The following is extracted texts from the proposals to Georgia in response to a RFI. These proposals are shown on the web page of the GA SAFE Commission here:

http://sos.ga.gov/index.php/elections/secure_accessible__fair_elections_safe_commission

The comments here are those of Harvie Branscomb of electionquality.com, a Colorado election quality advocate, frequent election watcher in many Colorado counties in many elections, and participant in committees involved in the Colorado adoption of a uniform voting system as well as the Risk Limiting Audit by appointment of the Colorado SOS. Each vendor's section is treated separately under major headings. Green highlighting indicates my opinion in favor of what is expressed in the text, yellow is to suggest caution and special interest, red to indicate great concern. Comments mostly appear after each paragraph in brackets [] and are the opinion of Harvie Branscomb. What is printed in bold was copied from the State's request documentation by the vendors.

----------Clear Ballot----------

ClearVote will provide every voter with the opportunity to cast an identical paper ballot, including those using accessible systems. ClearVote also gives election officials greater transparency when reviewing an election. In a recount or close contest, this transparency gives election officials complete confidence in the accuracy of the results.

[The identical paper ballot for all voting methods is a best practice, and affords much reduced risk of association of a ballot sheet with a voter. The frequent appearance of the word "transparency" in this vendors proposal is an indication of focus of the company – one that is clearly friendly to verification and public accountability.]

The ClearVote system has established itself as the most auditable and reliable voting system on the market because of how the system preserves the voter's original ballot and never uses a summary or barcode ballot.

[Both summary ballot and bar-code are formats that will necessarily differ from absentee ballot, causing a potential risk for anonymity of the ballot sheet. Bar-code also adds a concerning layer of obscurity to the actual marks on the paper ballot. These two "features" advertised by other vendors are responsibly rejected by Clear Ballot.]

The most innovative capability of ClearVote is its ability to connect results directly to the voter's marks. Our innovative vote visualization allows administrators to have a clear view of a voter's intent, for a level of transparency that is unmatched. ClearVote allows election administrators to prove that every ballot has been counted as cast; an immeasurable benefit to our clients that will provide unparalleled value to the State of Georgia.

[Yes, ClearBallot is unique in providing a machine-assisted method of examining digital images (meaning in this case gray scale pictures) of paper ballots. This provides unique advantages for human cognition to enhance accuracy during the adjudication phase of election tabulation.

Dominion provides a threshold of pixel count within target that also permits visual consideration and adjudication of some ambiguous marks. ClearBallot's mechanism is much broader, allowing most ambiguous marks to be compared as a group.]

Ballot Sets

The concept of Ballot Sets was developed to eliminate duplicate effort in the programming and proofing of accessible touch screen voting and UOCAVA ballots. ClearDesign allows users to auto-generate ballot styles in various formats that are identical in our tabulation system. It also allows election officials to create a ballot style in multiple formats, such as a 20-inch, double-sided ballot for the polling place, but a 2-card 8.5x11-inch double-sided ballot for UOCAVA voters who may not have access to a large form printer.

[Ballot styles in various formats on paper will introduce a risk for ballot anonymity- likely to produce a unique style ballot for a given voter. But this is optional. While the cast vote records may be identical in the tabulation system this does not solve the anonymity issue for the paper and digital pictorial images thereof.]

High quality, off-the-shelf components provide optimal throughput for every precinct with 200 DPI grayscale images, the highest quality digital ballot imaging of any voting system on the market today.

[Clear Ballot images are in fact much clearer than other vendors with one bit per pixel image formats (only black or white pixels)]

Our technology digitally sorts every voted oval in an election making it easy for our customers to look at and confirm voter intent. ClearCount identifies and categorizes ovals by density in the candidate target area, which may represent uncaptured voter intent, ensuring every ballot is counted as intended.

[Voter intent is likely to be captured during adjudication that might not be captured if adjudication only takes place for overvoted contests, blank ballots or in case of Dominion, within a threshold designated for "ambiguous" marks.]

Digital Adjudication

ClearCount eliminates the need for election officials to manually duplicate paper ballots. Absentee ballots deemed unreadable by the system can be reviewed digitally. This allows officials to quickly and easily process ballots for voter intent by examining high-resolution images of the cast ballots, reducing the risk of human error inherent in ballot-handling, and significantly improving the speed and integrity of the tabulation process.

[While ClearBallot can adjudicate from a scan of a ballot that is totally machine unreadable, this presumes that all the voter intent is visible in the scanned image. Unfortunately that may not be the case, such as when the ballot is folded to obscure some selections. Other vendors will likely require duplication of voter intent on a new ballot sheet for machine tabulation to be used. Clear Ballot's reduction in need for duplication is desirable to avoid duplication error but also there are cases where the paper ballot must be used as a source for adjudication, not just the

image. In particular, during any audit of tabulation, the ballot sheets must be examined rather than the images thereof because of possible differences between them.]

2. Describe how your solution would accommodate each of the proposed methods of in person voting described in Section 3.4. Discuss the pros and cons of each method as it relates to your solution.

Clear Ballot proposes the ClearVote solution as an option for Method 1. This system includes digital scan tabulators and accessible ballot marking devices that produce identical paper ballots for in-person voting that are scanned in each precinct. This would be complimented by high-speed commercially available scanners for absentee, UOCAVA, and provisional ballots which would be tabulated centrally at the county office.

We believe this is the solution Georgia should consider for the following reasons:

• It provides an identical paper ballot for every voter

[best practice to achieve and maintain ballot sheet anonymity]

• There is no system "reinterpretation" of the voter's intent on summary ballots or bar codes

[The original gestures made by the voter are recorded on paper via hand-marking and not hidden within digital codes that the voter will not be able to verify. The summary ballot (choices only) isn't used thus allowing the voter to verify from a full set of choices as originally provided while voting. A best practice.]

• It provides the greatest level of auditability, transparency, and anonymity

[Three buzzwords but that are fundamental to integrity, verifiability and accountability. I'm looking for these concepts in the other vendors' proposals.]

