

# Real-world election failures

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# **DRE** voting machines (**D**irect **R**ecording **E**lectronic)

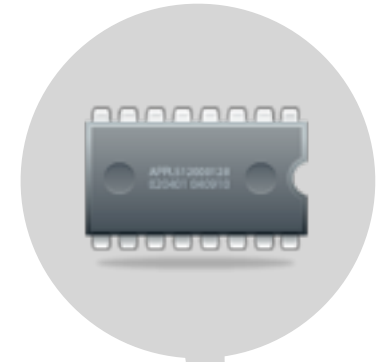


# **DRE** voting machines (**D**irect **R**ecording **E**lectronic)



touch screen / buttons  
graphical display

flash memory



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graphical display



## Election officials stay optimistic, even after fire destroys Harris Co. voting equipment



by Kevin Reece, Sherry Williams & Ron Trevino / 11 News

khou.com

Posted on August 27, 2010 at 8:38 PM

HOUSTON – Even though more than 10,000 pieces of voting equipment were destroyed in a three-alarm fire at the Harris County Election Technology Center Friday morning, officials said voters should have nothing to worry about when the elections begin in a few months.

The warehouse, located on Canino at Downey, caught fire around 4:20 a.m. Friday, causing an estimated \$40 million in damages.

### Related:

- [Raw: 3-alarm fire destroys voting equipment in NE Houston warehouse](#)
- [Raw: Witness gives details of warehouse fire](#)
- [Photos: Fire destroys voting equipment](#)
- [Alternative voting options considered in wake of fire](#)
- [Harris County court holding emergency meeting concerning election center fire](#)

# **\$40M Settlement**

**\$14M spent immediately buying new eSlate machines, backup paper ballots, etc.**

**eSlate machines borrowed from many other counties**

A field study.



**Webb County, TX**

**LAREDO**



# Webb Co. primary election

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**March 7, 2006**

Voters could use either paper or DREs

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**Lawsuit**

Bring in the experts.

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Opaque, undocumented format



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per-machine logs kept during runtime

a timeline of important election events

e.g. “terminal open,” “ballot cast,” ...

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**We found a number of troubling anomalies**

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			03/07/2006	15:34:47	13 Print zero tape
			03/07/2006	15:36:36	13 Print zero tape
	160999	SUP	03/07/2006	15:56:50	20 Normal ballot cast
			03/07/2006	16:47:12	20 Normal ballot cast
			03/07/2006	18:07:29	20 Normal ballot cast
			03/07/2006	18:17:03	20 Normal ballot cast
			03/07/2006	18:37:24	22 Super ballot cancel
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## Logs starting mid-day

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Polls opened around **7 AM** across Webb Co.

What happened between 7 and 3:30?

**Lost votes?**

# Problem #2

## Election events on wrong day

A normal voting pattern:

Votronic	PEB#	Type	Date	Time	Event
5142523	161061	SUP	02/26/2006	19:07:05	01 Terminal clear and test
	161115	SUP	03/06/2006	06:57:23	09 Terminal open
			03/06/2006	07:01:47	13 Print zero tape
			03/06/2006	07:03:41	13 Print zero tape
	161109	SUP	03/06/2006	10:08:26	20 Normal ballot cast
[... 9 more ballots cast ...]					
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The election was held on **03/07!**  
**Ballot box stuffing** the day before?

## A different pattern:

Votronic	PEB#	Type	Date	Time	Event
5145172	161061	SUP	03/06/2006	15:04:09	01 Terminal clear and test
	161126	SUP	03/06/2006	15:19:34	09 Terminal open
	160973	SUP	03/06/2006	15:26:59	20 Normal ballot cast
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26 machines with **exactly two ballots**  
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(always for the same guy)

We learned that these might be  
“**logic and accuracy test**” votes,  
erroneously included in the tally



**We examined the machines directly**

# Findings

## **Machines containing only two votes**

Hardware clock appeared normal

Most likely L&A test votes

## **Others**

Hardware clock set incorrectly

...just enough to account for anomaly

**This is not proof of correct behavior!**

# **Problem #3**

## **Insufficient audit data**

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**Paper records missing**

Zero tapes

Cancelled ballot logs

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**Procedural errors by administrators, pollworkers**

(but the machines didn't help)

