ClearVote 2.3

ClearDesign System Overview

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Clear Ballot Group
2 Oliver Street, Suite 200
Boston, MA 02109
857-250-4961
clearballot.com

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Preface

This section defines the purpose of this document.

About this document

This document describes the following:

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

This document complies with the requirements of the *Voluntary Voting System Guidelines* (VVSG), Version 1.0, 2005, Volume II, Section 2.2, "System Overview."

Scope of this document

This document contains the following sections:

- Chapter 1. System description
- Chapter 2. Operational environment
- Chapter 3. COTS components in the ClearDesign system
- Chapter 4. Internal interfaces
- Chapter 5. Quality attributes

Intended audience

The document is for state and federal election officials and their voting system test laboratories. This document is 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. System description

The ClearDesign election management system (EMS) is a multiuser ballot design, layout, proofing, and production system. As shown in Figure 1-1, the ClearDesign EMS is the ballot-design component of the ClearVote product family.
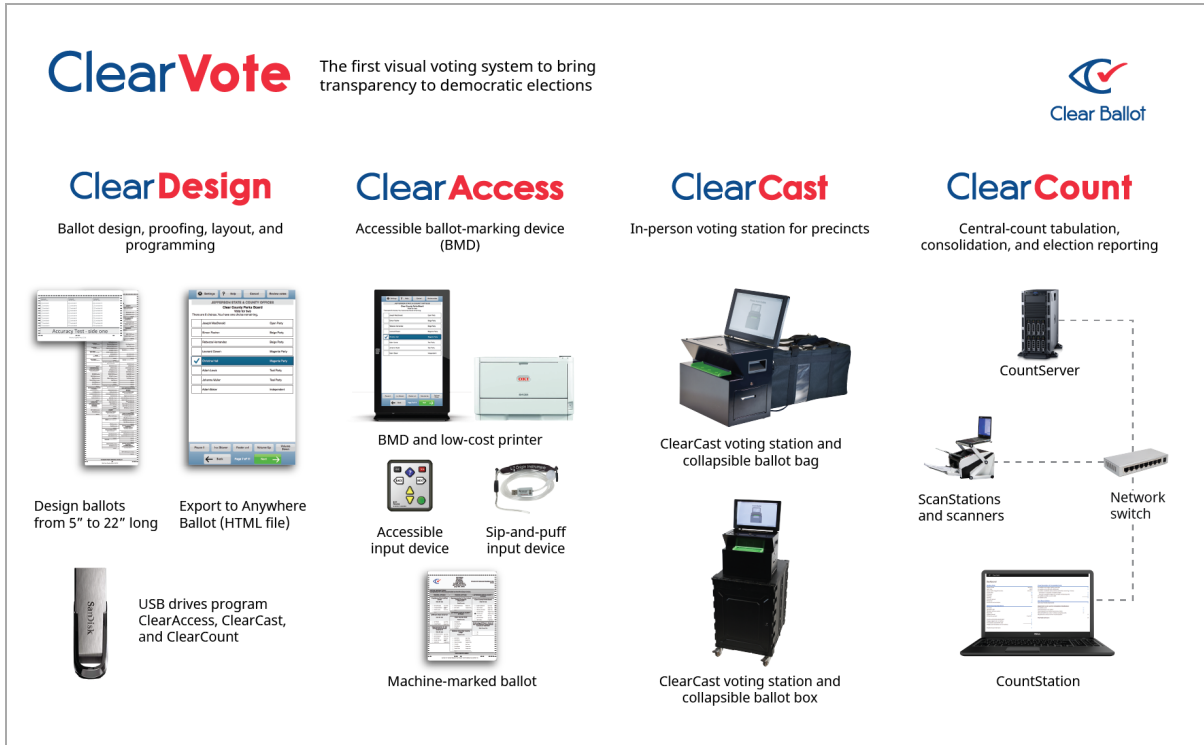

Figure 1-1. The ClearVote product family

1.1   Hardware components of ClearDesign

Figure 1-2 shows the configuration of the physical hardware components of ClearDesign.
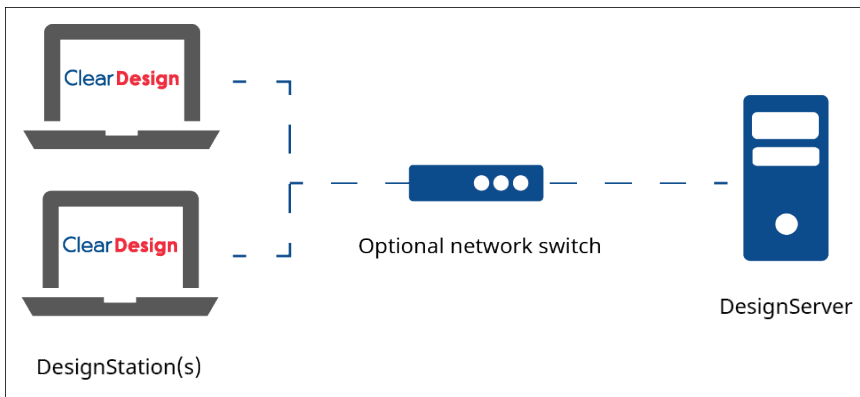

Figure 1-2. Hardware configuration of ClearDesign

Table 1-1 describes each hardware component of the ClearDesign EMS. All components are commercial off-the-shelf (COTS) hardware and are connected over a closed, wired Ethernet.