• It is the most cost-effective solution of the 3 methods under consideration

[Hand marking via method "1" is promoted by ClearBallot.]

The thermal paper used for ClearCast reports is affected by the environment. Extended exposure to high heat conditions (100°F and above) will cause the readability of the thermal tape to diminish. If this is a concern, archival quality thermal paper, carrying additional coatings to protect against degradation due to heat, is available.

[Unlike other vendors, ClearBallot exposes and works around the known weakness of thermal paper.]

With our proposed Election Night Reporting system, the State will be able to provide online, statewide, public audit capabilities, should you choose to provide that level of granularity.

[This may be the only proposal that declares support for public audit capabilities – definitely something that has only recently been made possible by technological advances of voting systems. As ballot scanned images and cast vote records are now generated by newest designs of voting systems, and since we are capable of implementing substantive anonymity of these records, it is inevitable that the public (and more specifically campaigns on the presumed losing side) will want access to them to assist in and verify the auditing of elections as well as to gain confidence in the centralized and mechanized components of the election process.]

The Clear Ballot system produces the highest quality digital images of identical paper ballots in the industry. This provides voter anonymity and transparency.
This is essential to ensuring the security and auditability of your elections.

[The quality of the digital image used for adjudication by Clear Ballot is currently best in class to my knowledge. The uniform format of ballot sheet is a best practice to achieve anonymity of ballot sheet and privacy of voter's vote adopted by only a few vendors, here only Hart and Clear Ballot.]

----------Smartmatic----------

The PCOS: Smartmatic's PCOS SAES-1800plus rapidly and accurately scans and reads paper ballots. After the voter confirms their selection, the scanner encrypts and saves the vote securely and anonymously, ensuring the voter's privacy and the integrity of the vote.

[An excellent goal -anonymous vote- and it is fundamental to voter privacy. However, due to Smartmatic's choice of an under-glass paper audit trail and "innovative Cut & Drop printer," the ballot sheet of record for BMD users is physically different from an absentee ballot or vote in-person hand-marked ballot. Like with ES&S ExpressVote, this different format leads to potential exposure of identity of voter when the ballot style (controlled by residence)is unique among multiple styles combined as a result of use of early voting models (voter choice of location to vote or all styles might be voted in one place).]

The BMD: Our A4-600 is a combination of a BMD and a Digital Scanner and Tabulator. It guarantees independent voting for any type of voter and provides a printed vote record with the use of an innovative Cut & Drop printer. The vote record is stored in two different and independent instances, in the device memory storage and in a printed format that can be read by humans and secondarily also in QR barcode format. The Cut & Drop printer includes also a scanner that performs two scanning processes: an OCR of the text printed and the QR barcode reading. The voting application performs a triple comparison of the selections made: temporary record on memory versus the QR scanned selections versus the OCR scanned selections. This way the system corroborates that the vote has been cast as intended. The BMD is a fully accessible voting solution, which provides the voter an optimized voting experience that adapts to their needs

[apparently the scanner reads via OCR from the printed paper after the voter has made onscreen selections and caused the paper to print under glass- this OCR is an unusual and probably best practice for a BMD. Perhaps this means that voters using assistive modes will get the advantage of hearing the contents of the physically printed paper. And the device itself can verify that the printer successfully printed the selections onto the paper when comparing to the expected contents in memory and also within the barcode.]

Secure, auditable and traceable: The highest and strongest levels of cryptographic suites, digital signatures, data redundancy and access control based on different roles and profiles are implemented in the Smartmatic solution. We never tabulate from barcodes.

[Smartmatic tells us the system does not tabulate the barcode, but it does obviously read the barcode. The voter will have difficulty believing that the final source of the vote is the printed text. I am unsure what the meaning of "traceable" is in the above paragraph. In some cases traceability is good, in others it leads to violation of voter privacy.]

6. Highly secure transmission capacity: Smartmatic's voting devices are capable of

transmitting the consolidated results package to the RMS via wireless technologies, such as GSM/GPRS/3G/4G USB modem connected through the USB ports, or also via Ethernet based wired technologies, such as VSAT, BGAN, and DSL. It is important to note that the voting devices are not connected to the network while the election is open.The equipment has no embedded modem to allow network connectivity.

[This somewhat confusing paragraph suggests that wireless communication of results is beneficial and recommended, yet also says there is no "embedded modem" and that "while the election is open" there is no connection to a network. These statements raise red flags about potential interference from internet sources when the election is not "open."]

Our CCOS solution processes all Vote-by-Mail ballots. It supports 2 types of ballots:
1. The traditional paper ballot manually marked by the voter. These ballots are delivered to the voter and returned by mail to be processed with our CCOS solution.

2. In order to facilitate voting for voters wishing to Vote-by-Mail, Smartmatic is offering a more usable and accessible option as second remote voting channel. Our Online Ballot Delivery (OBD) system allows voters to access their ballot at home via any web-enabled device (desktop, laptop, smartphone or tablet), mark their ballot and then print their ballot.

[Printing of a remotely delivered ballot for physical return is a best practice for remote voting. However, that is only a best, safest practice if the blank ballot is printed prior to marking by the voter. In this case the implication is that the system allows remote machine-marking of the ballot prior to printing. In that case, the voter intent may or not be traversing the internet, and may or may not be subject to interference at the remote users uncontrolled machine. Some states are experimenting with remote ballot delivery mechanisms but not promoting that for general use. Here Smartmatic seems to be suggesting use of remote ballot marking not only for general remote use but also for use prior to in-person voting where the remotely printed ballot becomes the source of voter intent for the BMD used in-person. If this is the case, then there is much greater concern about the actual verification of the paper ballot printed by the BMD where at least two separate sets of software may have hidden influence over the content – one doing the remote marking producing a barcode and the other within the BMD itself.]

Smartmatic either uses contact, or contactless smart cards to activate a voting session on the BMD. The information on the smartcard is very basic. It contains the ballot style for the voter, any accessibility options, provisional flag, associated provisional ID, and a digital signature.