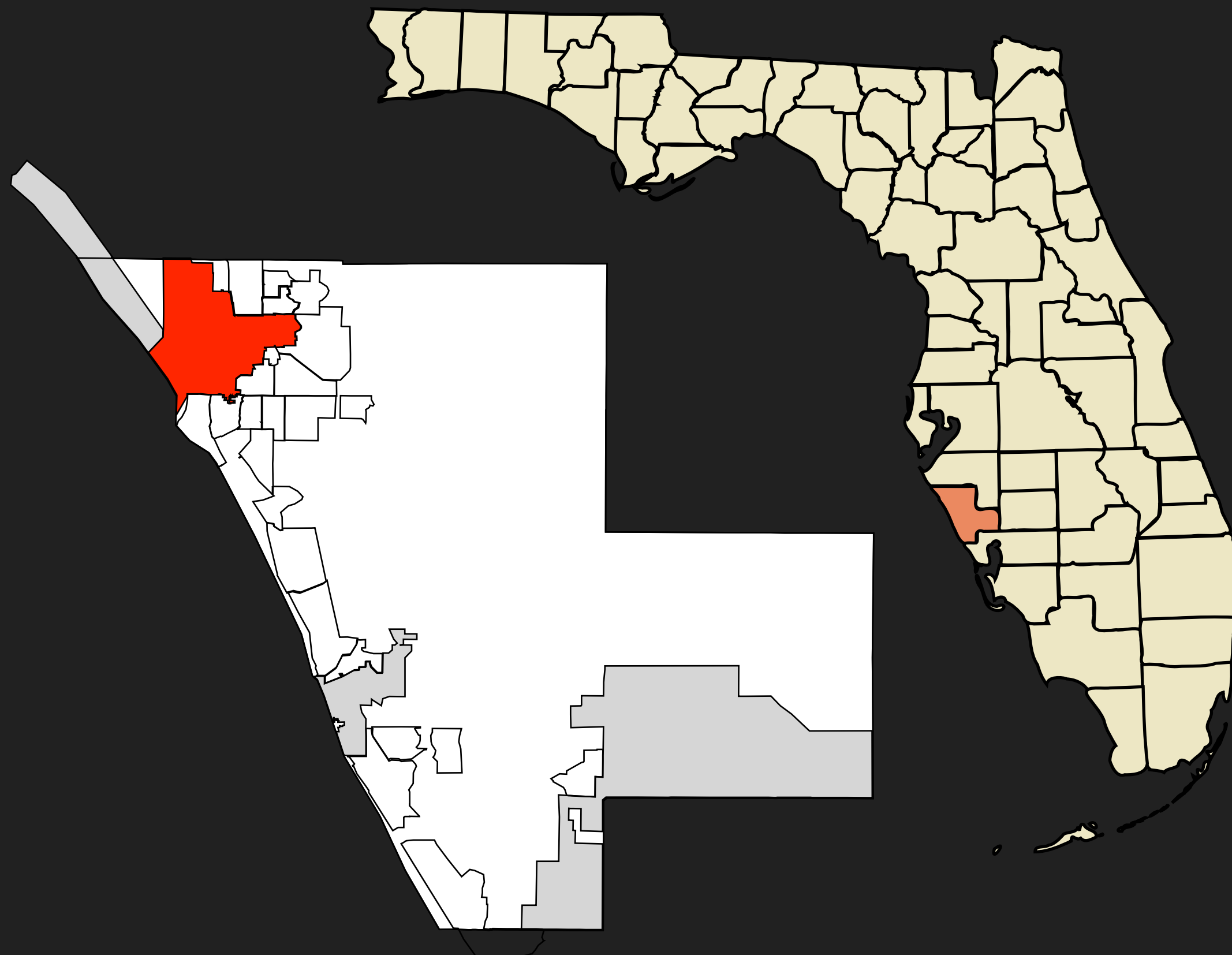
Honest mistakes  
or illegitimate votes?

No way to be sure.  
Believable audits  
impossible.

# Sarasota, Florida

CD-13 Race, November 2006

Christine Jennings v. Vern Buchanan



**In a nutshell...**

# Did voting machines steal a Democratic victory?

In Katherine Harris' old Florida district, more than 18,000 votes went missing -- and a Republican won a House seat by 369 votes.

By Katharine Mieszkowski

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The recount is over in the 13th Congressional District in Florida. The lawyers have won -- and the Democrat has lost. As in the presidential election of 2000, that loss appears to have been caused by a glitch in the voting process. But this time, the controversy centers on the very electronic voting machines many counties around the country purchased after the 2000 election in hopes of avoiding the sort of debacle that produced Bush v. Gore.