Table 1-1. ClearDesign hardware components

Item	Description
DesignServer	A computer running the ClearDesign software and hosting the election database and the web server that serves election reports. The DesignServer uses the Linux operating system (a configured version of which is installed with the ClearDesign software). The DesignServer is an appliance.
DesignStations	One or more computers for creating, formatting, and maintaining ballots. The DesignStations run the Windows 10 operating system. Users access the ClearDesign from a DesignStation. Users must have the appropriate permissions to perform specified functions.
Network switch (optional)	Connects multiple DesignStations to the DesignServer over a closed, wired Ethernet. The network switch is necessary only when your configuration has multiple DesignStations communicating with a Design Server. If your configuration has one DesignStation and a DesignServer, you can use an Ethernet cable to connect the DesignStation directly to the DesignServer.

All connections between devices in the ClearDesign system are private and wired. ClearDesign does not use wireless connectivity. Jurisdictions must disable wireless capabilities on any hardware that is used with ClearDesign.

1.2   User interface design

The ClearDesign software was designed to run in a modern web browser. Its interface is very familiar to a user of the Internet. For someone who already understands elections, the learning curve is short.

The generic (that is, nonelection-specific) user interface elements use modern browser-based controls. Examples of these elements and their descriptions have been taken from http://en.wikipedia.org/wiki/Graphical_user_interface_elements.

Table 1-2 lists the user-interface elements found in ClearDesign.

Table 1-2. User-interface elements in ClearDesign

User interface element	Description
Menus	Present a list of commands that the user can select and execute. Menus show the available operations in the software.
Controls or widgets	Enable users to read or edit information. Widgets are commonly used to: • Display collections of related items (drop-down menus and combo boxes) • Initiate actions and processes (buttons and menus) • Navigate within the application (links, tabs, scrollbars) • Manipulate data values (labels, check boxes, radio buttons, sliders)
Tabs	Allow the user to switch context. Users can move among multiple tabs by clicking the desired tab.
Cursor	Shows the position on the screen that responds to input from a keyboard or pointing device (mouse or touchpad).
Pointer	Echoes the movement of the pointing device (mouse or touchpad). The pointer is the location where actions such as clicking, touching, and dragging actually take place.
Insertion point	Is the position on the user interface where the focus is active. The insertion point represents the object that is used as the default subject of user-initiated commands, such as writing text, starting a selection, or performing a copy and paste operation through the keyboard.
Selection	Is a list of items where user operations take place. The user typically adds items to the list manually, although the computer may create a selection automatically.
Adjustment handle	Indicates the starting point for a drag-and-drop operation. The pointer usually changes shape when placed on the handle and shows an icon representing the supported drag operation.

