Sarasota's Vanished Votes

An Investigation into the Cause of Uncounted Votes in the 2006 Congressional District 13 Race in Sarasota County, Florida

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by

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ACKNOWLEDGMENTS

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Executive Summary

1.1 Background

In the close U.S. Congressional District 13 election, held in November 2006, 14.9% of the ballots cast in Sarasota County on the iVotronic electronic voting machines (a total of 17,846 ballots) showed no vote for either candidate in that race. The race was decided by a mere 369 votes. These uncounted votes caused a firestorm of controversy that resulted in two lawsuits challenging the election (one of which is still ongoing as of the date of this report), and an ongoing joint investigation by the U.S. Congressional House Administration Committee and the federal Government Accountability Office.

There is no question that the 2006 contest for the U.S. Congressional District 13 seat in Sarasota was a failed election, where thousands of voters who thought they had cast a vote in this race did not have their votes counted.

1.2 Method

In an attempt to find a conclusive reason for the excessive undervotes (uncounted votes), Florida Fair Election Center[1] has spent a full year conducting an examination of public records from the Sarasota County election. We have examined tens of thousands of records, including maintenance records, poll tapes, ballot images, event logs, audit logs, repair records, problem reports, official communications, emails, technical documents, Incident Reports, field technician reports, chain-of-custody logs, facility security records, and more.

We also obtained and analyzed thousands more records from other iVotronic counties that had the same touch screen voting system as Sarasota: ES&S Release 4.5, Version 2, with 12.1" screens and iVotronic firmware version 8.0.1.2—a firmware version that was never federally qualified, but was certified only in Florida. As of the date of this report, we have analyzed election records from Charlotte, Lee and Sumter counties—all of which experienced astronomically high undervotes on the iVotronics in the Attorney General's race—and also records from Martin County, which experienced substantially higher undervotes on the iVotronics in the Chief Financial Officer and Commissioner of Agriculture race. We are still analyzing election records from Broward County, where abnormally high undervotes were recorded in the Attorney General's race, and Miami-Dade County, where abnormally high undervotes were recorded on the iVotronics in the Attorney General's race and the U.S. Senate race. These are all iVotronic counties, and the high undervotes they experienced in certain races contrast sharply with consistently low undervote rates in Florida counties using other voting systems.

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[1] Florida Fair Elections Center and its sister organization, Florida Fair Elections Coalition, are non-partisan, non-profit organizations incorporated under the laws of the State of Florida. The Center is a 501(c)3 dedicated to election research and public education. The Coalition is a 501(c)4 dedicated to working for fair , accurate, transparent, audited elections. See www.FloridaFairElections.org

1.2 Findings

What we uncovered in our investigation is shocking: The iVotronic voting system failed to count over 100,000 votes in various races across the state of Florida in the November 2006 election. Furthermore, we have completely refuted the theories that substantial numbers of voters intentionally withheld their votes in the CD-13 race or that so-called "poor ballot design" was responsible for the uncounted votes. By process of elimination, the only remaining possible cause of the high undervotes is the catastrophic failure of the iVotronic voting system, and this report details the ways in which this catastrophic failure occurred.

Most important, we found a badly designed, shoddily-built, poorly maintained, aging voting system in a state of critical breakdown.

Our examination of records from other iVotronic counties was vital towards proving that machine malfunctions and software problems caused the Sarasota undervotes. In Charlotte, Lee and Sumter counties, astronomically high undervotes occurred in the attorney general's race, ranging from an almost incomprehensible 20-25%—meaning that the votes of one in four voters were not counted in the AG race in these counties. We also found abnormally high undervotes in Martin County in the Chief Financial Officer race and the Commissioner of Agriculture race. Notably, *Martin County had an absolutely normal ballot style in these races,* with the Chief Financial Officer race located smack-dab in the middle of the ballot "page" on the touchscreen screen. In Broward County, we found high undervote rates in the Attorney General's race. In Miami Dade County there were abnormally high undervotes in both the Attorney General's race and the U.S. Senate race.

Only the iVotronic voting system recorded double-digit undervotes in any race in Florida in the November 2006 election. In all counties where the iVotronics failed to count thousands of legitimate votes, the absentee ballot undervotes were a normal 1-3%. In a typical election, the undervote rates for absentee ballots are similar to the undervote rate for other methods of voting, but this was not the case in the November 2006 election.

In the affected counties, the absentee ballots had low undervotes but the machines had high undervotes. This fact in itself eliminates "voter disgust" as the primary cause of the undervotes, since voter disgust would have also extended to the absentee ballots and not just to the iVotronics. The other factor that eliminates voter disgust (or intentional undervoting) as a primary cause of the high undervotes is that in the CD-13 race, for example, voters in other CD-13 counties had a normal undervote rate in that race. This is not to say that some voters did not intentionally skip the CD-13 race, but that number was very few, as evidenced once again by the low undervote rate on the absentee ballots.

Poor "ballot design" is eliminated as a primary cause of the undervotes by looking at Martin County, an iVotronic County that experienced undervotes two times higher than the undervotes on the county's absentee ballots in both the Chief Financial Officer race and the Commissioner of Agriculture race, yet had a perfectly normal ballot design.

MARTIN COUNTY "BALLOT" PAGE

ATTORNEY GENERAL (Vote for One)		
Bill McCollum	REP	☐
Walter "Skip" Campbell	DEM	☐
CHIEF FINANCIAL OFFICER (Vote for One)		
Tom Lee	REP	☐
Alex Sink	DEM	☐
COMMISSIONER OF AGRICULTURE (Vote for One)		
Charles H. Bronson	REP	☐
Eric Copeland	DEM	☐

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The November 2006 election was a travesty for those who cast their votes on the iVotronics. Voters who voted on the iVotronics in the Attorney General's race, for example, were 325% more likely to have their votes uncounted than those who voted on Diebold optical scanners (which count paper ballots filled out by the voters).

In all iVotronic counties with high undervote rates, we found many of the same machine malfunctions that beset Sarasota County in the November 2006 election. These failures are detailed in the "Machine Malfunction" section of this report. We summarize some of our findings regarding these counties in this report, but a detailed analysis of the high undervotes in other Florida counties can be viewed in two reports by Florida Fair Elections Research Director Kitty Garber. This report, and the two reports by Ms. Garber, are available to read online at www.FloridaFairElections.org

This report identifies three areas of failure in Sarasota which, combined, show an election in a state of uncertainty and chaos:

> **Hardware:** Large-scale and multiple machine malfunctions were identified relating to touch screen responsiveness, batteries and power-supplies, ballot display, IRDA boards, video boards and cables, screens, system files, and other components.

> **Firmware and Software:** Our investigations uncovered evidence of unapproved, non-certified, or unauthorized firmware and software installation. We found written misstatements by the Florida Department of State and by the vendor, Election Systems and Software, regarding the operation of the iVotronic voting system. We found unexplained and anomalous event log and Unity Systems Log messages. We discovered evidence indicating a firmware "bug" that has not been addressed in previous reports.

> **Procedures:** Administrative procedural errors and misconduct by the Supervisor of Elections and elections staff were identified, such as the mishandling of vote data, lack of disclosure regarding numerous problems in the election, access by unauthorized persons to the Voting Equipment Facility, and the violation of state law with respect to the production of official election results and the Conduct of Election Report issued at the time of certification of the election.

The audit report[2] issued by the Florida Department of State (FLDoS) contains the following paragraph:

> *The audit team found no evidence to suggest or conclude that the official certified election results did not reflect the actual votes cast. The audit team also found no evidence of election procedural error, no evidence of unapproved or unauthorized software/firmware installation, manipulation or alteration, no evidence of machine malfunction, and no evidence of elections' staff misconduct that could have contributed to the higher than expected under-vote reported in the U.S. Congressional District 13 race." [Page 3]*

In our investigation, we examined the evidence that the state auditors deemed inconsequential, in their own words:

➢ election procedural error,

➢ unapproved or unauthorized software/firmware installation, manipulation or alteration,

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[2]Florida Department of State, Division of Elections, Audit Report of The Elections Systems and Software, Inc.'s, iVotronic Voting System in the 2006 General Election, February 2007. Available online at: http://election.dos.state.fl.us/pdf/auditReportSarasota.pdf

➢ machine malfunction, and

➢ elections staff misconduct.

We found serious procedural and substantive flaws in the audit conducted and commissioned by the Florida Department (FLDoS), which omitted essential areas of investigation that would have provided evidence that large-scale machine malfunction contributed to the unusually large undervote. We further found wrong assumptions and incorrect findings in the state-sponsored report issued by the Security and Assurance Information Technology Laboratory (SAIT). The Computer audit logs and event logs, maintenance records and incident reports we examined pointed to severe machine and screen malfunctions.

This paper acknowledges the firsthand reports of hundreds of voters who specifically complained *not* that they had *missed* the Jennings/Buchanan race, but that they had *voted in the race and their votes had disappeared on the review screen.* The descriptions by Sarasota voters of difficulties voting in this race are mirrored by contemporaneous reports of voters in Charlotte County, where astronomically high undervotes were recorded in the attorney general's race, also on the ES&S iVotronic voting machines.

1.3   Conclusions

By process of elimination, machine and/or software problems had to have caused the high undervotes in Sarasota County. We have eliminated intentional undervoting and "ballot design" as possible causes. The only remaining cause is the failure of the voting system itself.

We conclude that a broad array of machine malfunctions and programming problems absolutely contributed to the high undervotes in the Congressional District 13 Race in the November 2006 election in Sarasota County, Florida.

Further, the evidence suggests that the failure of the Sarasota elections office to take ameliorative actions suggested by the vendor exacerbated problems and drove undervotes even higher.

The warning letter issued by ES&S in August 2006 to Florida counties also appears to have contributed to the high undervotes. This letter, by incorrectly stating the full cause of the slow-response problem, prevented counties from calibrating their machines because they believed there was nothing they could do to solve what was described by ES&S as strictly a "firmware" problem. Our research shows that the slow response was due, at least in part, to failing screens that quickly lost calibration.

The slow-response problem and other screen calibration problems were exacerbated by large numbers of battery and power supply failures. In Charlotte County in particular, there is a direct correlation between the machines that experienced high undervotes and those that experienced electrical failures. (Machines with electrical problems in Charlotte County had an

average 31% undervote rate—meaning that one in 3 voters did not have their votes counted on those machines).

It should be noted that, in August 2006, ES&S was embroiled in a lawsuit over its faulty screens. Certainly the company did not want to draw attention to the fact that the screens in Florida were, once again, experiencing large-scale failures, and that the aging iVotronic machines were in a state of breakdown. Sarasota County also had a referendum issue on its county ballot in the November 2006 election that called for the county to abandon the touchscreens and switch to paper ballots counted by optical scan machines.

It should also be noted that the three entities that claimed the voting system had functioned correctly—the Florida Secretary of State, the Sarasota Supervisor of Elections, and ES&S—were defendants in two lawsuits seeking to overturn the results of the CD-13 race. The Florida Secretary of State, through the Division of Elections, was responsible for having certified this faulty voting system to begin with. The Sarasota Supervisor of Elections had defended the iVotronic system since its inception and continued to do so following the election—in many ways she had tied her reputation to the purported reliability of the iVotronic machines. ES&S, as the supplier, had nothing to gain and everything to lose by admitting that its voting system had failed, not only in Sarasota but across the entire state of Florida.

Regardless of the motivation of any of the involved parties, however, the fact remains that the breakdown of the iVotronic system was not disclosed, or even acknowledged, by those responsible for determining what went wrong in Sarasota County in the Congressional District 13 race in the November 2006 election.
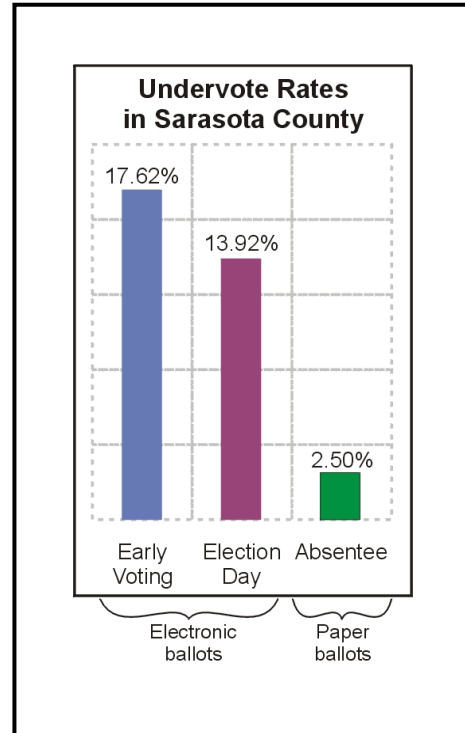
Introduction and Background

Something went very wrong in Florida in the close U.S. Congressional District 13 (CD-13) election in November 2006. An unusually high 14.9% of the ballots cast in Sarasota County (17,846 votes)[3] on the iVotronic electronic voting machines showed no vote for either candidate in the heavily publicized Congressional race. Republican Vern Buchanan edged out Democrat Christine Jennings by a mere 369 votes in a 5-county race.

All five counties included in the Congressional District conducted a recount, but the focus was on Sarasota County and its inordinately high percentage of ballots cast that showed no vote recorded for either candidate in the CD-13 race.

A week after the election, Sarasota County reprinted results from all 1,500 touch screen machines, and found the same totals. In November and December, Florida's Department of State conducted a two-phase formal audit of the machines and the election procedures.[4]

Undervote Rates in Sarasota County

17.62%		
	13.92%	
		2.50%
Early Voting	Election Day	Absentee

Electronic ballots | Paper ballots

The state also commissioned eight computer experts to examine the software source code of the voting machines.[5] In addition, the federal House Administration Committee formed a task force to investigate the election. The task force asked the U.S. Government Accountability Office (GAO) to conduct an investigation to determine if machine problems contributed to the Sarasota undervote. Computer experts, political scientists, and journalists have rigorously analyzed the ballot data and published their findings. The losing candidate, Christine Jennings, has dropped her lawsuit to run again for the same congressional seat in 2008, but a non-partisan lawsuit to overturn the election is still ongoing.

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[3] The total iVotronic undervotes include provisional ballots but do not include absentee ballots, which were counted on a high-speed optical scanner.

[4] *Audit Report of The Elections Systems and Software, Inc.'s, iVotronic Voting System in the 2006 General Election for Sarasota County, Florida.* (February 2007). Florida Department of State.

[5] *Software Review and Security Analysis of the ES&S iVotronic 8.0.1.2 Voting Machine Firmware.* February 23, 2007. Prepared for the Florida Department of State by the Security and Assurance in Information Technology Laboratory (SAIT), Alec Yasinsac, et. al. http://election.dos.state.fl.us/pdf/FinalAudRepSAIT.pdf.

More than a year later, speculation and theories abound. Investigations have proven intriguing but inconclusive. The simple, yet important question remains: Why did the ES&S iVotronic voting machine results show no vote in the CD-13 contest on 17,846 electronic ballots? [6]

In our quest to find a definitive reason for the excessive undervotes, Florida Fair Election Center examined tens of thousands of records — maintenance records, result tapes, ballot images, event logs, audit logs, repair records, problem reports, official communications, technical documents, investigation reports, and more. We collected this information in the face of unresponsiveness, hostility, misinformation, and continuous stonewalling on the part of the Sarasota elections office, which repeatedly refused to provide information in a timely manner and has still not provided some of the documents we requested.

What we found was an election gone awry – multiple machine failures and malfunctions, procedural errors, uncertified software, and other problems that, combined, most assuredly contributed to the high undervote rate: Hundreds of voters telling of their vote selections vanishing from the review screen; failures of recently replaced machine components; election procedures that violated state law; unidentified and/or unauthorized persons gaining access to the VEF (voting equipment facility); screen malfunctions reported by ES&S and ignored by the county Supervisor of Elections; event logs with missing records; unexplained manual adjustments to the vote totals ten days after the election, and much more. We have uncovered new, pertinent information regarding these failures.

Our review of the reports released by the State raised new questions as we discovered contradictions in significant information, important evidence that was omitted or minimized, and official findings that were based on erroneous assumptions.

By process of elimination, we have disproved the theories that either "voter disgust" or so-called "ballot design" caused the excessive undervotes.

Perhaps the search for a single answer to the question of what caused the undervotes in Sarasota County has blurred the bigger picture, which turns out to be a dismal view of myriad problems besetting the Sarasota 2006 general election. After only an incomplete examination of the tens of thousands of records we requested, we find it difficult to even continue asking the original question.

We ask instead: How could the results of any election be trusted when so many problems occurred on so many different fronts? How could something *not* have gone terribly wrong in the final tallies in Sarasota County in the November 2006 election?

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[6] The Sarasota 2006 Election Summary is at http://www.srqelections.com/results/gen2006sum.htm.

.Election results by precinct are at http://www.srqelections.com/results/gen2006pct.htm

We are fully aware of the complexities and difficulties in running any election, and we are aware that perfection is impossible. Elections, however, are conducted on behalf of citizens and should be open and transparent. It is the *cover-up* of the massive problems that occurred in the Sarasota election that is unacceptable, an insult to the voters of Sarasota County, and a blow to this country's democratic ideals. Why would the Florida Division of Elections and the Sarasota County Supervisor of Elections choose to defend these machines rather than the rights of citizens to have their votes cast and counted accurately and openly? The complete lack of transparency in government is the second great tragedy of the Sarasota 2006 General Election.

High Undervotes on the iVotronics Statewide

3.1 Undervote Spikes on the iVotronics

Shortly after the 2006 election, we became aware that Sarasota was not the only Florida county to experience excessive undervotes on their iVotronic voting systems. Undervote rates in the attorney general's race in three counties—Charlotte, Sumter, and Lee—were nothing short of astronomical. One in four ballots cast on the iVotronics in Charlotte and Sumter Counties did not contain a vote for the second most important office in state government. In Lee County, one in five ballots on the iVotronics did not register a vote in the race. The undervote rates in the attorney general's race in these three counties—ranging from 20% to 25%--were *seven to eight times* the statewide median undervote rate in this race, which stood at just over 3%. In contrast, undervote rates on paper absentee ballots in all three counties hovered around 3%, in line with Florida's other counties.

Still, this was only part of the story of a statewide failure of the iVotronics in the 2006 general election. In January, the state published its usual post-election overvote and undervote report—mandated by the legislature since the problems of 2000 and 2002. This report looks at undervotes and overvotes in the top two races on the ballot by voting system and by county, ostensibly to evaluate the performance of the state's certified voting systems and election procedures. The idea is to identify and address problems immediately in order to avoid another repeat of Florida's embarrassing 2000 election debacle.

The state report did not explicitly state that the iVotronics did not perform as well as other systems, but that fact was easily deduced from the data presented in the report and the accompanying tables. In both races examined in the report—the U.S. Senate and Governor's races—the summary rates on the iVotronics far exceeded those of any other equipment in use in Florida.

3.1.1 The First Clue: Summary Undervote Rates on the iVotronics

In the U.S. Senate race, the state report showed that the undervote rate on the iVotronics was a whopping 123 percent higher than on the Diebold optical scanners, the state's most widely used system. Even compared to the other all touch screen system—the Sequoia Edge—the iVotronic undervote rate was much higher:[7]

- iVotronic—2.23%
- Diebold Optical scanner—1.00%
- Sequoia DRE—1.84%

In the governor's race, which had very low undervote rates statewide, the iVotronics again had significantly higher undervote rates:

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[7] We have not used data for the ES&S optical scanner because that system, as of the date of this report, is only used in Florida as part of a blended system that includes the iVotronics.

- iVotronic—1.02%
- Diebold Optical Scanner—0.62%
- Sequoia DRE—0.86%

3.1.2 The Real Shocker—County-Level Undervote Rates

When we investigated this disparity further, we were shocked to find that the state's report actually obscured the real problem—incredible undervote spikes in a few counties. Overall, most of the iVotronic counties had rates similar to those using other types of equipment, but undervote spikes in one or two counties drove up the summary percentages.[8] These were excessive by three measures:

(1) they were vastly higher than those experienced in other counties;
(2) they were vastly higher than those experienced in other top-of-the-ballot races in the same county; and
(3) they were much higher than those on absentee ballots in the same race in the same county.

3.1.2.1   U.S. Senate Race

In the U.S. Senate race, the summary undervote rate on the iVotronics was driven skyward by the highly anomalous 4.37 percent undervote rate in heavily populated Miami-Dade. In fact, Miami-Dade accounted for nearly half of all the undervotes in the Senate race on the iVotronics! When Miami-Dade was removed from the calculation, the summary rate on the remaining iVotronics fell from 2.23 percent to a more normal 1.74 percent. While still higher than the rate on the Diebold scanners, this undervote rate is actually lower than the 1.84 percent undervote rate on the Sequoia DRE.

Table 3.1.2.1-1: Undervotes in the U.S. Senate Race for the iVotronics Counties

County	Precinct Tabulator	Undervotes	Undervote Rate
Broward	iVotronic-15"	6886	1.88%
Charlotte	iVotronic-12"	560	1.22%
Collier	iVotronic-12"	2024	1.44%
Lake	iVotronic-12"	934	1.24%
Lee	iVotronic-12"	1510	1.16%
Martin	iVotronic-12"	546	1.23%
Miami-Dade	iVotronic-15"	**15,110**	**4.37%**
Nassau	iVotronic-15"	230	1.17%
Pasco	iVotronic-12"	1849	1.63%
Sarasota	iVotronic-12"	1394	1.16%
Sumter	iVotronic-12"	347	1.26%
Total		31,390	2.23%

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[8] See Garber, "Lost Votes in Florida's 2006 General Election, Part I" for a more in-depth discussion of iVotronic undervote rates statewide. This report may be viewed online at www.FloridaFairElections.org

3.1.2.2   Governor's Race

We found a similar situation in the governor's race. Two iVotronic counties—Sarasota and Miami-Dade —had rates that were substantially higher than the other iVotronic counties. Sarasota had the highest undervotes in the state in the Governor's race. The two counties together accounted for almost half of all the undervotes reported on the iVotronics. While Sarasota's undervote rate of 1.40 percent may not seem excessive, it was more than twice that of the Diebold optical scanners (0.62) and more than 60 percent higher than that on the Sequoia DRE. When these two counties were removed from the calculations, the summary rate for the other iVotronic counties fell to 0.81 percent. As in the Senate race, this was still more than on the Diebold optical scanners, but less than on the Sequoia DREs.