[the smart card is a mechanism that can associate a voter identity with the voted ballot. "Very basic" is best practice. What is described isn't "very basic." An "associated provisional ID" is a route to exposing voter identity within the BMD and ought to be avoided. Instead of voting provisional ballots on a Smartmatic BMD, provisional ballots could be voted in-person on hand-marked paper that is demonstrably anonymous, contained within an envelope that contains voter identity details. That method provides verifiable physical separation of voter identity from voter intent and not some invisible use of a numerical and presumed breakable link.]

As it can be observed on the above diagram, the difference between our offer for this method

and the way the State of Georgia foresees it, is that using Smartmatic's BMD, it is not necessary to introduce a paper blank ballot to mark the choices, and then retrieving the now marked paper ballot to be inserted into a PCOS for actual casting the vote. Smartmatic's BMD manages it all in the same equipment, without paper ballots, saving time, simplifying the logistics and operation, simplifying the voter experience and increasing the efficiency and accuracy by eliminating manual steps in the process from authentication to casting the vote. Even though, in the event that the State decides to implement this voting method, we offer our PCOS and BMD solutions.

[Both "in the same equipment" and "without paper ballots" are red flags. In the same equipment means that the same software instance both marks and tabulates the voter intent. That isn't wise, just as the DRE became an undesirable choice for similar reasons. I'm not sure why Smartmatic claims an advantage here "without paper ballots" when presumably the "cut & drop" device does print on some kind of paper. Again, the high "efficiency" of the Smartmatic BMD solution suggests excessive dependence upon the voter to catch any errors in the printout.]

PCOS
Our software is able to provide the voter the opportunity to review their selections again before recording the vote. After the voter confirms their selections, the vote is recorded and the paper ballot is stored inside the ballot box for audit purposes.

[Recent research suggests that voters are not likely to "review their selections again" after reviewing once on a BMD screen. While the design could involve reading back the voter intent after scanning on the PCOS I do not believe that is what is described here. What the software does to "provide the voter the opportunity" is not made clear.]

Another differentiation is that, considering that the ballots marked by the voters are paper-based, the system offers the option (during election configuration) to store in the voting device, aside of the image of the scanned ballots, a vote receipt of the selections read, facilitating the manual recounting of ballots, and random auditing processes of the election equipment that tabulate the votes and generate the election results.

[Here we see a description of what seems to be a human readable cast vote record. The text suggests that this might be used for "manual recounting" but I hope not. If there is a paper record that was either marked manually or verified by the voter, that should be the one to be used for recount and as the source of evidence for "random auditing." By the way, "random auditing processes" ought not be "of the election equipment." This suggests that the device's

software will be auditing itself.]

BMD

Furthermore, our solution protects voter privacy, and provides all necessary mechanisms to allow the voter to verify that their vote is being cast according to their will.

[While the statement is clear, the means of providing that protection of voter privacy are not. My understanding is that there is little or no provision for protecting voter privacy when a voter happens to be voting early on a BMD device (and associated paper ballot format) where they will be the only one voting on the ballot style defined by their residence address. I also question if the mechanisms to allow the voter to verify are "all that are necessary."]

In relation with the CONS of this voting method [1]:
• When using the PCOS, voters are forced to execute two steps in order to properly cast their votes: filling manually the paper ballot and then introducing it into the PCOS.

[This separation of steps is advantageous to verification of the contents of the ballot sheet. It allows for independence of the marking by software from the tabulation by software.]

2.2 MET H O D 2
In-person (early and election day) voting is conducted solely with BMD. Based on the Smartmatic's BMD A4-600 in the following way:
We don't foresee any disadvantage from our solution to this voting method, only advantages:

[Smartmatic supports BMD-for-all]

• Cost savings - only one voting machine model to be acquired, reducing services costs and since no paper ballots are needed, the amount saved on the paper acquisition and ballot printing is very significant, given that paper ballots must be printed without knowing in certain how many of them will actually be used.

[I am still unclear why Smartmatic is claiming their BMD solution doesn't require paper ballots.]

• No more paper handling - at the end of the voter experience, the voting machine prints and shows the voter their selection, and upon confirmation, the vote is cast. This is done with the use of the Cut & Drop printer attached to the BMD and allows the voter to verify the paper record behind the glass of the Cut & Drop printer.

[In effect the same as the VVPAT of the DRE, much criticized in election integrity circles.]

• Simplified Voter experience - this is what we consider the main benefit of our BMD system. The voter is not required to perform multiple steps for casting his vote, therefore investing more time to complete his vote. Smartmatic's simplified process is particularly beneficial for voters with mobility impairments. Regardless the voter is voting visually or aurally, they can verify the printed selections without having to handle the ballot and decide to approve or reject the paper record. If the voter approves the ballot, the voting machine generates an electronic ballot cast record, prints an approval mark and a unique code to facilitate risk-limiting audits. Finally, the machine drops the printed receipt in the ballot box. Otherwise, when the voter chooses to reject the paper record, the voting machine also drops it in the ballot box marking it as rejected.

[Note that the device prints on the paper record after the confirmation is complete, including a code that identifies the record to associate it with digital cast vote record. If the voter can see this code then they may have access to identify the record associated with themselves. If the printing takes place beyond the vision of the voter, it is possible for the vote record to be invalidated without knowledge of the voter.]

By combining hardware and software components in the voting solution, Smartmatic's BMD machine offers several voting experiences (audio, audiovisual, Sip&Puff, buddy buttons) that allow users with limitations to be able to exercise their right to vote independently, meaning that no assistance from the poll worker or any other person is needed

[Assistance from poll workers is very valuable and most likely needed.]

…our recommendation is the usage of only the BMD, simplifying the voting process for the voters and thus, increasing the accuracy and efficiency of the whole election.

[It is unclear how the accuracy of the election increases by all persons voting on BMD. Agreed there will be less evidence for failed capture of voter intent, as a generic BMD solution provides no mechanism for expression of confusion, misunderstanding, and disability beyond the capability of the BMD, etc. Any inaccuracy associated with the hand-marked paper ballot can be accommodated and corrected during a well implemented risk limiting audit where human eyes look at enough evidence on paper and adjudicate enough voter choices to reach a correct outcome based on tabulation.]