Figure 1-3 shows some of user interface elements that are made possible through a browser.
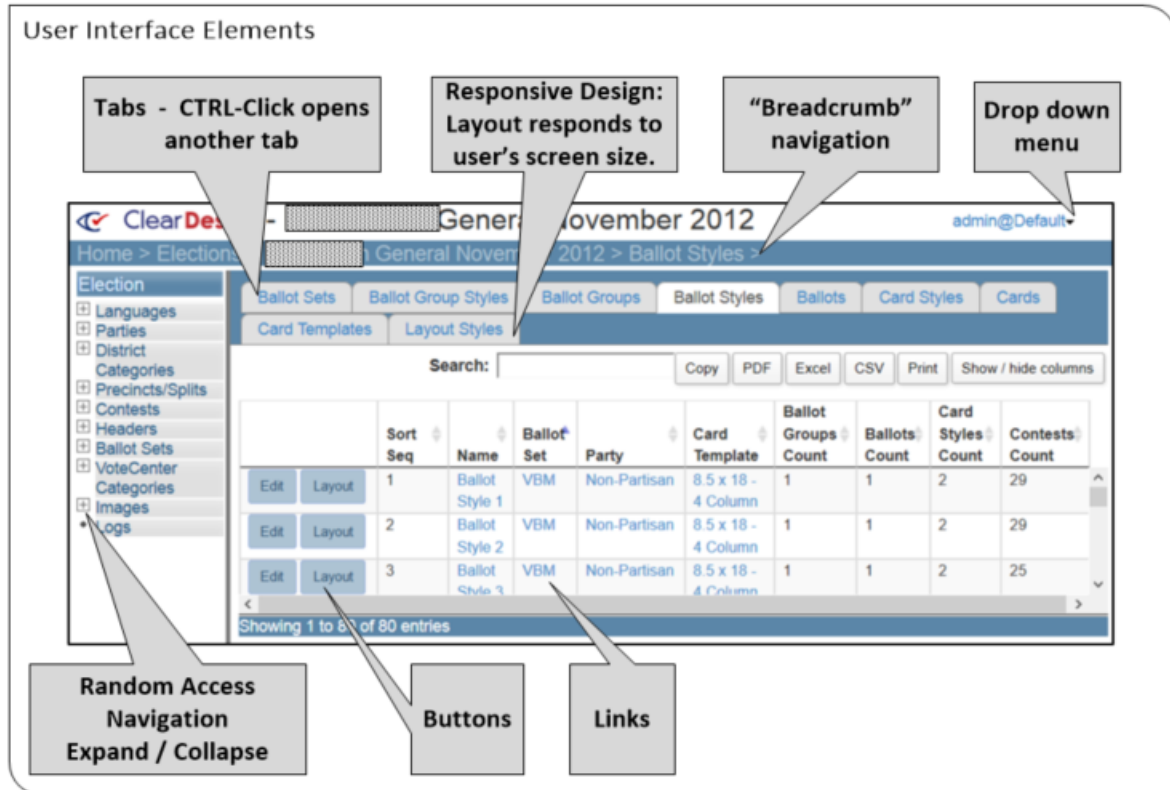
Figure 1-3. User interface elements

Figure 1-4 shows how to customize the default ballot layout by using a drag-and-drop operation to remove line spacing to squeeze the content and avoid printing another card.
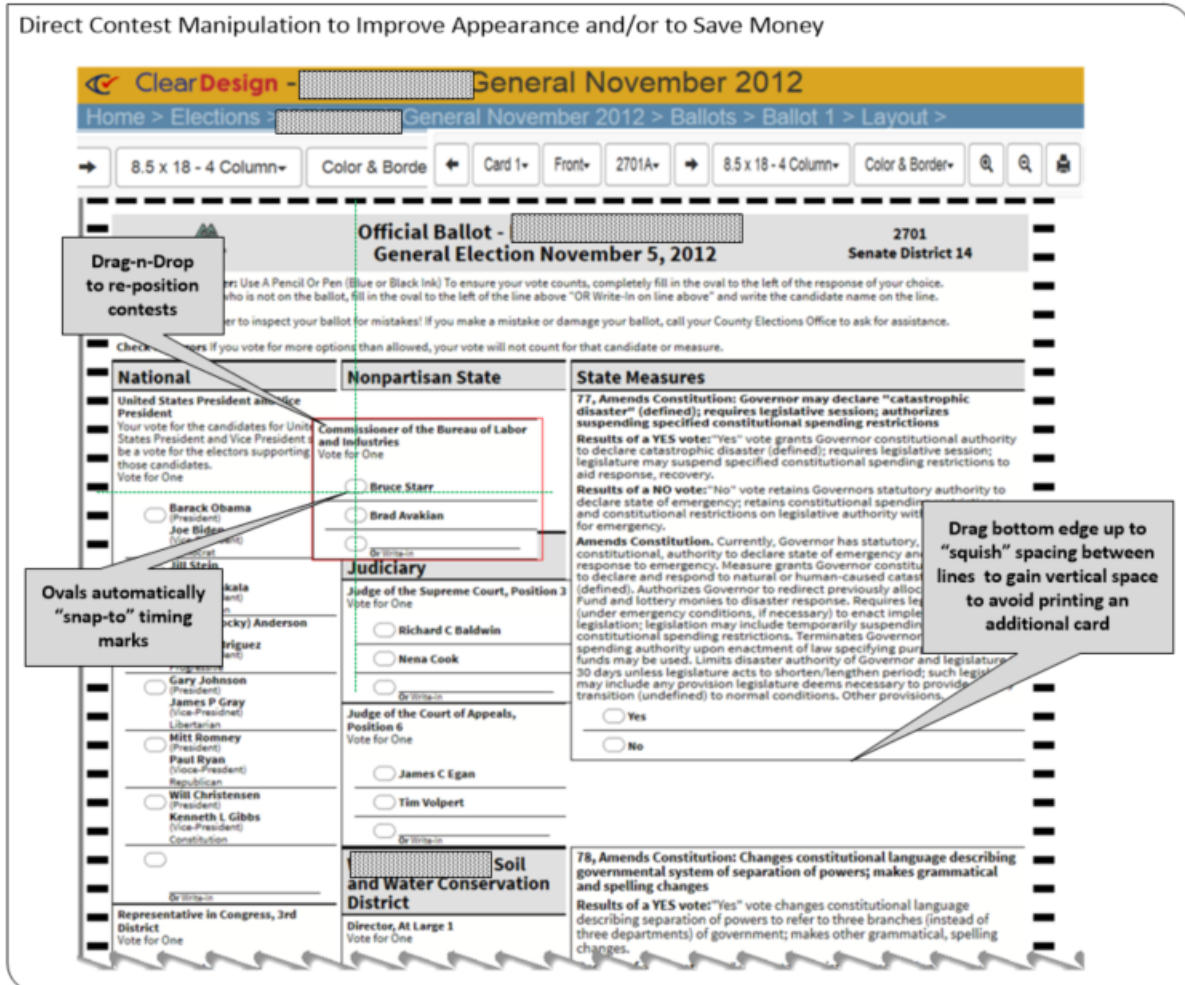
Figure 1-4. Direct manipulation of contest elements

