

Analysis of the Election Data from the 12 June 2018 First Primary in South Carolina

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Executive Summary

We have been analyzing the South Carolina election data since 2010 on behalf of the League of Women Voters of South Carolina and more generally the citizens of South Carolina. Our analysis of the 12 June 2018 First Primary election is presented here.

We note that the software used in the ES&S paperless Direct Recording Equipment (DRE) iVotronic voting computers¹ was upgraded for the 12 June primary, as was the county headquarters software for configuring and managing elections. Given the extensive documentation on the shortcomings of the ES&S system, with two known bugs that have led directly to votes not being counted in South Carolina or to votes being counted incorrectly, one might have hoped that the known and obvious errors and problems would have been fixed in the upgraded software. With the light turnout of a primary election, we cannot say that we have enough data to conclude that the known errors have been fixed. We can, however, point out that some of the prior anomalies persist, suggesting strongly that there are certainly still bugs in the code.

Introduction

This is a report on our analysis of the election data for the South Carolina First Primary held 12 June 2018. We have analyzed the data using updated versions of the software we have been using since the 2010 General Election.

We emphasize that we make no claims that our analysis uncovers all possible problems or complications in the election system. We can only discover anomalies that present themselves in the data. And with the low turnout of a primary election, we would not argue that the new system really got a stress test under load. That will come with the 6 November General Election.

Changes for 2018

By the time of the 12 June primary, all counties were to have upgraded software with newer, certified, versions of code—both the firmware in the iVotronic voting computers and the election management system on a Windows desktop at county headquarters. One could see upgrades happening in various counties in the data from various counties in spring 2018 special elections; for the 12 June primary it does appear that all counties were using the new software.

¹ We refer to the iVotronics as “computers” and not “machines” so that voters will understand that the iVotronics are, as would be expected, subject to all the thousand natural flaws that computers are heir to.

There has been salutary simplification in processing the data that has come from the upgrade. In the past, although the counties were allegedly using the same software, there were slight variations in the EL30A report from county HQ that reports the actual election results for each precinct. Although it was possible for us to read and process all reports, the slight variations made for some special cases in our analysis programs.

For the 12 June primary, it appears that all counties except Fairfield and Marlboro have the same format for presenting the data in the EL30A. This makes our programming job much simpler. In addition, all the EL30A reports now include a column reporting vote totals loaded from the flash memory cards. This happens when iVotronics fail to function properly or when the handheld PEB cannot close the iVotronic. This would be one of several possible anomalies that would be flagged by our programs and would require human checking to ensure that processing had in fact gone properly.

The major change, from the point of view of our analysis, is in the event log reporting that becomes the EL155 report. These are the individual events recorded in each iVotronic, and the changes required some minor modifications to my programs. Most of these are inconsequential. Dates are now yyyy-mm-dd instead of mm/dd/yyyy in the EL152, for example. (This is a very sensible change in that a standard alphabetic sort on date produces a list in the proper order; the older format would require breaking the date apart to be able to sort first on year, then on month, and then on day.) The biggest changes were that some event codes have been dropped or are no longer used and some have been added. The 0001510/0001511/0001512., etc. codes used to be used for “vote cast” events. (Code 0001510 was the most common “Vote cast by voter” event.) These now all seem to be 0002900/0002901/0002902, etc., with code 2900 (“Vote cast by voter – Visual”) apparently replacing the 0001510 code. There are a number of codes that appear for the first time in the 2018 data. Among the codes that do not appear in 2018 is the “Terminal shutdown” code 0001633 that we could never get anyone to explain. We had heard several different explanations for what that meant, but none were reasonable given the data, and we were told in a direct conversation with a programming manager at ES&S that they didn’t know either.

Problems that might indicate hardware failure

Given the lighter turnout of a primary, it is harder to project iVotronic failures. However, we note that nearly every county had at least one iVotronic that failed to open properly. We also note that screen calibration events seemed much more common than in the past. There were 2150 “Calibrate screen” (code 0000169) events AFTER 9:00am on 12 June. These would presumably not be an initial calibration for quality control; those would have happened no later than the opening of the polls. The 2150 calibration events are more than the number of code 0000169 events for the 2016 General Election and should therefore be a cause for concern.

The big warning is the 0002209 code, “Memory block-to-block compare failed”. This is (I am sure) the internal check that the three internal memories have the same cast vote record

stored in them. There were 6, 2, 3, and 4 terminals that had these errors in 2010, 2012, 2014, and 2016, respectively, but 57 such terminals in the primary. That's a huge change and could indicate aging equipment.

We have been concerned all along, and are now more concerned, that iVotronics that report hardware errors like the 0002209 code continue to be used for voting and their votes are counted as if there had been no such error event recorded. iVotronic 5128090 in Georgetown County, for example, recorded 1335 instances of error code 0002209, and yet its 67 votes were collected as if no error had occurred.

It is additionally troubling that the events recorded now seem different. In the past, closing the iVotronic would always trigger an event 0001416 "Copy audit data from TF 1 to CF" ("Terminal Flash to Compact Flash). In the case of errors like the 0002209, we would see events 0001417 and 0001418 recording the copying of the second and third terminal memories to the flash memory card; this would permit the usual two-out-of-three vote as to what the cast vote record was and which memory of the three was the outlier. We see in the 12 June primary data no instances of code 0001416 and no record that the internal memories have been copied to the memory card. Either all the verification of which memory was in error is now being done in the iVotronic, or no use of the redundancy is happening, or this valuable message has simply been dropped. We believe this to be bad practice.