On Monday, Florida election officials named Republican [Vern Buchanan](#) the victor in the race for the House seat that Katherine Harris -- the Katherine Harris who was Florida's secretary of state during the 2000 recount -- vacated to run for the Senate. The Florida Elections Canvassing Commission, which is made up of Gov. Jeb Bush and two other elected Republican officials, said that the results of the recount showed Buchanan had beaten Democrat [Christine Jennings](#) by 369 votes in a race where nearly 240,000 votes were cast. The commission awarded the victory to Buchanan despite the fact that the mystery of more than [18,000 missing votes](#) has not been resolved.



Photo: AP/J. Scott Applewhite

Christine Jennings, the Democratic candidate in Florida's unresolved 13th Congressional District, second from left, after posing with freshman members of the House for a group photo on the steps of the Capitol in Washington on Nov. 14, 2006.



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***... mystery of more than 18,000 missing votes ...***

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Photo: AP/J. Scott Applewhite

Christine Jennings, the Democratic candidate in Florida's unresolved 13th Congressional District, second from left, after posing with freshman members of the House for a group photo on the steps of the Capitol in Washington on Nov. 14, 2006.

# Undervote rates by race

U.S. Senate

1.14%

Congress

12.90%

Governor

1.28%

Atty General

4.36%

C.F.O.

4.43%

Absentee

2.5%

ES&S  
iVotronic

14.9%

# Theory #1: Rational abstention

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Nobody seriously believes this.

# Theory #2: Human factors

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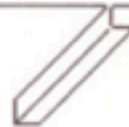
Were voters confused by the ballot design?

OFFICIAL GENERAL ELECTION BALLOT  
SARASOTA COUNTY, FLORIDA  
NOVEMBER 7, 2006

CONGRESSIONAL

UNITED STATES SENATOR  
(Vote for One)

Katherine Harris	REP	<input type="checkbox"/>
Bill Nelson	DEM	<input type="checkbox"/>
Floyd Ray Frazier	NPA	<input type="checkbox"/>
Belinda Noah	NPA	<input type="checkbox"/>
Brian Moore	NPA	<input type="checkbox"/>
Roy Tanner	NPA	<input type="checkbox"/>
Write-In		<input type="checkbox"/>



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

REP

☐

Jeff Kottkamp

Jim Davis

DEM

☐

Daryl L. Jones

Max Linn

REF

☐

Tom Macklin

Richard Paul Dembinsky

NPA

☐

Dr. Joe Smith

John Wayne Smith

NPA

☐

James J. Kearney

Karl C.C. Behm

NPA

☐

Carol Castagnero

Write-In

☐

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# Theory #3:

# Machine malfunction

# Theory #3: Machine malfunction

Did engineering failures of the machines *induce* the undervotes?

Did voters *see* their undervotes on the summary screen?

**Poor touchscreen calibration**

**Poor touch sensitivity**

Hardware and software failures

**Manufacturing defects**

**Dan Rather Reports** had a long piece on this issue

**Angle of view to the screen**

# Theory #4: **Fraud!**

No evidence to support this.

Exceptionally difficult to prove.

Never ascribe malice to what can adequately be explained by  
incompetence. – Napoleon

# Machine vs. human error

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## Critical concept relative to Florida law

If the summary screen showed "Jennings" and the machine recorded "none", then Jennings should win

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**Regardless, the machines failed to capture voter intent**

Experts on both sides agree **Jennings would have won**

# State investigations



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Same results as before (largely meaningless)

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## **"Parallel" election tests**

Poorly conducted, inconclusive results

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Poorly conducted, inconclusive results

## **Software examination**

Found nothing (but significant / unrelated security holes)

Never looked at the hardware

# What happened?

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## State lawsuits

Judge denied plaintiff's discovery motion

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## **Congressional Committee on House Administration**

GAO investigation affirmed result (Jennings conceded)

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## **Florida banned electronic voting systems**

Jennings ran again and lost to then-incumbent Buchanan

# What's next?



# What's next?

**Four years later, we still don't know what happened**

*Rice study: bad layout causes errors, but voters fix them*

*Iowa study: slow touchscreens increase error rate*

*Theory: Sarasota suffered from both problems*

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**We need better recount / challenge procedures**

Transparency is more important than vendor trade secrets

# The California Top-To-Bottom Study

Summer 2007

## **Biggest study of its kind, ever**

40+ researchers (source code, "red team,"  
documentation, accessibility)

three vendors (Diebold, Sequoia, Hart InterCivic)

**<http://www.sos.ca.gov/voting-systems/oversight/top-to-bottom-review.htm>**

## **Significant flaws found with each vendor**

Viral attacks possible!