1.3   Software design

The purpose of the ClearDesign software is to create, validate, produce, and manage the informational elements that constitute an election. The ClearDesign system provides the tools, the automated checking, and the reports that enable a jurisdiction to create ballots with a high degree of confidence that they will perform properly. Figure 1-5 shows the process of setting up the ClearDesign environment to create an election.
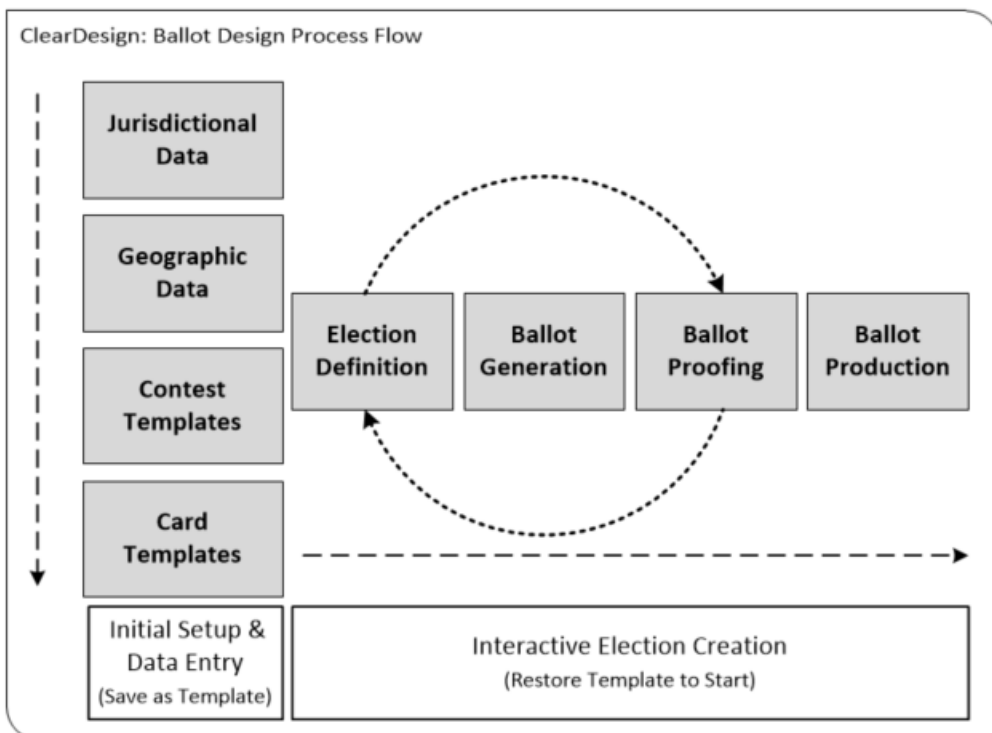
Figure 1-5. Setting up the ClearDesign EMS to create an election

1.3.1 Initial setup and data entry

Much of the information imported into the ClearDesign environment populates the menus and dialog boxes in the user interface. Table 1-3 lists the initial setup and data entry information required by ClearDesign.

Table 1-3. Initial setup and data entry information required by ClearDesign

Setup and data entry information	Description
Jurisdictional data	Includes: • Localization of terminology (such as, precincts versus election districts versus wards) • Enumeration of languages, political parties, district categories, headers, common geographical elements (such as the county seal), and ballot layout styles (including party placement)
Geographic data	Includes district listings, precinct and split listings, and their relationships.

Table 1-3. Initial setup and data entry information required by ClearDesign (continued)

Setup and data entry information	Description
Contest templates	Include the "vote for" contest type (candidate, measure, recall), cross-endorsement, assignment to a header, district assignment, and rotation.
Ballot set templates	Represent the ballot sets to be produced (such as, federal-only contests, sample ballots) and the ballot sizes that support the implementation of the Anywhere Ballot.
Card templates	Establish the dimensions and format of the ballot: • Card height (5 inches to 22 inches) • Number of columns • Front and back orientation (portrait or landscape), • The oval position (to the left or right of the candidate name)

1.3.2 Election creation

The ClearDesign EMS incorporates the elements listed in Table 1-4 into the environment that creates the election.

