Election Systems and Software, Inc.
Direct Recording Electronic Products:

iVotronic Touchscreen Voting System
and Unity Software

An Evaluation

Prepared for
The Secretary of the Commonwealth of Pennsylvania

by

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Summary

This report contains the findings of the examiner appointed by the Secretary of the Commonwealth arising out of a certification examination of the Election Systems and Software, Inc. iVotronic touchscreen voting system and Unity software conducted in Harrisburg on November 16-17, 2005 pursuant to the Pennsylvania Election Code, 25 P.S. §3031.1.

Based on the examination, both iVotronic and Unity may be certified under specified conditions.
Introduction

Election Systems and Software, Inc. ("ES&S") presents a suite of products for certification. Those related to optical scan voting are treated in a separate report. This report deals with the company’s DRE product, iVotronic, and Unity, its election setup and tabulation software.

The Pennsylvania Election Code, 25 P.S. §3031.7, requires a voting system to be examined by the Secretary of the Commonwealth or “an examiner appointed by him” for compliance with mandatory statutory standards. I was the “examiner appointed by him” for the ES&S examinations held November 17-18, 2005. In addition to the Pennsylvania Election Code, the Help America Vote Act ("HAVA"), 42 U.S.C. §15301 ff. also requires certain minimum standards for voting systems used in elections for federal offices. This report details my conclusion based on both sets of mandatory requirements.

Unity

Unity is the name of a set of software programs that operate collectively to define elections, program tabulating machines, lay out ballots and accumulate results. Because multiple types of voting equipment may be used within the same jurisdiction (e.g. DREs for in-precinct voting and optical scan for absentee), it is useful to have a single, comprehensive suite of software to accomplish all necessary tasks from a single database.

Unity 3.0 runs under Windows XP and includes the following components:
- Election Data Manager (EDM) version 7.4.3.0
- Image Manager (IM) version 7.4.1.0
- iVotronic Image Manager (IVIM) version 2.0.1.0
- Hardware Programming Manager (HPM) version 5.2.2.0
- Election Reporting Manager (ERM) version 7.1.1.0
- Audit Manager version 7.3.0.0

Unity 3.0 also includes other modules not submitted for certification because they are not applicable to Pennsylvania, such as Data Acquisition Manager. The interplay of the above components is illustrated in the figure on the next page.

The Audit Manager is used to set up and administer accounts and passwords. Even though login is required to bring up Windows XP, a separate login can be required to access various Unity components. Audit Manager maintains a database of all authorized user IDs and passwords. It also produces audit log reports of significant election events. For example, it is able to list every event and who performed it so that irregularities can be pinpointed. To do this, it read audit log files that are updated by other Unity programs.

Election Data Manager (EDM) is used to set up elections, from the geographic structure of jurisdictions, down to parties, races, candidates and issues. It is designed to
support elections in numerous states, and therefore allows a generous, and at times dangerous, set of options for defining elections and their characteristics. Some information is designed to be entered once and edited only infrequently, such as the geographic structure of a county and its election districts. Other information, such as candidate names, will change in every election.

The principal output of EDM is a set of files defining ballot styles and various election parameters. The “Ballot Styles” files are read by other programs in the Unity suite to perform different functions, such as setting up tabulating equipment to recognize different ballot styles and count them properly.

After EDM has been run, two different Image Managers are used to define particular ballot layouts. IM is for optical scan ballots and iVotronic Image Manager (IVIM) is for DREs. The layout information is used to update the ballot styles file with precise measurements indicating where candidate ovals appear on the ballot, for example. Image Manager is able to produce camera-ready files from which optical scan ballots can be printed.

Once the Ballot Styles database has complete information, Hardware Programming Manager (HPM) is able to create media with ballot program coding for the Model 100 and Model 650 optical scan units. An analogous product, AIMS, is used to produce ballot programming for AutoMark.

HPM understands tabulating options and its output is needed so that vote totals can be reported properly from various tabulators. The Election Reporting Manager (ERM) receives ballot data from the tabulators and tabulation parameters from HPM so it can produce jurisdiction-wide totals.
Unity is designed to support all ES&S products, and even permits several different types of voting equipment to be used in the same county. This objective, along with a need to support the diverse election requirements imposed by multiple states, makes for a complex product requiring considerable training to use properly.

iVotronic

The iVotronic with firmware 9.1.2.0 was submitted for certification. This is a touchscreen DRE machine with an onboard VVPAT printer and battery backup power supply. It is programmed for an election through the use of a supervisor Personalized Electronic Ballot ("supervisor PEB") that is inserted in a slot in the machine. Data is transferred from the PEB to the iVotronic through an infrared (IrDA) interface.