## **Diebold and Sequoia “conditionally recertified”**

Only one machine per precinct for accessibility

Other votes on paper

## **Hart InterCivic has comparable sanctions**

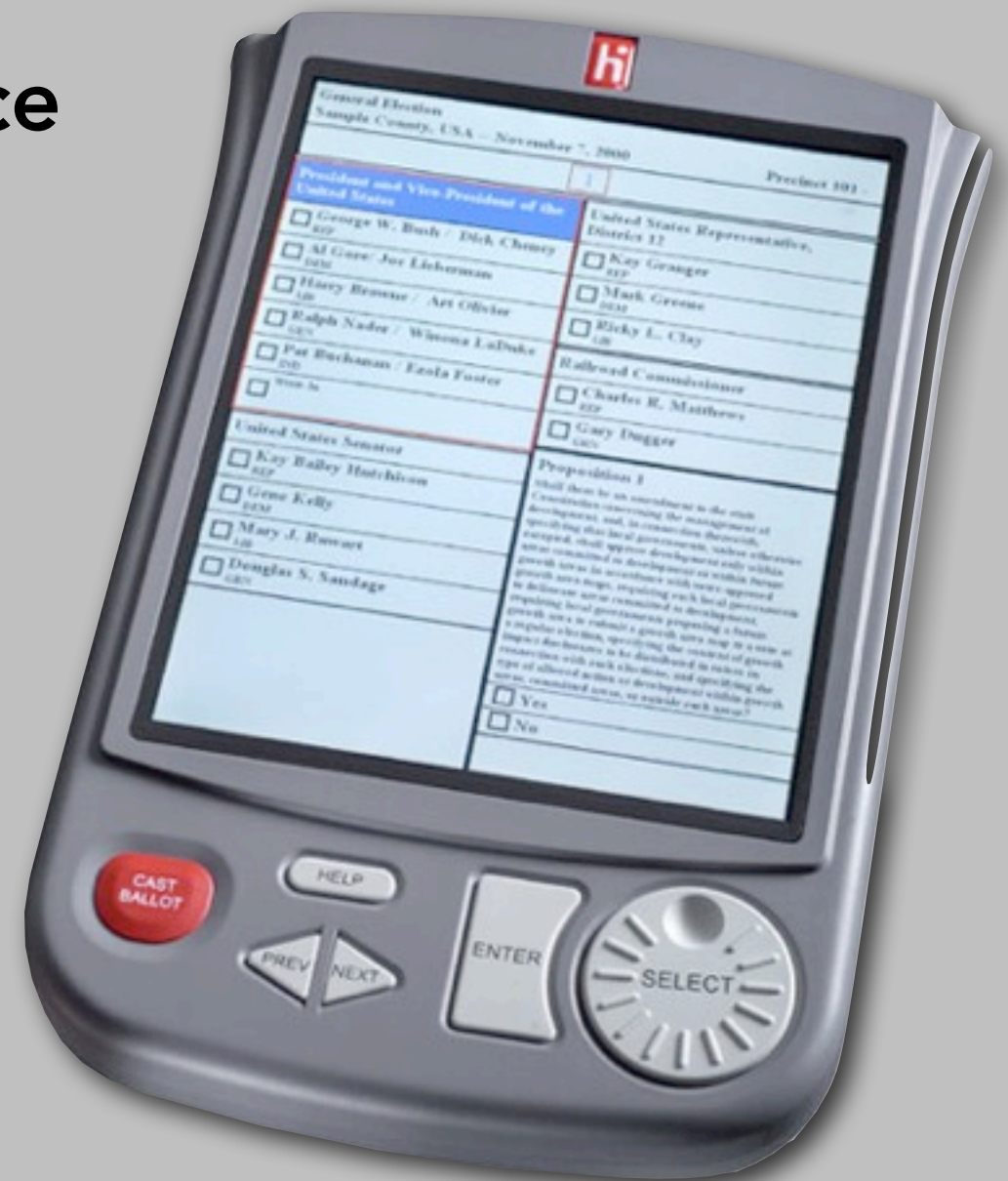
Revised conditions announced later

(e.g., reboot inventory computer from CDROM after every DRE machine connected)