Table 1-4. Elements in an election

Element	Description
Election definition	Refers to template selection, selection of contests to be included, entry of candidate names, and text for measures and referendums.
Ballot generation	Refers to the calculation of all ballot styles based on the districts included in the current election and which contests go on which ballot style. After the ballot styles are generated, the ballot text can be laid out dynamically. The ballots can be examined for their aesthetics. Small manual adjustments can be made, such as repositioning contests.
Ballot proofing reports	Enable election personnel to check the following: • The geographic relationships are correct. • All contests have been included. • Candidate names are correctly spelled.

Table 1-4. Elements in an election (continued)

Element	Description
Ballot production	Generates the following: • The PDF files to send to the ballot-printing company • The ballot definition files (BDFs) that program the elections in the ClearCast and the ClearCount systems. • The HTML files that enable a voter to mark and print a ballot on the ClearAccess station.

Chapter 2. Operational environment

This chapter describes the pre-election operational environment of the ClearDesign system, is the ballot-design system in the ClearVote suite of products.

Figure 2-1 shows the operational relationships between the ClearDesign EMS and the other ClearVote products.
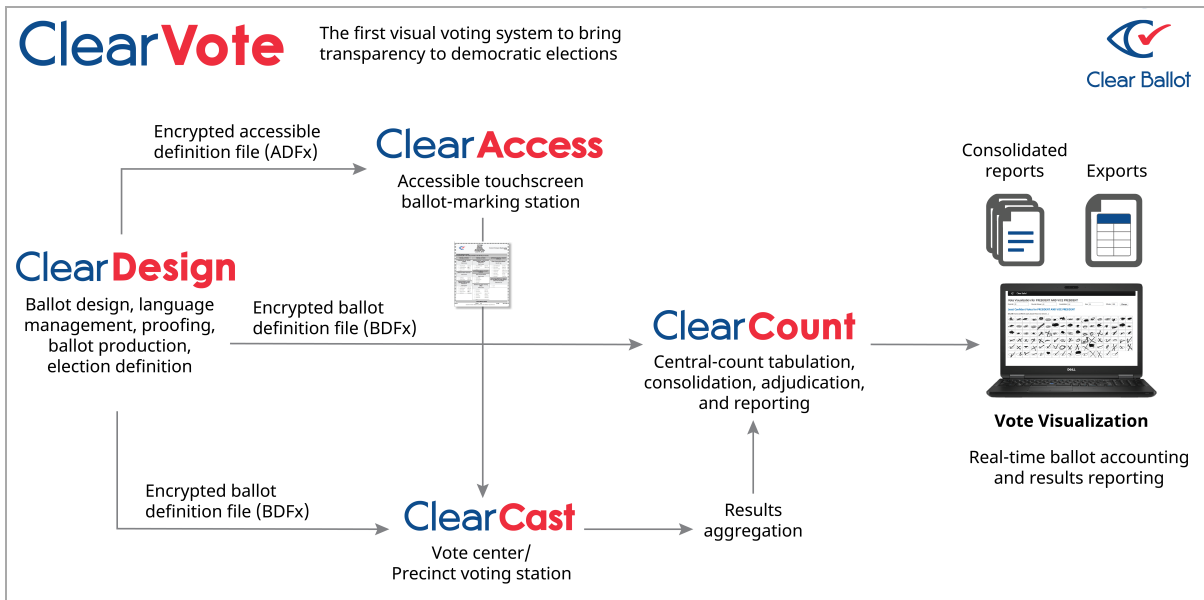
Figure 2-1. Operational relationship between the ClearDesign EMS and other ClearVote products

