Provisional Report to Pilot Election Review Committee by Harvie Branscomb

Note that a set of recommendations for PERC are at the end of this document.

An election system can be broken down into several separate component parts starting with access to ballot by potential candidates, money flow for advocacy on behalf of candidates and methods of getting out the vote, determination of eligibility of the representations of voter intent (signature verification, etc.), chain of custody of the various representations, interpretation and aggregation of the representations (what we are referring to as the "voting system"), and means of storage and distribution of knowledge of the results and outcomes.

Probably all of these components are equally important to election integrity and deserve close attention. What the PERC is assigned to evaluate is (not simply) the voting system part. It is the one portion where quantitative measures of quality are possible to bring to bear and it is the one part (of all those mentioned above) where a great deal of innovation has been applied and is going to be applied for the next ten years, at least.

Colorado is benefiting from the attention of five substantial competing vendors of voting systems, four of which were deemed adequate to satisfy Colorado's requirements for a voting system in time to be piloted in the 2015 election. All have proved to be successful in executing at least two elections. All have the stated support of their host counties, some even voicing support with dogged passion.

Clearly the state has received benefit from extending the project from Dec. 2013 until Dec. 2015 and this benefit came from the fact of continued competition among vendors. If we had selected one system in 2013 as Secretary Gessler originally intended, we would have a system in place today that we would have already found substantial fault with. And that vendor would probably by now be looking more towards California or another state for guidance about what bells and whistles need to be added.

I am evaluating the facility of these four systems to provide evidence for an evidence-based election to the public. I plan to comment on the potential for any of these systems to evolve into the best possible system for Colorado voters as innovation takes place.

My overall conclusion is that whatever benefit can be gleaned from buying all of the components of the "voting system" from the same company the result will not in any way look like a uniform "election system." Among the many benefits of the 8 county pilots is that a substantial amount of cross observation and pollination of various election methods has taken place when observers like myself visited all eight. I spent hours explaining best practices seen at other counties and identifying could-be-better practices in each. What jumps out is that our 64 counties do not run elections the same way. Even those with the same vendor equipment do not run their elections the same way.

Compare Teller to Jeffco! I've heard that Larimer duplicates paper ballots onto DRE equipment but Denver is doing almost the same thing- duplicating damaged paper ballots onto a ballot marking device that produces a paper ballot where the voter intent is coded into a QR code.

There is vast variation of election practice around the state and it is not necessary that all variations be eliminated. More importantly, any possible requirement to buy from a single vendor will not produce more than a superficial move towards uniformity. Yet it will cut off the opportunity for competition to continue to bring us more efficiency, more accuracy and more verifiability among other positive qualities.

There is no question in my mind that the Secretary will disadvantage Colorado if he decides to adopt a single vendor system in Colorado. We already know he will be disappointing 6 counties out of 64 if he does so. And those counties represent a significant portion of Colorado's population regardless of which 6 it is.

Meanwhile what benefit will be obtained? The need for a few less county support personnel at CDOS?   A shorter distance between one county loaning a spare system and another county receiving one? These are truly minor benefits. Mesa Clerk Sheila Reiner says her reason for supporting a uniform single vendor system is defense against a federal lawsuit. That isn't a good reason either.

PERC should be realistic about the missed opportunity that comes with any arbitrary decision to reject one or more of the vendors. If such a decision is made it should not be based on price, for that decision can and should be up to the purchasing county. It should not be based on size of the vendor. It should not be based on current flaws that can be readily remedied.

It should be based on characteristics that that cannot be corrected that will hinder the integrity of Colorado elections. I know of at least one such consideration- the strong advantage that comes from identical format ballots regardless of method of voting.

ES&S has an innovative product called ExpressVote that is a ballot marking device that produces a 4 inch wide thermal paper representation of the voter intent in a series of bar codes. It also prints the contest choices on the Express Vote paper, but what can be verified by the voter is not what the scanner will read. Each of these machine marked ballots is unequivocally identifiable when it is rare at a polling place. If we used Express Vote in precincts like other states do, there would be plenty of examples of each style to protect the identity of the voter. But we use vote centers and early voting where unique ballot styles are not that rare. One turned up as a random selection in the Jeffco RLA mockup and was not audited as a result. Express Vote is a very small step away from a DRE, and it is rapidly evolving back into precisely that- with its own capability to tabulate without need for the paper. We should be very concerned about the direction ExpressVote is taking as it is so close to bringing back the electronic ballot.