# Hart eSlate architecture

Local network in the polling place

Controller sees all machines,  
collects all votes together



# Cryptography?

**HMAC-SHA1 for integrity checking of cast ballots**

Single shared key for the entire election

**OpenSSL in some places, but incorrect cert checking**

**No crypto on voting-machine local network**

# Network protocol?

**Messages that directly read and write to memory**

Officially used to test whether code is authentic

Also allows votes to be extracted or changed

Enables virus injection

**Regular voters have access to the network port**



# Viral attacks?

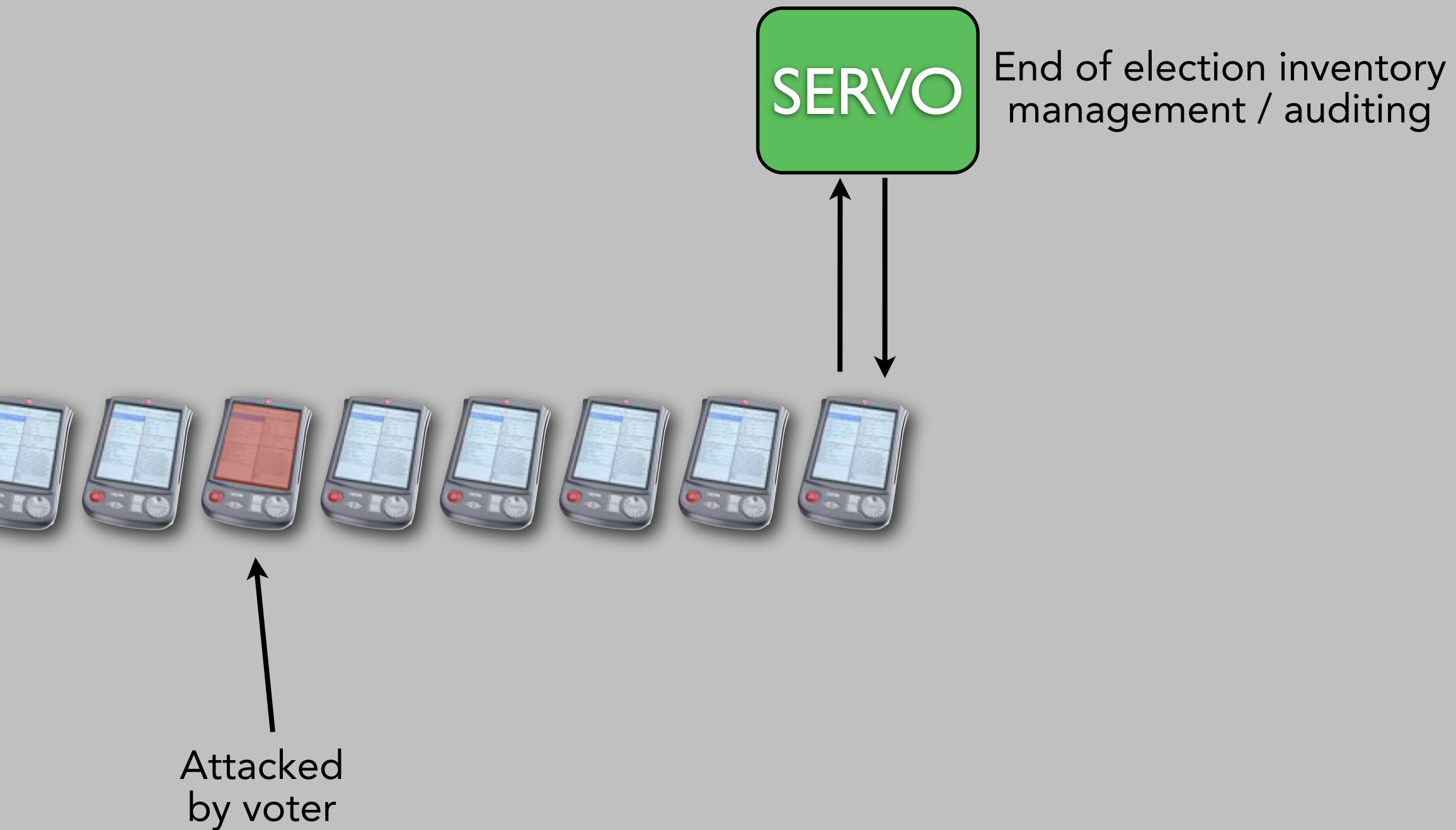
SERVO

End of election inventory  