After the polls are opened, a poll worker activates the machine for voting by inserting and removing a voter PEB. The ballot style appropriate for that voter is then displayed on the screen, and the voter may begin voting in the usual touchscreen DRE manner. After a ballot is cast, the machine is deactivated and no other vote can be cast until another voter PEC is inserted and removed.

To cast a vote, the voter has two options, although the reason behind offering both is unclear. There is a physical button at the top of the unit for the voter to press. Alternatively, the voter can press a "soft" button that appears on the touchscreen. The modes of interacting with the hard and soft buttons are slightly different, as is the machine’s response to them. My recommendation would be to dispense with one or the other, since the presence of both is confusing – the voter does not know which one to press, and the voting booth is not a place that should promote confusion.

Multiple iVotronic units may be used in a polling place. They are not networked, but ballots from the entire polling place can be accumulated on a single PEB for tabulation on any one of the machines. Because of the integrated VVPAT printer, zero tapes are produced on a separate unit called a "communications pack." This device is fundamentally a printer with communication interfaces and a modem for uploading results. To produce a zero tape, the communications pack is connected to the iVotronic temporarily and the polls are opened. The zero tape is printed on the pack. The pack is then connected to the next iVotronic, etc. until zero tapes for all have been produced. In another operating mode, the pack produces a combined tabulation for all of the machines at a polling place. These totals should naturally all be zero.

At the close of polls, summary tabulation report can be printed out on the attached VVPAT printer or on the communications pack. In addition, ballot images can be written to a PEB, which can be transported to election central for accumulation.

iVotronic is accessible to visually impaired voters through an audio interface and ADA scroll buttons and is also accessible to wheelchair-bound voters.
The Examination

Present at the examination on November 16-17, 2005 were the Commissioner of the Bureau of Commissions, Elections and Legislation, various representatives of the Department of State, public observers and representatives of the vendor, Election Systems & Software, Inc. The examination began at approximately 9:00 a.m. in Harrisburg at the offices of the Secretary of the Commonwealth and lasted approximately 11.5 hours in total. The examination was recorded on videotape and transferred to four DVDs, which constitute the official record of the proceedings.

The iVotronic unit was tested by casting sample votes and then running through two standard tests.

Logic

The initial version of iVotronic that was demonstrated did not implement correctly the Pennsylvania method of overriding straight party votes in vote-for-many offices. If a voter votes straight party but then wishes to cross over to one or more different candidates in a partisan office, she need only touch a single candidate. The mark opposite that candidate should remain on, while all others in that office should be erased.

The initial behavior observed was that in the situation described, the candidate touched after a straight party vote was deselected instead of singularly selected. This corresponds to the “All-States” method of tabulation (more properly, the “All States Except Pennsylvania Method”). If a voter made a straight party selection and then changed her mind and deselected that party, she received a factually incorrect message stating, for example, “You have chosen to deselect ALL of the candidates of this party: DEMOCRATIC. Any candidates that you have individually selected from a different party will be retained.” This message is wrong because it is not true that the voter has chosen to deselect all Democratic candidates. In fact, all the Democrats individually voter for will be retained. The message should read, “You have chosen to deselect all candidates not individually selected from this party: DEMOCRATIC. Any candidates you have individually selected from this or a different party will be retained.”

The vendor’s defense is that the message displayed is merely from a text file and could be easily changed during election definition. While this may be true, the fact remains that the iVotronic documentation does not mention Pennsylvania or the Pennsylvania method, and does not instruct the operator how to change the message so it reads correctly.

The behavior of iVotronic differs from that of AutoMark. AutoMark faithfully implements the Pennsylvania method. The prominent undervote warning messages from AutoMark are missing on iVotronic. Instead, the voter is alerted on a summary screen of any offices that were undervoted, and it is easy to ignore the alert and cast an undervoted ballot anyway.
The Logic Repair

During the overnight interval between days 1 and 2 of the examination, the vendor repaired iVotronic’s deviation from the Pennsylvania method. This required a change to the unit’s firmware. The change was made in Rockford, Illinois and sent to Harrisburg via email. It was recovered and placed on a flash card for loading into the iVotronic. This resulted in a new version number, 9.1.3.0a, and will require ITA qualification.