We finally comment on the disturbing fact that several iVotronics, in Horry, Lexington, and Marlboro Counties, recorded different numbers of votes from what was included in the official counts. It has always been possible to count the number of "vote cast" events in the EL152 and the number of votes in the EL155 cast vote record and verify that the numbers came to the same value. For the first time, in the 12 June primary, we have several iVotronics that had different numbers. Invariably these were instances in which the iVotronic was clearly failing. In these iVotronics, the log file ends abruptly, there is no record of closing, and there are fewer "vote cast" events (by one or two) in the EL152 than there are instances of cast votes in the EL155.

Event codes with no explanation

We have been troubled since we began analyses by the fact that a number of events were deemed important to record in the EL152, but no one ever bothered to finish the software job to report what those events were.

An event in the iVotronic is almost certainly recorded as a timestamp for when the event occurred, the PEB number if a PEB was used in the event (like opening and closing the iVotronic), and a code number. This compact logging information is then expanded at county HQ into the EL152 report, where the code numbers are used in a lookup table to expand into their English explanation.

It is in our opinion a strong statement about the poor software quality in this election system that there are event codes that expand into the explanation “UNKNOWN”. This means that the programmer felt that an event was worth recording, but never finished the job of putting the English explanation in the table for the EL152. And it means that neither quality control nor management bothered to ensure that all codes were expanded.

Further, we see that eleven of the “UNKNOWN” event codes in the 12 June primary data DO NOT APPEAR in either the 2014 or the 2016 General Election data. In the rewrite, were there new codes added for which sloppy practice resulted in no explanation in the table? Were there changes in the software that resulted in existing codes triggering event logging for the first time? And if the latter, was there no one noticing that prior sloppy practice was now newly exposed? We do not understand how these anomalies could occur in a software production environment with proper quality control.

Timestamp anomalies

Perhaps correlating with the event codes problems mentioned just above, we note that the EL152 timestamps continue to go forward and backward in time, contrary to what anyone would expect in anything that purports to be a system log. A look at an EL152 excerpt from Chester County says it all:

5132179	130966	SUP	2018-05-23	13:57:41	0001607	Clear-n-test terminal flash successful
		SUP	2018-05-23	13:58:20	0000116	Select: Configure Terminal
		SUP	2018-05-23	13:58:26	0001650	Terminal - exited service menus
123887		SUP	2018-05-23	14:02:14	0001001	Confirm PEB ballot failed by user
147244		SUP	2018-06-12	06:55:17	0001303	Transfer PEB vote data to terminal
143916		SUP	2018-06-11	19:32:43	0001319	Update PEB's terminal record
		SUP	2018-06-12	06:55:23	0000019	UNKNOWN
143400		SUP	2018-06-10	09:25:04	0001024	UNKNOWN
146732		SUP	2018-06-10	18:31:29	0000066	UNKNOWN
146728		SUP	2018-06-10	09:25:24	0001882	UNKNOWN
146732		SUP	2018-06-10	18:31:58	0000019	UNKNOWN
146728		SUP	2018-06-10	09:19:32	0001920	UNKNOWN
147244		SUP	2018-06-12	06:58:49	0002006	Print task was cancelled
		SUP	2018-06-12	06:58:53	0001672	Terminal Opened
123887		SUP	2018-06-12	07:05:22	0000621	Warning: Terminal reset from voting
		SUP	2018-06-12	07:07:12	0002900	Vote cast by voter - Visual

Concomitant with several “UNKNOWN” events, we see the clock going back two days in time, then jumping forward and backward nine hours on the 10 June date, and then returning to what is probably the correct time and date.

We also see instances in which the timestamp is a genuinely bogus value, such as 1994-01-1. -14:-26:

We have in the past seen timestamps that were all zeros, and we have seen some that were midnight on 1 January 1994 (this would appear to be the epochal beginning of time for the iVotronics), but we have not seen before a timestamp that did not expand properly into an actual date and time.

These anomalies simply will not happen with high-quality software.

Counting votes twice

There were apparently 148 voters in Wallace Precinct in Marlboro County who had the distinct privilege of voting twice in the 12 June primary. This error was not caught by the county or the state, and the totals as reported are simply wrong. There was an iVotronic, serial number 5123479, that was clearly failing. Instead of adding in just the five votes from that iVotronic into the totals, the other 148 votes in that precinct were added to the totals from their memory cards in spite of the fact that the votes had been added in with the usual PEB-based process. Instead of 153 total votes in the precinct, the total was reported as 301 by double counting the 148 to get 296 and then (correctly) adding in 5 more.

Curiously, one of the five votes on this iVotronic occurs backwards in time, on 11 June:

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SUP    2018-06-12 07:46:15    0002900 Vote cast by voter - Visual
SUP    2018-06-12 08:15:09    0000621 Warning: Terminal reset from voting
135993 SUP    2018-06-11 18:36:48    0002900 Vote cast by voter - Visual
136057 SUP    2018-06-12 08:22:21    0000585 UNKNOWN
135993 SUP    2018-06-11 18:44:48    0002816 Terminal-FlashFull:Vote Saved state
```