2.1 Pre-election phase

Figure 2-2 shows operational environment of ClearDesign in the pre-election phase.
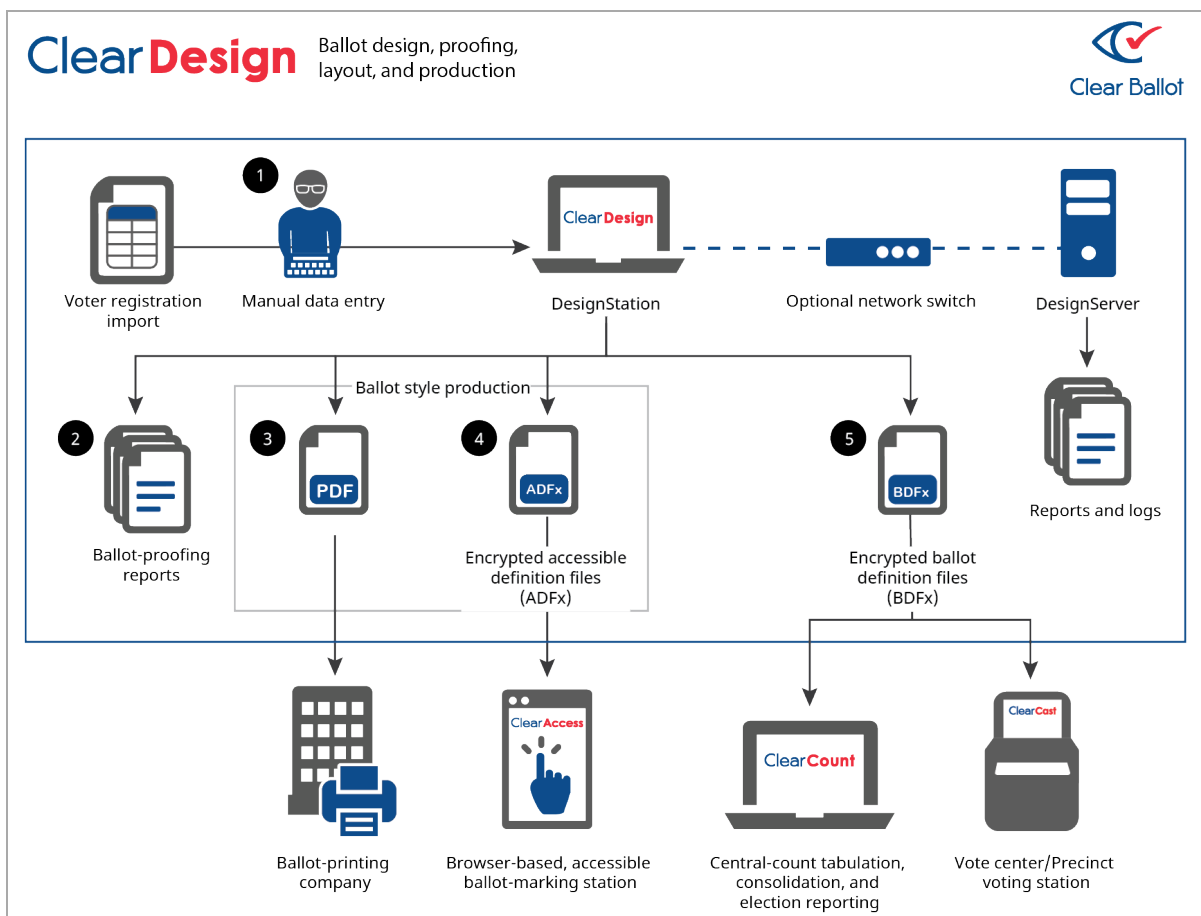
Figure 2-2. Overview of the ClearDesign operational environment

The following list explains the numbers shown in Figure 2-2.

1. A jurisdiction can enter election definition data manually or import it.

2. Ballot proofing is a critical step in creating an election. A library of reports is available for the ballot designer to check the ballots. For example, reports allow a designer to check that candidate names appear as intended, that precincts are correctly assigned to districts, and that contests appear on the correct ballot style.

   Table 2-1 shows the categorization and number of ballot-proofing reports available in the ClearDesign EMS.

Table 2-1. Ballot-proofing report categories

Ballot-proofing report categories	Number of reports
Ballot Group Styles	4
Ballot Groups	4
Ballot Sets	2
Ballot Styles	6
Ballots	6
Candidates	2
Card Styles	6
Cards	5
Contests	9
Counter Group	2
Device Types	3
District Categories	3
Districts	4
Headers	5
Languages	2
Layout Styles	2
Logs	1
Precincts	9
Splits	9
Vote Centers	4
Vote Center Categories	3
Voter Group	6
Total reports	**97**

3. When the ballot designer has finished proofing, ballot style production is completed in a single step. Two forms of ballots are produced simultaneously:

- The PDF files that are sent to the ballot printing company

- HTML Anywhere Ballot files that can be loaded onto a device capable of running a modern browser

When loaded into a browser, the Anywhere Ballot enables in-person, accessible ballot marking. (For more background, see http://civicdesign.org/projects/anywhere-ballot/)

4. The Anywhere Ballot is a single HTML file that contains all the data that a modern browser needs to display a single ballot style. This ballot style allows voters (disabled or not) to select and verify their choices, mark one or more ballot cards, and print them on a low-cost laser printer.

In operation, all ballot styles for an election are packaged as a single zipped file that can be copied to a USB drive for installation on the ClearAccess ballot-marking station. When the device is loaded, it can be used directly in a vote center or configured to allow only certain ballot styles to be displayed at a particular polling location.

5. The ClearDesign EMS produces a zipped file that encapsulates all the files needed to program an election in the ClearCast and the ClearCount systems.