A complete set of ballots was cast on the iVotronic with the new firmware and tabulated. It now correctly implements the Pennsylvania method without any loss of counting accuracy.

Physical security

Several aspects of the iVotronic design have negative security implications. The compact flash card, which can contain audio ballots and long text ballots, is inserted in the iVotronic at the polling place. This raises the question by what secure mechanism, if any, it gets to the polling place, and what prevents substitution of a different flash card. While there are various consistency checks performed between the flash card and the PEB, it is accepted practice to load ballot programming at the warehouse and seal it in place in the machine, rather than resorting to the relatively uncontrolled conditions at a polling place.

Various cables are connected to the iVotronic at its top edge as viewed by the voter. These connections are open and unsealed and the connectors can easily be disconnected by a voter. While such tampering would probably be apparent to the poll worker, no such temptation should be present.

The communications pack has modem upload capability so results at the close of polls can be transmitted to a central location. The Department has determined that such modem transmission is not permissible. The perceived risk that an intruder might obtain the telephone number of the recipient computer and introduce spurious totals, whether realistic or not, outweighs the small speed advantage afforded by modem transmission.

Zero tape

25 P. S. 3031.7(16) provides that “If the voting system is of a type which provides for the computation and tabulation of votes at the district level, the district component of the automatic tabulating equipment shall include the following mechanisms or capabilities: … (v) It shall be equipped with an element which generates a printed record at the beginning of its operation which verifies that the tabulating elements for each candidate position and each question and the public counter are all set to zero and with an element which generates a printed record at the finish of its operation of the total number of voters whose ballots have been tabulated, the total number of votes cast for each candidate
whose name appears on the ballot, and the total number of votes cast for, or against, any question appearing on the ballot."

iVotronic is a district level system, and the “district component” must be equipped with an element that generates the required printed records. While iVotronic with the VVPAT produces totals at the finish, it does not produce a zero record (commonly called a “zero tape”) at the opening of polls. To do that, the communications pack must be connected to each voting unit in turn, and a zero tape is produced on the printer attached to the pack. In this configuration, the “district component” is not equipped with an element that generates the printed record, as required by the statute.

One might argue that the combination of the iVotronic and the communications pack together, when connected, are equipped with the required element. However, the statute clearly contemplates that the element be a permanent part of the district device. The reason can be found by considering the purpose of the statute. An old method of election fraud was to use machine on which votes had already been cast. Some method is necessary to assure the public that this has not occurred and that each unit has been properly zeroed for the election. Connecting a foreign device to a voting machine and having it print a zero tape does not provide the necessary assurance.

The problem is easily solved. Since the VVPAT printer already produces a totals report, as required by the latter prong of the statute, it would be a simple matter for it also to produce a zero report on the opening of polls.

The iVotronic VVPAT

To comply with statutory requirements in other states, ES&S has added a “Voter-Verified Paper Audit Trail” (VVPAT) printer to iVotronic. This printer allows a voter to vote normally as with a regular DRE and review and edit her choices on the machine’s screen, but take one additional step before proceeding with the irrevocable act of casting the ballot. The extra step is to view a contemporaneous piece of paper containing the voter’s choices. The voter then has the chance to review her choices, which is the step of “voter verification.” If she agrees that they correctly reflect her desired votes, she then takes the final step of confirming the ballot. If she disagrees with the paper record, she may engage in the digital analog of a spoiled ballot process, void the ballot and vote again without having her first ballot recorded.

An “audit trail” must be distinguished from an “audit log.” An audit trail permits examination of an image of each ballot cast for recount or retabulation purposes. It is possible to count an entire election from an audit trail. An audit log is simply a time-stamped record of significant election events, such as the opening of poll, insertion of a PEB, closing the polls, etc. While an audit log is important to diagnose and explain alleged election irregularities, it cannot be used to count votes. iVotronic can maintain both an audit trail and an audit log.
VVPAT systems differ in the methodology of how the ballot is printed, how it is shown to the voter, what handling the voter is permitted to perform on the ballot, what sorts of security mechanisms are used to prevent ballot-box stuffing with forged ballots, etc.