The fact that Sarasota had the highest undervotes in the state in the Governor's race is especially interesting since the CD-13 race was located on the same page with the Governor's race.

Table 3.1.2.2-1: Undervotes in the Governor's Race for the iVotronic Counties

County	Precinct Tabulator	Undervotes	Undervote %
Broward	iVotronic-15″	3231	0.88%
Charlotte	iVotronic-12″	376	0.82%
Collier	iVotronic-12″	490	0.70%
Lake	iVotronic-12″	787	1.04%
Lee	iVotronic-12″	954	0.73%
Martin	iVotronic-12″	342	0.77%
Miami-Dade	**iVotronic-15″**	**4,684**	**1.35%**
Nassau	iVotronic-15″	164	0.83%
Pasco	iVotronic-12″	913	0.80%
Sarasota	**iVotronic-12″**	**1,673**	**1.40%**
Sumter	iVotronic-12″	248	0.90%
Total		13,862	1.02%

3.1.2.3   Attorney General's Race

Of all the undervote spikes on the iVotronics in the 2006 election, the worst by far were in the attorney general's race. Five counties—Miami-Dade, Broward, Charlotte, Sumter, and Lee—had abnormally high undervote rates in this race. All use the iVotronics as their primary voting equipment. Miami-Dade and Broward, which use 15″ iVotronics, both had rates around 9 percent, about three times the state median undervote rate for this race of 3.14 percent. Their rates, however, were less than half of those experienced in the remaining three counties, which all used exactly the same voting system as Sarasota—12″ iVotronics with 8.0.1.2 firmware.

Taken together, Florida's iVotronic counties had a summary undervote rate in the attorney general's race that was about *three times that of any other voting system in the state*. (See Figure 1 below.) A comparison of the undervotes on the Diebold optical scanner and the iVotronics is particularly interesting since nearly equal numbers of voters used each of these systems.

Using the numbers below, if all Florida iVotronic voters had cast paper ballots on the Diebold optical scanners*, more than 95,000 additional votes would have been counted in the attorney general race.*

Table 3.1.2.3-1: Undervote Rates in Florida's 2006 Attorney General's Race by Voting System

Vendor	System Type*	No. of Counties	Ballots Cast	Undervotes	Undervote Rate
Diebold	Optical scan	31	1,557,587	42,366	2.72
ES&S	Optical scan	21	730,272	22,171	3.04
Sequoia	Touchscreen	4	1,001,807	30,087	3.00
ES&S	Touchscreen	11	1,588,091	137,415	**8.65**
Total		67	4,877,757	232,039	

**Note:* Diebold and ES&S optical scan systems were so-called "blended" systems that used DREs for voters with disabilities.
Source: "Analysis and Report of Overvotes and Undervotes in the 2006 General Election," January 31, 2007, Florida Department of State, Division of Elections.

Figure 3.1.2.3-1: Attorney General's Race Undervote by County
(Counties with fewer than 7,000 total votes were omitted from the chart to improve readability.)
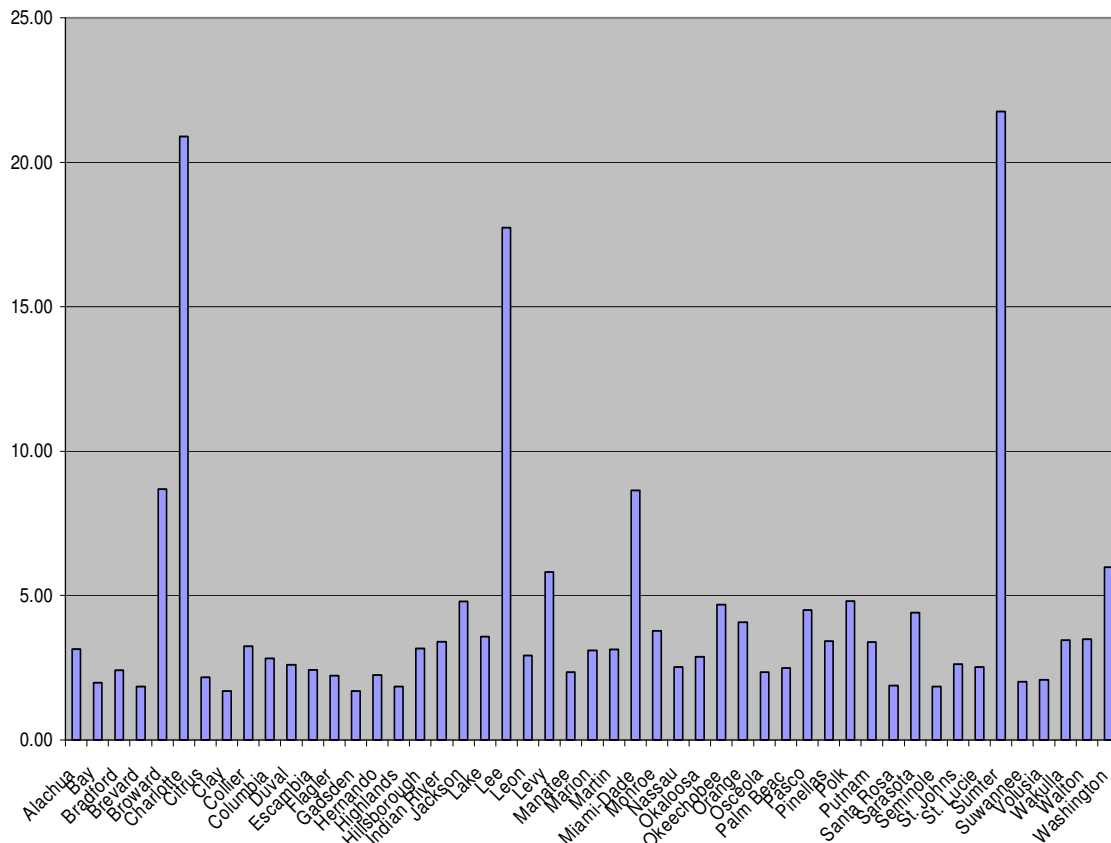
3.2 iVotronic Problems Nationwide[9]

Malfunctions of the ES&S iVotronic voting machines are far from unique to Florida. In 2006, votes were changed on the review screens in at least 11 counties in six states, and votes were flipped on the selection screens in at least 22 counties in at least 9 states.

The iVotronics have a long and disturbing history of losing and miscounting votes. For example:

➢ April, 2002: Approximately 5,000 of the nearly 18,000 ballots cast during the early voting in Dallas on iVotronics were not properly counted, according to the county's assistant elections administrator.

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[9] For a summary of ES&S-caused election problems, see *ES&S — the Midas Touch in Reverse.* November 14, 2006. Ellen Theisen. http://www.votersunite.org/info/ESSMidasinreverse.asp .

For more information and references, see "*ES&S in the News — a Partial List of Documented Failures.*" http://www.votersunite.org/info/ES&Sinthenews.pdf and http://www.votersunite.org/electionproblems.asp?sort=date&selectstate=ALL&selectvendor=ESS&selectproblemtype=Machine+malfunction

- September, 2002: iVotronics lost 8.2% of the ballots in the 31 Miami-Dade precincts that the ACLU examined — losing as many as 21% in some precincts.

- November, 2002: The Raleigh, NC elections director stopped using iVotronics for early voting when they failed to record 436 ballots cast on the machines in a single day.

- January, 2004: With one contest on the ballot, iVotronics reported 134 blank ballots in a Broward County, FL election with a 12-vote margin of victory.

- March, 2004: According to the Sarasota County, FL Supervisor of Elections, the votes of 189 people were never counted by the iVotronic machines.

- March 2004: ES&S installed uncertified software on the iVotronics used in four Indiana counties because, according to the company, the certified software "won't tabulate the votes."

- November, 2006: A mayoral candidate in Waldenburg, AR (population 80) voted for himself, but the iVotronics recorded no votes for him. Eight or nine other voters, including his wife, claimed to have voted for him also.

The above examples are only a handful of scores of well-documented vote-counting failures on the iVotronics. The machines have repeatedly malfunctioned during elections, flipped votes on the selection screen, changed votes on the review screen, and failed to display candidates and races — all across the United States. In the 2006 election alone, of 1022 reports from the media, poll workers, and voters, 216 reports relayed problems with iVotronics in 74 different counties in 16 different states.[10]

The tragic and unacceptable loss of thousands of votes in Sarasota County is no surprise once this election is seen for what it is — one more in an already long, and rapidly growing, list of iVotronic failures.

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[10] Ibid 9

Machine Malfunctions

4.1   Overview

Sarasota County experienced a massive number of machine failures in the November 2006 General Election. Over half the county's 156 precincts experienced machine problems so severe that machines had to be repaired or removed from service for part or all of the day. Four hundred fifty-five (455) Incident Reports filled out in the polling places on Election Day were related to machine problems.

Hundreds of voters reported that their vote in the CD-13 race did not show up on the review screen. Hundreds of voters also complained that the machines responded slowly and required extra exertion to register their choices. Dozens of voters reported a "split screen," with Christine Jennings' name at the bottom of the first screen of the electronic ballot and Vern Buchanan's name at the top of the second screen. Precinct reports note that machines wouldn't open, went down, wouldn't stay up, wouldn't respond, chirped while the voter was voting, cancelled the ballot, or went directly to the Service Menu when they shouldn't have.

Not only did machines fail during the General Election, but hundreds of machine malfunctions were addressed before the September Primary, between the Primary and General Election, and following the General Election. Some problems were addressed by DecisionOne, the maintenance company contracted by ES&S to perform maintenance on the Sarasota machines, but some problems were severe enough to require machines being returned to ES&S for evaluation and repair.

The other counties with double-digit undervote rates on the iVotronics also experienced abnormally high numbers of machine problems similar to those experienced in Sarasota. These problems are explored in this chapter.

4.2   Machine Problems Ignored by ES&S, the Florida Department of State, and the Sarasota County Supervisor of Elections

In the aftermath of the failed CD-13 election, ES&S has continuously maintained that the Sarasota iVotronic voting system operated well. For example, ES&S spokesman Ken Fields was quoted in *PC World* on October 6, 2007 as saying that "Sarasota County's voting system performed properly and exactly as it was designed to function."[11] The Florida Department of State also claimed that "no anomalies were discovered in the machines; they functioned exactly as designed."[12] Sarasota County Supervisor of Elections Kathy Dent expressed confidence in the machines' performance on numerous occasions following the failed election, including the following sentence, approved by Dent that appeared in an ES&S letter to Florida supervisors shortly after the November 2006 election:

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[11]http://www.pcworld.com/printable/article/id,138114/printable.html#
[12] Florida Department of State Press Release, November 30, 2006

Supervisor Dent has stated publicly - and affirmatively - that she is confident the equipment functioned well.

As recently as December 9, 2007, both Florida Secretary of State Kurt Browning and Sarasota Supervisor of Elections Kathy Dent were quoted in the Miami Herald[13], where both attributed the cause of the high undervotes in the CD-13 race to "voter disgust," despite the fact that voter disgust was eliminated as a primary cause of the undervotes in the state's own report. The SAIT report commissioned by the state contains the following:

We know that there are approximately 18,000 undervotes, which is more than 13% of the total CD13 vote and is three to ten times the average undervote in other races. There is no dispute that this undervote is abnormal and unexpected and that it cannot be explained solely by intentional undervoting. (Page 7)

4.2.1 ES&S Warning Letter
Despite the statements by the Florida Secretary of State, the Sarasota Supervisor of Elections, and ES&S that the machines had performed well, in fact just the opposite is true. The machines performed poorly. Sarasota experienced large numbers of machine failures, as further described in this chapter. Furthermore, E&S had *warned* Florida counties prior to the election that some machines would *not* operate as designed, and that counties should expect a "slow response" time on some machines. This warning was issued as part of a letter[14], dated August 15, 2006, that was mailed to all supervisors of elections in Florida with iVotronic voting systems and copied to David Drury, the Chief of Florida's Bureau of Voting Systems Certification. (The ES&S letter may be viewed on pages 76 and 77 of this report, and Chapter 8 is devoted to further analysis of the letter).

There are three red flags when conducting any investigation:

1. When information is withheld
2. When information provided is incomplete.
3. When information provided is incorrect.

Is it just a coincidence that all three entities that played pivotal roles in the post-election audit failed to turn over their copies of this important acknowledgment of machine problems? The failure to disclose the ES&S warning letter seems even more problematic in the context of the post-election declarations that the machines performed properly and "exactly as designed," when exactly the opposite was true.

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[13] *Voter Database Given Okay Ahead of Primary*, by Mary Ellen Klas, Miami Herald, Dec. 9, 2007

[14] This letter was first obtained by Florida Fair Elections Center from a Florida supervisor of elections, shared by us with other voting activists, and subsequently posted on the website of the North Carolina Coalition for Verified Voting, where it was subsequently "discovered" by attorneys for Democratic candidate Christine Jennings

4.2.2 Incomplete and Incorrect Election Records

On a number of occasions, in our attempts to obtain election records from the Sarasota County elections office, we were given incomplete or incorrect information. For example, one disk that was supposed to contain post-election computer audit logs instead contained bits and pieces of computer logs produced *before* the election—and these bits and pieces were essentially gibberish.

Sarasota's maintenance records were given to us piecemeal—it wasn't until eight months after the election that the elections office acknowledged that all maintenance records are kept on a central database. When we requested the spreadsheet for all machines from that central database, we were given only a partial spreadsheet with some information for each machine deleted. While examining emails and other records, we found references to "Return Merchandise Authorizations" (RMAs) where machines had been returned to ES&S for repair, but we have only received one RMA (from 2004) despite providing the elections office with specific RMA numbers. As of the date of this report, we still have not received all maintenance information for all machines.

The costs for obtaining these records were arbitrary and sometimes excessive. For example, we received a written quote of $100 to obtain a disk of all elections emails from January 1, 2007 through the end of July. The final cost of this disk, however, was $571—for the time spent by elections staff to redact, for unstated reasons, an unknown number of emails. When we notified the elections office that the cost of this disk was excessive and that we no longer wanted it, we were told we could not obtain any additional records until we paid the $571.

Rather than checking with Division of Elections attorneys to determine what was or wasn't "proprietary" according to state law, the Sarasota elections staff relied on ES&S to determine which records could be given to us.

In Charlotte County, records were scarce. A poll worker told us that the instructions from the elections office were to "not bother" filling out incident reports because the problems that this poll worker and others were experiencing were countywide and were known to the elections office. Despite these widespread problems, however, Charlotte County stated, on the Conduct of Election report required by state law, that it had *no* machine problems in the 2006 general election.

Also in Charlotte County, we were told by elections staff that they had no records as to which iVotronic machines were in what precincts—which we found incredulous—and then we stumbled upon those very records in an on-site records inspection.

A more in-depth approach was essential in Charlotte—talking directly to poll workers and voters—because of the dearth of election records kept by the elections office and reluctant, incomplete, and slow compliance by the supervisor of elections. Acquiring the necessary public records and information from the Charlotte County elections office was a difficult and protracted process. We discovered that, unlike Sarasota and Lee Counties, which have an

abundance of records, the Charlotte elections office does not routinely maintain many normal elections records, such as election day telephone logs, cast/cancel ballot logs, iVotronic custody sheets, and zone tech logs. Only a handful of incident reports were available from Charlotte, even though we were informed by poll workers and voters that they had called and written about their complaints. A Charlotte poll worker told us that incident reports about machine problems were discouraged.

Lee County had by far the best records, although they were more expensive to acquire than those in the other counties. Compliance with our requests was not swift but it was fairly complete. Records in Sumter County were not as extensive, but the supervisor of elections and her staff were prompt, forthright, and courteous in meeting all our requests, as were the election staff in Martin County.

None of the counties was forthcoming regarding the real problems with the ADA machines—if they had even been informed of the real problem by ES&S.

The lack of uniformity in records—both in the type and the diligence with which they are kept—makes comparisons across counties more difficult. Further, the failure of some elections offices to comply with requests completely and promptly makes the process of acquiring records frustrating, time-consuming and costly.

These are only a few examples of the myriad problems we encountered in response to our requests for records that are supposed to be public. Despite these obstacles, however, we persisted and learned a great deal about the extensive machine problems that beset the Sarasota County November 2006 election—and the similar problems that occurred in other iVotronic counties.

4.3   Screen Problems

All iVotronic screens in Sarasota were replaced between October 2003 and January 2004, just before the expiration of the warranty on the original machines. Maintenance records[15] show that the replacement of the screens was supervised by Pivot International and that most of the replaced screens were manufactured by Bergquist Company. The reason for the screen replacements was a faulty manufacturing process utilized by Bergquist that caused the screens to fail under humid conditions. As reported by Dan Rather in the "Trouble With Touch Screens,"[16] the machines were built in Manila in a sweatshop without air conditioning, exposing the screens to humid conditions that eventually caused them to fail.

Screens were also replaced in Charlotte, Lee and Sumter counties during the same general time period. In total, Bergquist ended up replacing approximately 23,000 screens across the U.S.

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[15] All maintenance and repair records to be posted on website

[16] "The Trouble With Touch Screens," *Dan Rather Reports*, http://hd.net/drr227.html

The replacement of all the screens did not solve the problems, however. Maintenance records from Sarasota, Charlotte, Lee and Sumter counties, along with Zone Technician reports and Incident Reports filled out in the polling places, show that screen problems continued to plague Sarasota and the other counties *after* this wholesale replacement.

Recent Sarasota maintenance records describe all of the following:

➢ Frozen screens
➢ Flickering screens
➢ Strobing screens
➢ Flashing screens
➢ Rainbow screens
➢ Upside-down screens
➢ Red screens
➢ Blank screens
➢ Black screens
➢ Gray screens
➢ Dark screens
➢ Fuzzy screens
➢ Screens out of calibration
➢ "Unable to calibrate" messages
➢ Hard-to-press screens (requiring greater exertion to select a candidate)
➢ Screens with slow response
➢ Screens with no response
➢ Screens that didn't work because they had been improperly glued in place
➢ Screens that failed to record CD-13 votes, leaving the review screen blank (confirmed by poll workers)
➢ Screens with reversed lines.
➢ ADA Screens that displayed the same candidate's name twice on all ballot styles
➢ ADA machines that displayed the wrong screen or pulled up the audio ballot by mistake
➢ Screens that switched between the ADA and regular ballot *while voters were voting.*
➢ Screens that did not display Amendment 3
➢ Screens that failed to record votes in the U.S. Senate race, losing them on the review screen
➢ Screens that flipped votes in the Governor's race.
➢ Large-print (ADA) screens where a portion of the display was too faint to see.

The reason for the 2003-2004 replacement or attempted repair of the touch-screens screens in Florida counties (including Sarasota, Charlotte, Lee and Sumter counties) is explained in detail by Patricia Dunn, PhD, senior scientist at The Bergquist Company from October 28, 1998 until February 14, 2006, in a sworn affidavit[17] dated April 3, 2007. Dunn states that in 2001, she began conducting tests that showed the failure of Bergquist screens in humid

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[17] United States District Court, District of Minnesota, The Bergquist Company vs. Hartford Casualty Insurance Company, Affidavit of Patricia Dunn, pdf-page 6: http://hd.net/drr_files/Bergquist.pdf

conditions, due to a particular production processs employed by Bergquist. Dunn says that Bergquist did not change this production process despite her recommendations to do so, and that she was particularly concerned about the high humidity conditions in Manila, where Pivot International was building iVotronic machines for ES&S using Bergquist screens. In a letter to Bergquist executives, Dunn described the Bergquist screens manufactured between 2000 and 2002 as "time bombs waiting to go off."

An ES&S Operator's Manual[18] from 2001 (the year that Sarasota's machines were ordered and presumably the year they were built), contains the following warning:

> *The only environmental restriction for the iVotronic Voting System pertains to temperature and humidity. Normal operating conditions require a temperature range of 60-100° Fahrenheit and non-condensing humidity of less than 95%.*

Was ES&S unaware that the iVotronics were being manufactured in the Philippines in a hot and humid climate without air conditioning,[19] and were being delivered to hot and humid Florida jurisdictions, some of which did not have climate control in their storage facilities at that time?

Regardless who was ultimately to blame for the faulty screens, they were quietly replaced or repaired in Florida's iVotronic counties, without charge and without publicity.

Our investigation has shown, however, that the screen replacements did not solve the screen problems in Sarasota and other counties. Maintenance reports from 2004, 2005, 2006, and 2007 continue to show large numbers of screen failures. These failures may be related directly to the screens themselves, or may be caused by other factors, as described below in Chapter 4.3.1.

4.3.1   Causes of Screen Problems

Possible causes of screen failures include the failure of PEBs, video cards, video drivers, touch-screen controllers, controller drivers, infra-red boards, smoothing filters, memory overload, careless or improper maintenance procedures, a programming bug, a virus, defective or dead batteries, the IRDA (infra-red) video cables, IRDA (infra-red) circuit boards, defective power supplies, unexpected interactions between existing software/hardware and the 8.0.1.2 firmware, and/or poor quality control in manufacturing, to name just a few possibilities.

Some of the above problems, such as failed video cards, IRDA video cables, IRDA circuit boards, dead batteries and failed power supplies, are listed frequently on Sarasota maintenance reports. Some maintenance reports refer to screens that were improperly glued in place. Maintenance personnel were unable to diagnose other screen problems, but instead returned the problem machines to ES&S for repair or replacement.

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[18] ES&S Operator's Manual to be posted on website

[19] "The Trouble With Touch Screens," *Dan Rather Reports*, http://hd.net/drr227.html

Whatever the causes of the "screen" problems in Sarasota and other counties, replacing the screens in 2003-2004 may have solved some problems, but it did not solve many others.

