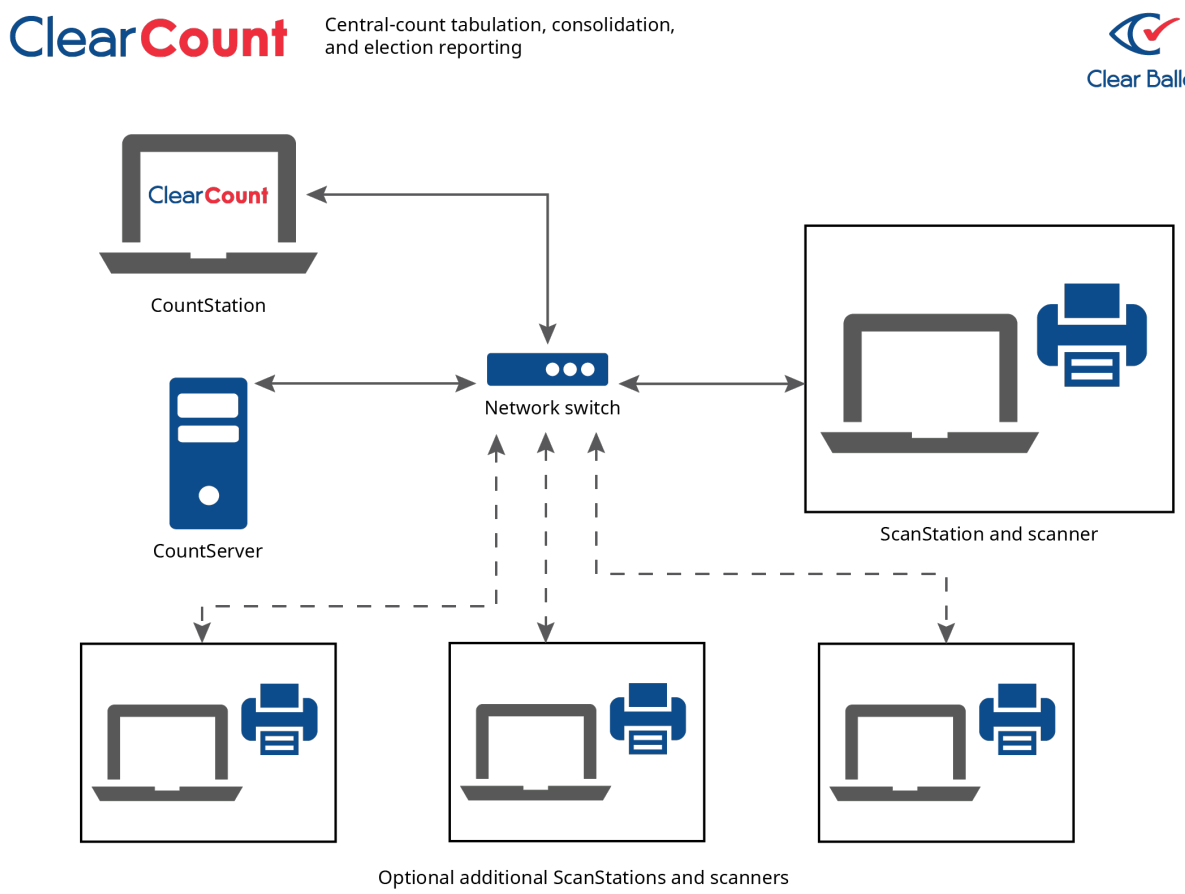

Figure 1-1. ClearCount hardware configuration

1.2 ClearCount software

The ClearCount software contains the components listed in Table 1-2.

Table 1-2. ClearCount software components

Component	Description
Tabulator application	The Tabulator software is stored on the CountServer and an instance of the Tabulator application runs on each ScanStation computer to handle the ballots it scans. The Tabulator application analyzes the incoming images and transfers them to the local output folder named *CBGBallotImages*, from where the CountServer computer retrieves them. The Tabulator application is accessible from a CountStation.