The figure below gives a taxonomy of VVPATs:

In this taxonomy, the iVotronic VVPAT is a continuous-roll, no indicia, real-time audit trail. In a continuous roll system, the audit trail is printed on a roll of adding machine tape that is pooled from a source reel to a take-up reel in a unit that is locked in the machine. A “no indicia” system does not print cryptographically encoded information on the audit trail that can be used to invalidate a ballot. Crypto indicia systems used encoded information not readable by the voter for various cross-check and anti-counterfeiting purposes. iVotronic does not do this. It does print a bar code corresponding to each ballot on the VVPAT, but this bar code is used for rapid tabulation, not for ballot invalidation. A “real-time” VVPAT prints a line each time a voter makes a selection or deselects a candidate, as opposed to other VVPATs, which only print out the ballot at the time the voter indicates a desire to cast a final ballot.

It is not necessary to analyze the iVotronic VVPAT in detail, since its design precludes its use in Pennsylvania. A fatal flaw in continuous roll systems is that they allow a complete violation of voter privacy. Since the ballot images are recorded on paper in the order in which they are voted, merely comparing each ballot image with the poll list (or any other record of the order in which voters voted), will reveal every voter’s choices in a given precinct. Such a system would violate 25 P.S. §3031.7(1), which states that no electronic voting system can be approved unless it “provides for voting in absolute secrecy and prevents any person from seeing or knowing for whom any voter, except one who has received or is receiving assistance as prescribed by law, has voted or is voting.” It also violates the Pennsylvania Constitution: “All elections by the citizens shall be by ballot or by such other method as may be prescribed by law; Provided, That secrecy in voting be preserved.” Pa. Const. Art. VII, Sec. 4. Thus even the Legislature
may not impair the right of privacy in voting, and certainly may not provide for a system that would expose to view the votes of all voters in a jurisdiction.

Because of this constitutional provision, the iVotronic VVPAT cannot be used in Pennsylvania and cannot be certified. The poll list is not a secret document, and nothing prevents a volunteer authorized by a candidate or political party as a “watcher” from remaining all day in a polling place and recording the order of voters and, if necessary, which machine they voted on. If a recount is ever requested from the VVPAT, the ballot of every voter who used the machine will be revealed, in contravention of the Pennsylvania Constitution.

The continuous roll design is puzzling because ever since DRE voting became legal in Pennsylvania in 1980, every DRE system used in this state has included a paper audit trail function because 25 P.S. §3031.1 requires that such a system “shall provide for a permanent physical record of each vote cast.” These audit trails are not visible to the voter, and great pains are taken by the vendors to avoid any possible matching of a ballot image to a specific person. Some systems produce contemporaneous audit trails; that is, a ballot image is printed internally each time a voter casts a vote. Others maintain a record on computer media that can be printed out on demand after the close of polls. In both designs the audit trails are randomized so that the image printed is not necessarily that of the voter who just finished voting. Continuous roll systems fly in the face of at least 25 years of required randomization.

Even if a randomized VVPAT were to be produced, a different feature of the iVotronic audit trail also precludes certification. Each ballot image printed contains a unique number called an electronic index number (EIN) whose purpose is to allow the paper record to be matched with the (randomized) electronic record maintained on the machine. While such a number might prove useful in analyzing any discrepancy between the paper record and the electronic one, it constitutes an identification mark in contravention of Pennsylvania law. 25 P.S. §3063(a) provides that “No ballot which is so marked as to be capable of identification shall be counted.” The purpose of this statute is to inhibit vote-selling. If a voter places a unique mark on a ballot so party officials can learn positively how he voted, he can be rewarded with cash after the election. What largely prevents vote-selling is the secrecy of the ballot. If a voter claims to have voted a particular way, there is no way for him to prove it.

The iVotronic VVPAT provides an easy and convenient method of proof. All the voter has to do is write down the unique EIN printed on the VVPAT before leaving the voting booth. He then provides that number to his party. When the audit trail is printed out, the party will be able to verify that he voted as claimed. This is true even if the randomized electronic audit trail is used. The voter must not be allowed to see any unique identifier on the ballot.

The vendor has suggested that if its VVPAT mechanism is not certified, it will remove the printer from the iVotronic and rely entirely on the communications pack to
produce reports. This would contravene 25 P.S. §3031.7(16)(v). Instead, the onboard printer should be retained but used for printing zero tapes, totals reports and a listing of the electronic audit trail.

Unity

Unity was examined by having the vendor demonstrate the functionality of all the modules in detail. Unity was tested by having it program tabulators for elections and accumulate results from the various machines centrally using Election Reporting Manager.

