

## Clear Ballot's Comments to Draft Colorado Rule 21.4.14: Specification for a Single Ballot Cast Vote Record

### Background:

From the very beginning of its design process dating back to 2011, Clear Ballot recognized the need to create a modern voting system that could be independently audited by a variety of independent methods including automated independent audits, precinct audits, random tabulator and/or batch audits and Professor Stark's Risk Limiting Audits. In addition to the log files, machine readable reports and the visualization of the electorate's intent, the single ballot cast vote record (CVR) is an essential tool to assist in the conduct of an independent audit.

Accordingly, the following principles guided our design:

- COTS ballot scanning requirements:
  - *Repeatable paper counts* - The system had to be able to count ballots reliably with repeatable results across the entire range of scanners being offered for certification.
  - *Scan to retention* – To preserve the integrity of the election and reduce the incidence of human error, the image of EVERY item scanned must be preserved as it was produced by an unmodified COTS scanner. De-skewing and cropping the image are the only alterations to the raw images that are performed by the scanner manufacturer's COTS software.
  - *High quality images* - To achieve the highest possible accuracy in assessing voter intent, Clear Ballot scans at 200 DPI, grayscale and stores two images (front and back) for every item scanned in the industry standard JPG format.
- Requirements to support a range of audit methods:
  - *Traceability* - The ability to automatically create a unique image ID that could be used to reliably and efficiently locate its corresponding physical ballot (see discussion below of pre-imprinting a unique serial number).
  - *Tabulation flexibility* - The ability to tabulate any arbitrary selection of batches or the entire election.
  - *Randomization* - The easy assignment and selection of random ballot cards using any method to produce random numbers.

Additionally, Clear Ballot extensively investigated the use of pre-imprinting options. The reason to pre-imprint is to facilitate matching a ballot to its cast vote record in the event that the order of the ballots off the scanner is not preserved. It is Clear Ballot's experience that it is easy to train an operator to maintain ballot order. If the operator knows that the ballots in a given box are out of order, he or she can simply indicate that fact on the box label. Then, for boxes or batches that have been randomly selected for an audit, the ballots can be deleted from the election and the boxes re-scanned taking care to keep the ballots in order. A new CVR can then be produced and

the audit can continue. Given the ease and simplicity to recover from ballots being out of order, Clear Ballot decided against supporting pre-imprinting for the following reasons:

- Since ballots can be oriented in up to 8 ways (including landscape for ballots under 12” long), it was not feasible to precisely locate a pre-imprinted serial number in such a way as to prevent damaging a timing mark which, in turn, could prevent the batch from being re-scanned and automatically tabulated. This potential lack of repeatability was decisive in our thinking not to pursue pre-imprinting as a way to accurately locate a physical ballot.
- Only high-end, expensive scanners support pre-imprinting. Clear Ballot wanted to make its voting system affordable by jurisdictions of every size.
- Pre-imprinters are typically dot matrix printers which use a ribbon which introduces a consumable and becomes an added thing for the scanning staff to worry about.

#### Comments on draft rule 21.4.14

The following **bolded comments** reflect the Clear Ballot's recommendations on draft Rule 21.4.14:

21.4.14 Ballot-level Cast Vote Records and Exports. All voting systems certified by the Secretary of State for use in Colorado on or after January 1, 2016 must meet the following requirements for ballot-level cast vote records and exports on or before December 31, 2016:

(a) The voting system must capture a ballot-level cast vote record (CVR) consisting of a single record for each ballot tabulated, showing the manner in which the voting system interpreted and tabulated the voter's markings on the ballot, as adjudicated and resolved by election judges, if applicable.

(b) The voting system must be able to aggregate in a single file and export all CVRs in comma-separated value (CSV) text format.

(c) The CVR export must contain the following fields, with values or data populated by the voting system:

(1) CVR Number. A sequential number from one to the number of CVRs in the export file. This can be used as an alternate method to identify each CVR.

**In practice, this field should be kept as a placeholder but re-populated once non-ballot images have been filtered out (see suggestion to #3 below and suggestion to add a new field below #6).**

(2) Batch ID. Identifies the batch in which the paper ballot corresponding to the CVR is located.

(3) Ballot Position. Identifies the position of the paper ballot corresponding to the CVR within the batch. Target cards scanned to identify the batch must not be included in this count.

**Suggest deletion of the second sentence in the above clause. Clear Ballot already excludes Target Cards from the CVR. This real issue is the real-world situation where non-ballot cards that are inadvertently scanned (e.g. worksheets) and are eliminated during the manual adjudication step. As long as the non-ballots images can be readily identified and filtered out without compromising the ability to efficiently retrieve the physical ballot, we believe the requirements for computing sample size and the efficient and accurate retrieval of a physical ballot in the course of conducting a Risk Limiting Audit can be fully met without the second sentence (see suggested addition below item 6).**

(4) Imprinted ID. If the scanner model supports imprinting a unique character string on the ballot during the scanning process, the voting system must populate this field with the unique character string.

(5) Ballot Style. Indicates the ballot style of the paper ballot corresponding to the CVR.

(6) Device ID. Identifies the scanning device by model, serial number, and/or scanning station identifier.

**SUGGESTED ADDITION: Provide a means for determining if a ballot has been 1) automatically adjudicated, 2) adjudicated by a human or 3) neither (i.e. not automatically adjudicated and not human adjudicated), or 4) whether the card is not a ballot at all (e.g. a worksheet or target card). This suggestion is made to be able to maintain complete transparency while giving the state the ability to modify the rules governing the audit, without requiring a change in the voting system's software.**

(7) Contest and Choice Names. Each contest and choice on any ballot in the election must have its own field so that voters' choices in all contests can be easily and independently tabulated after the CVR export is imported into a spreadsheet application.

**SUGGESTED ADDITION: Party affiliation to anticipate the potential of a cross-endorsed candidate.**

(a) The header or field names in the CVR export must unambiguously correspond to names of the contests and choices on the paper ballots. The use of choice ID and contest ID to identify each choice must be avoided because they require cross-referencing to other sources to determine the choice and contest names.

Clear Ballot respectfully requests that the second sentence be deleted because this requirement be satisfied by a step following the creation of the CVR in order to create the desired format. The reason for this is that the header row becomes unwieldy with the concatenation of the contest name (which could be long), the choice name and, as mentioned above, possibly party affiliation. Additionally, retaining machine readable IDs in the header, allows for an easy, open source, post-processing tool to be provided to help automate a Risk Limiting Audit. Clear Ballot has developed and will provide such a tool at no cost to counties.

(b) The contests and choices must be listed in the same order as they appear on the ballots.

(c) A vote for a choice must be indicated by a "1". No vote for a choice or an overvoted condition must be indicated by a "0". Choices that are not applicable to the CVR must be left blank.