4.3.2 Calibration and Screen Linearity Problems Contributed to High Undervotes

The Bergquist Company, the manufacturer of the vast majority of touch-screen screens used in Sarasota, Charlotte, Lee and Sumter counties, acknowledges screen "linearity" problems in a 2005 user's manual.[20]

"Linearity" may be an unfamiliar word to most people with respect to touch screen voting machines, but it is a critical component in a successful voting experience. Two definitions of linearity follow, as described by companies that manufacture touch screens:

> *Linearity - The ability of a display device to produce an object the same size anywhere on the screen. For example, poor linearity may show the same line of text one size when it is at the top of the screen but a different size when it is at the bottom of the screen.[21]*

> *Linearity - The degree to which the actual location of a pixel on the screen corresponds with its intended location. Nonlinearity causes screen images to be more distorted in one area of the screen than in another. This is sometimes caused by poor voltage regulation in the monitor's electronics.[22]*

The 2005 Bergquist user's manual describes linearity problems at the *edges of its screens*, which it refers to as "edge linearity anomalies." The manual states, "Because of the varied linearity that exists between touch screens, you may want to calibrate the edges of the touch screen more precisely."[23] This is relevant since it means that the edges of the screens tend to have greater distortion and can be different on different machines. It is particularly relevant since both the CD-13 race in Sarasota and the Attorney General's race in Charlotte, Lee and Sumter were positioned at the edge of the screen (CD-13 was at the very top of the screen on page 2 and the Attorney General's race was at the very bottom of page 3 of the Sarasota electronic "ballot").

Calibration problems and screen linearity problems occurred frequently in Sarasota County. Some poll workers complained that they could not calibrate portions of the screens. In addition to the complaints regarding the CD-13 race, some voters complained about the U.S. Senate race, stating that their votes in that race disappeared on the review screen. Other voters complained that their votes in the Governor's race flipped from their intended choice to another

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[20] *Bergquist Installation Instructions and User's Guide,* pdf-page 4
  http://www.bergquistcompany.com/objects/Touch_PDF_Docs/Cntrl_Install_020205.pdf

[21] Extron Corporation, http://www.extron.com/company/index.aspx

[22] ELO Company, http://www.elotouch.com/Products/mongloss.asp#l

[23] *Bergquist Installation Instructions and User's Guide,* pdf-page 4
http://www.bergquistcompany.com/objects/Touch_PDF_Docs/Cntrl_Install_020205.pdf

candidate. Numerous maintenance records note calibration problems; other maintenance records note that screens "could not be calibrated."

Interestingly, Martin County chose to re-calibrate screens on machines with a "slow response" problem. Sometimes calibration resolved the slow-response problem; sometimes repeated re-calibration was required. Some machines were not helped by the procedure, suggesting a different source of the problem. In Lee County, one poll worker was able to confirm that the responsiveness problem on one of his machines was the result of mis-calibration. With the help of a computer-savvy friend, he was able to pinpoint where voters needed to press in order to get their selections to register (just above the intended box). He notes there were no more problems once he began informing voters where to press. The correlation between slow response and screen calibration is important considering the numerous screen replacements *after* the 2006 election.

Repeated calibration problems are often the first symptom of total screen failure.

There is little doubt that calibration and slow response problems played a role in causing hundreds of undervotes in Sarasota County, as explained further in Sections 4.5.

4.4   Ballot Display and PEB Problems
In addition to the screen problems listed above, some voters stated that no matter how carefully they searched their ballots, the CD-13 race *was not there at all*. This would not be the first time that iVotronic voting machines had simply failed to display a candidate's name on the electronic ballot.[24]

As noted earlier, hundreds of voters complained that they voted in the CD-13 race but their selection did not show up on the review screen. These voters had to go back and make their selection a second time. Other voters reported a "split screen," with Christine Jennings' name at the bottom of the first "page" of the electronic ballot and Vern Buchanan's name at the top of the second page. Some voters, including Christine Jennings herself, noted that the CD-13 race was "grey and fuzzy," whereas all other races were crisp and sharply defined.

An elections worker taking telephone complaints wrote the following:

> *"I received several comments from voters who informed me that when they attempted to cast their ballot for Christine Jennings, the screen automatically jumped to the next screen. Also, I heard reports from voters who could not even locate Christine on the ballot." -- Dan Z.*

Other complaints described similar ballot-display problems, such as the following email sent to Supervisor Dent:

> *I am writing to report a voting irregularity on 11-7-06 at precinct 40 for Congressional seat 13. At the time of [my] original vote, I saw Vern Buchanan's name on the ballot but not Christine Jennings. Upon review of ballot the names showed up blank...I then revised and completed the*

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[24] Coconut Creek, Florida, Parallel Election Results http://www.ecotalk.org/FirstParallelElection.htm

vote by marking the blank. It was not correct the first time and many people who are not computer literate would have had difficulty. My sister voted about an hour later at the same location and was cautioned about Christine Jennings being on another page. This caution was not given to me showing inconsistent reporting of the problem. ~ Susan A.

Clearly, there were numerous ballot-display problems in the CD-13 race, and these ballot display problems most assuredly contributed to the undervotes in that race.

4.4.1 Candidate's name displayed twice on ballot

Both Florida state audit reports assume that a display or vote-recording problem would not have affected just one race. Since the CD-13 race was the only race in Sarasota County with a double-digit undervote rate, they suggest that the undervotes were not caused by a display or vote-recording problem. The following attachment to the official Sarasota "Conduct of Election" report following the September 2006 Primary contradicts that assumption, and shows that anomalies *can* affect just one race on the ballot on all ballot styles:[25]

> Issue with Zoom Ballot Candidate Selection.
> It was brought to our attention that there was an issue with the Zoom ballot on the 12" ADA iVotronic. On the County Commissioner race (a Universal Primary Contest) if a candidate was selected the name of the selected candidate would appear again below the initial selection. In the testing that we performed we found that it only occurred on that one race and was consistent on all ballot styles.

4.4.2 Problems with the PEBs (Personalized Electronic Ballots)

These display problems point to a problem with the PEBs (personalized electronic ballots), the black hockey-puck-sized cartridges used to "bring up the ballot" for each voter. These mysterious cartridges, which are actually mini-processors,[26] operate on a lithium battery. Each PEB contains the "ballot definitions" and is a vital component of the iVotronic voting system.

The SAIT report never acknowledges that the PEBs are processors, but instead refer to the PEBs as "non-volatile memory storage devices." Was the SAIT team unaware that the PEBs are processors? If they were, why didn't they mention this important fact in their description of the devices?

If the PEBs had simply been re-inserted in the voting machines immediately after the Sarasota election, it would have been clear whether some electronic ballots were missing the CD-13 race completely and whether many ballots contained a split-screen in the CD-13 race. It would have answered once and for all the questions about what the voters did and did not see with each PEB used to bring up the various ballot styles.

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[25] The Conduct of Election report was submitted to the state at the time of certification of the September primary and attached to an email sent on September 11 by John Kennedy, Network Administrator for the Sarasota elections office, to Supervisor of Elections Kathy Dent and IT Manager Terry Williams:

[26] Patent of the Votronics , including a description of the PEB as comprising a "second processor"

4.4.2.1   Memo from Election Science Institute

Steven Hertzberg of the Election Science Institute was one of the few who recognized the importance of the PEBs. On December 6, 2006, Hertzberg wrote an advisory email to Sarasota Supervisor of Elections Kathy Dent, which was also posted on the ESI website as an "Open Letter to Sarasota County." It is included below in its entirety because of the important points it contains:

> ***Open Memo to Sarasota County***
> ***http://electionscience.org/blog***
>
> *ESI applauds all of your county's and state's efforts to perform a meaningful audit of House race 13. We have reviewed your audit plan and strongly suggest that you add the following items:*
>
> G   *Inspect all of the CF memory cards that were used in the iVotronics on Election Day.*
> *Each memory card contains a copy of the Ballot Definition Files (BDFs) used on Election Day. If voters on some machines were presented with an inaccurate ballot, then this is where the problem will most likely reside. If you can't identify which memory cards were installed in the iVotronics with high undervote rates, then you will have to inspect all of memory cards. ESI understands that nine ballot styles were used in the county on Election Day, please make sure that an "additional" (or 10th) ballot style does not exist on these memory cards and that each of the ballot styles presented on these memory cards exist as originally designed.*
>
> G   *Inspect all PEBs used in precincts with high undervote rates. PEB's are the device used by the poll worker to instruct the iVotronic to display a single ballot style so that a voter may cast their ballot. We understand that six PEB's were deployed to each precinct. All PEBs at each of the high undervote precincts should be inspected to make sure they only activate one of the nine ballot styles officially published by the county. If there is a 10th ballot style present on one of the CF memory cards, then you will need to determine if any of the PEBs activate this 10 ballot style.*
>
> G   *Determine if the logic and accuracy (L&A) tests were conducted on all of the iVotronics and CF memory cards prior to Election Day.*
> *ESI understands that sometimes election officials do not have all of the resources and time necessary to L&A test all voting machines prior to Election Day. A well designed L&A test should have caught*

BDF errors. Are the machines with high undervote rates also machines that were not L&A tested?

ESI believes that the above steps will isolate the problem, which resides either in the Ballot Definition Files actually deployed on Election Day and/or the PEBs employed by poll workers. The error will not be found by testing BDF's resident on the ES&S Unity Server or by testing BDF's on new CF memory cards, as these BDF files are not likely corrupt.

Ultimately, we believe that this will prove to be a setup problem that was not caught due to the limited use of appropriate quality controls in the election process. Given the information that we have, we believe that the cause of the high undervote rate will not be found in the iVotronic itself. Of course, our opinion may change as additional information becomes available.

_____

Steven Hertzberg, Election Science Institute

Supervisor Dent forwarded Hertzberg's recommendations to David Drury, Chief of Florida's Bureau of Voting Systems Certification and one of the chief architects of the state's audit plan. Why was there no follow-up to Hertzberg's suggestions? Why has no one simply put the PEBs back into the iVotronic machines to determine exactly what voters saw or didn't see on their ballots during the November 2006 election? Why didn't the state or the SAIT investigators think it necessary to examine the PEB firmware to determine if it contained a bug or if it might have interacted in some unforeseen manner with the iVotronic firmware? This is particularly important in light of the fact that there is reason to believe that the PEB firmware used in the Sarasota election may not have been the state-certified version of the firmware, as further discussed in Section 5.2 of this report.

4.4.2.2   "Upgraded" PEB batteries
ES&S forbids local election officials to open a PEB or change the PEB batteries—PEBs are returned to ES&S for "maintenance" and battery replacement. In the summer of 2006, ES&S replaced the batteries in at least half the county's PEBs with "upgraded batteries." What was this "upgrade," and why was it necessary? Were these upgraded batteries being used for the first time in any election?

4.4.2.3   Recommendation
The PEBs used in the Sarasota November 2006 election have never been examined to see what ballots were actually displayed to Sarasota voters. The PEBs in Sarasota should have immediately been re-inserted in the applicable voting machines to see the actual ballot displays that were seen by voters. This would have cleared up questions about split-screen ballots and whether some machines did not display the CD-13 race at all. It is late, but perhaps not too late to do just that. This procedure should be performed using the original PEBs

used in the election and the iVotronic machines that remain sequestered. Also, the PEB firmware should be analyzed for bug and/or ballot-programming errors.

PEB

> **RECOMMENDATION:** The PEBs in Sarasota should have immediately been re-inserted in the applicable voting machines to see the actual ballot displays that were seen by voters. This would have cleared up questions about split-screen ballots and whether some machines did not display the CD-13 race at all. It is late, but perhaps not too late—this same procedure should be performed by the GAO or other independent investigators using the original PEBs used in the election and the iVotronic machines that remain sequestered.   Also, the PEB firmware should be analyzed in the same manner that the iVotronic firmware was analyzed.

Each PEB is a processor

4.5   Slow Response Times Caused Undervotes

On August 15, 2006, Linda Bennett, Regional Account Manager for ES&S, sent a letter to "FL Users" describing a slow response condition that occurred on 12" touch screens used with the iVotronic firmware version 8.0.1.2 — the iVotronic system used in Sarasota County. The letter states:

> *We have determined that the delayed response time is a result of a smoothing filter that was added to iVotronic firmware versions 8.x and higher. This smoothing filter waits for a series of consistent touch screen reads before a candidate name is highlighted on the ballot. In some cases, the time lapse on these consistent reads is beyond the normal time a voter would expect to have their selection highlighted.*

Subsequently, ES&S provided the applicable counties with a poster to place in every polling place explaining how to use the touch screen "to ensure your ballot is cast properly." The second of three instructions says:

> *Hold down your selection until it is highlighted. This may take several seconds.*

Slow response time means that voters have to exert more pressure and wait longer for their selections to be highlighted on the touch screen. Slow response times result in voter error, which in turn results in undervotes, as further explained in this chapter.

Prior to the election, ES&S warned Florida election supervisors of response times *100 times slower* than a normal or recommended response time might occur on some machines. In a letter[27] sent to Florida supervisors of elections on August 15, 2006, ES&S states that voters might experience a "delayed response time of

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[27] Letter to be posted on the FFEC website with a link here. (This letter was first obtained by Florida Fair Elections Center from a Florida supervisor of elections, shared by us with other voting activists, and subsequently posted on the website of the North Carolina Coalition for Verified Voting, where it was subsequently "discovered" by attorneys for Democratic candidate Christine Jennings).

several seconds" on the 12" screens used in eight Florida counties[28] when attempting to make a selection on the screen. While "several seconds" might not sound long to someone unfamiliar with touch-screen technology, a normal response time is only 30 milliseconds (30/1000ths of a second). Thus, it is patently absurd that ES&S would claim, following the election, that the machines had "performed exactly as designed," when ES&S had already acknowledged a severe machine problem.

The ES&S letter in its entirety, together with other troubling misstatements and contradictions included in it, are addressed in Chapter 8 of this report.

Jeff Morris, vice President of Mammoth Marketing, which handles the marketing for Bergquist Company, the screen manufacturer, wrote in a professional journal: [29]

> When novice users attempt to operate a touch screen, delays in response time can lead to user errors.

He goes on to say that "5-wire" touch screens (which are used in Sarasota County), permit faster response times, typically well below 30 msec."

As stated above, the iVotronics in Sarasota County experienced response times up to or exceeding 100 times the recommended response time. There are several reasons why slow response times lead to user errors. Novice user (in this case, most voters, since they so rarely use the machines, and particularly voters who have never used the iVotronics, the elderly, and voters without any computer experience), are at a loss about how to deal with such problems when they occur. In general, voters tend to blame themselves when they encounter machine problems and are often embarrassed to ask for assistance, believing it is they who have erred.

Because so many machines failed in Sarasota, long lines formed at some precincts. Voters who know that other people are waiting to vote may feel pressured to hurry and not take the time to deal with specific problems they encounter. A Zone Tech report from Precinct 120, for example, which had a 34.31% undervote rate, notes that "people were waiting 1.5 hours in line to vote." Precinct 150, with a 19.68% undervote rate, reported "long waits of 20-30 minutes; too few machines."

The slow response time problem was compounded by the fact that Supervisor of Elections Kathy Dent failed to display the warning poster provided by ES&S with its recommendation that it be displayed in each voting booth. Voters were thus unprepared for this problem and did not know how to respond when it occurred. Dent's failure to display this poster is discussed further in Chapter 6.3 of this report.

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[28] The eight Florida counties that used the 12" iVotronic screens in the November 2006 general election are: Sarasota, Lee, Charlotte, Sumter, Lake, Pasco, Martin and Collier

[29] *"Five-Wire Touch Screens Make Inroads."* by Jeff Morris. Information Display: Official Monthly Publication of the Society for Information Display. August 2002. Vol. 18, No. 8.
http://www.bergquistcompany.com/objects/Technical_Library/Articles/5_Wire_Info_Display.pdf

There are scores of poll worker comments and voter complaints about the slow response times of the Sarasota iVotronics. This problem in itself – clearly a machine problem as acknowledged by the vendor – most assuredly caused hundreds of undervotes in Sarasota County.

Sarasota poll workers' comments to a Miami Herald reporter[30] describe the difficulties voters—and poll workers—were having:

> [Poll worker] Rowland… said some people had such trouble getting the screen to register their votes that she devised other techniques for ballot casting.
>
> ''I was telling people to use their knuckles,'' she said.
>
> She said she then turned the machines off and called technicians to check them out. When the machines were turned on again after 40 minutes, she said, the technicians gave her a frustrating explanation:
>
> ''They have to really press down hard. They're not pressing hard enough,'' she said the technician told her.
>
> At another precinct on Election Day, poll worker Marie Glidewell said that she had to repeatedly push the screen to activate the ballot page.

It is noteworthy that the four counties with 12" screens and excessively high undervote rates – Sarasota in the House District 13 contest; Charlotte, Lee and Sumter in the Attorney General contest – did *not* put up the ES&S poster warning voters of the slow response time of the screen. Martin County, however, which also has 12" screens, trained its poll workers and *did* put up the ES&S poster at the polls. Martin County had elevated undervotes in both the Chief Financial Officer raced and the Commissioner of Agriculture race, but it avoided the huge undervote spikes found in Sarasota in the CD-13 race and in Charlotte, Lee and Sumter in the attorney general's race.

Another important difference between Martin Counties and the counties with extremely high undervotes is that Martin County chose to calibrate screens when the slow response problem occurred. This successfully solved the slow response problem in most cases, according to numerous incident and field technician reports.

The ES&S warning letter regarding slow response time specifically states that the slow response is caused by a problem in the firmware with "the smoothing filter," as further explained in Chapter 8 of this report. As a result, most iVotronic counties apparently believed there was nothing they could do to ameliorate the slow response problem when it occurred. Martin County, on the other hand, calibrated its screens when the slow response happened and substantially mitigated the slow-response problem as a result. If the ES&S letter misstated the cause of the slow response problem, it had the effect of

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[30] Link to Miami-Dade article on website (direct newspaper link no longer valid)

making the problem worse, since most counties did not attempt calibration to fix the problem because they believed it was in the firmware. This is evident on the event logs from the various counties. Martin County's event log shows 78 screen calibrations, whereas the event logs from Sarasota show 6 screen calibrations; Charlotte, 8 screen calibrations; Lee, 5 screen calibrations; and Sumter, 2 screen calibrations.

But this anomaly is not the end of the story. Our investigations led us to explore the functionality of touch screen controllers and smoothing filters. What we learned raised additional questions about the ES&S "smoothing filter" letter and the slow response time on the screens.

4.5.1 Important Correlation
Many voters who complained about the slow response time also complained that their votes in the CD-13 race disappeared on the review screen. While this does not necessarily mean that one problem was connected to the other, it is nonetheless a correlation worth noting.

4.6   Votes Cast but Not Recorded on the Review Screen
It should be noted that voters rarely take time to write letters or emails about their voting experience. In 2004, for example, which had fewer reports of machine problems, the elections office received only a dozen or so emails from voters and only a few of those were complaints.

In 2006, however, voters complained in droves. Hundreds of voters wrote to the elections office and local newspapers, took time to participate in a newspaper poll regarding their voting experiences, filed complaints with Christine Jennings attorneys, and turned out in person to attend a public forum on voting problems they had experienced.[31]

While many complaints mentioned the slow response time of the machines, including a need to exert additional pressure to highlight a selection on the screen, the vast majority of complaints were about the failure of voters' selections to appear on the review screen in the CD-13 race. The vendor, Department of State, and the Supervisor of Elections have all implied or stated directly that these voters were mistaken and that they had simply overlooked the CD-13 race. This may have occurred in some instances, but certainly not all.

4.6.1 Voter Comments
We invite you to decide if the following voters, who sent emails to the elections office during or after the election, were mistaken and had actually missed the CD-13 race:

➢ *I diligently voted each candidate by using my sample paper ballot as a reference and going through the touch screen. When I viewed my summary there was nothing checked in this category. ~ Judy O.*

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[31] The public forum held in Sarasota on November 16, 2006 was sponsored by People for the AmericanWay, VoterAction, Common Cause, the ACLU, and Florida Fair Elections. A video of voters relating their voting problems at this forum may be viewed at http://www.pfaw.org/pfaw/general/default.aspx?oid=23681

- *I cast my vote for Christine Jennings and, when I got to the review screen, it had not been recorded. I understand that some people are arguing that, because it was first on the page, it had somehow been missed. I know that this is not the case. I made it a point to find that particular race and cast my vote for it first as that was the one I was most concerned about. As a CPA and a Financial Systems Consultant, I am extremely anal about checking everything twice. I am even more careful when voting since my actions there can impact so many people. I reviewed each race and each page, line by line multiple times before moving on to the next. You never know when you might accidentally touch the wrong box and I wanted to make absolute sure that I had not screwed up. I am certain that I cast a vote in every race, including that one. When I got to the review page, it showed that I had not voted in that particular race. I went back and rechecked the box and it showed up the second time. I was then able to hit the "Vote" button. ~ Kelly L.*

- *I thought you should be interested in what happened in the voting booth today…I voted for all my candidates, and distinctly remember pushing Christine Jenning's name and seeing it highlighted. When I finished voting, I reviewed everything, And Christine's name DID NOT come up on the [review] screen. I reviewed it AGAIN, and it STILL didn't show that I had voted for her. My vote for Congress DID NOT register. I called someone over, and after checking it for me, they said I probably didn't push it HARD ENOUGH. I KNOW it registered when I pushed it the first time, because I was soo careful and I remember seeing the line focus on it. (also, voting for Christine Jennings was the MAIN reason I wanted to vote). My concern, now, is that this might happen frequently and many voters will not even catch it. I'm really worried. I think a notice should be put in the paper to let voters know how important it is to double check their ballots. It takes a lot of time and many people will not bother.*
- *~ Bonnie Z*

- *I am writing to report voting irregularity on 11-7-06 at precinct 40 for Congressional seat 13. At the time of original vote, I saw Vern Buchanan's name on the ballot but not Christine Jennings. Upon review of ballot the names showed up blank...I then revised completed the vote by marking the blank. It was not correct the first time and many people who are not computer literate would have had difficulty. My sister voted about an hour later at the same location and was cautioned about Christine Jennings being on another page. This caution was not given to me showing inconsistent reporting of the problem. ~ Susan A.*

- *When I stepped into the voting booth this past Tuesday, I was aware of the potential problem you reported during early voting...re Buchanan vs Jennings. Therefore I was particularly careful when I voted for Jennings AND observed that the box beside her name was highlighted. However, upon utilizing the review screen, I discovered that no vote for this contest had been registered. The system allowed me to reenter my selection and*

indicated that it had accepted it…how can I be re-assured that my 2nd entry was accepted? ~ Warren P.

The above handful of emails is representative of the hundreds of complaints received regarding this problem.

In the last email, above, the voter asks a pertinent question. What guarantee did voters have that their second entry would be recorded by the machine? The iVotronics are designed to record the vote the first time around. Since this obviously did not happen on many machines, what assurances can be provided to voters that their second selection, made on the review screen, actually "took?"