The ClearDesign EMS can lay out ballots of different lengths for the same election. With this feature, 18-inch ballots can be mailed to voters, and 11-inch ballots can be printed on demand at a polling place or voting center with a low-cost laser printer. For 11-inch ballots, two ballot cards may be needed to display all the contests that appear on a single 18-inch ballot. The benefit is that all ballots can be tabulated in the same way, and a low-cost laser printer can be used instead of an expensive printer that is required to print an 18-inch, two-sided ballot.

2.2 Logging and reporting

See the following:

- "Logs" and "Ballot proofing reports" in the *ClearDesign User Guide*
- "System log" in the *ClearDesign Administration Guide*

Chapter 3. COTS components in the ClearDesign system

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

3.1   COTS hardware

The ClearDesign EMS runs on COTS hardware that is subject to rigorous manufacturer testing.

See the *ClearVote Approved Parts List* for specific hardware models.

3.2   COTS software

All third-party software included in the ClearDesign system is unmodified.

All software, both ClearDesign and third-party, is stored in the Clear Ballot source-control management system.

3.3   Communications services

All hardware in a ClearDesign system is connected over a private wired Ethernet. Wireless connections are not supported.

Chapter 4. Internal interfaces

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

4.1 Physical interfaces

Table 4-1 lists the physical interfaces between the hardware components of the ClearDesign EMS.

Table 4-1. Physical interfaces between ClearDesign components

Connection	Physical interface
DesignServer to network switch. For a configuration that has a DesignServer and multiple DesignStations.	Ethernet CAT cable
DesignStation to network switch. For a configuration has a DesignServer and multiple DesignStations.	Ethernet CAT cable
DesignStation to DesignServer . For a configuration that has a Design server and a single DesignStation.	Ethernet CAT cable
USB drive to DesignStation.	USB 2.0/3.0 cable

For more information about the physical interfaces, see the *ClearVote Approved Parts List*.

4.2 Functional interfaces

The ClearDesign system has three categories of interfaces:

- Data imports used to create elections
- User interaction by HTTPS URL requests
- Data exports used to create the following:
  - A BDF or BDFx file used by the ClearCast and the ClearCount systems
  - An ADFx file used by the ClearAccess station

4.2.1 Data imports

The ClearDesign EMS supports imports in the following formats:

- ClearVote BDF

  See the *ClearDesign Ballot Definition File Guide*.

- GEMS standard import
  See the file GEMS_Standard_Import_Format_1.5_Revision_5.1.pdf, which is packaged with the *ClearDesign Software and Design Specification*.

- OCVR
  See the file OCVR_2017 format.xlsx, which is packaged with the *ClearDesign Software and Design Specification*.

- North Carolina Statewide Computerized Voter Registration System (SEIMS)

- Ohio import format

4.2.2 User interactions

Users of the ClearDesign EMS interact with the server via a web browser and the Clear Ballot URL APIs. The URLs use HTTPS.

4.2.3 Data exports

The ClearDesign EMS exports the following:

- ClearVote BDFs (.bdf and .bdfx)

  See the *ClearDesign Ballot Definition File Guide*.

- ClearVote ADF (.adfx)

  See the *ClearDesign Accessible Definition File Guide*.

- Various reports that can be saved in PDF, HTML, or CSV formats

4.3 Benchmark directory listings

The About screen provides directory listings of the ClearDesign and third-party software components. The *ClearDesign System Identification Guide* also contains the information found on the About screen.

4.4 Performance characteristics

During data entry, the performance of the ClearDesign EMS can be characterized by its speed and responsiveness:

- No noticeable delay occurs for browser actions, such as inserting or deleting text.

- Speed of navigation between tabs and of saving changes is critical to the usability of the ClearDesign EMS. In general, tab-to-tab response time is less than 5 seconds.

- The ClearDesign EMS saves additions or changes to an election definition (such as, entry of geographic data or contest information) as they are made.

After all data entry, ClearDesign performance is divided into the areas listed in Table 4-2.

Table 4-2. ClearDesign performance areas after data entry

Performance area	Refers to
Ballot style generation	The calculation of which contests appear in which ballot styles
Ballot style layout	The dynamic placement of contests and measures on ballot cards suitable for printing
PDF card printing	The rendering of all PDF files sent to the ballot printing company
BDF export	Creating a zipped file of all data needed to tabulate and report on an election

4.5   Ballot layout and generation performance

Ballot generation refers to the calculation of which contests should appear in which ballot styles. Ballot layout refers to the layout of each ballot style onto one or more cards of a designated size.

Table 4-3 lists performance data for an election with the following attributes:

- Districts: 139
- Precincts: 132
- Splits: 294
- Contests: 103
- Ballot dimensions:
    - 8.5" x 18"—3 column
    - 8.5" x 18"—4 front, 3 back

Table 4-3. Performance Data

Task	Count	Time
Ballot styles generated	227	0:41
Ballot styles laid out	208	13:29
PDF cards printed	1058	1:55
BDF export (.bdfx)	NA	0:17

Chapter 5. Quality attributes

This chapter describes the quality attributes of the ClearDesign EMS.