Quickly and accurately audit voting records - Smartmatic's voting system guarantees the vote is cast as intended by the voter by allowing the voter to first review the selections made prior to casting the vote, then verifying their paper record, the human readable portion of which is tabulated (no tabulation from barcodes).The vote record is stored in two different and independent instances, in the device memory storage and in a printed format that can be read by humans and also in QR format. The cut&drop printer of our BMD includes also a scanner that performs two scanning processes: an OCR of the text printed and the QR barcode reading. The voting application performs a triple comparison of the selections made:
1. The temporary record in memory

2. The QR scanned selections Versus and
3. The OCR scanned selections, which is voter verifiable
This way the system corroborates that the vote has been cast as intended. Once the voter confirms, the vote is recorded permanently on the memory media and the vote is actually recorded as cast. In the other hand, at the end of the election day, when the polls are closed, the voting machines tally the votes and generate a results report which can be verified by counting manually the printed vote records. Another method to audit the voting records is through the audit logs. Every Smartmatic's system maintains immutable internal audit logs, in which all actions performed by every user, exempting those that violate voter privacy, are recorded.

[Its is a valuable feature that human readable text is tabulated via OCR. But there is no proof to the voter that this is the case. The text above also indicates that the vote is recorded permanently on the memory media and that suggests that this device is a DRE with a paper trail. Its not clear what "those that violate voter privacy" means – but the audit log is clearly somehow redacted as it is made.]

In addition, we are the voting system vendor for Los Angeles County, the largest electoral county jurisdiction in the United State,
(5.2 million registered voters) over 4,000 square miles of geography. We will be completing the County's development of SW & HW, as well as required certification in time for the March 2020 primary election: This entails producing 31,500 voting machines and providing ALL required services to implement and support.

[The LA system is not in place yet, and one wonders how much of this proposal is based on characteristics of the yet to be implemented LA design.]

A risk-limiting audit involves manually examining
portions of an audit trail, which voters have had the opportunity to verify, ensuring that their recorded selections are accurate. Solutions which do not produce voter verifiable paper records, such as paperless touchscreen voting devices, cannot be audited this way. However, since our BMD prints a paper record containing an Audit Identifier (AID), our solution is able to support comparison risk-limiting audits for the ballots cast in a BMD at polling locations. Our solution can add this AID after the vote is cast, thus preventing the potential threat from violating voter privacy. Once the official results are available on the RMS, the election official can compare a randomly chosen paper record, with a digital image of the vote and its interpreted votes, by searching the AID printed on the vote receipt by the BMD. The same abilities exist in the CCOS solution as well.

[An "opportunity to verify" does not ensure that recorded selections are accurate. Here we see that the printing of the "AID" is after the "vote is cast" suggesting that the printer does affect the permanent record of the vote after the voter can no longer see it. The "AID" itself is the key to a comparison audit and best practice. And it is desirable that the voter not see the "AID".]

- Secrecy of voters: Smartmatic's voting machines strongly protect the sanctity and

secrecy of the voter's vote, through two main mechanisms:
a. Shuffling the vote file system: using a simple algorithm, the voting machine scrambles the contents of the file system, every time that a vote is cast, so that no external registry of the order in which voters used the machine can be used to trace a vote to a voter. This process guarantees the County that the shuffling occurs in both the logical (file system tables) and physical (disksectors) instances.
b. Ballot Secrecy: no personal information is ever recorded into the system, which makes it impossible for the voting machine to know who is voting at any given point in time.
These two mechanisms ensure to the County that the record of the vote cannot be traced to the voter.

[Smartmatic does address voter privacy with some awkward language such as "secrecy of voters." Voters aren't anonymous (with very rare exceptions) and they certainly aren't secret. The shuffling of disk sectors is a very deep and clever feature to avoid seriously technical attempts to associate voter intent with a voter. I hope they will at some point address the potential for associating voter intent to a voter through a rare style in a collection. Suffice it to say "these two mechanisms do not ensure to the County that the record of the vote cannot be traced to the voter." Particularly for mail ballots or for early voting.]

One of Smartmatic's BMD voting device primary strengths is that it was specifically designed to simplify the voter experience, considering especially voters with disabilities. The main advantage of our voting system is that no paper handling is required. At the end of the voter experience, the voting machine prints and shows the voter their selection, and upon confirmation, the vote is cast. This is done with the use of the Cut & Drop printer attached to the BMD and allows the voter to verify the paper record behind the glass of the Cut & Drop printer.

[These sound like features of the DRE, neither deemed particularly beneficial.]

Regardless the voter is voting visually or aurally (headphones), they can verify the printed selections without having to handle the ballot and decide to approve or reject the paper record. If the voter approves the ballot, the voting machine generates an electronic ballot cast record, prints an approval mark and a unique code to facilitate risk limiting audits. Finally, the machine drops the printed receipt in the ballot box. Otherwise, when the voter chooses to reject the paper record, the voting machine also drops it in the ballot box marking it as rejected.

[Note that the printer has the capability of rendering the paper record uncounted, thus opening a possible route for software interference with the record after casting.]

Smartmatic is willing to escrow code to the State, with release triggers representing the norms for voting systems (bankruptcy of the system provider, election contest, etc).

[Release to a court for election contest is a beneficial policy.]

The Smartmatic OBD solution is engineered for customers
who want to implement a remote online ballot delivery platform, which offers convenience to mark ballots anywhere. OBD is a fully accessible web-based platform, which allows eligible voters to access their ballot via any web-enabled device (desktop, laptop, smartphone and tablet), mark their selections and produce a printed, scannable ballot, or a unique, cryptographically secured ballot with a QR code summary of their selections. The printed version of this ballot can be sent in an envelope for vote-by-mail, and either a printed version or a digital one can be taken to a polling place to be scanned by a BMD for rapid and instantaneous vote validation and casting. In addition, Smartmatic proposes using this electronic ballot delivery solution for military service personnel and overseas voters. The Board could benefit by using OBD as their electronic ballot delivery solution, because this product is fully integrated with the voting solution we are proposing. In addition, OBD not only reaches overseas voters in a more usable and accessible manner, but also brings that benefit to all voters either voting by mail in early voting or in-person during Election Day.