Table 1-2. ClearCount software components (continued)

Component	Description
Election database	A centralized election database resides on the CountServer. An election database collects and collates the output of each Tabulator instance. The resulting data is accessible through election reports from a CountStation.
Election reports	The browser-based suite of reports provides election results and analysis. The reports allow election officials to review individual card images. A web server on the CountServer computer stores the reports, which are viewable from a CountStation.
Card Resolutions tool	This tool allows election officials to review and resolve unreadable cards from a CountStation. Election officials can review the unreadable cards that the ClearCount system digitally outstacks, determine whether the cards are votable, and process the cards accordingly.
User and election management	From the User Administration pages, the administrator can do the following • Add, rename, or delete users • Assign access levels • Change user passwords From the Election Administration pages, the administrator can do the following: • Create or delete an election • Set an election as active • Change the election phase • Merge ClearCast election results • Back up or restore an election These features are accessible from a CountStation.

All files that make up the ClearCount software reside on a single CountServer computer that is shared by all connected ScanStation computers. The Tabulator application on each ScanStation computer is read at run-time from files that reside on the CountServer computer.

The only software programs that need to be installed on the ScanStation computers, besides the Microsoft Windows operating system and drivers, are the scanner software and drivers required by the scanner hardware.

The only software program that needs to be installed on the CountStations, besides the Microsoft Windows operating system and drivers, is an approved browser.

1.3 Readiness testing

For detailed information about readiness testing of ClearCount, see the *ClearCount Installation Guide*. ClearCount does not have a particular test mode. Instead, jurisdictions must follow the appropriate naming conventions to differentiate between a system test and a full election. Logic and accuracy (L&A) must follow the rules and regulations of each jurisdiction. The development of L&A tests for a jurisdiction occurs during readiness testing.

Chapter 2. Operational environment of the system

This chapter introduces the pre-election, election, and postelection operational environment of the ClearCount system. The process flow diagram below illustrates the relationships between election phases. The following sections describe the activities associated with those phases.