4.6.2 Poll Worker Reports and Confirmations of Voter Complaints
On many occasions, poll workers *confirmed* voter complaints, as evidenced in the following sample of Incident Reports filled out by poll workers and field technician reports:

Precinct 19: *"Clerk reports several complaints that voters make selections that do not appear on the summary screen.   The selection has to be highlighted in blue two or three times before the summary page reflects the selections."*

Precinct 16: *"Machine did not record U.S. Congressman; did record on Review."*

Precinct 18*: "Machine…not recording vote…Voter voted on screen – didn't show up on review screen. Cancelled ballot and moved to another machine. More than one [voter] with trouble on machine."*

Precinct 14: *"Voter punched for one candidate but another kept coming up. Activator watched her but finally the right one came up."*

Call Center: *"I received several comments from voters who informed me that when they attempted to cast their ballot for Christine Jennings, the screen automatically jumped to the next screen."*

Precinct 18*: "… verified that vote registered at the race level but didn't appear at review screen; vote does not show on review even though race [was] voted."*

Precinct 19: *"Many hundreds of voters complaining…"*

Precinct 46: *"Touch Screen has weak spot that is a nuisance to voters. Misses selections on some pages. Wait is too long – more than 5 seconds as reported by Precinct Tech."*

Precinct 4: *"Voter voted for a candidate but iVotronics registered another candidate; voter made correction on review screen."*

Precinct 25: *"Voter put finger on selection box for Crist, box marked – He picked up his finger – Crist was deselected and bottom box (write in) was selected. Voter reselected and review was correct."*

Precinct 60*: "iVotronic would not respond to "Yes" command [during machine startup]*

Precinct 98: *"The unit did not respond to touch. Heavy pressure was required to activate choices. Machine was closed after 5 ballots cast."*

Precinct 101: *"iVotronic -- on 2 known occasions, reverses complete lines. It eventually rights itself, but obviously some problem exists."*

Precinct 124: *"Slow screen response – John looked at iVotronic and had it recalibrated. It didn't appear to fix the problem. John closed the iVotronic and removed it from the voting line."*

Precinct 25: *"Senate race vote was selected but review screen showed no selection – choice blank. Voter was able to correct."*

4.6.3 Sample of Zone Tech (Field Technician) Reports Regarding Slow Response

Precinct 19: *"Clerk reports several complaints that voters make selections that do not appear on the summary screen. The selection would be highlighted in blue two or three times before the summary page reflected the selections."*

Precinct 32: *"Not using [machine] after recording some votes. Touchscreen not working properly, hard to record vote, needed to push hard and jiggle to record vote."*

Precinct 37: *"Slow machine taken out of service by clerk."*

Precinct 5: *"Long delay before screen recognizes finger pressure"*

Precinct 46: *"Touch screen has weak spot that is a nuisance to voters. Misses, selections on some pages, wait is too long—more than 5 seconds.*

Precinct 103: *"After PEB is inserted, trying to select ballot style takes a while to register. Further note: Some of the iVos had same problem. However, after being wiped w/ alcohol swab, problem seemed to go away."*

Precinct 98: *"Touchscreen not responding well. Unit not being used."*

4.7   Battery and Power-Supply Failures

Although the exact number is difficult to determine, there were scores of battery and power-supply (also called power brick or power converter) failures in Sarasota during early voting and Election Day in the November 2006 election. The reason that it is impossible to assign an exact number is twofold: 1) We still have not received all the after-election reports of machines that failed during the election, although we know these reports exist; and 2) poll-worker descriptions of machine problems are often vague, such as statements that a machine is "not working" or was taken out of service, without further explanation and without listing a machine number, making it impossible to determine the exact cause of failure, or to determine which machine was affected. (It should be noted that many poll workers did provide detailed descriptions of machine failures including machine numbers). In some cases, poll worker reports of machine problems are followed up by reports by roaming

field technicians (called "Zone Techs" in Sarasota County), but in other cases there are no follow-up reports. Similarly, even in precincts where machines were removed from service during the election, there is not always a report explaining why.

Still, the information we do have makes it clear that loss of electrical power played a critical part in machine failures throughout early voting and on Election Day. Numerous Incident Reports and Zone Tech Reports during the election note that machines are not receiving power or that the batteries have failed.

Prior to the election, while clearing and testing the iVotronics, maintenance personnel listed sixteen machines that had "no power," three machines that would "not power up at all," three that had "unknown" problems, and three with "system failure." Scores of other machines would not start up on election morning, had to be charged up during Election Day, or were taken out of service during the election. Battery and backlight problems were reported in twelve additional precincts. Sixty-six (66) low battery messages appeared on the event log on 21 different machines during the November election, but the event log did not record all low-power problems.

The ES&S Operator's Manual states there are only two reasons for "chirping" machines: Low-battery problems and a voter leaving a voting booth without pushing the "Vote" button. There were several reports of chirping machines unrelated to a voter failing to push the "Vote" button, meaning that these chirping machines were experiencing low-battery problems.

Numerous other machines also experienced problems indicative of low power, including no "splash" screen, blank screens, gray screens, black screens, "sluggish" machines, machines that went into "sleep" mode between voters, slowed response times, and diminished backlighting. In several instances there were reports of machines not receiving AC power even though they were plugged in.

4.7.1 Low Battery Problems in Charlotte and Lee Counties
The most unexpected discovery we made during our investigation of Charlotte's election concerned the connection between low battery messages and high undervote rates. A poll worker told us that his precinct had several machines that were exhibiting problems with responsiveness and missing votes from the review screen. Finally, one of the machines quit altogether. At that time, it was discovered that the machine's battery was completely dead. It was removed from the daisy chain and plugged in separately. (Up to five iVotronics are connected in series at the precinct.) The machines that remained daisy chained together continued to malfunction, but the machine that was separated from the others began to work properly.

This observation confirmed what we discovered in our examination of the event log—that low battery events correlated with exceptionally high undervote rates. In fact, we found that low battery machines had a combined undervote rate of an astonishing 31.25 percent. We also found that machines in the same precinct with a low battery machine also had very high undervote rates. In addition, this observation provided evidence that power supply problems could

have exacerbated a variety of screen and display issues and triggered a problem that led to the review screen problem.

Invoices from Charlotte County indicate that the county replaced more than 11 percent of its power supplies following the election.

In Lee County, elections staff also came to the conclusion that the power supplies were the problem, as evidenced by the following paragraph in their Conduct of Election report:

> *On Election Day we also had approximately 12 machines that had problems with "white screens." We believe there is a problem on some of the machines where the machine is not getting power from the outside power supply (standard outlet and/or power cords) at the point of entry into the machines themselves, thereby relying on battery power to operate and running the batteries down. We think this is the problem because all of our batteries were replaced prior to the general election.[32]*

Sarasota, Lee and Charlotte Counties replaced all their stick batteries just prior to the election.

4.7.2   Failure of Newly Purchased Batteries
Sarasota County replaced all its "stick batteries" between the 2006 primary and general election—at a cost of $196,500. These stick batteries are composed of six rechargeable NiMh (nickel-metal hydride) batteries placed in a plastic sleeve. They operate both the screen and display on an iVotronic machine. (As discussed in Section 4.4, there were hundreds of screen and display problems in this election).

Despite this mass replacement, however, scores of battery failures occurred during the November 2006 general election, as further explained at the beginning of this section [Section 4.7].

On our visits to the Sarasota VEF (Voting Equipment Facility, or warehouse) following the election, we inquired about stacks of cardboard boxes lining one wall of the warehouse and were told they contained failed batteries.

Why were the new batteries failing?

4.7.3 Power Supply Failures
Invoices and maintenance records reveal that dozens of power supplies were replaced prior to the September primary. At least 100 more power supplies were replaced between the primary and general election, according to Zone Tech (field technician) Rick Magee, one of the technicians who assisted at the warehouse to set up the machines for the general election. Even after so many power supplies were replaced, however, more failures occurred during the election.

Magee said that the power supplies are encased in Styrofoam insulation inside the iVotronic booth, and as a result they tend to overheat and fail. He said that

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[32] Lee County Conduct of Election Report, 2006 General Election, Page 2

the way they tested to see if the iVotronics were receiving power was to touch the booth in the area where the power supply was installed and see if it was warm. Magee noted that in some instances, at the precincts he visited on Election Day as a Zone Tech, the booth on some machines was "cold," meaning that the power supply had failed.

Maintenance records from 2002 state, "Installed insulation pad on inside cover" [of each machine].Could a simple miscalculation as to the effect of this insulation on the power supplies have caused so many power supply failures to overheat? Or were the power supplies defective?

Numerous maintenance reports, Incident Reports, and ZoneTech Reports note that the iVotronics were not receiving AC electrical power. The following sections explain what happens to the iVotronic machines when the power supplies fail.

4.7.4   iVotronic Batteries and Electrical Design
The website of the Smithsonian Institute's National Museum of American History includes the following photo of the Votronic—the predecessor to the iVotronic—and a description which reads in part: "[The] Votronic touch-screen vote recorder was the first *battery-operated* direct recording (DRE) voting device."[33]

Votronic touch-screen vote recorder
The Votronic vote recorder was the first battery-operated direct recording electronic (DRE) voting device. When on, the screen reveals a ballot. The voter indicates choices by touching the appropriate boxes on the screen using a plastic stylus. Developed in 1991, the Votronic was used primarily in North Carolina, where it replaced gear-and-lever machines and punch card systems. Courtesy International Foundation for Election Systems

The early iVotronics have more similarities to the original Votronics than do the newer iVotronic models. In fact, in 2001, the same year that Sarasota, Charlotte, Lee and Sumter counties (11 counties in total) ordered iVotronic voting systems, an ES&S representative stated that "the only difference between the Votronic and iVotronic systems is the addition of the ADA [audio ballot] functionality."[34]

Although various experts have stated that it would be unlikely for the iVotronics to run solely on battery power, the large number of battery and power supply problems experienced in Sarasota and other iVotronic counties call into question

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[33] http://americanhistory.si.edu/vote/future.html

[34] http://www.in.gov/sos/elections/pdfs/minutes8-7-01.pdf [page 4]

the electrical design of the voting machines. It seems likely that the older iVotronics in use in Sarasota and other Florida counties in the 2006 general election may have been originally designed to run solely on batteries, and that running on electrical power was an afterthought. This is confirmed in a number of ways.

An ES&S Operator's Manual published in 2001, the same year that Sarasota County took delivery of its first iVotronics,[35] states the following:

> *Terminals: AC power is used to charge the batteries in the iVotronic and electricity from the batteries is used to run the terminal, therefore, voting can continue normally when an AC power outage occurs at the polling place. D-Sized NiMh batteries power the terminal display and touch screen only. [Page 72]*

> *The iVotronic can operate in many settings, at election headquarters, curbside, or at the precinct. This adaptability results from several key features. First the iVotronic requires no AC power to run because all system components are battery operated, though the terminal can be plugged into a wall socket to charge the batteries while in use. [Page 12]*

What was apparently intended as an innovative feature to allow voting to continue during power outages, and later as a feature to allow curbside voting, was instead a feature that created havoc in multiple elections statewide from the inception of the machines. The maintenance records we obtained, going back to 2002 and continuing through the 2006 general election, are rife with messages including "battery failure," "no power," "power failure," and a variety of other messages relating to low-battery conditions.

It seems apparent in reviewing incident reports and ZoneTech reports that the iVotronics run on batteries unless they are plugged directly into the wall through an A/C adaptor located in the back of each iVotronic machine. This is not how the iVotronics are normally connected, however. The usual method is to plug one machine into another into another, in a "daisy chain" configuration. When the machines are electrically connected in this daisy-chain manner, they are serially connected -- if the power fails to one machine, it means the other machines do not receive power either and the batteries in all machines down-line are not being charged. Without electricity to charge them, the batteries generally last just 2-4 hours.

The device that charges the iVotronic batteries is called a "power supply"[36] by ES&S. It is an AC/DC converter that is installed inside the booth that holds the iVotronic machine (see Fig. 1 below).

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[35] It is not clear if Sarasota received its first delivery of iVotronics in December 2001 or January 2002

[36] http://www.essvote.com/supplyshop3/product.php?cat=DRE&sub=31&pid=97&act=view

Figure 3: Power Supply Installed in iVotronic Booth*

*This is not the iVotronic model used in Sarasota County, but it was the only photo available to us that shows the power supply (the rectangular black box) installed in an iVotronic booth.

4.7.5 The Effects of Battery and Power-Supply (Converter) Failures

The fact that some machines were reported as not getting AC power even though they were plugged in makes it important to discuss how this affects the operation of the iVotronics. Why were the new batteries and the power supplies failing? And what were the results of these failures?

The NiMh rechargeable "stick batteries" run the display and the screen itself. Since the screen and the display are the primary voter interfaces, low battery power affects almost every aspect of a voter's experience.

Extensive failures of "power supplies" (AC/DC converters that convert 120 volts to 9 volts), caused a significant number of Sarasota voting machines to operate on batteries that were not being charged up during the election. Since these batteries are only designed to last 2-4 hours, many machines slowly lost power, failed completely, or registered a "Low-Battery Lockout" message on the event log.

The iVotronics have a history of erratic behavior when operating on low battery power. In 2003-2004, low-battery problems in Miami-Dade caused the emergence of two interacting bugs that scrambled data in the voting-system audit log, assigned vote totals to the wrong machines, and created phantom machine serial numbers with votes attributed to the phantom machines. This problem was described in a letter by then Supervisor of Elections Orlando Suarez, which included the following paragraph:

> *In my humble opinion (and based on my over 30 years of experience in the information technology field), I believe there is/are a serious 'bug' in the program(s) that generate these reports making these reports unusable for the purpose that we were considering (audit an election,*

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recount an election if necessary, use these reports to certify an election).[37]

Professor Douglas Jones, a University of Iowa computer sciences professor who serves on the Iowa Board of Examiners for voting machines, assisted Miami-Dade in diagnosing and correcting this particular problem. In his written instructions to election officials, Jones wrote:

> *If your ES&S iVotronic comes up with a low power warning on the screen, immediately check the connection to the power brick, and if this does not correct the problem, lock the machine and put it out of service until a replacement power brick is obtained that, when tested, clears this warning message. Do not allow voters to cast votes on machines with low power warnings, as there is evidence that these machines will not always be able to reliably record data in their internal memory…[38]*

Despite statements by ES&S, however, it is clear that the iVotronic does not give a "low battery lockout" message until the battery is completely drained. Until that happened, hundreds (if not thousands) of Sarasota voters continued to use machines that were operating on diminished battery power, which, at the very least, affected the backlighting and thus the ballot presentation to those voting on the affected machines.

A number of "low power" and "no power" reports show the solution was to "reset" the battery (meaning to re-nest it in its installed position). If the machines had been running directly from wall power, it would not have mattered whether the batteries were "reset" or not.

A Charlotte poll worker told us that in his precinct there were a total of eight iVotronics—five daisy-chained together in one grouping and three daisy-chained together in a second grouping. He said the group of five machines had problems all morning, with voters complaining of slow response and votes disappearing from the review screen in the attorney general's race. One machine in particular was causing the greatest number of complaints, and finally, around 11 am, the machine quit while a voter was voting. It was determined that the battery in this machine was completely dead. The elections office advised the poll workers in this precinct to disconnect the problem machine from the daisy chain and plug it into "its own power" through the A/C jack in the back of the machine. They did so—and the machine worked fine from that time forward! The other four machines in the daisy chain, however, continued to elicit voter complaints for the remainder of Election Day.

This observation confirmed what we discovered in our examination of the Charlotte County event log—that low battery events correlated with exceptionally high undervote rates. In fact, we found that low battery machines in Charlotte had a combined undervote rate of an astonishing 31.25 percent. We also found that other machines located in the same precinct with a low battery machine also had very high undervote rates. In addition, this

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[37] The complete Suarez memo to be posted on website

[38] "Recommendations for the Conduct of Election in Miami-Dade County using the ES&S iVotronic System," Douglas Jones, June 7, 2004 http://www.cs.uiowa.edu/~jones/voting/miami.pdf

observation provided evidence that power supply problems could have exacerbated a variety of screen and display issues and triggered a problem that led to the review screen problem.

Lee County's Conduct of Election report for the 2006 general election showed that they also had significant power-related problems. It states that they had at least a dozen machines with "white" screens due to run-down batteries, even though they also replaced all their stick batteries just prior to the election. The conclusion stated by the Lee County elections office on the Conduct of Election report was that the failed batteries were in some way related to problems with the booth power supply. (We counted at least 15 such machines.) The county's problem log from Election Day shows the extent of the problems—one field technician was charged with the responsibility of changing batteries as he made his rounds.

Although it appears that failed power supplies caused batteries to fail because they were not being charged, it is also possible that the batteries were defective, as warned by ES&S in its Operator's Manual:[39]

> *Because the possibility of defective battery packs exists, ES&S recommends that extra battery packs be available during the election. Battery packs may be purchased from ES&S." [Page 23]*

4.7.6   How diminished battery power can cause a "bug" to emerge

Many of the problems that occurred during the Sarasota November 2006 election are symptomatic of programming bugs.

The following graphic[40] describes how low-battery problems in Miami-Dade County in 2003-2004 caused the emergence of the two interacting 'bugs,' which in turn scrambled audit log data.

Anatomy of a Bug ... or two

With the help of Miami-Dade County and Douglas Jones, a University of Iowa computer sciences professor who serves on the Iowa Board of Examiners for voting machines, ES&S discovered two interacting bugs that show up when the battery is low.

The first bug? two lines of source code were in the wrong order. Source code is the list of instructions for the computer to follow. Two lines in the wrong order may seem like a 'small' bug, but ... consider how important it is to give instructions in the correct order. For example:

1. Jump off the bridge.
2. Tie the bungi cord around your feet.

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[39] Ibid

[40] ES&S iVotronic Audit Log Bugs, Ellen Theisen, http://www.votersunite.org/info/auditbug.asp

The second bug? the accumulation software misreads data from redundant memory.

We have to ask:
- How many other odd, undetected bugs are lurking in voting machine software?
- How many of them affect the results rather than the audit log?
- How many do the vendors already know about -- and aren't telling?
- How many are still undiscovered by the vendors?

Here's how the ES&S iVotronic bugs work:

1	**The battery voltage is too low.**
	The battery might have run down, or it might have been defective in the first place.
2	A low-battery message is written to MEMORY1 inside the iVotronic.
	This is normal. The iVotronic tracks all events, including "low-battery" events.
3	The software writes the "low-battery" message BEFORE it moves to a new, blank space in the memory.
	So, the low-battery message overwrites the previous event message, causing the data to be garbled. Fortunately, **this bug** doesn't overwrite any vote records, just event log records.
4	The iVotronic tests the writing process. It reads back the data it just wrote to memory and finds that it is garbled. So it quits — it doesn't write the "low-battery" message to MEMORY2 or MEMORY3.
	This means the data in MEMORY2 and MEMORY3 remain uncorrupted ... and are different from MEMORY1.
5	At the end of the day, data from MEMORY2 is copied to the flash card for auditing.
	The iVotronic checks MEMORY1 which is the normal place to copy the data from. When it discovers that MEMORY1 doesn't match MEMORY2, the iVotronic assumes MEMORY1 is bad, so it copies from MEMORY2.

| 6 | The Unity accumulation software misreads the data from MEMORY2.

Configuration data is stored differently on the three memory chips, and the accumulation software is only set up to understand the way it's stored on MEMORY1, which is the normal source of its data.

So, when Unity reads the data copied from MEMORY2, it reads the serial number incorrectly. This can cause a variety of errors in summary reports, particularly if the "phantom" serial number matches the serial number of a real machine. |
|---|---|

The large scale battery failures in Sarasota County could have caused the emergence of a new bug, or interaction of bugs. The SAIT investigators acknowledged the existence of bugs in the iVotronic source code and also acknowledged that their investigation could not have uncovered all such bugs.

> *"…we make no claims that we found all bugs or defects in the code."*[41]

Several of the same symptoms that appeared in Miami-Dade also appeared in the Sarasota election, leading to speculation that a bug, or interacting bugs, may have been responsible for the undervotes, as further described in Section 5.3.1.2.

4.7.7   "Redundant" Machine Memories Do Not Always Match
The ES&S Operator's Manual states (Page 72):

> *The voter terminals store all voted ballot images in three separate memory chips. Each*
>> *of those chips contains a complete record of all ballots that were cast on that voter terminal. Whenever a voter terminal powers up (each time a voter begins using it), the images in those three chips are compared to each other. If they are not identical, the voter terminal issue an error message on the display and then powers down to prevent further use. This prevents large amounts of corrupt data from being stored or transferred in the system.*

One thing that became clear from the diagnosis of the Miami-Dade problem in 2003-2004 was that the three internal memories of an iVotronic machine may not always match under certain conditions. Since each of these memories holds vote totals ("a complete record of all ballots that were cast on that voter terminal"), it appears to be possible for one memory to hold one set of vote totals while another memory in the same machine holds a different set of vote totals. There are four different ways to access the memories of an iVotronic voting machine. Even ES&S recommends collecting data in at least two different

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[41] SAIT Lab Report, Page 20

ways to ensure the accuracy of an election. Thus, in a controversial election, it would seem to be important to extract vote totals through each of those methods to compare one set of vote totals to another, and to disclose the results of these different extraction methods. The four methods of vote extraction are:

1. Via PEBs (Personal Electronic Ballots). This is how Sarasota County collected vote totals at the precincts on Election Day.

2. Via Compact Flash Cards. This is the method of vote collection used for all Sarasota early voting sites. An ES&S Technical Bulletin states that early voting results should be collected on flash memory cards, not on the PEBs because vote data may be lost.[42] On November 10, 2006, three days after the election, Sarasota appears to have uploaded all precinct (Election Day) vote audit data from the flash memory cards—a normal procedure to double-check election results—but the results have not been disclosed.

3. Via serial port directly to a laptop computer

4. Via EEPROM chips, as was purportedly done by the Florida Division of Elections as part of the state audit. The ES&S Operator's Manual [Page 72] states that there are three EEPROM memory chips in each iVotronic terminal. The FLDoS auditors, however, only looked at a few machines and only looked at two of the three EEPROM chips.

5. An ES&S "proprietary" document explaining how the internal memories may not always match each other is shown in Appendix D.