[these topics handled earlier]

----------ES&S----------

Solution must have functionality to quickly and accurately audit voting records.
ES&S RESPONSE
The ES&S system will allow the State of Georgia to effectively and efficiently audit election results while maintaining the secrecy of the ballot.

[maintaining secrecy of the ballot ideally means ballot anonymity, not confidentiality. Each ballot sheet (in multi-sheet elections, each sheet is tabulated separately) must not be traceable to the voter, either by the public or by election officials. Producing and maintaining anonymity of each ballot sheet is an excellent goal, hence highlighted in green. Unfortunately ES&S's solution includes a feature that contradicts this goal. That is the difference in physical and logical format between absentee ballot sheet and in-person (ExpressVote) ballot sheet. This difference means that if either format is rare in any accounted-for collection, the ballot style of the ballot sheet may reveal the identity of the voter among those living at an applicable address for that style. This problem generally arises in central count situations such as absentee voting and also in vote centers such as early voting.]

To ensure security and protect voter anonymity, the ballot images and CVRs are stored with random names assigned to each ballot image file and have their file timestamps obfuscated

[File timestamps can be a route to associating a ballot sheet with a voter. Obfuscation of timestamps is useful to maintain anonymity in the tabulation context, whereas during eligibility it may be needed. Note that the sequence of in-person voters could be aligned with timestamps. This obfuscation is desirable to maintain ballot sheet anonymity.]

Electionware provides online adjudication that retains both the CVR as initially tabulated and the adjudication board's modified CVR. The ballot image, the machine-generated original CVR, and the review board modified CVR can be reviewed alongside each other.

[I'm almost sure they didn't mean online but onscreen. ES&S is a latecomer to onscreen adjudication that may be available only in the most recent software]

Solution must incorporate encryption and digital signatures as security measures.
ES&S RESPONSE
The ES&S system employs security in depth, meaning multiple layers of complementing measures. Security measures include integrated warning and alerts, user roles, data encryption, digital signatures, and physical security. No voter information is stored to the voting system software, ensuring voter privacy and security.

[as stated above, if the format of the ballot sheet is obviously different between mail and in-person voting, or between in-person paper and in-person BMD, then if any format is rare, it may contribute to association of the voter with the ballot sheet. Common format for all ballot sheets is a best practice to maintain anonymity and therefore voter privacy.]

13. Describe the accessibility features of your proposed solution for voters with disabilities.
ES&S RESPONSE
The ExpressVote allows voters to cast their votes unassisted, thereby maintaining their privacy and anonymity. Every ExpressVote is fully accessible, allowing any voter to select any ExpressVote without the need to declare a disability or be relegated to certain devices.

[assistance during voting is a user-friendly feature of election law that need not be avoided if avoidance leads to complex designs that otherwise impact integrity. Voters are not anonymous, in fact they must be identifiable in order to be deemed eligible to vote. Ballot sheets are expected to be anonymous in elections. Voters ought to be able to choose to have assistance and not be expected to use technical solutions. Unassisted voting does not necessarily maintain privacy. Second point- if ES&S BMD are all assistive then the device identity does not imply a potential loss of anonymity of the produced ballot. This is a beneficial feature, but costly if many BMD are purchased per each location.]

[The ES&S proposal contained little information within the range of my interests – namely anonymity, transparency, and auditability. That is why there are fewer extracts and comments for ES&S here]

---------- Dominion ----------

Audit Mark
Every single ballot in the election is imaged and appended with Dominion's patented AuditMark, a record of how the system interpreted the voter's selections. This ballot-level audit trail allows election officials and other stakeholders to review not only the ballot images, but also the tabulator's interpretation of each ballot.

[The Audit Mark allows a ballot image to CVR comparison but is not the basis of the well implemented risk limiting audit that looks at paper and compares that to the CVR and not the "ballot image."]

Each image is labeled with the tabulator, batch, and sequence number within the batch, which corresponds to the physical ballot in the stack. The AuditMark is appended directly to the image showing how the vote was interpreted at scan time. This AuditMark will also include any adjudications applied to the ballot for voter intent. Even if ballots for a given batch are mixed after scanning, these multiple records provide a way of correlating the digital Cast Vote Record data to the image scanned and finally to the physical paper ballot. While the AuditMark allows ballot-level auditing, it is never tied to the voter.

[The sequence number is a desirable way to associate central count ballot sheets to the cast vote records. It isn't desirable for in-person use because the order is typically the same as the order of voting on the device hence a risk for voter privacy. If the ballots become mixed up after scanning, deliberately or otherwise, unless a number has been imprinted, there would be great difficulty to recreate the original order to correlate the CVR with the paper ballot. The correlation is needed for a ballot level comparison audit. One could do it by comparing the images to the paper and resorting the stack only with great patience. Dominion has central count options that do imprint numbers that can be used for audit linkage.]

Ballot Marking Devices
Dominion's primary offering for ballot marking devices is the ImageCast X, which can be configured as a ballot marking device or a direct recording electronic with a Voter Verifiable Paper Audit Trail printer.

[Dominion is making a DRE version, not deemed desirable for several reasons.]

Voters make their selections on the ImageCast X, which then prints a paper ballot. The printed choice summary ballot contains a written summary of the voter's choices, as well as a 2D barcode that is read by Dominion's ImageCast Central tabulator. No votes are stored on the ImageCast X touchscreen unit. The ImageCast Central tabulators store and tabulate all votes.

[The ImageCast X when not a DRE, loses the tabulation and vote storage capability. However the ImageCast X printed ballot does save the voter intent to be tabulated in a non-verifiable QR code.]