management / auditing



Attacked  
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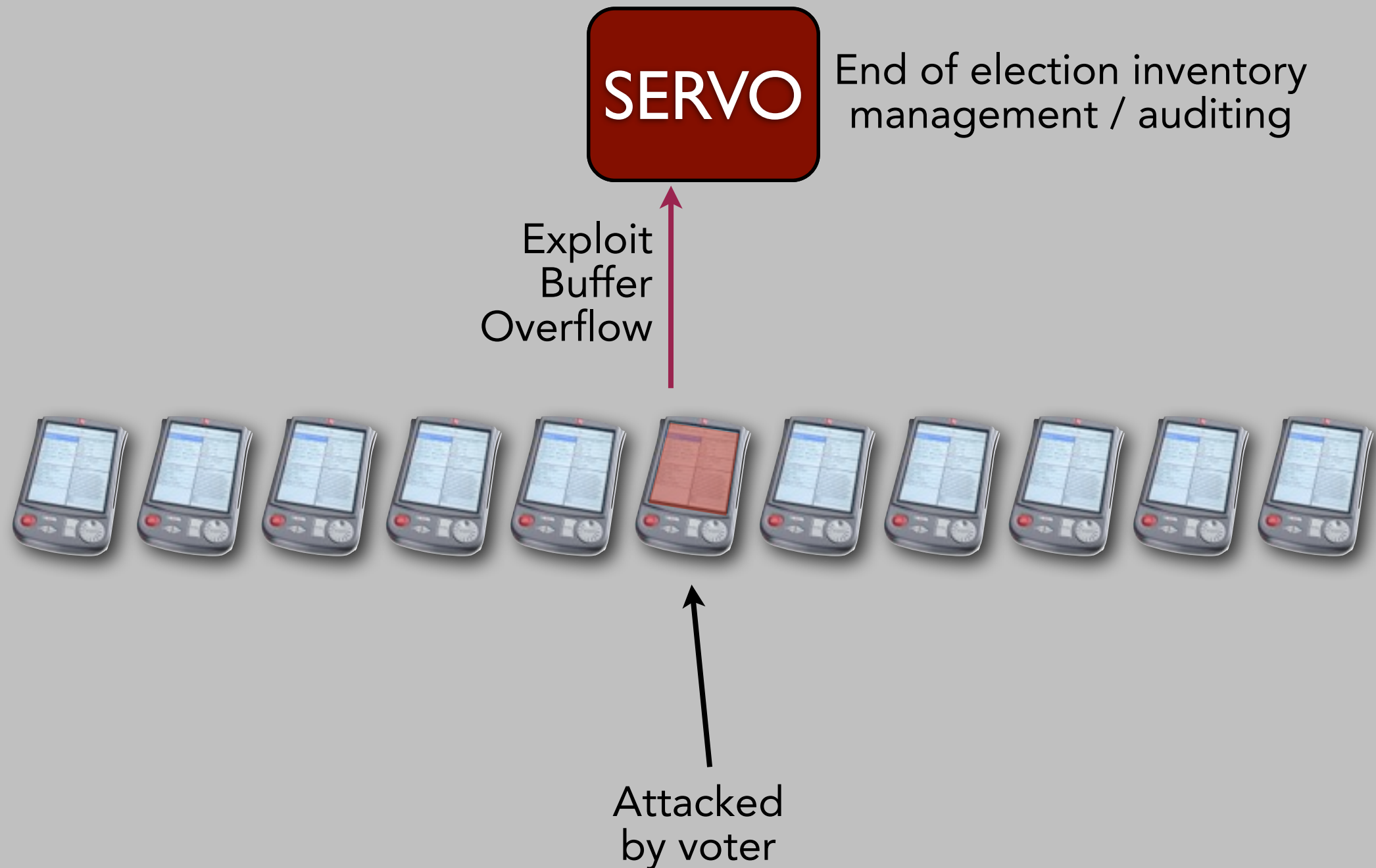
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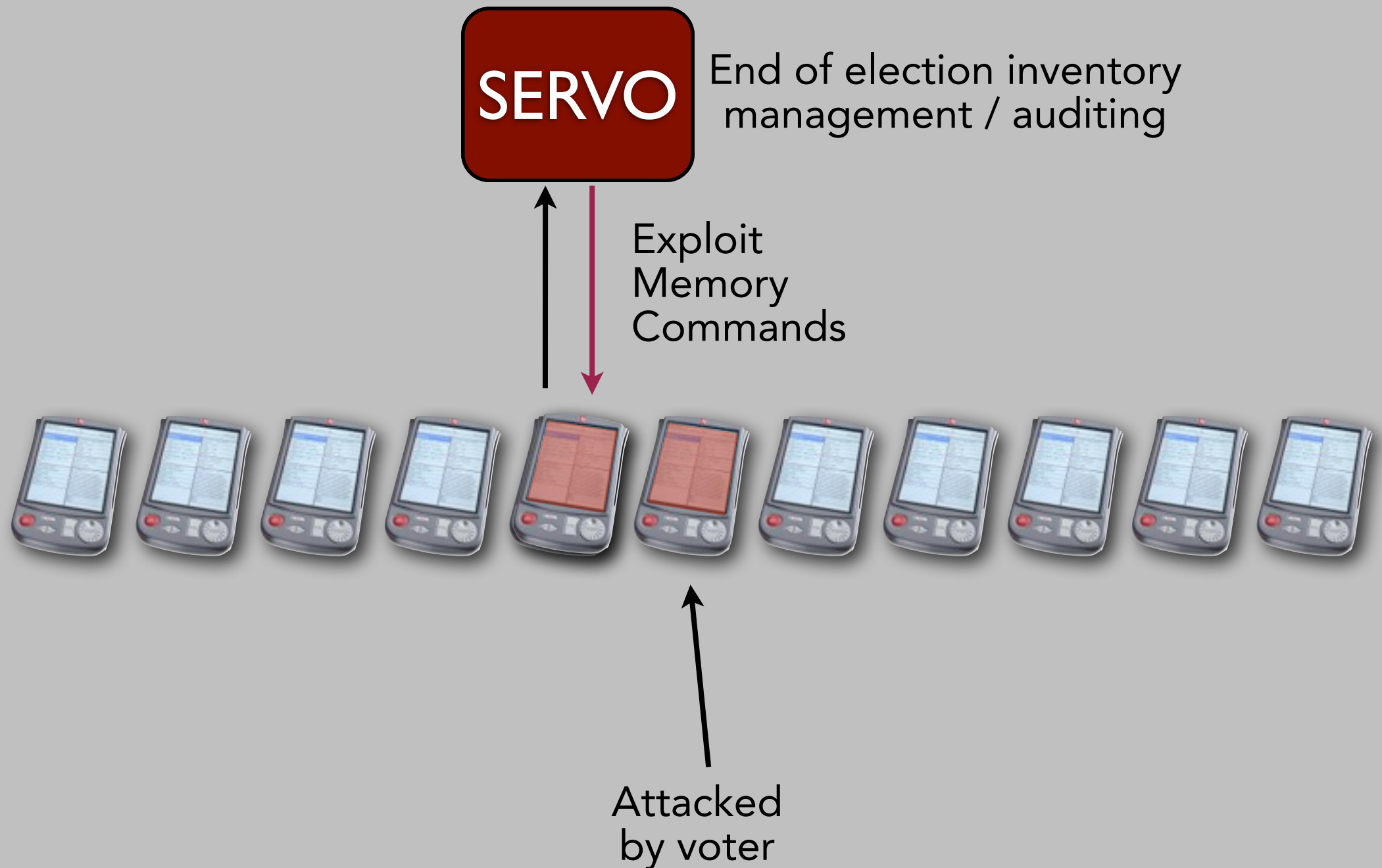


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# Viral attacks?

**SERVO**

End of election inventory  
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All subsequent machines compromised.

Attacked  
by voter

**No easy way to clean a compromised machine**

Must replace internal chips by hand

**No easy way to detect compromised machines**

Hacked machine can correctly answer network queries

## **Other Hart problems**

Audio unit can be overheard with a short-wave radio

“Adjust votes” feature in tabulation system



Premier (née Diebold, now part of ES&S) and Sequoia had similar problems.

(Results confirmed by follow-on study in Ohio.)

# What's next?

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**Some states following California's lead (but not Texas)**

Limit use of DREs to one per precinct

Mandatory audits to compare paper to electronic records

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Mandatory audits to compare paper to electronic records

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**Optical scan paper ballots growing in popularity**

Example: Travis County (Austin, TX) dropping eSlate after 2012