4.7.8   Recommendation

Votes should be cast on iVotronics with low-battery conditions to see how the machines react and how accurately they record votes. In addition, votes should be re-collected from a sampling of the sequestered iVotronics using all four methods of vote extraction to see if the results from each method concur with one another.

4.8   Negative Protective Count

The Protective Count is a count of all votes cast on a specific iVotronic terminal from the time of its production. This is opposed to the Public Count, which is the count of votes in any given election. The Protective Count should, of course, always be higher than the Public Count.

The ES&S Operator's Manual states that the Protective Count "can never be zeroed or erased" [Page 94]. Despite this claim, one Sarasota iVotronic terminal displayed a Protective Count that was one vote *less* than the Public Count, as described in the following email:

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[42] Post Technical Bulletin on website

September 8, 2006

Ms. Kathy Dent
Sarasota County Election Office
101 S. Washington Boulevard
Sarasota, FL 34236

Dear Ms. Dent,

We understand that Sarasota County experienced an issue with an iVotronic reflecting a negative number on the protective count during the September 5, 2006 Primary Election. This resulted in the end of night protective count value being one less than the public count value. In the absence of further evaluation or analysis of this unit ES&S would speculate that during the preventative maintenance event, when the battery was replaced on this unit, the protective count was set to a value of negative 1.

ES&S would welcome the opportunity to review this unit in more detail and provide Sarasota County with a more thorough explanation if needed.

Sincerely,
Linda Bennett
Regional Account Manager

Cc: Al Moraczewski – ES&S, Director of Field Services

We question how (and why) a technician could reset the value of the protective count, which is intended to function as a type of "odometer," recording the usage of the machine during its entire lifetime.

This event calls into question ES&S' claim that the protective counters cannot be altered, and casts doubt on the accuracy of the protective count on any iVotronic terminal.

4.9 Machines can produce zero tapes even though votes have already been recorded.

We discovered a circumstance where an invalid zero tape can be produced. If a terminal is added to the other terminals in a precinct after voting has already begun, a zero tape must be printed for the new terminal. When the zero tape is printed for the added machine, however, it prints a zero tape for all the other machines in the precinct at the same time. This occurred at the North Port SOE early voting site. We were given only the later zero tape, showing zero votes cast on all machines—even though votes had already been cast on all but the newly added machine. We were told that the original zero tape would have to be located, but we have not received it as of the date of this report.

Although any votes already cast on the original machines should be noticed when the final results tape is printed, the ability to print a zero tape for machines already containing votes is a serious design problem.

4.10   ADA machines were not working properly

Under the Help America Vote Act, each precinct must have at least one ADA[43] machine (machines specially equipped for voters with disabilities). These machines are normally used by regular voters when not being used by voters with disabilities. In the November 2006 election, however, something was wrong with the ADA machines in Sarasota, Charlotte, Lee, Sumter and Martin counties that severely restricted their use.

Poll workers in Sarasota County were instructed not to use the Zoom (large print) Ballot on the ADA machines, while poll workers in Charlotte, Lee, and Martin counties were instructed not to use the ADA-equipped machines at all for regular voters on Election Day.

In these four counties, restrictions on using the ADA machines represented a change in policy for this election. Although our information on this issue is sparse, it indicates that this new policy was recommended by ES&S because of a firmware problem in the ADA machines.

To our amazement, each county gave a different reason for not using the ADA machines or certain ADA features, as explained in the following sections.

4.10.1 Sarasota County

In an email to Sarasota Supervisor of Elections Kathy Dent, a poll worker stated that a voter with visual impairments could see each candidate's name on the large-print (zoom) ballot, but the selection boxes next to each candidate's name were too faint to see. Supervisor Dent responded that this was a "firmware issue" that she would bring up at the ES&S Users Group meeting at the end of September 2006.

In an "Action Alert" to all poll workers, however, Dent did not mention this firmware issue, but instead gave the following reason for not using the large-print ballot:

> *No large print buttons for this election, discourage use of this ballot type as it is twice as long as a standard print ballot. Use the magnifying sheet if a voter wants the large print.*

Another problem with the large-print, or zoom ballot, is described in more detail in Section 4.5.1 above. In brief, this problem, which occurred in the Sarasota primary election in September 2006, caused a candidate's name to appear twice on the screen when the candidate's name was selected by a voter. This problem occurred in just one race but on all ballot styles, according to the memorandum attached to the primary election Conduct of Election report.

4.10.2 Charlotte County

Charlotte County Supervisor of Elections Mac Horton first told us that the county instructed poll workers not to use the ADA machines for regular voters because

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[43] The ADA acronym stands for Americans with Disabilities Act and is commonly used to describe machines that accommodate voters with disabilities.

regular voters were "confused" by the special ADA buttons on the machines and many voters mistakenly pulled up the audio ballot instead of the regular ballot. He doesn't say why this became a concern in November 2006 and not before, but his explanation does come closest to explaining what we see on the event log and on cast/cancel ballot logs in other counties, as discussed in Section 4.11.7.

 A Charlotte County poll worker confirmed Supervisor Horton's statement, telling us that elections office staff instructed the workers not to use the ADA machines for regular voters because of problems experienced with the machines presenting a regular ballot.

The poll worker's report is backed up by telephone messages, incident reports, and the machines' event log. Poll workers in at least two precincts pleaded for special permission to use the ADA machines for regular voters because so many other machines had failed and long lines were forming as a result. Even when presented with a pressing reason to use the ADA machines for regular voters, the response from the elections office was to only use the machines "if absolutely necessary." Interestingly, even though these poll workers had received a qualified approval to use the machines for regular voters, the event log shows that they did not do so.

The Charlotte event log also makes it clear that use of the ADA machines was discouraged. Since there were many more voters in the general election than in the primary election, one would expect to see more votes on the ADA machines in the general election. Exactly the opposite happened in Charlotte County, however, as shown in the following table:

With only 169 ADA ballots cast in Charlotte County's entire general election -- despite long lines at some polling places and poll workers desperate for more machines -- it is clear there was a major problem with the ADA machines that prevented their use for regular voters.

4.10.3 Lee County
Lee County Supervisor of Elections Sharon Harrington told us that the elections office decided to limit use of the ADA machines because voting on them took "three times longer" for regular voters than voting on a non-ADA machine. When asked for clarification, she insisted that it took much longer for all functions on the machine—loading the ballot, selecting language, and actual voting—not just for disabled voters, but also for regular voters.

Election records show, however, that in the few precincts where ADA machines were used for regular voters in Lee County, the voting time was approximately the same as for the rest of the machines.

Although Supervisor Harrington told us that they did not want to have long lines because of delays on the ADA machines, the incident reports from Lee County suggest just the opposite: it was *not* using the machines that caused long lines and long delays.

Incident reports from the general election in Lee County show that poll workers were instructed to limit use of the machines to disabled voters. No such restrictions were placed on the ADA machines during the primary election, however.

4.10.4   Sumter County
When told of Lee Supervisor Harrington's contention that it took longer to vote on the ADA machines, the Sumter County supervisor of elections said that she had never heard of such a problem with the ADA machines. She said that she has always reserved the ADA machines for the use of those who need them.

4.10.5   Martin County
Martin County Deputy Supervisor of Elections Debbie Dent told us that ES&S had recommended to them that they not use the ADA machines for regular voters. When asked why ES&S had made this recommendation, she first said that it was because the ballots were "not pretty." She later explained that ES&S had recommended against using the ADA machines because the ADA ballots did not have all the features of the regular ballot—such as color. At yet a later date, she further explained that the regular ballots on the ADA machines showed the ballot "coding" for this election, which she said would have been confusing for voters. (By coding, she meant the formatting characters that indicated that text should be centered, boldfaced, and so on).

4.10.6   Problem Discussed at September 2006 ES&S "Users' Meeting"
We believe it is likely that the problem with the ADA machines was indeed discussed at the ES&S Users' Meeting held at the end of September, as stated by Sarasota County Supervisor of Elections Kathy Dent in the email referenced in Section 4.11.1 of this report. Even though that meeting brought together elected officials at public expense to discuss public business involving problems with the ES&S voting system and the expenditure of public funds, the minutes of that meeting are not available to us.

Whatever the real reasons were for not using the ADA machines for regular voters, they were so severe that many ADA machines recorded no ballots whatsoever --even when poll workers were faced with a shortage of machines due to the failure of other machines in the precinct and even when the result was long lines and delays for voters.

4.11   Summary of Machine Problems in Charlotte, Lee and Sumter Counties
Our research revealed that Charlotte, Lee, and Sumter counties—which had 20-25% undervote rates in the attorney general's race—experienced machine-related problems similar to those reported in Sarasota[44]:

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[44] Despite Charlotte's relative lack of election records, our knowledge of circumstances there is more extensive than in the other two counties because of the time we actually spent there and our contacts with concerned citizens.

- Voters in all three counties complained about difficulties in getting their choices to register on some machines—that is, slow or delayed response and the need for excessive pressure.

- In Charlotte, there were numerous complaints that selections in the attorney general's race disappeared from the review screen.

- Many Charlotte voters complained that they could not find the AG's race on their ballot, even though a sample ballot was used to show the location of the race.

- ADA machines in all three counties were not working properly and were not available for use by regular voters as they had been in the primary. In precincts with other malfunctioning machines, the result was long lines and extended waits for voters.

- In Lee County, where some precincts ignored the directive to restrict use of the ADA machines, the summary undervote rate on these machines was significantly lower than on the regular machines (16% vs. 21%). (Sumter and Charlotte recorded too few votes on their ADA machines for us to be able to calculate meaningful undervote percentages for those counties.)

- All three counties experienced machine-related problems similar to those found in Sarasota County—that is, blank, black, white, flickering, frozen, rainbow, and dim or dark screens as well as screens with upside down text, lines, and dead spots; slow or unresponsive screens; loss of calibration; failing batteries and power supplies; bad IRDA boards; frayed video cables; defective video boards, and many other problems.

- Charlotte and Lee Counties, like Sarasota, experienced numerous low battery problems, even though all "stick" batteries had been replaced in the months just prior to the election at a cost of hundreds of thousands of dollars. Lee County's Conduct of Elections report confirms the electrical problems and speculates that the problem was with the booth power supply.

- In Charlotte County, precincts with low battery machines had some of the highest undervote rates in the county.

- In Charlotte County, poll workers were instructed not to fill out incident reports because extensive machine problems were happening countywide and were already known to the elections office. Charlotte County's official Conduct of Election report, however, then stated that no problems had occurred in the election!

4.12 Martin County—Our "Control" County—A Huge Surprise

As we neared the end of our investigation into the undervote problems in CD-13 and the attorney general's race, we belatedly realized that we needed to compare what happened in these high undervote counties to the experience of a

county using 12" iVotronics that did not experience undervote spikes in 2006. This would help us to determine the relevant differences that resulted in much lower undervote rates. We wanted to choose a county that also used a single-column format ballot in order to preserve comparability. With only two iVotronic counties—Collier and Martin—that fit this description, we selected Martin because of its relatively small size and proximity to our offices.

What we found was a surprise. We knew that Martin County, which uses the same voting equipment as the high undervote counties, had generally fared much better in the 2006 election. Undervote rates in four of its six top-of-the-ballot races were at or below the state median, but we were surprised to find that two of the statewide races, Chief Financial Offer and Commissioner of Agriculture, had substantially higher undervotes on the iVotronics than on the absentees. Still, the undervote rates in these races were not nearly as high nor as divergent from absentees as those experienced in Sarasota in the CD-13 race or in Charlotte, Lee and Sumter counties in the attorney general's race.

Table 9.1: Undervote Rates for Martin County's Top-of-the-Ballot Races, by Voting Mode

Race	Polling		Early Voting		Absentees	
	Ballots Cast	**UV%**	**Ballots Cast**	**UV %**	**Ballots Cast**	**UV %**
U.S. Senate	28,298	1.37	15,946	1.00	9,042	1.55
U.S. Representative	28,032	1.13	15,848	1.00	8,981	2.03
Governor	28,298	0.85	15,946	0.63	9,042	0.85
Attorney General	28,298	3.68	15,946	2.53	9,042	2.52
Chief Financial Ofc.	28,298	**7.30**	15,946	**8.53**	9,042	**3.09**
Com. Of Agriculture	28,298	**7.62**	15,946	**8.66**	9,042	**4.35**

It was striking, however, to see the same pattern in Martin County that we had observed in the other high-undervote counties, where abnormally high undervotes occurred in one or two races on the ballot (In addition to the high undervotes in the CD-13 race, Sarasota County also had the highest undervotes in the state in the governor's race—and both races were on the same ballot page). In Martin County, the higher-than-normal undervotes occurred in only two races, which were placed consecutively on a perfectly normal ballot page (shown in Section 10 of this report).

We looked at the basic data from Martin County to see if we could figure out why it avoided the same massive undervote rates as its counterparts. We inspected incident and zone tech reports as well as precinct level results, the event log, ballot images, and the system logs to see if we could find clues to the difference in outcome.

Contrary to our expectations, we found that Martin County experienced significant machine problems on Election Day, most of which were related to slow or delayed response. We also found that in at least some circumstances these problems appeared to be related to somewhat higher undervote rates in the two races in which the county experienced higher-than-average undervote rates—the races for chief financial officer (CFO) and for commissioner of agriculture. As seen in the table above, Martin County's undervote rate on the iVotronics in the CFO race was more than double that experienced on absentees. On further examination of the ballot images, we also found that the undervotes had the same overrepresentation of straight party voters as found in Sarasota, Charlotte, Lee, and Sumter anomalous races.

Perhaps, most significant, however, was our finding that Martin County dealt with its screen problems very differently from the other counties. We believe this holds an important clue to why Martin County's undervotes did not skyrocket like those in Charlotte, Lee, Sarasota, and Sumter.
Their field technicians responded to the slow response problems by recalibrating the screens. On Election Day, there were 75 "terminal screen calibrate" messages on the Martin County event log, plus 3 during early voting. Sarasota, Charlotte, Lee, and Sumter each only had a handful of such messages on Election Day.

The manner of dealing with the slow-response problems in Lee County on their problem log make it clear that they believed that the problem was a "smoothing filter" issue that resided in the firmware and that there was nothing that could be done about it. Coincidentally, on the same day that we discovered these messages in the Martin County event log, we received an incident report from Lee County that showed that some of their slow response problems were actually caused by screen miscalibration..

Evidence of Unapproved or Undisclosed Software/Firmware Installation, Manipulation or Alteration

5.1 "New Program File" for "Primetime" Use

On November 8, 2006, one day after the election and 3 days before the start of the recount for the CD-13 race, Linda Bennett of ES&S sent the following email to John Kennedy, Network Administrator for the Sarasota County elections office. The subject line of this email is: Recount.

> **From:** Bennett, Linda [mailto:libennett@essvote.com]
> **Sent:** Wednesday, November 08, 2006 3:31 PM
> **To:** Kennedy, John
> **Subject:** FW: *Recount*
>
> John, here are the only recount program procedures we have on file that I can find. **I know you will, but still feel the need to say it....please do a dry run of your new program file to be sure it is doing what it is supposed to before using it "primetime".**
>
> Also, your 5 sets of headers will be arriving for Thursday delivery.
>
> Please call me if you have any questions or need anything at all. Good luck on your recount.
>
> Thank you.
>
> Linda   [Emphasis added]

Information about a "new program file" to be used for the recount has never been disclosed to the public. We found this brief reference to it only among the 30,000 emails we reviewed. But the email raises some disturbing questions. Was this file installed to correct a problem or problems that occurred during the election?

When we asked for a copy of this file, we were told it was "proprietary." When we asked for the name of this file, we were told that even its name was "proprietary." Finally, on September 10, 2007, we received the following reply from the Sarasota elections office:

> *The new program file to which you refer had to do with revised ballot definition for the machine recount and is exempt from disclosure under 812.081 & 815.045 F.S.*

This responses raises more questions than it answers and does not explain the exact purpose of this "new program file."

5.2 Uncertified PEB firmware used in Sarasota?

It is a felony in Florida for a vendor to provide uncertified firmware or any uncertified voting system component or upgrade. Thus, a correct version number for each component and for all software is very important—its purpose is to allow verification that voting system firmware and components are the

same as those checked and certified by the state. The confirmation that the correct version numbers have been used in an election, although certainly not a guarantee that the correct firmware or components are installed, is a basic step in examining any election.

In Sarasota County, however, the PEB firmware version used in the November 2006 election does not match the version number certified by the state. Why wasn't this caught or noted in the FLDoS audit report?

The certification document for Sarasota's voting system[45] states that the certified PEB firmware is Version 1.7. This firmware version is also listed in the FLDoS audit report and on ES&S invoices. All poll tapes and the data shown on the touch screen screens, however, show that firmware version 1.07, not 1.7, was in use during the November 2006 general election.

We have already discussed the PEBs' crucial role as part of the iVotronic voting system in Section ___ of this report—they are the electronic ballot boxes that hold the vote count.   What guarantee do Sarasota voters—or the losing candidates in the November 2006 election—have that the PEBs used to record their votes were using a certified version of the firmware?

The state certification document for Sarasota's iVotronic voting system lists the PEB versions allowed for use in Sarasota as follows:

> PEB Rev:iV1.7-PEB-S, iV1.7b1-PEB-S, iV1.7b2-PEB-S, iV1.7c-PEB-S,

But firmware version 1.07 is shown at the top of a typical poll tape for Sarasota's November 2006 election (and version 1.07 was also listed on the touch screen screen itself):


```
Terminal S/N: V103829-B
PEB S/N PS100711-A (MW 1.07)
Software Version 8.0.1.2
Created 05/12/05  14:15
Copyright ES&S, Inc. 1993-2003
All Rights Reserved
Diagnostic check completed: OK
iVotronic I


GENERAL MUNICIPAL & SPECIAL ELECTION
POLLING LOCATION REPORT


Total Public Count:                        612


Number of Terminals Opened:                  9
Individual Voter Terminal Data
   S/N V106543
         Public Count:                      72
      Protective Count:                     482
      OPENED   06:19:18 11/07/2006
      CLOSED   19:11:04 11/07/2006
      Coded Ballot Count:                    0
```

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[45] http://election.dos.state.fl.us/votemeth/systems/syssearch1.asp

A similar discrepancy exists with the Unity software. The state certification document refers to Unity firmware version 2.4.4.2, but computer logs and ES&S correspondence refer to version 2.4.4. Oddly, the FLDoS audit report states that Sarasota was using Unity firmware version 2.4.4.2 "with elements of version 2.4.3." This does not make any sense. A firmware version is a firmware version. This is similar to someone saying they have a bucket of white paint with elements of black in it. What that means is the paint is now gray and is no longer white. So it is with firmware versions—as soon as elements of another firmware version are added, it is no longer the original version.

Each firmware version has its own unique features and problems. For an example of this, listen to E&S sales representative Lou Didier joke about the horrific problems with Unity firmware version 2.4.3 at an ES&S Users Group meeting videotaped in June 2007 in Oregon.[46] And yet the state says that elements of this problematic 2.4.3 firmware version were used in Sarasota.

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5.3   Undisclosed and unexplained computer log anomalies

An examination of the iVotronic event logs and the Unity System Logs shows abnormal activities, discrepancies, anomalies, and error messages for which we were unable to obtain explanations from the elections office. Some of the events they reveal were not reported on any other records or in the county election reports.

5.3.1   Event Log

The Event Log is a vital audit log used by computer scientists to analyze ES&S elections.   We discovered both design weaknesses in this log and anomalies pertaining to the Sarasota 2006 election.

5.3.1.1   Weaknesses in the Event Log

All the counties we have studied to date provided their event log and other computer audit logs in an **.**LST (list) format, but Sarasota provided its logs to us in a **.**TXT (text) format. Sarasota was also the only county to change the name of this file (from E2152 in the other counties to EL152All).

A critical weakness in the iVotronic machine Event Log (and for all iVotronic and Unity Logs) is that they are printed in a text format. Thus, someone with insider access can alter any event log or other log without detection. In fact, we are aware that the Sarasota elections office gave some investigators an abbreviated event log that only showed machine events through November 7. The event log we received (early in the process) showed events through November 10. An event log is meaningless as an audit tool if event messages can be so easily replaced or altered, or the log itself truncated. The withholding of any part of any computer audit record would be, at the very least, a shameful lack of disclosure.

The Event Log shows when the Service Menu and ECA Menu are entered, but it does not show what functions were performed after entering those menus, except for date/time changes.

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[46] ES&S Users Group Meeting, Oregon Conference, June 2007, ES&S Representative Lou Didier, http://blip.tv/file/287120

5.3.1.2 Missing Event Log Entries Indicative of a "Bug"

The ES&S Operator's Manual states the following regarding the Event Log:

> *In addition to the actual ballot images, Voter Terminals record a chronological event log. This event log includes every event that took place on the terminal: from clearing and testing for the current election, opening the polls, and votes cast to closing the polls, producing results, and finally collecting the audit data. Each event log consists of the event code, the time the event took place, and the serial number of the PEB used to activate the terminal for the event."*

We observed, however, that the Sarasota Event Log was missing numerous "events":

> ➢ In 2006, there were only five Print Precinct Results" messages on the Event Log. In 2004, however, there were 338 "Print Precinct Results" messages. All or most of Sarasota's 156 precincts did print results tapes on election night in 2006. Why don't these show up on the Event Log?

> ➢ In 2006, there was only one "Audit Upload" message on the Event Log. In 2004, however, there were 1,528 "Audit Upload" messages. The ES&S Operator's Manual says that the Event Log is supposed to show the collection of audit data from each machine, but no such messages appear on the 2006 Sarasota Event Log. Why not?

The Event Log is an important audit log. The fact that it was missing data in the Sarasota 2006 general election may be indicative of a bug, in much the same fashion that scrambled audit log data indicated a bug in the Miami-Dade elections in 2003-2004. Although ES&S was quick to assert in the Miami-Dade debacle that no votes were lost, Professor Doug Jones wrote the following:

> *The problem is that if the audit records are corrupted, how do you know the voting records are not also corrupted?* [47]

5.3.2 Unexplained anomalies in the Unity System Log #68A[48]

The Unity Systems Log shows all events that occur throughout an election pertaining to the Unity Server. We discovered many anomalies and undisclosed events by examining this log.