ImageCast X Direct Recording Electronic

The ImageCast X can also be configured as a DRE configuration when accompanied by the VVPAT (Voter Verified Paper Audit Trail) thermal printing unit. The VVPAT method provides feedback to voters using a ballot-free voting system. The VVPAT is an independent verification system for voting machines designed to allow voters to verify that their vote was cast correctly, to detect possible election fraud or malfunction, and provide a means to audit the stored electronic results.

[Like Smartmatic, Dominion seems to value an election with no ballots. The consensus is that this isn't best practice for verifiability and hence for confidence.]

ImageCast Precinct
The ImageCast Precinct is one of the most widely used tabulators with over 100,000 units deployed worldwide. It is one of the most reliable optical scan tabulators, and safely stores and tabulates each vote from every ballot – including hand-marked ballots and choice summary ballots.

Used in large scale elections, the ImageCast Precinct is the industry's most reputable and reliable optical scan tabulator. Not only does the ImageCast Precinct tabulator consistently tabulate votes, it also has a strong track record on wireless results transmission in large, complex elections.

[Wireless results transmission is also a concern for Dominion.]

Simplicity and scalability are the main advantages of using the ImageCast X. To vote using the ImageCast X, a voter is provided with an activation card to activate the voting session and reveal the voter's specific ballot style. Once the voter has reviewed their ballot and has confirmed they are ready to print, the ImageCast X can print a reduced choice summary ballot on standard non-proprietary paper (8.5" x 11" or 8.5" x 14"), which contains a written summary of the voter's choices, as well as a 2D barcode which is read by any ImageCast tabulator.

[Dominion for BMD uses a choices-only ballot format and with a barcode containing the tabulatable voter intent. The format for BMD is always different from absentee format or in-person hand marked paper, thus leading to potential risks for voter privacy because of rare styles as described previously. The Dominion BMD does require review of ballot choices prior to printing, and leaves little motivation for the voter to later verify the contents of the paper. Likewise the reduced choice summary is difficult to verify because it likely does not identify all of the choices adequately.]

The ImageCast X configured as a Ballot Marking Device, or a Direct Record Electronic, supports an efficient tabulation process, while preserving both a paper audit trail and digital ballot images to support an efficient audit process.

a) Method 1: In-person (early and election day) voting is primarily conducted with optical scan paper ballots marked by hand. Ballot-marking devices are available to be used as

needed. Ballots (hand-marked and marked using ballot-marking devices) are scanned by digital scanners and deposited into a secure ballot box.
Potential solutions for Method 1 include utilizing the ImageCast Evolution as an all-in-one ballot marking device and tabulator, or alternatively, utilizing the ImageCast X as the ballot marking device and paired with an ImageCast Precinct as the tabulator:

Method 1
Dominion Voting has a variety of options available to meet the requirements set forth in Method 1.
ImageCast Evolution (ICE). The ICE is the only "all-in-one" ballot marking device and precinct tabulator on the market today. If the jurisdiction were to select this product offering then it would be the only unit required to meet the needs set forth in Method 1, drastically reducing the number of units needed to be deployed in any given jurisdiction. Dominion anticipates that additional information would be provided as part of any Request for Proposal that would further delineate the requirements set forth in this method of voting. At minimum 2-6 units per location would be sufficient to handle any Accessibility Voting requirements as well as Early Vote and in Precinct voting that would be done primarily on paper.

ImageCast X BMD or VVPAT with ImageCast Precinct. In this configuration, the ImageCast X can be utilized in either a BMD configuration or in a similar DRE configuration with an associated Voter Verified Paper Audit Trail (VVPAT). In a VVPAT configuration, the voter prints the verifiable audit trail and cast the vote electronically. In the BMD configuration the voter prints the ballot which is then subsequently scanned in the ImageCast Precinct Tabulator. In either configuration, the jurisdictions would only need 1-2 ImageCast X units per polling location. The associated number of ImageCast Precinct Tabulators would remain 2-6 units depending on the factors highlighted above.

[The DRE configuration is not a best practice for verifiability.]

Solution must have functionality to quickly and accurately audit voting records.
Agreed. Dominion provides strong auditing capabilities at every phase of the election event. Below, we provide details regarding auditing of the system and components to support a secure election project, auditing of vote records to provide timely election night returns, and post-election audit services to ensure transparency and accuracy of the election.

[Transparency is good but not ensured by the voting system or the post election audit. It requires best practices in both equipment use and audit.]

Ballot Audit Review
Dominion has developed a Ballot Audit and Review system to assist election officials in performing election canvasses and risk-limiting audits. This tool will be capable of sorting and filtering images of ballots by ballot style, precinct, polling location, contest and candidate, for the purposes of a recount or post-election audit. Officials can review all the digital ballot images in an election, or a subset of ballots based on the chosen filtering conditions.
This tool will provide an efficient and user-friendly interface for reviewing ballot images and associated results, as well as providing a framework to support a variety of auditing

methodologies.
This tool allows multiple officials to access digital ballot images with their Digital Ballot AuditMark marks, digital Cast Vote Records, and related review notes. Filtering options enables the creation of ballot review subsets for specific audit reviews. This tool resides in a secure post-election environment that is separate from EMS.

[Dominion allows access to ballot images but these are not appropriate for use as primary evidence in a risk limiting audit. In particular Dominion systems are often set up to drop out the red color from ballot images, thus ensuring that these images do not represent all that is on paper. In Colorado, the targets on ballots are printed in red so that they do not appear in the ballot image used for adjudication. Properly implemented tabulation audits will access paper and not only images.]

Officials can create ballot review sets by filtering for any given audit scenario including specific requests from Election Committees and other internal and external parties. Users may make notes to individual ballots and ballot review sets to aid in follow-on reviews and audit discussions. Administrators may create and assign a ballot review set to a specific official. Upon reviewing each ballot, officials may add a note, mark it for additional review, or mark it as complete. Ballots within a ballot review set may be sorted against these attributes as desired. Efficiency is realized through filtering and sorting capabilities. Officials may select specific filter criteria including District, Precinct, Precinct Split, Contest, Candidate, Tabulator, Outstack Conditions, Mark Fill Percentage, Adjudicated, Ballot Type, and or Ballot ID.
Flexibility is realized through user-friendly screen designs to aid in the rapid selection of filters and their choices in both large and small data set scenarios.