The vendor conducted a thorough walkthrough of the use of various modules of Unity, even down to a detailed examination of various screens. All of the modules presented for certification were reviewed in this way, and a number of issues arose, as discussed below.

Uploads

We were able to import results successfully from the M650 scanner and the iVotronic. Uploading from the M100 could not be demonstrated because of a faulty media reader. It will be necessary for the vendor to demonstrate uploading to the satisfaction of the Department of State before the M100 can be certified.

Illegal options

Unity is a very complex system because it must handle the huge variety of voting practices encountered throughout the United States. It is unrealistic for a vendor to support numerous distinct versions of its system one for each state, so ES&S has taken the logical approach of building all possible election options into a single system.

Unfortunately, the number of options that can be chosen in setting up an election is large. Some options, such as a straight party race, are mandatory in Pennsylvania. Others, such as ballot rotation, are illegal. Yet others, such as the sort sequence for tabulation reports, are completely optional to a jurisdiction. For some options, it is not at all clear whether they should be chosen or not. In some circumstances it was necessary to seek a legal opinion from the Department of State counsel’s office.

Here are more examples. EDM allows a race to be eliminated from the ballot completely if no candidates are running. This is illegal in Pennsylvania. The race must be shown, and there must be enough write-in spaces provided to vote for the maximum number of allowed candidates. EDM offers an “Eliminate Write-Ins” option. This must be chosen in Pennsylvania for primaries but must not be chosen for general elections. Another option is whether to expand cross-filed candidates (that is, list them separately for each party that has endorsed them) or once only (with a list of the endorsing parties). This choice is up to the county, but it is mysterious to me how a county elections director
would know that since an opinion of counsel was needed to determine the answer. Some other options are legal but simply unwise. One of these is to allow the voter to cast her ballot without viewing a summary page. This should not be chosen because it eliminates any undervote warning and clearly increases the risk of error. Another option is “allow overvote,” which is not only illegal in Pennsylvania but in all federal elections under HAVA as well.

The Unity manual is 265 pages long. In it, the term “straight party” occurs 114 times. The word “Pennsylvania” occurs only once, describing an option for printing absentee ballots. There are no instructions on how to invoke the Pennsylvania method, for example, nor any indication that ballot rotation must not be chosen. Legal setup of an election is entirely up to the training and experience of the programmer at the county board of elections.

Not only does the word “Pennsylvania” not appear in the appropriate place in the Unity manual, it also does not appear on Unity setup screens. Some options are not explained in the documentation at all. One of these is a very dangerous option called “straight party inclusive logic.” Apparently required in Indiana, but nowhere else, this option causes the machine to select candidates automatically on behalf of the voter if she has not voted for the full number of candidates allowed in an office.

Some setup choices that appear innocuous can cause anomalies that might evade proofreading. In the primary election that was set up by the vendor in advance, the wrong font size was selected for write-in names. The ballot face looked completely normal. However, when a write-in was entered for “Rose Johnson,” the font was so large that only the letters “ROSE” appeared on the ballot and the review screen. This is a type of error that might not be noticed until an election is actually in progress.

If a jurisdiction codes an illegal election it would likely provide every losing candidate with grounds for a lawsuit and would reflect badly on the jurisdiction, the vendor and the Department of State. Therefore, all reasonable steps must be taken to prevent users from selecting illegal options.

An effective way to do this is to provide a configuration file, to be set once in each jurisdiction, indicating the state in which the jurisdiction is located. This state information can be used to cause illegal options to be grayed out and therefore non-selectable. A closely related method would be to have a statewide setup file which for each option indicates whether the option (1) must be chosen; (2) must not be chosen; or (3) is optional. Those options that are mandatory should not be deseletable. The ones that are illegal should not be selectable.

It is unlikely that the vendor will be able to make these changes and obtain ITA qualification for them in a short period of time. Therefore, for this certification, but not for any subsequent one, I recommend that a checklist be prepared by the Department, in
consultation with ES&S, to be furnished to any Pennsylvania county that acquires Unity, detailing the selectability of each option.

Security

The various modules of Unity can be set to either require passwords or not to access them. Passwords are important not only for security but for auditability. The Audit Manager records the ID of any user who invokes various functions, such as changing vote totals. If the user is not required to log in, the Audit Manager cannot record his user ID, and it will not be possible to identify the person who made a change. Passwords should be required for all Unity modules.