5.3.2.1 Sarasota created two completely different Unity Systems Logs

We received two completely different versions of Unity Systems Log EL68A from the Sarasota elections office. It appears that a second hard drive was created for use in the recount. The problem is that both logs from both hard drives were being maintained and used simultaneously, and that each log contains completely different entries.[49] This compromises the integrity of the audit log and shows that a "separate set of books" can easily be created. We believe the

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[47] "Count Crisis," by Matthew Haggman, Daily Business Review, May 13 , 2004
http://www.law.com/jsp/article.jsp?id=1084316008117

[48] While Florida State law requires the county elections office to provide public records to us on request, the law does not require them to answer questions about the records. They have told us they will not answer our questions, so we were unable to obtain explanations for these anomalies.

[49] Both logs to be posted to website.

elections office was unaware that it had given us two conflicting logs, since one of Kathy Dent's assistants told us that the IT Department had not made a copy of the first CD they gave us and "couldn't remember" what was on it.

5.3.2.2 Other Unity Log Anomalies

➤ When the early-voting data was read, every single precinct upload caused a "time stamp mismatch" error as recorded in the Unity Systems Log. Why?

➤ The Unity System Log shows that the elections office uploaded and deleted voting results data from the set early-voting flash memory cards several times before uploading the results data for the final time. Ms. Dent has repeatedly denied that any problems occurred on election night. Why, then, was it necessary to collect voting results data from 6 machines, then delete it; collect data from one machine, then delete it; collect data from all early-voting machines (except North Port City Hall), then delete it, and then finally upload all results data for the last and final time?

➤ When the early-voting data for the 2006 general election was read into the election reporting system, none of the Unity Systems Log messages indicated that the data was for early voting, but in the 2006 primary and in the L&A testing for the general election, the upload message for every precinct included "(EV)." Why the inconsistency?

➤ The Unity Systems Log shows that absentee vote data was uploaded to the server. Then another set of absentee vote data was uploaded and added. But the second "added to" set was missing two large blocks of precincts: Precincts 31 through 60 and Precincts 105 through 145, as shown on Unity Log EL68A. Why?

➤ Why, on November 15 and 16, does the Unity Systems Log show that the Election Reporting System was entered and exited six times without any other events logged? And why were these entries so far out of chronological order?

➤ At the end of Unity System Log for the *September primary*, there are several stray entries. One is for November 7, 2006 and reads:

11-07 08:47 pm EXITED ELECTION IN ELECTION REPORTING MANAGER

And yet, this entry does not show up at all on the November 7 log, where there is no indication that anyone exited the election reporting manager at 8:47 pm. How did an entry from the November log get added to the September primary information and why does it not show up on the log for the November election?

5.3.3 Unexplained Anomalies in Manual Adjustments Log EL68

Why were 474 manual adjustments made to the vote data, including *subtraction* of votes in the CD-13 race, in a total of 60 (out of 156) precincts on November 17 — ten days after the election, as shown on Manual Adjustments Log EL68 (also referred to as the "Results Correction Log")?

5.4 Oracle

Oracle is a powerful database management program. The State Audit report states that Oracle was installed on Sarasota's Unity System but not used:

> *"Sarasota County Supervisor of Elections' staff did not use the iVotronic Image Manager or the Oracle database, although these items are installed as part of their Unity system."*

The drive directories, however, show numerous Oracle messages beginning shortly after midnight on election night, including "udump" (deadlocked databases) and 139,000 data bytes with the message "alert - balfound" (ballots found).   There are dozens of Oracle messages that appear late on election night?   What is the meaning of the "udump" and "balfound" alert messages? Why do these Oracle messages appear if Oracle was not being used?

Evidence of Procedural Errors and Misconduct

6.1 Unauthorized access to the VEF (Voting Equipment Facility, or warehouse)

The Voting Equipment Facility (VEF) is the central hub of touch screen machine storage, machine maintenance, and machine set-up for each election.

The FLDoS report states:

> *Access to the VEF is restricted to the Supervisor of Elections and to authorized personnel with special identification that permits entry to the facility.*

In actuality, however, records show unauthorized access to the VEF by former employees, unknown users, and by unknown persons who were assigned an "Elections Spare Card."

The "Election spare card" entries appeared daily. When we asked the elections office for any records that would indicate who had accessed the warehouse, they responded in writing that they did not keep sign-out logs for these spare cards and had no such records. We then made a list of 15 questionable cards, 13 of which were used to access the VEF in October and November of 2006 and forwarded that list to the county and to the county attorneys.

Following our questions about these security breaches, Supervisor of Elections Kathy Dent conducted an internal investigation and issued an "Access Control Report."[50] Ms. Dent's self-investigation concluded that seven cards had been re-assigned to current permanent and temporary employees, but her investigation of the remaining six cards reports:

1 questionable card was simply explained as "**Election spare**"
1 was identified as **"not assigned"**
4 were identified as **"invalid zone access"**

Two other access cards were active but were not used during October and November 2006. One of these cards was issued to a former employee, the other to Gary Greenhalgh, an E&S sales manager. (Note: We obtained access-card records only from October 1, 2006 through the beginning of December 2006 and thus do not know if other unauthorized entries occurred before that date).

In a later review of the access-card records, we noted one additional anomaly. In an email, one member of the elections office staff requests a new access card for John Kennedy, Network Administrator for the elections office, stating that he had lost his original card. Access-card records, however, show that the "lost"

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[50] To be posted on FFEC website. *Access Control Report.* January 18, 2007. To: Kathy Dent, Supervisor of Elections, Sarasota County, Florida. Team Members: Nancy DeWitt, Thomas W. Goodell and Robert "Bobby" Walker.

card and the newly assigned card were used at different times on the same days just preceding Election Day.

In summary, access to the VEF and the main elections office does *not* appear to have been adequately restricted to authorized personnel. In fact, six cards gave access to unknown persons during the election cycle, and two other cards provided potential access to people who were *not* elections office personnel.

6.2   Unsecured and unprotected PEB (Personalized Electronic Ballot) cartridges

One type of PEB cartridge, the Factory Test PEB, offers unprotected and insecure access to the iVotronic voting machine. The SAIT Lab report states:[51]

> *When a Factory Test PEB is present, all password checks are bypassed: in places where the user would normally need to enter a password, the password check is bypassed, the machine functions as though the correct password had been entered, and a log entry is appended to the event log as though the user entered the correct password. This undocumented backdoor poses a risk of unauthorized access to critical system functions, because it provides a way that a malicious individual could bypass the password checks by tampering with a PEB."*

The SAIT report also discusses the potential problems of access to *any* PEB by someone with malicious intent, including the uploading of malicious firmware to the iVotronic machines or the spreading of a virus that could alter election results.

The FLDoS audit report states that "the PEBs were stored in cages under dual custody."

Rick Magee, a Zone Tech for the 2006 general election and one of the people who set up the iVotronic machines in preparation for the election, told us that although the supervisor and ballot-activator PEBs were kept in locked, sealed cages, the PEBs used to set up the election were left on top of a cart throughout the election set up—in an open box.   Magee did note that the VEF is protected by an alarm which was turned on every day at the close of business, but the practice of leaving PEBs out in an open box is, at the very least, a poor security procedure.

Even if these were not "factory test" PEBs, any unguarded access to any PEB provides an opportunity to manipulate the outcome of an election.

6.3   Supervisor Dent neglected to warn voters about the slow response times

In consultation with her staff, Supervisor Dent chose to ignore a poster distributed by ES&S warning voters about the slow response time on the iVotronics. Instead, Supervisor Dent and her staff decided to simply keep the "Touchscreen Voting – Easy as 1,2,3" posters already in the iVotronic booths.

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[51] *Software Review and Security Analysis of the ES&S iVotronic 8.0.1.2 Voting Machine Firmware*. February 23, 2007. Prepared for the Florida Department of State by the Security and Assurance in Information Technology Laboratory (SAIT), AlecYasinsac, et al.

Not only did Supervisor Dent fail to display the ES&S warning poster, she never sent out a notice asking poll workers to inform voters about the slow response problem, even after it became apparent during early voting. Eventually, just prior to Election Day, Dent did ask poll workers to tell people to review their ballots carefully, but still does not mention the—by then—known problems of slow response and votes disappearing from the review screen.

The failure to display the ES&S warning poster and the failure to warn voters about this problem after it became apparent were poor decisions that unquestionably contributed to the high undervote rate in Sarasota County.

As with any mechanical problem, forewarned is forearmed. (For example, if someone knows that a car requires 3 presses on the accelerator before turning the key, the starting of the car will be much smoother than someone trying to start the same car without that knowledge). In Sarasota County, however, voters were unaware that they would have to exert more pressure and press longer to make their selections. For many hundreds of Sarasota voters, the 2006 election was more of an obstacle course than a successful voting experience.

On Election Day, volunteers for candidate Christine Jennings distributed the following flyer to hundreds of voters:

Christine Jennings For Congress

EVERY VOTE COUNTS!

Electronic voting is still new to many of us; here are four things you can do to make sure your vote counts:

1. Make sure you cast a vote for each race in which you intend to vote.
2. Electronic ballots have a review screen at the end of the ballot. REVIEW YOUR BALLOT CAREFULLY to ensure that it has accurately recorded your vote for each race.
3. If you notice a problem, immediately notify a poll worker and write down the serial number of the flawed machine.
4. Contact our office at (941) 366-3981 to report any problems; please have the flawed machine's serial number handy.

DOUBLE CHECK YOUR BALLOT!

Paid for by Christine Jennings for Congress

Jennings' notification to voters, and warning articles in local newspapers, may be one reason that the undervote rate dropped to 13.92% on Election Day from the 17.62 % undervote rate during early voting.

The ES&S warning poster, which Supervisor Dent chose not to display, addresses the three major problems that voters experienced in the 2006 general election: The need to exert extra pressure, the slow response time, and the problem with votes not showing up on the review screen. Did ES&S know about the review screen problem in advance of the election? Following is the ES&S Poster that the company recommended posting in each iVotronic booth to warn voters about the slow response problem.
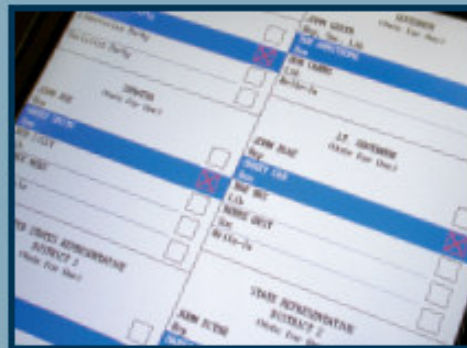
Sarasota Supervisor of Elections Kathy Dent chose not to display this warning poster, which ES&S had recommended displaying at each voting booth.

6.4 Misconduct in the handling of vote data

Florida law requires poll tapes[52] to be posted as soon as the vote count is completed. Florida Statutes § F.S. 102.071 reads:

Tabulation of votes and proclamation of results.—The election board shall post at the polls, for the benefit of the public, results of the voting for each office or item on the ballot as the count is completed. [Emphasis added]

One of the main reasons for requiring that poll tapes be printed immediately is that it is a protection against the manipulation of vote results. Once the results are on a hard paper copy, it is much more difficult for anyone to alter results without detection. Until the poll tapes are printed, however, there is nothing to prevent the malicious alteration of election results by a corrupt insider with access to the PEBs, flash memory cards, or the central Unity server.

In Florida, poll tapes are normally posted on the door of each precinct, and some counties post early voting and absentee poll tapes at the central elections office on election night..

In Sarasota County in the November 2006 election, however, elections staff did not even begin printing the poll tapes for any of its seven early voting sites until 10 a.m. on November 8—the day *after* the election.[53] This late printing is clear by looking at the early voting poll tapes, which show the date and time each tape was printed.

The FLDoS audit report does mention the late printing of the poll tapes as not being in conformance with "established procedures,"[54] but it does *not* mention that this late printing was a violation of state law. The audit report includes the following recommendation:

> *Require the production of the Early Voting results tape on election night after the polls close.*

6.5 Missing flash memory cards and undisclosed collection of vote data

The iVotronic Custody Log for Precinct 69[55] states that two voting machine seals were "broken in transit" and two flash memory cards were "missing." Two broken seals and two missing memory cards holding the votes? How could this have happened and why wasn't it investigated or disclosed on the Conduct of Election report?   The elections office has never disclosed these and other broken seals mentioned in other reports, nor has it disclosed or explained how carefully controlled flash memory cards, holding vote data, can go missing.

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[52] Poll tapes are the printout of cumulative vote totals for each race. There is one poll tape for each precinct; one poll tape for each early voting site; and one poll tape for each machine run of the absentee ballots.
[53] Early voting poll tapes to be posted on website
[54] Page 3 of the FLDos State Audit Report
[55] iVotronic Custody sheet for Precinct 69 to be posted on website

6.6 The North Port City Hall Mystery -- two different stories regarding North Port's critical votes

Story #1: Supervisor of Elections Kathy Dent was quoted in two different articles in the *Sarasota Herald Tribune*[56] as saying that memory cards were improperly removed from the voting machines at the end of early voting, and that these memory cards were blank when elections staff tried to upload them on election night at the elections main office. Because these cards were blank, Dent said, someone had to go to the VEF warehouse where the machines were stored and collect the vote results from them late on election night.

Story #2: In this version, Supervisor Dent did not say that the memory cards were blank, but instead that poll workers had *forgotten* to take the memory cards out of the machines and that someone had to go to the VEF warehouse to retrieve them.[57]

The Event Log shows that someone entered the critical Service and ECA menus on every one of the North Port City Hall machines around 11 pm on election night, *before the results tapes had been printed as hard-copy evidence of the vote totals.* This fact supports Supervisor Dent's version of events as explained to the *Sarasota Herald Tribune*, since the simple retrieval of memory cards would not have required entering the Service and ECA menus.

Photo of a flash memory card similar to the SanDisk cards used in each iVotronic voting machine to collect vote audit data. The flash cards used in the iVotronic machines are a commercial version of the flash memory cards used in digital cameras.

The activities at the warehouse on election night, which include additional machines being opened as described in Section 6.6.2, may have been completely benign—or not. By not following proper procedures and failing to print any early voting results tapes until the morning after the election, Supervisor Dent opens herself up to criticism and speculation about what really happened that night in the warehouse – particularly in light of her changing story and in light of the fact that North Port was the *only* early voting site where Christine Jennings lost to Vern Buchanan. Following is a table showing the vote totals for both candidates at each of the seven early voting sites:

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[56] Link to Sarasota Herald Tribune articles

[57] Part I -- http://blip.tv/file/285743 ; Part II -- http://blip.tv/file/286097 ; Part III -- http://blip.tv/file/287182

Table 6.6-1   Early-voting totals for Buchanan and Jennings

Early Voting Site	Votes -- Buchanan	Votes – Jennings	Undervotes
North County Library	146	415	147
Terrace Bldg. (main elections office)	1,946	3,059	937
Fruitville Library	1,452	2,044	533
Gulfgate Library	2,263	3,328	1,155
Venice Office	3,363	3,821	1,706
North Port SOE	1,128	1,305	744
North Port City Hall	592	537	211
TOTAL	10,890	14,509	5,433

The North Port City Hall vote totals were the last totals uploaded on election night, at 11:45 pm. The fact that critical machine menus were entered into at the VEF on election night under questionable circumstances makes it relevant to discuss the importance of these menus.   We address the vulnerabilities regarding access to these menus and Sarasota's lack of password protection in Section 6.7 of this report.

6.6.1   Venice Early Voting Machines

Two machines from the Venice early voting site were opened at the warehouse shortly after 9 pm on election night – again without disclosure to the public or to affected candidates – and the Service and ECA Menus were also entered on these machines.

➢ Machine #118360: This machine was taken out of service on October 24, the second day of early voting, following eighteen consecutive "Low Battery Lockout" messages. A nineteenth "Low Battery Lockout" message immediately precedes the entry into the Service and ECA menus on election night. Because this machine was taken out of service early, it recorded only 21 votes.

➢ Machine #106176: We do not have any problem reports for this machine, but it was also opened shortly after 9 pm on election night and the Service and ECA menus entered.   This machine recorded a total of 61 votes and 16 undervotes (a 26.23% undervote rate).

Why were these machines opened at the warehouse on election night, before poll tapes were printed to provide hard-copy evidence of the vote results?

6.6.2 Precinct 64

The Sarasota elections office has not disclosed that all sixteen voting machines used at Precinct 64 on Election Day were entered into on November 10, 2006 – three days after the election – and the Service and ECA menus were entered. These machines recorded a total of 992 votes, and the undervote percentages ranged from 8.9% to 25%, with 5 of these machines recording an undervote rate over 20%.

Why were these machines opened three days after the election and the Service and ECA menus accessed?

6.6.3   Precincts 17 & 24 -- ADA Machines

Precinct 24: ADA Machine #106711 was opened at the warehouse on November 10 and its Service and ECA menus entered. The screen on this machine went blank partway through Election Day, and it was taken out of service at 11:15 am. It had 19 votes on it and 4 undervotes. Why was the ECA menu entered on this machine 3 days after the election?

Precinct 17: ADA Machine # 105690 was opened at the warehouse on November 10 and its Service and ECA menus opened. (There were no reported problems with this machine. It had 33 votes on it and 0 undervotes). Why was the ECA menu entered on this machine 3 days after the election?

6.7   Sarasota Menu and Password Problems

As described in the sections above, critical machine menus were entered into at the VEF on election night under questionable circumstances, and more machines were entered three days after the election – all without disclosure. Thus, it is relevant to discuss the importance of these menus and the passwords that are supposed to protect them.

The ES&S Operator's Manual states the following:

> *Password protection restricts access to the Service Menu and the Elections Central Applications Menu"… Typically, election officials do not divulge the menu passwords to precinct officials. If precincts require the Service Menu or Elections Central Applications Menu passwords, extenuating circumstances exist and trained personnel should be present at that polling location to oversee the situation. [Page 76]*

The SAIT report notes severe weaknesses in the password protection to critical functions of the iVotronic voting machines. The SAIT report states:

> *The weakness of the Upload Firmware and Service passwords are of primary concern, because someone who knows those two passwords can replace the software on the iVotronic with malicious software that switches votes from one candidate to another, that turns valid votes into undervotes or deletes them entirely, that infects the machine with a virus, or that otherwise compromises the integrity of the election. These functions should be better protected. Our judgment is that the password mechanisms on the iVotronic are poorly conceived and poorly implemented. The consequence is that the passwords by themselves do not do a good job of preventing unauthorized individuals from accessing critical system functions.*

We discovered the following password vulnerabilities in the November 2006 general election in Sarasota County:

➢ Poll workers noted that some machines went straight to the Service Menu

➢ The ES&S maintenance forms (used by both Sarasota and Charlotte counties to record machine problems) have the password for the Service Menu *printed on the form*, along with specific instructions as to how that menu may be entered. The form says, "ES&S Confidential" at the bottom.

➢ Other maintenance forms had the passwords for the ECA Menu and the Upload Firmware Menu handwritten on the front of the form. [We are not including these passwords in this report, even though they are easily accessible on these maintenance forms].

➢ All 10 machines from the North Port Early Voting site were opened between pm on election night and the Service and ECA menus were entered (before the results tape was printed as hard-copy evidence of vote totals).

➢ Machine # 118360 and Machine # 106176, from the Venice early voting site, was opened at 21:15:15 (9:15pm) on November 7, election night, and both the Service and ECA menus were entered into *before* the printing of the results tape.

➢ All sixteen machines from Precinct 64 were opened on November 10, after the election but before the machine recount, and the Service and ECA menus were entered.

➢ The event log from the state's first parallel test shows that the ECA menu was entered around 6 am on the morning of the test, conducted as part of the post-election audit. It is not necessary to enter the ECA menu to change the date and time, so why was this menu entered?

The SAIT report further notes that the Service Menu, the ECA Menu and the Upload Firmware Menu consist of three, easy-to-guess letters. These passwords are hard-wired into each machine and cannot be changed by election administrators. The fact that ES&S prints the password to critical machine functions on forms that go to possibly hundreds of jurisdictions means that an untold number of people have knowledge as to how to access these sensitive iVotronic machine menus, easily allowing the uploading of malicious firmware.

Menus as shown in an ES&S Operations Manual[58]

Service Menu

☐ Clear and Test Terminal

☐ Set time and Date

☐ Qualify PEB(s)

☐ Test Printer

☐ Test Modem

☐ Upload firmware

☐ Set Volume

☐ Enter Elections Central Menu

Elections Central Application (ECA) Menu

☐ Prepare PEB for polling location

☐ Test Vote

☐ Clear Supervisor PEB Vote Totals

☐ Prepare PEB for PEB Audit

☐ Prepare PEB for Serial Audit

☐ Upload PEB Vote Results

☐ Upload PEB Audit Data

☐ Print Report to Screen

☐ Print Report to the Printer

☐ Start Election Qualification Trail

☐ Color Option Numbers

☐ Exit to Service Menu

Sarasota Fact:
The Service Menu was entered 70 times during the November election cycle and the ECA Menu was entered 34 times, according to the Event Log, with no message as to what function was performed.

6.8 Broken chain of custody for voting machine seals

Recommended Procedure:	**What We Observed:**
During the recount, elections employee Karen Crete explained the importance of recording all seal numbers as the machines are opened, "so the chain of custody is intact." [59]	Around noon on the first day of the recount, we learned that the numbers of seals being taken off the voting machines were NOT being recorded — thus breaking the chain of custody for those machines. We lodged a formal complaint with the Canvassing Board, and all seal numbers were recorded henceforth.

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[58] ES&S Operator's Manual to be posted on FFEC website

[59] Our discovery of the unrecorded seals and the Canvassing Board's response may be viewed as part of two half-hour videos on www.shadowvote.org.

Weaknesses and Gaps in Florida's Post-Election Audits

7.1   Assumptions and limitations of the SAIT Report[60]

The SAIT report has been used by ES&S to vindicate the iVotronic voting system in the Congressional District 13 race. However, the SAIT investigation is far from a vindication.

7.1.1 Assumptions of the reviewers

The SAIT team made significant assumptions, which, if false, call into question the validity, and even the relevance, of their findings. These assumptions were based on trust in ES&S and the Florida Department of State:[61]

They assumed that the source code they were given to examine was the exact source code used to build the firmware that was used in the Sarasota County machines during the 2006 elections.

They assumed that the software used to build the firmware from the source code worked correctly, conformed to standards, and contained no bugs or unexpected behavior.