Considering that we are starting afresh with a new voting system choice in Colorado it would be a regrettable mistake to allow the Express Vote to be used in Colorado because of its unusual physical format and the inability of ES&S to change this format to a standard full sheet of paper. ES&S does have another accessible device known as AutoMark and it does produce a full face ballot that can be indistinguishable from mail-in ballots. This would be a better choice than Express Vote for Colorado.

On the other hand, the DS850 proved extremely helpful to the mock RLA with its voter

independent edge printed serial numbers. This is a technology that will be added to all systems once the RLA details are made clear and one of the states (most likely Colorado) implements it. Now that we know that an edge printed serial numbering system is practical and works, we can expect to see that feature added to whatever systems are used in Colorado in the future- if we encourage that to happen. How soon and how it will be implemented depends on the competition that we have enjoyed and will continue to enjoy if multiple systems are sold in Colorado.

The DS850 is also remarkable in respect to its sorting capability. This is super useful if electronic adjudication is not being used, but once that is put in place, and the ballots are numbered, there is less need for the sorting facility. I would use its three trays for pre-sorting ballots by contest choice and also undervote prior to a recount- so that human judges could then check the machine sort to be sure that all presumed undervotes and out of target voter intent is properly counted. That would be a fabulous innovation that ES&S could uniquely add to their system. In that case it would be highly desirable as a central count device for a wealthy county (able to buy at least two.)

Likewise Dominion in-person ballot marking devices produce a non-standard paper ballot where the voter intent is electronically hidden in a QR code that isn't verifiable by the voter and verifiable contest choices are digitally printed on the paper but not in a format identical to mail-in ballots. In the case of Dominion, because of the use of COTS hardware, they are capable of changing the format of the ballot so that the verifiable text on the printed paper ballot is what is interpreted when scanning by central count. And they are technically capable of changing the entire printed format of the in-person ballot so that it is indistinguishable from a mail-in ballot. But only if we ask for that - by making it a condition of acceptance prior to some future election such as 2018.

Hart and Clear Ballot both endorse and employ in-person ballot marking that produces an indistinguishable paper ballot format. In fact, if these ballots can be corrected by the voter by hand marking them in case of for example a power failure. Hart and Clear Ballot have avoided the need for massive duplication of in-person ballots onto standard mail-in stock to achieve privacy of the voter intent in a state where we do not vote by precinct. Dominion is capable of joining this club.

Colorado is at a unique point in time where it can make the right decision to make sure that all paper ballots look alike. It would be a serious mistake to miss this chance.

Likewise Colorado is in a position to eliminate the electronic ballot - while implementing an electronic secondary representation of each ballot. The electronic ballot of record is one of the Achilles heels of the DREs. The QR ballot of Dominion and the barcoded ballot of ExpressVote both are virtually electronic ballots- the voter intent recording cannot be verified by voter or by election judges. It is printed on paper, but that basically does the auditor and the voter no good in current form as a QR or barcode. Dominion can relatively easily change this and has talked about plans to do so, but ES&S is probably too large and invested in current products to change it. Colorado should phase out the electronic ballot in all of its forms with the removal of the DREs (as they are naturally replaced).

All the systems are relatively auditable- all have a scheme for identifying ballots in a sequence in a box. All can produce batch subtallies. But technically the systems vary in how they digitize the ballot and the quality of the electronic secondary representation that is used by election judges during adjudication and would be used by the public after they obtain copies via CORA.

The air gap that forces the scanned voter intent to be physically transferred to the tabulation device is an important integrity facility that legacy equipment embraces. It should be continued into the future because it makes any transfer of results physically visible to all present including watchers. This will clarify the requirement for results to remain confidential until polls close.

