EXAMPLE ATTACK DOCUMENTATION

Touch Screen Calibration

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Taxonomy: precinct-level
Applicability: touch-screen user interfaces

Method:

Touch-screen input devices are actually entirely separate devices from the display screens that they overlay. As a result, there is no built-in relationship between the coordinates of a spot on the display screen and the coordinates sensed when someone touches directly over that spot. Instead, the software for the touch-screen interface must learn which spots on the touch sensor overlay which spots on the screen. This is called touch-screen calibration. In the case of the transparent plastic touch sensors that are in common use today for both voting machines and personal digital assistants (PDAs or PalmPilots), the calibration drifts slightly, so recalibration can be required on a fairly frequent basis.

Accidental miscalibration of touch-screen voting systems is probably more common than any deliberate efforts, however, it is possible to deliberately miscalibrate a touch-screen voting system to discriminate against certain candidates. In general, candidates who are assigned to voting targets near one edge or corner of the screen are easier to attack this way than those with centrally located targets.

To calibrate the machine normally, you typically go through a ritual where you are asked to touch a target at at least three locations on the screen, frequently two opposite corners and one central spot (on PDAs, this is usually part of the welcome or set-up sequence for new users). Deliberately touching the wrong location during calibration can make it very difficult to touch the voting target for a candidate whose target is on the same side of the screen as that miscalibrated location.

Resource requirements: The perpetrator must control the calibration of the touch screens. Since re-calibration is sometimes required after temperature or humidity changes, or after the machine is subject to vibration or shock, it is always possible to recalibrate voting machines at the precinct. Once miscalibration is discovered, competent precinct-level workers will typically remove the machine from service or recalibrate it. Therefore, this attack can only be effective if it is done with the cooperation of the precinct workers or if the precinct workers are so badly trained that they do not respond to calibration problems.

Potential gain:

Small and difficult to assess because every voter whose vote is changed is extremely likely to notice.

Likelihood of detection:

Each voter who notices that when they try to vote for one candidate, another candidate lights up or nothing happens is likely to complain. Polling place workers who use the touch screen are likely to notice.

There are voter errors that can lead to very similar symptoms (most notably, accidentally resting an idle finger on the touch screen while attempting to vote with a different finger). This can lead polling place workers to blame the voter when the machine is actually miscalibrated, lowering their response time to miscalibrated machines.

Countermeasures:

Preventative measures:

Forcing the pollworkers to use the touch screen is important. If the pollworkers are required to touch the screen with some precision as frequently as the voters vote, will be forced to notice the extent of any miscalibration. In contrast, if the pollworker interface does not involve touching the screen, they will have a far easier time blaming voters for any complaints about calibration (usually phrased "I tried to vote for X and it didn't work").

Voter interfaces with very broad voting targets make the system less sensitive to calibration, for example, where the voter is allowed to touch anywhere on the candidate's name instead of being required to touch a small target.

Physical design that discourages the voter from resting idle fingers on the screen will reduce the likelihood of voter error being confused with calibration problems. Raised ridges around the edge of the screen, for example, can help.

Elimination of the touch screen clearly eliminates this problem, and there are touch-screen technologies that sense the actual shape of the touch instead of sensing the "center of gravity" of the touched area. These latter technologies can sense the physical shape of the display screen itself or the shape of the edge of the opening over the display screen, and they can calibrate themselves against this shape, eliminating the opportunity to miscalibrate the touch sensor.

Detection measures:

Observing the frequency of voter complaint should be a very useful measure, as should observation of the frequency of recalibration.

Citations:

For a discussion of pre-election testing of touch-screen calibration, see http://www.cs.uiowa.edu/~jones/voting/miamitest.pdf (section 11, pages 20-23).

The St. Petersburg Times, Broward Official Apologizes for Voting Mess, Sept 20, 2002, contains a reference to touch-screen calibration problems. There have been many other reports of such problems, but little hard evidence.

Retrospective:

The common assumption that DRE voting systems must use touch-screen technology is unfortunate. The Hart Intercivic dial interface and the push button interfaces used by several of the older DRE systems such as that made by Microvote are clear evidence that there are other possibilities.