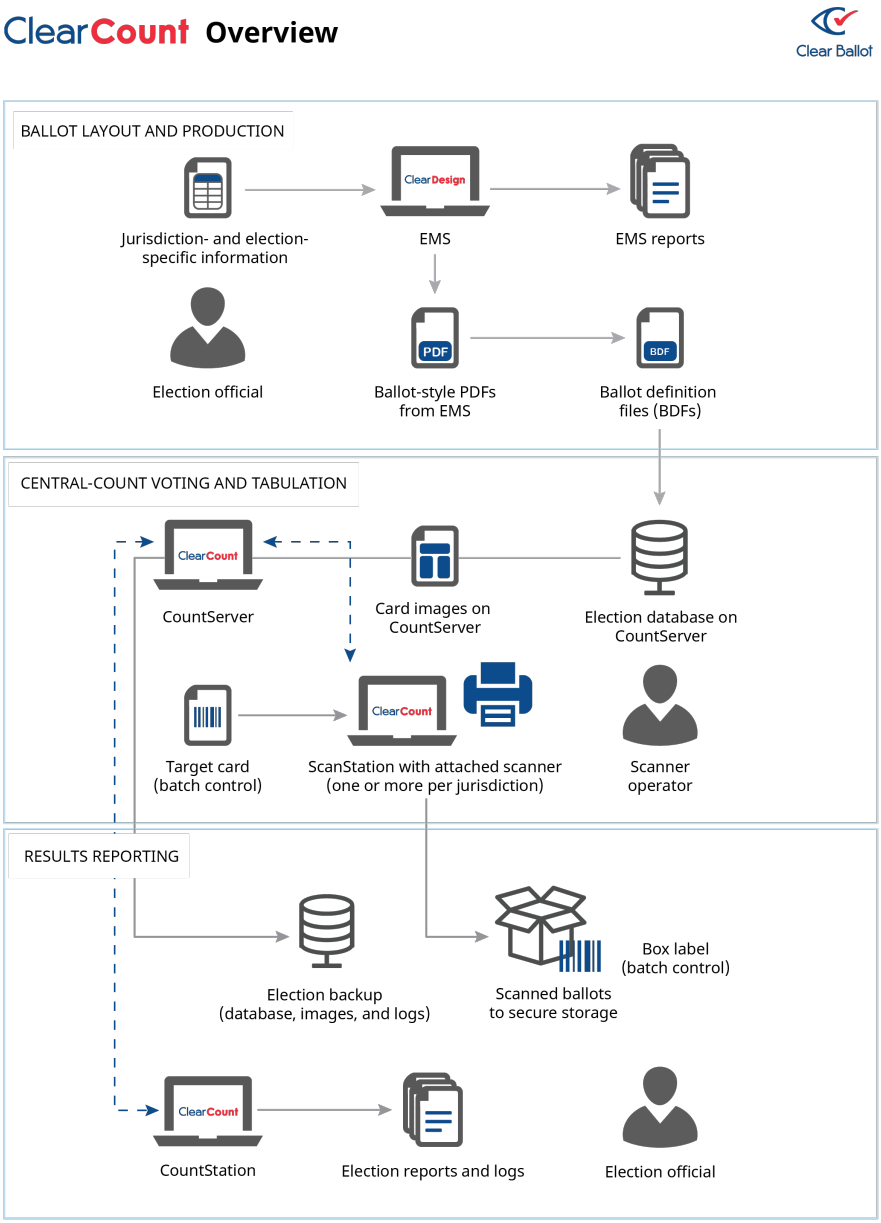

Figure 2-1. ClearCount process flow

2.1 Pre-election phase

The ClearDesign EMS is used to create ballot styles and generate election definitions. Ballot styles are rendered as PDFs that are then sent to be printed. The election definitions are exported as encrypted BDFs for importing into the ClearCount system. The jurisdiction maintains control of ballot configuration throughout the process.

The ClearCount zero report, which proves that no votes have yet been cast and validates the contest data in the BDFs, consists of a Statement of Votes Cast report that is generated after the election is created, but before the scanning of ballots begins. This version of the report shows all candidates and choices with zeroes in all vote positions (votes, overvotes, undervotes, and nonvotes).

The election administrator imports the BDF from a USB drive to a CountStation and uses it to create the election. Upon creation of the election in the ClearCount system, all information in the BDF is imported into the database.

When the jurisdiction is ready to scan and tabulate the ballots, it needs to perform the following tasks at the central-count location (as described in the *ClearCount Installation Guide*):

- Set up the necessary equipment. This includes the CountServer computer, the ScanStation computers, the scanners, the CountStation computers, and the closed Ethernet network that connects them.
- Ensure the scanners and associated scanning software are configured correctly by checking the settings.
- Establish a ballot preparation area adjacent to the scanning area and prepare the ballots for scanning.
- Prepare target cards and box labels.
- Create users and assign access levels.
- Import the BDF and create the election (the election becomes active and automatically enters the Scanning phase).
- Start up and initialize the ScanStation computers.
- Prepare the zero report.
- Arrange for the voter-marked ballots to be delivered securely to the central-count location.
- Begin scanning the ballots.

2.2 Election phase

The ballot preparation staff prepares the ballots for scanning and affixes an identifying box label to each box (or other container) of ballots. This facilitates Clear Ballot's Ballot-to-Image Traceability feature, if needed later. The staff delivers boxes of ballots to the scanning areas, where scanner operators await them.

Scanner operators scan the ballots from each box preceded by their identifying target card. A target card includes a barcode and ID that is used to form the name for each card image file. The ID on the box label and target card match. When finished, the scanner operator returns the scanned cards to the box (or other container) and initials the box label to indicate that the ballots have been scanned. The ballot preparation staff picks up the box of scanned cards and delivers it to the designated location.

These steps are repeated until all ballots are scanned.