Here is a tabular comparison of the systems for qualities relevant to transparency:

Criterion	Clear Ballot	Dominion
Identical ballot format, all methods of voting	yes	no
accessible cast vote record	yes- spreadsheet	unformatted text or image
air gap from scanning to tabulation	no	optional
on screen adjudication replaces duplication	yes	yes
resolution of ballot image	1704x2840x8bpp .jpg	1702x2806x1bpp .tiff
addressability of ballot	box number + sequence	scanner + batch + sequence
filename of ballot scan	AB-001+10001.jpg	00001_00003_000038.tif

Criterion	ES&S	Hart
Identical ballot format, all methods of voting	no	yes
accessible cast vote record	image	xml data
air gap from scanning to tabulation	no	yes
on screen adjudication replaces duplication	no	yes
resolution of ballot image	408x512x8bpp or 408x762x8bpp .pdf	1704x3338x1bpp .png
addressability of ballot	printed_serial +i	Batch + sequence + page+order+
filename of ballot scan	83354i.pdf	Batch2_Ballot82_Pg01_ScanOrd

Note that in documents received via CORA ES&S has the lowest spatial resolution of 408 by 512 pixels but they use an 8 bit format that could allow representation of grayscale. Dominion and Hart both use 1704 width by around 3000 pixels high but single bit per pixel. (the Y axis depends on the size of the ballot paper).
Single bit per pixel has no color or gray scale capability. I will try to provide examples in a separate email.

Clear Ballot has by far the best digital representation of the ballot with 1700 pixels across and 8 bits. The representations of voter intent of Clear Ballots are simply that- clear.

There are many other technical criteria one might use to evaluate- for example over the weekend I received the CD containing the system audit logs and various other documents for seven systems (Denver not included). I have not yet been able to discern the relative quality of these logs, but I have seen there are differences. Any of the defects found can probably be remedied as long as there is still an opening for decisions on purchase.

It would be wise to remember that the real benefit of a quality system is revealed under conditions of adversity and not in the conduct of a perfect election. For the most part relatively little adversity was met during this election (except Jeffco and their recall election). I am willing to venture a guess that of the 40 counties not planning to upgrade in 2016 most would really like to see the results of the 2016 election with say three or four new voting systems being used before they make their decision about what to buy. My guess is that over time the relative merits of these four systems will become more apparent, and their merits will actually accrue as we test them, especially if counties are willing to frankly share their experiences.

All of the serious considerations point to a continuation of use of multiple vendor systems in Colorado. Here is what I hope the PERC will recommend:

1) for 2016 all systems that were piloted in 2015 plus all legacy systems may be used- new pilot systems with upgrades under further temporary certification. Counties may buy the systems but with the following conditions for acceptance:

1) Express Vote may not be purchased. It may be rented for further pilot use until the 2017 election.
2) Dominion in-person and UOCAVA voting may be used in its current condition by rental only until the 2017 election. Dominion is encouraged to provide an in-person paper format indistinguishable from the mail-in format for the 2017 election.
3) No ballot of record should be encoded primarily in a non verifiable code such as QR. All voter intent to be scanned for interpretation and adjudication regardless of source should be human readable.
4) All systems should use an air gap between scanning and EMS/tabulation. Users of Dominion and ES&S can do this via an option with the present system. Hart enforces the air gap. Clear Ballot systems can be rented but should not be purchased until the air gap is enforced.
5) No ES&S system should be purchased until electronic adjudication has been implemented.
6) All systems sold in Colorado should have the capability of edge printed serial numbers for voter independent identification of paper/scan/cast vote record preferably by the 2017 election.

If some of these requirements need legislative implementation then the 2016 legislature can be asked to pass the appropriate bill.

Those are the basic recommendations I have and thanks very much for your consideration. As I continue my research I expect to be providing much more detailed quantitative information about the transparency and accuracy of these 4 systems. Unfortunately the time frame for this decision is too close to the election to do this project justice and CORA has failed to provide the necessary documents at an accessible cost and sufficiently early time delivery in many cases.

Harvie Branscomb