5.1 Safety

The ClearDesign system runs solely on COTS hardware. All relevant safety information is provided with the system component as part of the manufacturer's documentation. You can get the manufacturer's documentation from your Clear Ballot representative.

See also "Applicable standards" on page 27.

5.2 Security

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

- Access control
- Use of a closed network
- Security-minded administrative practices

For more information, see the *ClearDesign Security Specification*.

Because the ClearDesign EMS is a ballot-generation system, there is no direct voter interaction. Voter privacy is not an issue. The ballots that the ClearDesign EMS produces contain no information that could be used to personally identify a voter. Therefore, the ClearDesign system does not include any special privacy measures.

5.2.1 Usernames and passwords

The DesignServer and DesignStation computers require usernames and passwords to prevent unauthorized access.

5.2.2 Roles and permissions

The ClearDesign EMS uses roles and permissions to control the access to specific functions. The permissions are based on the type of entity (district, precinct, contest) and the action (view, add, edit, delete) that is allowed.

Some entities have more actions than others. For example, the election entity can perform the basic add, edit, delete, and view actions and also the backup, restore, and report actions.

The basic permission required to access an entity is the view permission. If view permission is not granted, no other permission for that entity is granted.

The altering of permissions requires edit permissions on roles. When roles change or users change roles, internal checks in the ClearDesign system prevent a user from accidentally locking the system.

Users can remove role-editing permissions from themselves to prevent themselves from making more role changes.

5.2.3 Use of a closed network

A closed network means that the DesignServer and DesignStation computers communicate with one another over a hardwired Ethernet that is never used to access the Internet or any external networks.

The DesignServer and DesignStation computers are never used to run any software not required for the ClearDesign system.

5.2.4 Integrity of the operating system and ClearDesign software

Clear Ballot uses the following mechanisms to maintain the integrity and security of the operating system and the ClearDesign software:

- Configuring the system such that only predetermined software is allowed to be executed (by implementing a software restriction policy and creating a whitelist)
- Removing extraneous programs
- Disabling the autoplay feature
- Disabling wireless and Bluetooth Internet access
- Running virus-scanning software

5.2.5 Privacy

Because the ClearDesign EMS is a ballot-generation system, there is no direct voter interaction. Voter privacy is not an issue. The ballots that the ClearDesign EMS produces contain no information that can identify a voter. Therefore, the ClearDesign system does not include any special privacy measures.

5.2.6 FIPS 140 compliance

Clear Ballot products—ClearDesign, ClearAccess, ClearCast, and ClearCount—are written in the Python language using the standard Python libraries. The standard Python hashing libraries use OpenSSL on the Linux platforms, including Ubuntu and the Windows cryptographic libraries on the Windows platforms. Where native Python support does not exist, a thin wrapper has been created to access the underlying cryptographic libraries.

Clear Ballot products running on Ubuntu build the FIPS-certified version of OpenSSL during the build process. They use the OpenSSL FIPS version that is included as part of the FIPS certificate and build it in conformance with the security policy defined in the certification process. See https://www.openssl.org/docs/fips.html for more information.

Clear Ballot products running on Windows use the cryptographic system provided by the Windows operating system. Versions of Windows used by Clear Ballot products have a FIPS certificate.

When the Clear Ballot products start up, they check that the cryptographic module is operating in FIPS mode. If not, the product displays an error message and will not proceed.

5.3   Continuity of operation

The ClearDesign system runs on scalable, distributed hardware. To ensure continuity of operation, jurisdictions are responsible for:

- Hardware redundancy
- Periodic backups

The ClearDesign system runs on COTS computers. To ensure continuity of operation, jurisdictions should ensure that the batteries in these devices are fully charged before the opening of polls and that the devices remain plugged in during operation to ensure that the batteries are not prematurely drained.

5.4   System limits

See "System limits" in the *ClearVote System Overview*.

5.5   Applicable standards

The ClearDesign software runs on COTS computers and printers. Each piece of COTS computing hardware used in the ClearDesign system has an FCC, CE, or UL certification standard.

- 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.
- UL or other recognized safety mark shows product conformance to product safety requirements.

Clear Ballot recommends that COTS equipment also bear a safety testing mark by an OSHA Nationally Recognized Testing Laboratory (NRTL), such as the UL mark of Underwriters Laboratory.

5.6 Compatibility

The ClearDesign system produces ballot definition files in text format that are compatible with the ClearCast and the ClearCount systems.

The ClearDesign EMS also produces HTML files that can be rendered on a modern browser. The ClearDesign system supports Google Chrome. See "Installing Google Chrome" in the *ClearDesign Installation Guide*.