2.3 Postelection phase

In the ClearCount system, when the polls close, the election administrator switches the election from the Scanning phase to the Reviewing phase (in which a user with the proper permissions can modify existing contents of the election that allow remaking or correcting, but no newly scanned records can be added). See "Changing the election phase" in the *ClearCount Election Administration Guide* for detailed instructions. Any decision to reopen the polls can be implemented by someone with a dbadmin access level. The decision is a jurisdictional decision.

After the close of polls, the CountServer computer provides election results via a suite of election reports that can be accessed on a CountStation computer by users with the appropriate access level. Users can also export the results to a CSV file. The ClearCount system records the viewing and exporting of reports in the web activity log. Upon certification of the election, the election administrator switches the election to the Closed phase.

2.4 Logging

Logging occurs during election processing, as well as afterward, while election officials continue to access reports. The ClearCount system creates two logs:

- **Election activity log**—For each election, the ClearCount system creates a separate election activity log. This log tracks the Tabulator application start, processing, and end events; probable target card and scanning error identification; and server warning and error messages.
- **Web activity log**—The ClearCount system generates a single web activity log that tracks all users' web-based actions for all of the jurisdiction’s elections. This includes accessing election reports or individual card images, assigning write-in choices, remaking cards, and making changes to the election databases and users.

The logs can be viewed onscreen, printed, and exported.

For additional information about logging in the ClearCount system, including the logging of events in Windows and logins to the Linux operating system, see the *ClearCount Election Administration Guide* and the *ClearCount Installation Guide*.

Chapter 3. COTS components

This chapter introduces the COTS hardware, software, and communications services used in the ClearCount system.

For details about the COTS components, see the *ClearVote Approved Parts List*.

3.1 COTS hardware

All of the hardware used by the ClearCount system is COTS hardware.

3.2 COTS software

All third-party software included in the ClearCount system is unmodified. See the *ClearCount System Identification Guide* for a list of the third-party software.

The ClearCount system uses the Ubuntu operating system on the CountServer computer and the Microsoft Windows operating system on the ScanStation computers and CountStation computers.

Clear Ballot stores all software (ClearCount and third-party) in its source-control management system, as described in "Configuration control procedures" in the *ClearVote Configuration Management Plan*.

3.3 COTS communications services

All hardware in a ClearCount system is connected using a closed, wired Ethernet. Wireless connections are not supported. To distribute election reports, election officials can either attach a temporary drive to a CountStation computer to write to a CD or DVD or transfer the results to a USB drive. It is not necessary to connect a printer to the CountStation computer.

Chapter 4. Interfaces among internal components

This chapter describes interfaces between the components in the ClearCount system.

4.1 Physical interfaces among system components

The ClearCount system uses the following physical interfaces between components:

- ScanStation computer to Fujitsu scanner:
  - Fujitsu fi-6400 and fi-6800 scanners—USB 2.0 cables only
  - Fujitsu fi-7180 scanner—USB 2.0 or 3.0 cables
  - Fujitsu fi-7800 and fi-7900 scanners—USB 2.0 cables only
- ScanStation computer to network switch—Ethernet cable
- CountStation computer to network switch—Ethernet cable
- CountServer computer to network switch—Ethernet cable

For details about hardware components, see the *ClearCount Hardware Specification*.

4.2 Functional interfaces between components

For details of the functional interfaces between components, see "Software overview" and "Interfaces" in the *ClearCount Software Design and Specification*.

4.3 Benchmark directory structure

For the ClearCount benchmark directory structure, see "Software item identification" in the *ClearCount Software Design and Specification*.

Chapter 5. Performance characteristics

The key measurements of performance of the ClearCount system fall into three categories:

- Scanner hardware
- Ballot card registration and scoring
- Image saving

Note: Performance is the same in the test mode and the election mode.

5.1 Scanner hardware performance

Table 5-1 shows the sustained scanning speeds of supported Fujitsu scanner models for various ballot sizes.