They assumed that the touch screen controller did not fail in a malicious way, that is, that it "either functioned correctly or failed in a way that was detected and resulted in the machine being taken out of service."[62]

Considering the questions surrounding ES&S's claim that the touch screen controller was commercial off-the-shelf (COTS) software, and considering the widespread problems voters experienced with the touch screen's operation, the SAIT team's assumption that the controller functioned correctly appears—in retrospect—to be a significant and unwarranted assumption.

7.1.2 Limitations on the scope of the review

The team's scope of work was extremely limited. The report dedicates more than two pages to listing "Activities That Are Out of Scope for This Analysis (i.e. Things We Did Not Do)" and delineating disclaimers. For example:

> We did not conduct a comprehensive election audit. [page 19]

> We did not attempt to verify that the code is completely free of defects. ... fundamental limits on the ability of manual source code review ... impossible to check all code paths ... impossible to exhaustively enumerate and analyze the full state space that the code inhabits. Moreover, humans are fallible: just as the original software programmer

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[60] "Software Review and Security Analysis of the ES&S iVotronic 8.0.1.2 Voting Machine Firmware." February 23, 2007. Prepared for the Florida Department of State by the Security and Assurance in Information Technology Laboratory (SAIT), AlecYasinsac, et. al. http://election.dos.state.fl.us/pdf/FinalAudRepSAIT.pdf

[61] SAIT Report, page 18.

[62] SAIT Report, page 19.

can miss a defect in the code they write, so too can independent reviewers overlook subtle defects and bugs in the code. [page 19]

They did not review the PEB firmware. [page 19]

They did not do a dynamic, "hands on" review of the software, that is, they did not review how the software worked when it was actually operating. They explain:

Classically, software analysis usually involves a combination of static analysis (e.g., manual code review) and dynamic analysis (e.g., black-box testing, unit tests). This project was charged to perform static analysis of the code; dynamic analysis was not part of our charge. [page 19]

Then they say further:

However, even the combination of static code analysis, black-box testing, and clear-box testing cannot reveal the presence or absence of all faults in non-trivial programs. [page 20].

They did not review the software of the touch screen controller. They state:

Comments in the main processor code identify the part number of the microcontroller. The interactions with the controller are well defined and are under the control of the main-processor firmware, which we reviewed. [page 21]

They trusted ES&S' word that the controller was COTS, and they trusted *"comments in the main processor code"* to inform them of the part number of the controller.

In addition, poor coding practices added to the normal difficulties inherent in examining source code. The team tells us:

…there is a wide variation in naming and other readability characteristics

…control flow is not standardized and is often unintuitive.

Furthermore, the code had been patched and revised so many times, it was difficult to follow:

The code base is aging and shows the effects of numerous modifications. The team was frustrated by the code's limited readability, and we suspected corresponding reliability issues. [page 16]

7.2 Investigation in a vacuum
Information we uncovered in our investigation demonstrates the importance of evaluating the theoretical results of the State's software review in light of real-world facts.

Why the SAIT Team Believed No Virus Was Present in the Sarasota iVotronics:	Facts that Call the Validity of Team's Belief into Question:
The SAIT report warned of severe flaws in the iVotronics that made them extremely vulnerable to a virus attack via PEBs. The team concluded that there were "strong reasons" to believe no such virus was present during the election. Their reasons included:	The SAIT team's "strong reasons" to disbelieve the presence of a virus dissolve in the face of real-world facts.
Sarasota County PEBs are "carefully inventory controlled."	All PEBs were not carefully controlled.
Introducing a virus requires physical presence and access to iVotronic functions that are not available to the average voter.	Decision One, a company with a national contract with ES&S to perform voting system maintenance, maintained the iVotronics in the counties with the highest undervote rates, including Sarasota, Charlotte, Lee, Sumter and Miami-Dade.
The excessive undervote rates in Sarasota, Charlotte, and Lee counties would have required separate attacks in all three counties.	In at least one instance, Decision One used spare Charlotte County screens to replace Sarasota screens. Were other components traded among counties also?
Such an attack would require substantial technical sophistication and extensive advance preparation.	
While supervisor terminals, which are used to prepare PEBs for the election, are at high risk, they are stored in the VEF where access is strictly protected.	Unauthorized or unknown persons accessed the warehouse.

The SAIT team was not told that some of Sarasota's PEBs were *not* "carefully controlled," nor were they informed that unknown persons held key cards that gave them access to the warehouse. The team's belief that Sarasota administers its own elections and that its equipment is thus isolated from other counties indicates they were unaware that Sarasota's maintenance company also performs maintenance for other Florida counties and assisted in preparing for the 2006 election.

What other information might have assisted the SAIT investigators in evaluating their conclusions?

In addition, the following points were not included in either the Florida audit report or the SAIT report.

7.3 Aging Sarasota voting system

The Florida audit report states that the "initial certification" of the current "voting system release" was on August 18, 2005.[63] But the report fails to mention that Sarasota County purchased and began taking possession of its iVotronic machines in December, 2001, meaning that the machines were built in 2001 or earlier.

Did the SAIT investigators know the true age of the Sarasota voting system? They specifically state in their report that "aging hardware" is outside the scope of their investigation. By current standards, the iVotronic voting machines, like any 5-year-old computer,[64] would certainly be considered "aging."

7.4 Wrong Assumption that iVotronic firmware 8.0.1.2 was used only in Florida

The SAIT Report wrongly states that if the undervote problem had been caused by the iVotronic 8.0.1.2 firmware, then the same problem would have shown up elsewhere in the country. The SAIT investigators were apparently unaware that firmware version 8.0.1.2 was not used anywhere else in the country because it is only certified in Florida and nowhere else in the nation. The "uniqueness" of the undervote problem to Florida is mentioned 22 times in the SAIT report as a significant reason why the firmware could not be the cause of the undervotes. ***However, version 8.0.1.2 was not, and is not, federally qualified; we have confirmed that it was not used in any state except Florida.[65]***

What the SAIT report said:	Our Findings:
"FLORIDA UNIQUENESS. If the claimed behavior [high undervotes] were present in the certified iVotronic software, one would expect that *it would have been observed in other jurisdictions using the same software."* (Emphasis added).	Firmware Version 8.0.1.2 is certified in Florida but is not federally qualified (Florida does not require federal qualification). We have confirmed that firmware version 8.0.1.2 was only used in Florida and not in any other states.

7.5 Questionable Hash Test

The FLDoS Audit Report states:

> *"The audit team found the installed firmware to be an exact copy of the DOE escrowed firmware."* [Page 1]

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[63] Page 6.

[64] At least 5 years old at the time of the 2006 General Election

[65] See all federally qualified voting systems and firmware versions at
http://www.nased.org/NASED%20Qualified%20Voting%20Systems%20FINAL%20rev081407.pdf

Despite this statement in the Audit Report, however, we are quite sure that the DOE did *not* have an escrowed version of the iVotronic firmware, for two reasons:

➢ First and foremost, the DOE's *plan* for the audit (dated November 13, 2006, before the audit was conducted) *acknowledges there is no escrowed version*. The Audit Plan[66] states that the Division of Elections will "obtain the firmware EEPROM .bin file from the Division of Elections' 12" DRE." Conducting a hash test of a voting machine stored at the DOE is *not* the same as having the firmware escrowed. Additionally, we have been informed that the voting machines kept at the DOE are not properly secured but are in an open hallway easily accessible to vendors and others.

➢ Secondly, on December 4, 2006, we requested (with the invaluable assistance of John Washburn, a Wisconsin computer professional), the hash values of all components of all Florida voting systems. The DOE provided only three (3) of the 101 hash values requested. Instead of giving us the .BIN file for iVotronic firmware version 8.0.1.2, for example, the state instead provided the .ZIP file, which is the hash value of the *installation disk* for the firmware, not the hash value of the firmware itself. This is the equivalent of sending the cover of a book without the book itself.[67]

The FLDoS Audit Report states that the hash value of the 8.0.1.2 firmware is: **V8012.bin   E9EFF 14B28A49504DBEC9C2CA2DBC6929EC7F27E**

But the disk we obtained from the DOE lists the iVotronic firmware hash value as follows:
iVotronic Release 4.5 Version 2:
D:\Firmware files\iVotronic\12in terminal.zip
70110C42153CC5790C867BEC019284741EF8407C
443082 09/09/2005 16:27w GMT

The above .ZIP archive should contain the file, V8012.bin.

Recommendation: The contents of the .ZIP archive should be checked to see if the .BIN files contained within it match the 8.0.1.2 hash value listed in the FLDoS Audit Report.

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[66] The FLDoS Audit Plan is available on-line at: http://election.dos.state.fl.us/pdf/AuditPlan11-10.pdf

[67] For a more detailed account, including all hash values provided by the DOE, see John Washburn's write-up regarding our request and the response by the Division of Elections at http://washburnsworld.blogspot.com/2007_01_14_archive.html

Contradictions in the ES&S "Smoothing Filter" Letter

8.1   The Letter

Election Systems
& Software

11208 John Galt Boulevard · Omaha, NE 68137 USA
Phone: 402.593.0101 · Toll-Free: 1.877.377.8683 · Fax: 402.970.1285
www.essvote.com

August 15, 2006

Dear FL Users:

It has come to our attention after a number of inquiries from several of our iVotronic 12 inch screen users that some of your screens are exhibiting slow response times. After receiving some of these terminals in our Omaha, NE facility we were able to replicate a slow response during our testing.

After further analysis of the issue it has been determined that touchscreens on units with previous versions of firmware did not exhibit this condition. Therefore, our Engineering and Development Teams reviewed the differences in firmware code for versions 8.0.1.2 and 7.4.5.0 to establish the possible cause of this condition.

We have determined that the delayed response time is a result of a smoothing filter that was added to iVotronic firmware versions 8.x and higher. This smoothing filter waits for a series of consistent touchscreen reads before a candidate name is highlighted on the ballot. In some cases, the time lapse on these consistent reads is beyond the normal time a voter would expect to have their selection highlighted. This delayed response to touch may vary from terminal to terminal and also may not occur every single time a terminal is used.

The improvement will require an update to the firmware, and state-level certification. We have already taken steps to make the necessary changes to the firmware. Our plans are to certify this in the state of Florida in time for use for the November, 2006 General Election. This firmware upgrade would not involve any Unity software changes or upgrades to any other component of your voting system. This firmware change is only necessary for the 12" size iVotronic screens.

In order to avoid any potential issues at the polls on September 5th , it is our recommendation that you train your poll workers and voters to expect this slightly delayed response time for their highlighted selections. We have included with this mailing a sample voting booth instruction sign for your review and use.

It is important to note that this delayed response time in no way affects the integrity or reliability of the iVotronic voting system. All votes will be recorded securely and accurately as they always have been. No other functionality within the iVotronic system is compromised or affected by this issue.

It is our goal and focus at ES&S to provide secure, accurate and reliable voting systems to all of our clients worldwide. On behalf of ES&S, I can assure you that we are working with the Florida Division of Elections to rectify this situation and to prevent it from being an issue in all other future elections.

We will keep you posted on our developments as we work through the necessary phases of implementing this firmware in our 12" iVotronic screen counties in Florida.

Thank you for continued support.

Sincerely,

Linda Bennett
Regional Account Manager

Cc: David R. Drury, Chief, Bureau of Voting Systems Certification

8.2 Contradictions between the ES&S letter and the SAIT report

➤ If the slow responsiveness of many iVotronic machines was caused by a smoothing filter problem in the 8.0.1.2 firmware, as claimed in the ES&S letter, it would have been consistent on all machines. The SAIT report states the exact opposite of the ES&S letter:

The SAIT Report states:	ES&S' letter informs us that:
"The touch screen filter does not act differently on different screens."[Page 48]	"This delayed response to touch may vary from terminal to terminal and also may not occur every single time a terminal is used." The letter also states that the smoothing filter problem occurs only on 12" screens, not on 15" screens.

➤ The fact that the slow response problem varied from machine to machine is indicative of a bug, or indicative of an interaction of the firmware and faulty hardware. The failing screens are much more likely to have caused the slow response problem, as evidenced by the fact that calibrating the screens solved the slow response problems, at least temporarily. Slow response is a step on the road to a completely failed screen and no response at all.

➤ Alec Yasinsac, SAIT lead investigator, told us that he had looked for the smoothing filter in the 8.0.1.2 firmware, but did not find it. (He said he could not answer follow-up questions due to having signed a non-disclosure agreement).

➤ The smoothing filter is normally a function of the touch screen controller, not the machine firmware. The touch screen controller determines the validity of a "touch" and sends that information to the machine's processor. The SAIT team did not look at the touch screen controller because it was outside the scope of work determined by the Florida Department of State. Despite the fact that the SAIT team did not examine the touch screen controller, they did make several comments about it that raise additional questions:

The SAIT Report states:	Kevin Brown of the Hampshire Company, which manufacturers touch screen controllers told us that:
"The touch screen controller also performs other functions, such as providing information about the battery voltage level of the system and turning on and off the backlight."	Providing information about the battery voltage level of the system and turning on and off the backlight are **not** normal functions of a touch screen controller.

The SAIT Report states:	Kevin Brown of the Hampshire Company, which manufacturers touch screen controllers told us:
"The touch screen controller is a commercial off-the-shelf component." [Page 54]	Hampshire Company had bid on the contract to provide touch screen controllers to ES&S but his company did not get the contract because *ES&S had stated it was going to build its own controllers*. Mr. Brown said he believes that ES&S purchased blank controller microchips from Burr-Brown and then built its own controller circuit board around it.

Bergquist's own website states that it uses Hampshire Company for its touch screen controllers.[68] Since Bergquist provides most of the screens for the ES&S iVotronics, why didn't Hampshire Company provide the touch screen controllers for the iVotronics as it usually does for Bergquist screens?

The cause of the slow response problem is not addressed in the SAIT report, and yet it was a critical problem in the Sarasota election. SAIT lead investigator Alec Yasinsac told us that he did not see the ES&S smoothing filter letter prior to issuing the SAIT report, yet references to it are made obtusely in the SAIT report, which mentions internet discussion about the smoothing filter. Any internet discussion about the smoothing filter would have been in reference to the ES&S letter, so why did no one bother to read the letter?

SAIT report:

No explanation has been offered how the effect [delayed response] would confine itself to a single race on a single screen. The touch screen filter does not act differently on different screens.

ES&S Letter:

This delayed response to touch may vary from terminal to terminal and also may not occur every single time a terminal is used."

The glaring discrepancy between the statement in the SAIT report and the statement in the ES&S letter requires further investigation and a letter of explanation by one or both entities.

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[68] http://www.bergquistcompany.com/to_electrical_info.cfm

The Recount

9.1   Was there a recount at all?

There are no computer records indicating that the recount ever took place. In an email, ES&S   instructed the Sarasota County elections office to set up a separate hard drive for the recount. Sarasota did set up the separate hard drive, and it reset its database in preparation for uploading the recount results. However, the recount results were never uploaded and no Event Log is available to show what actually happened in the recount. Were the votes actually recollected from the internal memories of the iVotronics for the recount, or were Election Day poll tapes simply reprinted?

9.2   Sarasota did not follow ES&S Recount Procedures

The ES&S Operator's Manual states that the same PEBs should be used for the recount as were used during the election. Since any PEB from a precinct can be used to collect votes, Sarasota would not have had to use the master PEBs, but could have used any PEB from a given precinct. Instead of following the recommendations in the ES&S Operator's Manual, however, Sarasota used new PEBs for the recount. This means that the new PEBs had to be specially programmed to conduct the recount. The fact that Sarasota did not use the original PEBs points to a possible problem with the originals and a possible problem with the original ballot definition files.

Since Sarasota had to reprogram all new PEBs for the recount, was this the "new program file" referred to in the ES&S email in Section 5.1 of this report? If so, why was a new program necessary?

The fact that there is no Event Log from the recount is also problematic. The Event Log we received went through November 10, 2006, and showed that 18 machines were opened and the ECA menu entered on November 10. But what happened to the machines on November 11 and 12? We know there were many people at the warehouse on both days (by looking at the access card reports for the warehouse). An Event Log from the recount would also show what was done to the machines on November 11 and 12.

9.2.1 Recommendation

An Event Log should be created for the general election *through the recount.* This would what happened to the machines during the two days prior to the recount where no Event Log has been made available to us, as well as for the recount itself.

9.3   Public Observation at the Recount

On the first day of the recount, Supervisor Dent announced that there would be "no announcements until 3 pm." We objected, and read aloud from Florida Statute 104.29, which makes it a misdemeanor for election officials to deny citizens the privilege of observing the votes being counted and hearing them called out. Statute 104.29 reads as follows:

104.29 Inspectors refusing to allow watchers
while ballots are counted.—The inspectors or other
election officials shall, at all times while the ballots are
being counted, allow as many as three persons near to
them to see whether the ballots are being correctly read
and called and the votes correctly tallied, and any official
who denies this privilege or interferes therewith is
guilty of a misdemeanor of the first degree, punishable
as provided in s. 775.082 or s. 775.083.
History.—s. 8, ch. 26870, 1951; s. 51, ch. 71-136; s. 35, ch. 77-175; s
53, ch.79-400.

The lawyers asked to borrow our statute book, and after a while they decided that all poll tapes printed at the recount would be read aloud as they came off the machines. This was done and the total votes for Buchanan, Jennings, and the total number of undervotes were read aloud from each poll tape. Our challenge of Supervisor Dent's announced procedures and our reading of Florida Statute 104.29 may be viewed at www.ShadowVote.org.

Later, at a conference in Oregon where she was a keynote speaker, Kathy Dent said that we had read an "antiquated statute that had been repealed."[69] This is not the case. Florida Statute 104.29 is a current and valid statute.

9.4   Seals from the iVotronics Not Recorded at Recount
We were not allowed access to the iVotronic machines at the recount to see the poll tapes being printed. Only the official "observers" were allowed to do so. But around noon on the first day we discovered that the seals from the iVotronics were just being thrown in a plastic bag that contained all the seals that had been removed from machines in that precinct since the beginning of the election. This meant there was no way to tell which machines had been opened since Election Night. We objected, and all seal numbers were recorded henceforth. Did Supervisor Dent not want anyone to know that at least 18 machines had been opened and their Service and ECA menus entered three days after the election?

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[69] Part I -- http://blip.tv/file/285743 ; Part II -- http://blip.tv/file/286097 ; Part III -- http://blip.tv/file/287182

"Voter Disgust" and "Ballot Design"

10.1 Overview

Lacking information about the severe and extensive machine problems experienced in Sarasota County, many people believed the "spin" generated by ES&S, the Sarasota County Supervisor of Elections, and the Department of State that the cause of the undervotes must have been voter disgust regarding the "nastiness" of the CD-13 race or the "layout" of the electronic ballot page upon which the race appeared.

The ballot layout for the subject counties may be viewed in Appendices A, B, and C.

The high undervotes in the attorney general's race in Charlotte, Lee and Sumter counties—when they were mentioned at all, which was rarely—were stated to have been the result of a "similar" ballot design as that of the CD-13 race. The elevated undervotes in Miami-Dade and Broward counties in the attorney general's race, also on the iVotronics, were not mentioned at all. Neither were the elevated undervotes in the chief financial officer and commissioner of agriculture race in Martin County, another iVotronic county, which had a completely ordinary ballot design.

Not only did spikes in top-of-the-ballot races appear only on ES&S voting systems, but a further pattern emerged: The spikes occurred only in one or two races in each of these counties. When two races were affected, they were placed consecutively on the same ballot page. This is true for Sarasota, which, in addition to high undervotes in the CD-13 race, also had the highest undervotes in the state in the governor's race, located immediately following the CD-13 race on the Sarasota ballot. In Martin County, the elevated undervotes appeared in two consecutive races, the chief financial officer and commissioner of agriculture race, on a perfectly ordinary ballot.

Problems with the machines were denied by ES&S, the Department of State, and the Sarasota County Supervisor of Elections—in press releases and other public statements. Voter complaints of difficulty making their selections—due to the slow response of the machines and the need to apply extra exertion; votes disappearing on the review screen; and of ballot-display problems such as a split-screen display, where Vern Buchanan's name was at the bottom of the first page of the ballot and Christine Jennings name was at the top of the second page—were summarily ignored. Advice from one of the nation's top independent experts on the iVotronics to check the ballot layout still contained on the PEBs to determine what voters actually saw—and whether the CD-13 race had been left off some ballots completely—was also ignored. A pre-election letter from ES&S acknowledging the slow response of the machines was not provided by ES&S, the Department of State, or the Sarasota Supervisor of

Elections to attorneys in the contests of the CD-13 election race. The audits conducted by the Department of State and by SAIT were woefully inadequate.

Every other analysis of the CD-13 undervotes has looked only at Sarasota County—but those undervotes did not happen in a vacuum. The pattern that has emerged in our investigation makes it clear that the undervotes were a result of programming errors, bugs and/or machine malfunctions, as explained herein.

Nevertheless, we will present the two arguments promoted by ES&S, the state, and the Sarasota County Supervisor of Elections, with a caution that they should be considered in light of the extensive voting system problems presented in this report.

10.2 The Voter Disgust (Intentional Undervoting) Argument

Voter disgust has been dismissed by serious researchers and analysts as a significant cause of the CD-13 undervotes in Sarasota. Even the SAIT computer team' report concludes that intentional undervoting cannot explain the large number of undervotes in this race.[70] We only include this explanation here because it continues to be cited by the Florida Secretary of State and by Sarasota's supervisor of elections and her staff. In our last visit to pick up public records, staff members again told us that they believed the undervotes were caused by the nastiness of the race.

Why have experts dismissed intentional undervoting as a possible explanation? First, there is no reason why voters in Sarasota would have been any more or less disgusted than voters in other counties comprising the CD-13 district, all of which experienced normal undervote rates. Further, it would not explain the low undervote rates in this race among absentee ballot voters in Sarasota County. Absentee ballot undervote rates are normally within a percentage point or two of early voting and Election Day undervotes, whereas the undervote rates in Sarasota County ranged from 17.62% during early voting to 13.82 on Election Day to just 2.5% on the absentee ballots. It is also important to note that the "voter disgust" argument does not account for voter complaints.

