Is Technology the Answer?
Software Quality Issues in Electronic Voting Systems

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History

2000 presidential election chaos in Florida

Help American Vote Act

A rush to use Direct Recording Electronic (DRE) voting computers

Federal funds for purchase

South Carolina bought ES&S iVotronics 2004-2006: 46 counties, 2300 precincts, 3.5M voters, 12,000 iVos
The South Carolina System

The vendor is ES&S (Election Systems & Software)

iVotronic – The actual voting computer, about 13,000 statewide

PEB – The handheld device that activates the iVotronics

Unity – The software run at county HQ on a Windows desktop
Issues

Proprietary HW and SW

EVEREST report 2007 (for Ohio)
“lack[s] the fundamental technical controls necessary to guarantee a trustworthy election under operational conditions”

“several, pervasive, critical failures”

Florida State report following 2006 election in Sarasota

Data obtained 2010 (very messy) and programs written

Data obtained 2012, 2014, 2016, 2018—by now the data is actually very clean
Observed Problems

Procedural errors (as if everything works perfectly?)

Hardware failures (can’t deal with broken computers?)

Event codes with no explanation

Genuine bugs in the software that have led to votes not being counted properly

Entirely electronic, no paper trail, no way to verify the votes, no way to audit the results
<table>
<thead>
<tr>
<th>Voter ID</th>
<th>Vote</th>
<th>Name</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>5134625</td>
<td>3</td>
<td>59 Lindsay Agostini</td>
<td>SCH0002 School Board District 2</td>
</tr>
<tr>
<td>5134625</td>
<td>2 *</td>
<td>15 Peter Skewes</td>
<td>PRESIDENT AND VICE PRESIDENT U.S. SENATE</td>
</tr>
<tr>
<td>5134625</td>
<td>2</td>
<td>23 Rebel Michael Scarborough</td>
<td>CON0002 U.S. House of Rep Dist 2</td>
</tr>
<tr>
<td>5134625</td>
<td>2</td>
<td>30 Eddie McCain</td>
<td>SEN0022 State Senate District 22</td>
</tr>
<tr>
<td>5134625</td>
<td>2</td>
<td>33 Mia McLeod</td>
<td>HOU077 State House of Rep Dist 77</td>
</tr>
<tr>
<td>5134625</td>
<td>2</td>
<td>37 Joe McEachern</td>
<td>Sheriff</td>
</tr>
<tr>
<td>5134625</td>
<td>2</td>
<td>41 W/I DUNCAN BUELL</td>
<td>County Clerk of Court</td>
</tr>
<tr>
<td>5134625</td>
<td>2</td>
<td>43 Jeanette W McBride</td>
<td>Coroner</td>
</tr>
<tr>
<td>5134625</td>
<td>2</td>
<td>46 Gary Watts</td>
<td>CCL0007 County Council District 7</td>
</tr>
<tr>
<td>5134625</td>
<td>2</td>
<td>49 Gwen Kennedy</td>
<td>Soil and Water</td>
</tr>
<tr>
<td>5134625</td>
<td>2</td>
<td>56 Jeff Laney</td>
<td>SCH0002 School Board District 2</td>
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<tr>
<td>5134625</td>
<td>2</td>
<td>63 Kay Harvey</td>
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<tr>
<td>5134625</td>
<td>2</td>
<td>65 Bill McCracken</td>
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<tr>
<td>5134625</td>
<td>2</td>
<td>69 Shelley Williams</td>
<td>STRAIGHT PARTY</td>
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<tr>
<td>5134625</td>
<td>3 *</td>
<td>6 Republican</td>
<td>PRESIDENT AND VICE PRESIDENT</td>
</tr>
<tr>
<td>5134625</td>
<td>3</td>
<td>14 Donald J Trump</td>
<td></td>
</tr>
</tbody>
</table>
The Data

**EL155**—The cast vote record—the actual vote, the iVo serial number, the ballot style, and the precinct

**EL152**—The iVotronic log of events—iVo serial number, PEB number for events, timestamps, existence of votes cast

**EL68A**—The Unity system log at county HQ—memory card upload, vote totals upload, PEB serial numbers

**EL30A**—The “results” printout, by precinct, of votes for candidates and by which method the votes were accumulated
South Carolina is Unique

No other state publishes ALL the vote data the way SC does
North Carolina forbids showing the 155 to the voters
In most states only the election officials are allowed to see the data

Since we have one system statewide, and since we publish the data, I can analyze all the data with only one set of programs.
What Can We Learn?

Sometimes not all the votes get counted.

Richland, Horry, etc., 2010

Richland, 2012, due to a bug in the software

Sometimes the votes get counted twice -- Wallace
Precinct, Marlboro County

Sometimes the votes get counted in the wrong place –
Beaufort County 2010
Did New Software Help?

iVotronic firmware updated spring 2018

Still some curious things

UNKnown

Sick computers whose votes were counted
(Georgetown EL152)
Chester County, 12 June 2018

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