Table 5-1. Scanning speeds

Scanner model	Sustained ballots per hour by ballot size in inches						Typical jurisdiction size (central count)
	8.5 x 5	8.5 x 11	8.5 x 14	8.5 x 17	8.5 x 19	8.5 x 22	
fi-6400	5592 (est.)	3624*	2928	2448	2350	2236 est.	Large (>100 K voters)
fi-6800	7822 (est.)	5508*	4155	3352	3000	2800 est.	Large (>100 K voters)
fi-7180	3396 (est.)	2040	1692	1400	1300	1200 est.	Small (<25 K voters)
fi-7800	5364	5028*	3842	3556	3136	1566	Large (>100 K voters)
fi-7900	6746	5635*	4129	3926	3175	3108	Large (>100 K voters)

*Scanning cards in a landscape format

5.2 Ballot registration and scoring performance

In system tests, ballot registration and scoring were limited by the speed at which the scanners could process images. In volume tests, where images were tabulated directly without being limited by a scanner, 8.5-by-17-inch card images were registered and scored at rates of over 6000 ballots per hour.

5.3 Image saving performance

Image saving is currently limited by the rates at which the configured scanner and the Tabulator application can each process ballots. In system tests, image saving kept pace with ballot registration and scoring performance. The system was able to save ballots at rates of over 6000 ballots per hour.

Chapter 6. Quality attributes

The ClearCount system ensures product quality in the following areas.

- Provisions for safety, privacy, security, and continuity of operation
- Design constraints
- Applicable standards

Note: For additional quality characteristics, including reliability, maintainability, availability, usability, and portability, see "Design, construction, and maintenance characteristics" in the *ClearCount Hardware Specification*.

6.1 Safety

The ClearCount system and recommended methodology do not provide safety risks to operators. Clear Ballot addresses safety in the following documents:

- "Hardware protections" in the *ClearCount Functionality Description*
- "Safety" in the *ClearCount Hardware Specification*

All of the 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. Fujitsu, one of the manufacturers of the unmodified COTS scanners used in the ClearCount system, provides a hard-copy safety guide with each scanner. (A copy of the guide for each supported scanner model is included in the TDP.)

6.2 Privacy

Because the ClearCount system is a central-count system, there is no direct voter interaction. Voter privacy while voting is not an issue because no personal identification information is stored or collected, and jurisdictional procedures, such as ballot intake and preparation, randomize the ballots presented for scanning. The voted ballots that the ClearCount system processes at the central-count location contain no personally identifying information. Ballot-handling practices are the responsibility of the jurisdiction. Therefore, the ClearCount system does not include any special privacy measures.

6.3 Security

The ClearCount system and recommended methodology ensure security through the following mechanisms:

- Access control
- Use of a closed, wired network with FIPS 140-2 certified encryption algorithms

- Security-minded administrative practices

For full details about ClearCount security, see the *ClearCount Security Specification*.

6.4 Continuity of operation

The ClearCount system runs on scalable, distributed hardware. To ensure continuity of operation, jurisdictions should ensure they have redundant hardware capacity that undergoes full pre-election L&A testing. If continuity of operation is a high priority, the jurisdiction should avoid running the ClearCount system on a single scanner.

For detailed information about ensuring continuity of operation, see "Spare or backup devices" in the *ClearCount Maintenance Guide*.

6.5 Design constraints

Table 6-1 summarizes the testing of design constraints by Clear Ballot:

Table 6-1. Testing of design constraints

Characteristic	Tested ballot limit	Tested election limit
Vote targets (ovals)	Ballot with 3880 positions	1.05 million
Ballot styles	NA	120,000

Database size and acquisition of card image files are constrained by available space on computer hard drives.

6.6 Applicable standards

The ClearCount software runs on unmodified COTS computers and scanners. Each piece of COTS hardware used in the ClearCount system has an FCC Class B certification, a CE mark, and a UL or other safety mark affixed to it. Some accessory items may carry only FCC Class A electromagnetic interference limits.

- The FCC Class A or B Mark certifies that an electronic product's electromagnetic interference falls under the limits set by the Federal Communications Commission of the United States in its Declaration of Conformity and Certification procedures of 1998.
- The CE mark indicates a product's conformance to relevant European Union regulations.
- The UL or other recognized safety mark shows product conformance to product safety requirements.