[Sorting ballot images by Mark Fill Percentage could be very helpful in a review that either enhances or complements a risk limiting audit. When the public gets access to perform such a review, additional confidence can be obtained- and most notably by potentially losing candidates or campaign committees who most need to become confident in the election outcome.]

Furthermore, the Administrator may choose to distribute a large ballot review set across multiple users to speed the process.
The Cast Vote Record, (CVR) export, in JSON format, includes the highest degree of granularity, detailing up to each mark read by the system.

[the JSON format has been found to be difficult to handle in Colorado counties. Dominion provides a .csv version in Colorado for this reason.]

The ImageCast Ballot Audit and Review module will allow election officials to perform very intricate filtering and searches on the universe of ballots. Including loading sets of ballots, precincts, ballot styles, districts to be retrieved. The system will allow the election officials to read the output of any system that generates random sampling of ballots.
This process will generate ballot sets that can be reviewed by multiple parties. The ballot set will contain the ballot images with all the auditmarks, and the cast vote record for each ballot.

[This paragraph suggests that the voting system itself might facilitate or even conduct an audit. It is concerning that the voting system might connect to the audit sampling device to provide evidence for the audit. That is probably a mistake. Audit sampling must be copiously independent of the voting system.]

Post-election Risk Limiting Audit Capabilities

Democracy Suite at its core produces all necessary data for the State to perform Risk Limiting Audits. A Risk Limiting Audit presumes that the voting system is incorrect and customizes an audit package based on the acceptable risk limits and determines the proper number of ballots for review as an acceptable audit sampling.

Dominion is very proud to have assisted 58 of 64 Colorado counties that utilize Democracy Suite in the first ever statewide Risk Limiting Audit. To fulfill each Colorado county's obligation to perform a Risk Limiting Audit, Dominion prepared an export of ballot images, cast vote records, and all data necessary for the ballot manifest, which were integrated with a third party open source module.

[In a well designed audit, the voting system would not be providing data for the ballot manifest from which ballot sheets are sampled. Ballot images were used in Colorado only for purpose of comparing to paper to check if the sampled ballot was obviously the incorrect ballot sheet.]

The paper ballot acts as the final CVR. In case of system failure, the ballots in each ballot box can be rescanned on a different tabulator, on either an ImageCast Evolution, ImageCast Precinct or ImageCast Central.

[Not clear to me what this "acts as the final CVR" means. I think it should say the paper ballot is the source of verified voter intent, not the CVR.]

----------Hart----------

At the polling place, after marking a paper ballot, the voter feeds it directly into the Verity scanner/tabulator. After scanning, paper ballots are automatically deposited directly into the secure Verity ballot box.
The ballot image is stored as a cast vote record (CVR) on a Verity vDrive flash memory device that is later read by the Verity tabulation and reporting software. In addition, the digital scanner/tabulator can quickly tabulate results and print ballot count totals and summary or precinct-by-precinct reports on its built-in thermal printer, on COTS paper rolls.

[Be aware that "ballot image" may not mean a picture, it might be a digital pattern of vote choices such as a CVR]

There is no need to pre-sort the ballots; Verity sorts them digitally, minimizing paper handling. Powerful filters enable users to quickly retrieve high-quality digital images of exactly the ballots needed, if needed.

[Hart also relies heavily upon ballot scanned images (not patterns but pictures) in resolution that is its verb for the process of adjudication. Hart's images are one bit per pixel like others, except for Clear Ballot that is gray scale and therefore higher quality. Because the paper and not the image is the original source of voter intent, there will likely be cases where sorting of paper is desirable or necessary.]

It is easy to view, double-check, or audit the adjudication process. Color-coded flags indicate issues to be resolved, so ballot review board members can easily observe the adjudication process. Verity's extraordinary filtering capabilities enable team members to quickly zero in on the exact ballot or collection of ballot images needed for a quality assurance check, recount, or other task. Every action taken in Verity is tracked in a plain-language audit log, and you can view each ballot image in its annotated or original form. Verity provides full support for risk-limiting audits.

[This full support for RLA is unclear. Presumably it means in part there is a CVR for every ballot sheet. And one hopes it means that ballot sheets can be associated with CVRs without impinging on voter privacy.]

Tabulation/reporting. Sharing the same intuitive user interface as all Verity software applications, the tabulation/reporting solution tabulates cast vote records captured via the in-person scanning/tabulation devices in the polling place or the high-speed scanner and stored on flash memory modules.

This software application also provides reporting capabilities for a wide variety of system information gathered from other voting system components, including audit log from all devices including the ballot marking devices (which do not store votes but do capture auditing data).

[It isn't clear what auditing data is captured by the BMD and there could be advantages as well as concerns, but it is good practice that BMD do not store votes.]

For Method 1, voters hand-mark paper ballots for early and election day voting. Alternatively, voters can choose to mark ballots using Verity's accessible touchscreen ballot marking device; then print them. Voters cast their ballots by inserting them in the Verity scanner/tabulator, which captures the cast vote records and deposits the ballots into a secure ballot box.

Pros - Method 1
[besides lower cost]
• Hand-marked ballots viewed by many election stakeholders as the most trusted method of voting (voter selections never tabulated from a bar code or QR code)

[Hand-marked ballots are the most actually verified, and provide best evidence collected about vote capture quality. Risk limiting audits that are well implemented will correct enough ambiguous marks that aren't readable by machine to obtain a correct outcome of tabulation.]

• Efficient tabulation and transparent, human-readable ballots for audits and recounts

[Best practice.]

• Fast voting without long lines at the polling places because voters do not have to wait for an available touchscreen ballot marking device

[Costs of electronic vote capture result in unfair distribution of equipment to voters, voter tendency to vote at last minute makes it difficult to save money with this method.]