Most compelling, however, is the failure of the "voter disgust" argument to explain the astronomical undervotes in the attorney general's race in neighboring Charlotte, Lee and Sumter counties; or to explain the elevated undervotes in that race in Miami-Dade and Broward counties; or to explain the elevated undervotes in the chief financial officer and commissioner of agriculture race in Martin County—all on the ES&S iVotronic voting system.

Any explanation for the undervotes in Sarasota must also take into account the low undervotes in other CD-13 counties, the low undervote rate on the absentee

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[70] Alec Yasinsac et al, "Software Review and Security Analysis of the ES&S iVotronic 9.0.1.2 Voting Machine Firmware." Security and Assurance in Information Technology Laboratory (SAIT), Florida State University, Tallahassee, FL, February 23, 2007.

ballots in Sarasota County, and the high undervote rates in other iVotronic counties.

10.3 The "Ballot Design" Argument

Many people believe that the question of the cause of the undervotes has been solved—that it has been determined to be the result of poor ballot design. Even before the end of election day, elections office staff had concluded that voters were "reading over" the CD-13 race. Subsequently, arguments were advanced by some political scientists that voters missed the race because of its placement on the same page with the much longer and higher profile governor's race and the colored heading beneath. They concluded that this caused the race to be overlooked. While it is clear that the location of the CD-13 race did indeed contribute to the undervotes, we found no evidence that the contribution was more than a percent or two—certainly, ballot design cannot explain undervotes of this magnitude.

Furthermore, the ballot design argument fails completely when looking at high undervotes in other iVotronic counties with perfectly normal ballot designs, such as Martin County.

10.3.1 Expert's Analysis—Undervotes not caused by Voter Confusion

The ballot design theory is directly contradicted by the findings of one of the foremost experts in the United States on the effects of voting technology on undervotes, Charles Stewart. [71] Dr. Stewart analyzed the undervote in Sarasota's CD-13 race and concluded as follows:

> *The level of undervoting experienced using electronic voting machines in Sarasota County for the 13th congressional district greatly exceeds the undervote rates that were estimated to have occurred in other well-established cases of voter confusion. This suggests a substantial possibility that the exaggerated undervote rates in Sarasota County were not solely due to voter confusion, but also caused by factors related to machine malfunction.[72]*

Dr. Stewart remarked that the undervote rate on the iVotronics on election day were more than five times the rate on optically scanned paper ballots in that race; early voting ballots had an undervote rate about seven times the rate for absentees. In all other top-of-the-ballot races in Sarasota, the rates on absentees were similar to those on election day and early voting ballots.

Stewart goes on to say that studies of voter error due to poor ballot design have found the effects to be quite small—in the range of 1 to 2 percent and occasionally as high as 5 percent for an exceedingly bad ballot. In the case of Palm Beach's so-called "butterfly ballot" in 2000, researchers were able to

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[71] Charles Stewart is head of the political science department at the Massachusetts Institute of Technology and a participant and past director of the Caltech/MIT Voting Technology Project. He has written extensively on the subject of voting technology and residual votes (undervotes, overvotes, and invalid write-ins). He was retained as an expert by legal team for Christine Jennings, the Democratic candidate in the CD-13 race.

[72] Stewart (2006), 38.

examine the ballots physically and to determine that the error rate was less than 1 percent. Stewart also refers to the 2003 gubernatorial recall race in California in which a very long and confusing ballot resulted in an estimated error rate of approximately 0.35 percent (1/3 of one percent).

Stewart concludes that the excess undervotes in Sarasota cannot have resulted solely from voter error due to poor ballot design. Machine malfunction, he believes, is the source of a considerable portion of these undervotes.[73]

We observe that voters were far more likely to be confused by their inability to make selections on the screen, by watching their selections disappear on the review screen, and by ballot-display problems such as a split-screen, than they were by the ballot placement of the high-undervote races in the iVotronic counties.

10.3.2   Undervote Spikes Exclusively on the Ivotronics
Further implicating the iVotronics is the finding that throughout the state, there were undervote spikes[74] on the iVotronics in other top-of-the-ballot races—Miami-Dade in the Senate race; Sarasota and Miami-Dade in the Governor's race; and Charlotte, Sumter, Lee, Broward, and Miami-Dade in the attorney general's race. All of these counties use the iVotronics; the ones with double-digit undervote rates are all 12" iVotronic counties. In 61 of Florida's 67 counties, there were no undervote spikes—no double-digit undervote rates on a top-of-the-ballot race occurred in a county not using iVotronics.

10.3.2.1 Attorney General's Race
The attorney general's race provides the most compelling evidence that the undervotes on the iVotronics were not solely the result of a poor ballot design. We can determine conclusively that a normal undervote in this race is between 2 and 6 percent. If the upper limit of undervotes attributable to ballot design is 5 percent, then even the worst possible ballot with the most intentional undervoting in the state gives us an undervote that is less than half of the 25 percent rate experienced in both Charlotte and Sumter Counties.

10.3.2.2   Martin County
Finally, in Martin County, we found elevated undervote rates in two top-of-the-ballot races that had no ballot placement problems—the Chief Financial Officer's race which was in the middle of the page and the Commission of Agriculture race underneath but not near the margin of the page. Further, we found that Martin County also had some of the same machine problems as found in the other counties—although not to the same extent.

10.3.3   Evidence from Voters
Furthermore, the argument for poor ballot design is contradicted by what voters reported. They didn't report that the ballot was confusing. They said that the

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[73] Ibid., 35-40.

[74] Undervote spikes are excessive by three measures: (1) they are greatly higher than those experienced on the same race in other counties; (2) they are greatly higher than those experienced in other races in the same county; and (3) they are greatly higher than those experienced on absentee ballots in the same race.

race was missing or split over two screens; that they had trouble getting their votes to register; and they said that their votes disappeared from the review screen.

In Sarasota, voters on election day were notified by the media, the elections office, and candidate Christine Jennings about problems in the CD-13 race. This resulted in a reduction of about 4 percent in the undervote rate between early voting and election day. There is no evidence that problems diminished; on the contrary, voters continued to say that they were experiencing problems with votes disappearing from the review screen. The difference was that voters were alerted about the problem and knew what to do when it happened.

10.4   One Thing in Common—the Machines
All Florida counties with double digit undervote rates in a top-of-the-ballot race have one thing in common—they used the same type of iVotronic voting machines and they all used the newly installed 8.0.1.2 firmware. The ballot designs vary from county to county, and that in itself is an argument against ballot design being the cause of the high undervotes experienced in these counties. Martin County in particular has an absolutely ordinary ballot style, with one of the county's two high-undervote races located in the center of the ballot "page." What these counties share are excessive and anomalous undervotes in one or two races only—a pattern that is highly indicative of a bug in the firmware. In addition, our investigation has shown that all of the high-undervote counties experienced severe—and similar—machine problems, as described in this report.

Conclusions

When we began our investigation, we had no idea what we would find. How would it ever be possible to determine whether machine problems had caused or contributed to the CD-13 undervotes? But when Kitty Garber, our Research Director, began her study of other iVotronic counties in Florida and discovered high undervotes in those counties also, we knew we were onto something. Ms. Garber's report, "Lost Votes in Florida's 2006 General Election: A Look at Extraordinary Undervote Rates on the ES&S iVotronic,"[75] makes it clear that something was terribly wrong with this voting system in this particular election. When we discovered high undervotes on some machines in Martin County, which had a perfectly ordinary ballot layout, it became even clearer that ballot style was not the cause.

We found that the iVotronics—and only the iVotronics—experienced undervote spikes in top-of-the-ballot races across the state. *None* of the counties that used other voting systems recorded double digit undervote rates in any statewide race—not a single one.

IVotronic voters were much more likely to have their votes discarded than those who voted on other types of equipment, but that vulnerability was not evenly distributed. The problem of lost votes didn't happen in every iVotronic county. In those counties where high undervotes occurred, they didn't happen in every race or on every machine. The seemingly random occurrence of undervotes strangely echoes ES&S' description of the random effect of the smoothing filter problem on the machines.

As we gathered more and more maintenance reports and saw the horrific machine problems that occurred in the iVotronic counties, we were truly shocked at how bad those problems were. Specifically, we found that extensive calibration problems and other screen problems caused or exacerbated slow response times. Low power conditions, possibly due to the overheating of power converters, caused battery failures which in turn caused machines to malfunction or stop working altogether. Restrictions on the use of ADA machines because of unspecified firmware problems meant that many precincts did not have adequate numbers of machines, especially when other machines failed. The result was long lines and long waits for voters—a circumstance that always increases undervotes as voters hurry through the voting process. Ballot display problems, including a split screen in the CD-13 race for some voters and gray or fuzzy screens for others, imply problems with the PEBs or other components such as the video boards and IRDA boards. Without examining the PEBs used in the election, there is no way to know for sure exactly what voters were seeing—or whether the CD-13 race was displayed at all on some ballots. The disappearance of voters' selections on the review screen in the CD-13 race—reported by hundreds of Sarasota voters, confirmed by some poll workers,

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[75] Ibid 2

and reported contemporaneously by voters in other counties who saw their votes disappear on the review screen in the attorney general's race—is indicative of a programming bug in the machine firmware, PEB firmware, or an interaction of bugs in both. The split-screen problem experienced by some voters, with Buchanan's name at the bottom of one page and Jennings name at the top of the second page, can only be explained by errors in programming the "ballot definition" files located on the PEBs or by a bug in the PEB software. Finally, we found that the elections offices in the affected counties did not follow the vendor's suggested actions to ameliorate problems, and that this negligence exacerbated voters' difficulties using the machines.

In this context, it becomes clear that the problems in CD-13 and the attorney general's race were not exceptions—they were, in fact, the most visible and extreme examples of a voting system that had failed in top-of-the-ballot races throughout the state.

As we believe we have proved in our reports, extensive and severe machine malfunctions—particularly screen problems, battery problems, slow response problems, as well as ballot definition and ballot display problems—most assuredly contributed to the high undervotes in the Congressional District 13 race and in other Florida races where the iVotronics were used.

By eliminating intentional undervoting and ballot design, as we have done in this report, the only possible explanation for the high undervotes in Sarasota County and throughout Florida in other iVotronic counties is the failure of the iVotronic voting system.

Commentary

During the course of our intensive investigation, we had a few "a-ha" moments where a new awareness came upon us.

One of those moments occurred when we emailed a question to one of the few "experts" on voting systems in the U.S. The response was: "You probably know as much about this as I do." It wasn't a good feeling, especially since it happened numerous times during this investigation. Experts referred to the "wall of silence" and the difficulty in getting information about the operation of the machines. At some point it hit us full force. Because of the secrecy that surrounds voting systems in our country, because of the scarcity of information about the machines' operation, because independent scientists are not allowed to open up these machines to find out how they really work—no one but the vendor—and only a few people who work for the vendor—knows everything about these machines and the programming that runs them. Very few people even know how to audit them effectively, as evidenced by the fact that no one, a full year after the election, has put the PEBs back in the voting machines to see what voters actually saw on their ballots. Even the independent study done by the SAIT investigators was fatally flawed because its underlying assumption—that the iVotronic source code they examined was the same source code used to compile Sarasota's firmware—was never proven. The SAIT computer scientists did not look at the actual and aging Sarasota machines, and they were the recipients of incomplete or inaccurate information from both ES&S and the Florida Division of Elections that resulted in inaccuracies in their report.

So here we were, two citizens without technical backgrounds, trying to figure out what happened in an electronic election, being told that we knew as much about some aspects of the operation of the machines as anyone else. It was appalling to realize that it was true! We *do* know as much about the iVotronics in use in Florida—at least about some aspects of their operation—as just about anyone else. That fact should make all of us fearful because there is so much we still do not know and will never know! The information we did obtain was hard-won and rarely offered freely. We fear for the future of our country if our elections, the very foundation of our society, continue to be run on proprietary machines and secret software—without transparency or accountability.

Another realization occurred as we came to understand that written election procedures and actual procedures often differ. Security procedures in Sarasota County, for example, were generally followed—except when they were inconvenient or potentially embarrassing. Some problems with the machines were disclosed in the Conduct of Election report, but many more were not. Procedures regarding the recording of iVotronic seal numbers were followed—except when some machines were opened without disclosure. Lax procedures regarding access to the warehouse where the voting machines were stored; lax procedures regarding the security of all PEBs; and full access to the machines by

essentially unknown maintenance personnel, all had the potential to compromise the integrity of the voting system and thus the election.

Another "a-ha" moment occurred at some point during our investigation when it dawned on us that voting on touch screen machines *can never provide a uniform voting experience for all voters.* So many different components can fail—so many variables—that can cause one machine to perform differently from another. One voter might have a certain race on his/her "electronic ballot," while that ballot might be missing completely on another machine. One voter might have a split screen, or a fuzzy screen, while another voter sees a perfectly normal ballot layout. Machines that are out of calibration might make it difficult or impossible for some voters to register their selections, or might cause the flipping of votes from the intended selection to another, while other voters can vote with ease.

While all electronic machines are vulnerable to programming errors, tampering, or machine failures, there is a difference between touch screens and optical scanners that previously we had not fully grasped; that is, the experience of each voter who votes on a touch screen machine is a unique experience, depending on what is going right—or wrong—with that particular machine at that particular point in time.

We realized that the PDF file distributed by the Sarasota elections office, purportedly showing the "ballot design" in the November 2006 election, has no relationship to reality—no relationship to what voters actually saw—or didn't see—on their screens.

More than ever, we came to realize that only a hard-copy paper ballot can ensure that all voters have a uniform voting experience. Only a hard-copy ballot, filled out by a voter's own hand, can be checked after an election to confirm exactly what was viewed by any given voter.

We also realized that what was missing in Sarasota was the ability to confirm the *intent* of the voters. Because no one could confirm what voters saw or didn't see on their ballots, it became impossible to confirm what any given voter intended to do when it came to marking that ballot. What good does it do to print out voters' selections if nobody can confirm that the proper choices were actually presented to the voters, or that voters' intentions were properly recorded? Thus, the so-called "recounts" in Sarasota were based on vapor—no one could state with certainty if the undervotes being counted were intended by voters, or whether they were simply the result of one of many possible machine or programming malfunctions.

Bush vs. Gore emphasized the importance of uniformity in voting. In the course of our investigation, we came to understand that clearly such uniformity will never be possible with touch screen displays—there are simply too many ways those displays can fail, with no independent means to verify that such failures occurred or what effect they may have had on the voters' experience and the accuracy of the results.

We came to understand that none of the three most important elements of any election—accuracy, transparency, and accountability—were present in Sarasota County in the November 2006 election.

We were amazed, and exhausted, by the length of time and the difficulties in examining just one touch-screen election in such depth. A "paperless" election resulted, in fact, in tens of thousands of documents required to examine it. At some point we fully understood that if there had been paper ballots to recount after the election—to see both what races were displayed on the ballot and how voters chose to vote—we could have devoted the last year of our lives to other endeavors. We saw that while we could spend 12 months showing why this election did *not* represent the will of the voters, no one would ever be able to prove that it did—and we came to believe that this is a problem for our democracy that must be addressed.

With our new and renewed awarenesses about the vulnerabilities of electronic voting, we have reaffirmed our belief that all elections should take place on hard-copy paper ballots, filled out by a voter's own hand to confirm intent, and that every election should include a partial recount of those paper ballots—a statistically significant hand count—to confirm the counts produced by electronic voting machines. Paper ballots offer both transparency *and* accountability—two missing elements in the Sarasota election—but only if audited (hand counted) after every election.

We are pleased that the Florida legislature has mandated paper ballots for the 2008 election, but there is more work to be done. The voting process in our country will not be secure until all states follow suit—and until we also have meaningful audits of those paper ballots to double-check the counts on the electronic machines. Only with this system of checks and balances in place will we be able to say, with confidence, that "vanishing votes" are a thing of the past in our nation.

Even with paper ballots and significant audits, however, voters and candidates cannot be certain of fair and accurate elections unless we have election officials who truly believe that they conduct elections on behalf of *all* citizens. Florida has long been criticized for its partisan election administration, and rightfully so. We need to remove partisanship from our election management and insulate our election officials from political influence. The tremendous power wielded by voting machine vendors must also be addressed. Elections in the U.S. need to evolve from vendor-driven to voter-driven. Vendors should not be at the heart of the election process, but safely on the periphery where they belong.

Chapter 13

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Sarasota County – "Screen Shot" of CD-13 Race

U.S. REPRESENTATIVE IN CONGRESS
13TH CONGRESSIONAL DISTRICT
(Vote for One)

Vern Buchanan	REP	
Christine Jennings	DEM	

STATE

GOVERNOR AND LIEUTENANT GOVERNOR
(Vote for One)

Charlie Crist Jeff Kottkamp	REP	
Jim Davis Daryl L. Jones	DEM	
Max Linn Tom Macklin	REF	
Richard Paul Dembinsky Dr. Joe Smith	NPA	
John Wayne Smith James J. Kearney	NPA	
Karl C.C. Behm Carol Castagnero	NPA	
Write-In		

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Martin County – "Screen Shot"of Chief Financial Officer and Commissioner of Agriculture Race

ATTORNEY GENERAL
(Vote for One)

Bill McCollum	REP	☐
Walter "Skip" Campbell	DEM	☐

CHIEF FINANCIAL OFFICER
(Vote for One)

Tom Lee	REP	☐
Alex Sink	DEM	☐

COMMISSIONER OF AGRICULTURE
(Vote for One)

Charles H. Bronson	REP	☐
Eric Copeland	DEM	☐

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Sumter County – "Screen Shot" of Attorney General's Race*

STATE

GOVERNOR AND LIEUTENANT GOVERNOR
(Vote for One)

Charlie Crist Jeff Kottkamp	REP	☐
Jim Davis Daryl L. Jones	DEM	☐
Max Linn Tom Macklin	REF	☐
Richard Paul Dembinsky Dr. Joe Smith	NPA	☐
John Wayne Smith James J. Kearney	NPA	☐
Karl C. C. Behm Carol Castagnero	NPA	☐
Write-In		☐

ATTORNEY GENERAL
(Vote for One)

Bill McCollum	REP	☐
Walter "Skip" Campbell	DEM	☐

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*The ballot page for the attorney general's race in Charlotte and Lee counties is almost identical to Sumter's.

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ES&S Memo Regarding Mismatched Internal Machine Memories

Unity Election Reporting Manager (ERM) Audit Data Reports

If there are no terminals in a precinct or in an election that detect a low battery condition, then all audit data reports for that precinct or election will be printed fully correct and proper.

If certain terminals detect a low battery voltage condition, then the following tables describe the usage and follow on effects audit data memory and collection process.

	Audit Data Collected Via the Serial Port	Audit Data Collected Via the Compact Flash Card and From EEPROM Memory 2
Ballot Image Report (This is the report that would be used for recounts)	All ballots and votes cast are accurately and fully recorded. There are no lost ballots or votes.	All ballots and votes cast are accurately and fully recorded. There are no lost ballots or votes.
	All terminal serial numbers are reported correctly.	Certain terminal serial numbers printed on the report are invalid. Certain terminal serial numbers are not printed.
	All ballots and votes cast are present and printed on the report. All ballots and votes are grouped with the correct terminal serial number and in the correct precinct.	All ballots and votes cast are present and printed on the report. Certain ballots and votes are printed in a group associated with an invalid terminal serial number, but all votes and ballots are present and grouped with the correct precinct.
	Precinct ballot and vote totals are 100% accurate, matching all other ERM reports and precinct paper tape reports.	Precinct ballot and vote totals are 100% accurate, matching all other ERM reports and precinct paper tape reports.

	Audit Data Collected Via the Serial Port	Audit Data Collected Via the Compact Flash Card and From EEPROM Memory 2
Event Log Report (This report would not be used for recounts)	"Low Battery Detected" not recorded or printed on the event log.	"Low Battery Detected" not recorded or printed on the event log.
	Initial "Clear and Test" event log reported as an "Undefined Event"	"Clear and Test" event log correctly reported.
	All terminal serial numbers are printed correctly.	Certain terminal serial numbers are either omitted or incorrectly represented.
	All events, including ballot cast events, are listed, printed, and displayed correctly.	Events from certain terminals, including ballot cast events, are not listed under the correct serial number. All events are displayed on the screen. Some events are not listed on the hardcopy report. All other events are correctly reported.

iVotronic EEPROM Memory Maps

If there are no terminals in a precinct or in an election that detect a low battery condition, then all audit data reports for that precinct or election will be printed fully correct and proper.

If certain terminals detect a low battery voltage condition, then the following tables describe the follow on effects to the ERM audit data reports.

	EEPROM Memory 1	EEPROM Memory 2 and 3
Configuration Block (Contains terminal serial number and other configuration data)	1st Record is used and includes the terminal serial number.	Per offset design, the 1st Record is null and unused in Memory 2. Per offset design, the 1st and 2nd Records are null and unused in Memory 3. Terminal serial numbers are saved only in used, non-null Records.
	All configuration data is fully accurate and intact.	All configuration data is fully accurate and intact.
Event Block (Contains a log of all events)	The first terminal action, the "Clear and Test" event is initially and correctly logged to the 1st event record in the Event Block.	The first terminal action, the "Clear and Test" event is correctly logged to the 1st event record in the Event Block.
	This first event record, the initial "Clear and Test" event log is inadvertently overwritten, when a low battery detection log routine in the firmware is called. This offending routine changes one word in Event Block Memory 1, Record 1.	The offending routine detects an error when writing to the previously used record in Memory 1, thus aborting any attempts to similarly record this event into Memory 2 or Memory 3. The "Clear and Test" event log is left intact.
	The "Low Battery Detected" event is not recorded correctly. All other events are correctly recorded.	The "Low Battery Detected" event is not recorded. All other events are correctly recorded.
Ballot Image Block (Contains all ballot and vote cast data)	All ballots and votes cast are recorded accurately and fully in the Ballot Image Block.	All ballots and votes cast are recorded accurately and fully in the Ballot Image Block.
	No votes are ever lost. All data is fully intact and correct.	No votes are ever lost. All data is fully intact and correct.
Audit Data Collection Methods	EEPROM Memory 1 is used when collecting audit data using the serial port.	
	When using the removeable flash card for collecting audit data, data in the Event and Ballot Image Blocks of the three EEPROM memories are compared, and used to determine the source EEPROM is to be used for copying data to the flash card. If the data from Memory 1 do not exactly match data from Memory 2, and Memory 2 matches Memory 3, then Memory 2 is copied to the removeable compact flash card.	