Even when passwords are required, Unity as delivered recognizes global default passwords, that is, passwords that are set at the factory and thus usable with any iVotronic unit in the country. While the vendor recommends changing these passwords, this recommendation does not occur until page 105 of the Unity manual. It should be mandatory, not optional to change passwords. If the user does not change all passwords on first invocation of Unity, then Unity should shut down.

Unity runs on an ordinary Windows laptop or desktop. Such a machine could be connected to the Internet, have a wireless card or Bluetooth interface, or be attached to a local or wide area network. All of these represent security risks of varying risk. Unity makes no effort to restrict, or even monitor, these possible connections. The configuration of the Unity computer is therefore uncontrolled and unauditable. That is, after an election it is impossible to determine what sorts of modifications might have been made by an intruder, a virus, spyware or other species of malicious code. In fact, if the computer on which Unity runs has been connected to the Internet for even a brief time, there can no longer be any assurance that the system has not been corrupted.

If the vendor is unwilling to impose configuration restrictions through software, the Commonwealth must do so by other means. One way is compel the jurisdictions to run Unity exclusively on a standalone machine. This causes no hardship. If it is necessary on election night to report results to the press using a website, interim results can be transferred to a web server by flash drive or floppy disk.

Various efforts were made to tamper with election files, including ballot programming and results files. While files could be changed, a by-product of the Windows operating system, it was not possible to make any useful changes to the files. That is, the system detected that changes had been made and refused to read or process the modified files.

Source Code
Source code corresponding to each of the components presented for certification has been provided to the examiner.

Conclusions

1. I recommend certification of the following components under the conditions noted below:
   - iVotronic firmware version 9.1.3.0a
   - Election Data Manager (EDM) version 7.4.3.0
   - Image Manager (IM) version 7.4.1.0
   - iVotronic Image Manager (IVIM) version 2.0.1.0
   - Hardware Programming Manager (HPM) version 5.2.2.0
   - Election Reporting Manager (ERM) version 7.1.1.0
   - Audit Manager version 7.3.0.0

2. The vendor’s NASED qualification N-2-02-22-22-004 applies to iVotronic firmware version 9.1.2.0, not 9.1.3.0a. Therefore, evidence of ITA qualification of 9.1.3.0a will have to be furnished.

3. iVotronic must be reconfigured to produce an onboard zero tape at each machine.

4. The iVotronic continuous roll VVPAT must be disabled as violative of voter privacy under the Pennsylvania Constitution and 25 P.S. §3031.7(1). It is not recommended that the printer itself be removed – it should be retained for printing zero tapes, totals reports and the electronic audit trail.

5. Because of a hardware failure, it was not possible to upload results from the Model 100 ballot scanner into Unity. This capability must be demonstrated to the satisfaction of the Department of State prior to certification.

6. iVotronic and Unity should not be certified for use with modems or any wireless or network communication.

7. Unity must be operated as a standalone system without a network connection, local or otherwise.

8. Until ES&S has implemented a facility for preventing the selection of illegal ballot setup options, the Department of State must specify to jurisdictions using Unity a checklist stating for each option whether it is (1) mandatory; (2) illegal; or (3) optional.

9. Jurisdictions should be instructed as follows:
   a. Install iVotronic flash cards at the warehouse and seal them into the voting units.
   b. In the event there are no candidates nominated for an office, to allow a sufficient number of write-in lines for the maximum number of candidates to be voted for.
c. Both the hard and soft “cast vote” buttons should not be configured at the same time.

Some observed deficiencies are not sufficiently serious to warrant repair prior to this certification. However, I recommend that no subsequent version of iVotronic or Unity be granted unless the following problems have been corrected:

1. All user-tamperable connections on iVotronic must be removed or protected with a locking mechanism.

2. A prominent undervote warning must be given to the voter before she advances to a new screen. The behavior of AutoMark in this regard can serve as a model.

3. Unity must be modified so that election setup options that are illegal in Pennsylvania cannot be chosen by a jurisdiction either deliberately or inadvertently.

4. All Unity modules must require password access. A jurisdiction should not have the option of not requiring passwords. Unity should require all default passwords to be changed upon first use.

5. Leaving a sufficient number or write-in positions for each office, regardless of the number of candidates that appear on the ballot, should not be optional to a jurisdiction, but should be enforced by EDM

Respectfully submitted,

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