• Modern on-demand ballot printing streamlines early voting process and insures against running out of ballots on election day
• All voters (absentee, early, election day) vote on identical ballots whether hand marking or using a touchscreen ballot marking device

[Along with Clear Ballot – a best practice for defending voter privacy.]

Cons - Method 1
• Preprinting of ballots for election day can require overprinting and added paper expense

[Does require "overprinting," but by very predictable amounts in precinct polling places. In early voting, centralized repositories of complete sets of preprinted ballots are possible and BOD could be used for emergency printing.]

• Voting devices must effectively alert voters to potential mismarks

[Rather than a disadvantage, this is actually an advantage of hand-marks that voting devices (when not used as central count) can and do help alert voters to some contest choices that cannot be machine tabulated.]

Cons – Method 2
• Machine marked ballots may be questioned for accuracy if the selections are captured in a bar code or QR code

[Since to my knowledge the Hart system doesn't encode voter intent in a bar code, I'm not sure this is a "con." Machine-marked ballots may be questioned for accuracy if the paper ballot hasn't actually been looked at by the voter (or verified through the assistive system). Obviously there are many other "cons" as other vendors have noted.]

Method 3. Not recommended

[Agreed. Method three is unnecessary- early voting is much easier to supply with multiple pre-printed ballot styles even though many styles may be applicable in one place. Adams County Colorado has supplied dozens of vote centers with hundreds of preprinted ballot styles.]

• Solution must have functionality to quickly and accurately audit voting records.
Yes; Verity provides comprehensive, built-in auditing capabilities. Users can quickly and accurately audit voting records and can conduct risk-limiting audits.
Throughout all phases of operation, all Verity system components maintain complete audit logs. Every Verity device and application logs all user authorization/authentication, data entry, user interaction, and system events. Election managers can print or export audit logs from each device and application. Not every vendor's solutions include this comprehensive, built-in auditing capability.

[Verity ought not "conduct" risk limiting audits. It can facilitate them by providing CVRs and linking of records without linking to voter identity.]

Verity's tabulation/reporting software provides intuitive, easy to use dashboards to perform post-election audits, in a highly filterable way.
Referencing between the paper ballot and its digital image allows for post-election audits, including risk-limiting audits. By maintaining linkages between the cast vote record, the ballot image, and the ballot, Verity supports such audits. With Verity, auditors can compare the cast vote record that was tabulated with the original ballot.
Verity provides powerful filtering options to allow users to examine any subset of cast vote records they choose, so that the audit is truly independent of the voting system. Verity filters can be applied across the system to examine the cast vote records in your selected sample, run a tabulation report of just the votes in your selected sample, and view ballot images only from your selected sample.

[Again, performing post election audits is not a role for the voting system – the thing to be audited. Digital images (other than CVRs) do not play a role in the RLA- but can be useful for other reviews to compliment the post election audit. As the Hart text says, the audit is to be truly independent of the voting system.]

Solution must incorporate encryption and digital signatures as security measures.
Yes; Verity's unique architecture provides the reassurance of NIST/VVSG compliant cryptographic modules, while maintaining human readability of cast vote records, for auditability. Verity security measures optimize the use of encryption and digital signatures to protect from modification all election data, cast vote records and audit logs on physical media.

[Human readability for auditability is important. Here Hart also suggests that security measures are to protect from modification instead of only to prevent or limit access. That is an important point missing in other vendor proposals.]

While the digital scanner/tabulator retains all cast vote records in redundant locations, it does not store tabulated results but instead stores cast vote records and tabulates those records each time reports are generated from the device.

[It is a best practice to pay attention to CVR as a vital representation of the vote, but not as crucial as the paper ballot itself. The RLA establishes adequate credibility for the CVRs to represent the election based on the margin.]

Hart was the first voting system provider to use digital image capture, and Verity is Hart's second-generation system that uses this technology. Our digital scanner/tabulator captures images of the complete ballot and can accept multiple ballot styles and tabulate results on a precinct-specific basis.

[Kudos to Hart for pioneering the capturing of pictorial images of ballots now becoming universal.]

For security reasons, we do not publish complete details of Verity security features.

[This sounds ominously like security by obscurity.]

The following is a high-level overview of Verity security highlights:
• Verity is in no way connected to: Internet, any intranet or in-office networks, voter rolls/registration, voter personal data, campaign/donor information, party/campaign volunteer information or schedules, Voter communications regarding times/locations for early or Election Day voting, or email systems.
• Verity software cannot be remotely accessed by Hart or anyone else, including remote access for troubleshooting (no remote desktop).
• Cast vote record data is digitally signed using NIST-compliant FIPS 140-2 cryptographic modules.

[Use of digital signing to protect records from unauthorized modification is highly desirable.]

• Multiple redundant data backups ensure that any malicious data manipulation would be detected by comparing data sets during an audit (e.g., compare paper ballots to electronic cast vote records).

Hart supports the most rigorous post-election audits, including risk-limiting audits. Audit features allow election officials to maintain and access a detailed electronic record of all activities that occur related to the system, as well as the ability to review cast vote data to verify the results and detect any errors. Auditing is not only a big part of election security and verification of results but is also instrumental in the ability to detect attempted data manipulation. We believe that every state should have mandatory and consistent audit requirements and that audits should be conducted for every election. Audits help to provide voter confidence in the electoral process.

[Hart is clearly audit conscious in this proposal. Compliments to them for that.]

No segregated ballots. All voters cast the same type of ballot

[Again, to protect voter privacy, (almost) all voters cast the same type of ballot (which actually means all ballot sheets tabulated are of same type.) UOCAVA votes might come in on a different format to be duplicated onto standard forms.]

----------Unisyn----------

[Unisyn locked the pdf of their proposal so it cannot be extracted for comments. This appears to this reader to be a probably inadvertent indication of lack of interest in transparency. I transcribed one sentence.]

"RLA is a standard feature of the OpenElect suite of Software certified products."

[This is a not particularly convincing reference to RLA. It could hardly be a standard feature when the audit must be independent of the voting system.]

Harvie Branscomb 1/8/2018