

Securing Digital Democracy

Lecture 5 | *Security Procedures*



J. Alex Halderman
University of Michigan

Voter Registration

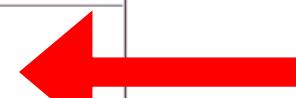
Voter
Authentication  Enfranchisement

Almost 1/3 of eligible U.S. citizens not registered!

5.1 Voter Registration

Voter Registration Application

Before completing this form, review the General, Application, and State specific instructions.

Are you a citizen of the United States of America?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	This space for office use only.		
Will you be 18 years old on or before election day?		<input type="checkbox"/> Yes	<input type="checkbox"/> No			
If you checked "No" in response to either of these questions, do not complete form. (Please see state-specific instructions for rules regarding eligibility to register prior to age 18.)						
1	(Circle one) Mr. Mrs. Miss Ms.	Last Name	First Name	Middle Name(s)	(Circle one) Jr Sr II III IV	
2	Home Address		Apt. or Lot #	City/Town	State	Zip Code
3	Address Where You Get Your Mail If Different From Above			City/Town	State	Zip Code
4	Date of Birth ____ / ____ / Month Day Year	5	Telephone Number (optional)	6	ID Number - (See Item 6 in the instructions for your state)	
7	Choice of Party (see item 7 in the instructions for your State)	8	Race or Ethnic Group (see item 8 in the instructions for your State)			
9	I have reviewed my state's instructions and I swear/affirm that: <input type="checkbox"/> I am a United States citizen <input type="checkbox"/> I meet the eligibility requirements of my state and subscribe to any oath required. <input type="checkbox"/> The information I have provided is true to the best of my knowledge under penalty of perjury. If I have provided false information, I may be fined, imprisoned, or (if not a U.S. citizen) deported.			  Please sign full name (or put mark) ▲		
				Date:	Month / Day / Year	

5.1 Voter Registration

Please fill out the sections below if they apply to you.

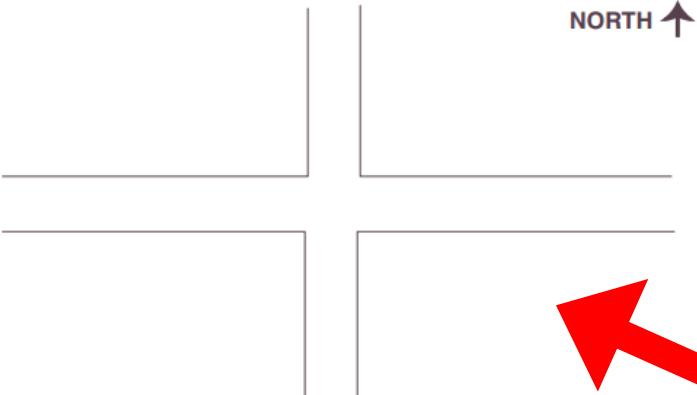
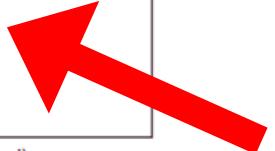
If this application is for a **change of name**, what was your name before you changed it?

A	Mr. Mrs. Miss Ms.	Last Name	First Name	Middle Name(s)	(Circle one) Jr Sr II III IV
---	----------------------------	-----------	------------	----------------	---------------------------------

If you were **registered before but this is the first time you are registering from the address in Box 2**, what was your address where you were registered before?

B	Street (or route and box number)	Apt. or Lot #	City/Town/County	State	Zip Code
---	----------------------------------	---------------	------------------	-------	----------

If you live in a rural area but do not have a street number, or if you have no address, please show on the map where you live.

C	<ul style="list-style-type: none">■ Write in the names of the crossroads (or streets) nearest to where you live.■ Draw an X to show where you live.■ Use a dot to show any schools, churches, stores, or other landmarks near where you live, and write the name of the landmark.									
	<table border="1"><tr><td>Example</td><td>Route #2</td></tr><tr><td></td><td>Grocery Store</td></tr><tr><td></td><td>Woodchuck Road</td></tr><tr><td>Public School</td><td>X</td></tr></table>	Example	Route #2		Grocery Store		Woodchuck Road	Public School	X	
Example	Route #2									
	Grocery Store									
	Woodchuck Road									
Public School	X									

If the applicant is unable to sign, who helped the applicant fill out this application? Give name, address and phone number (phone number optional).

D	
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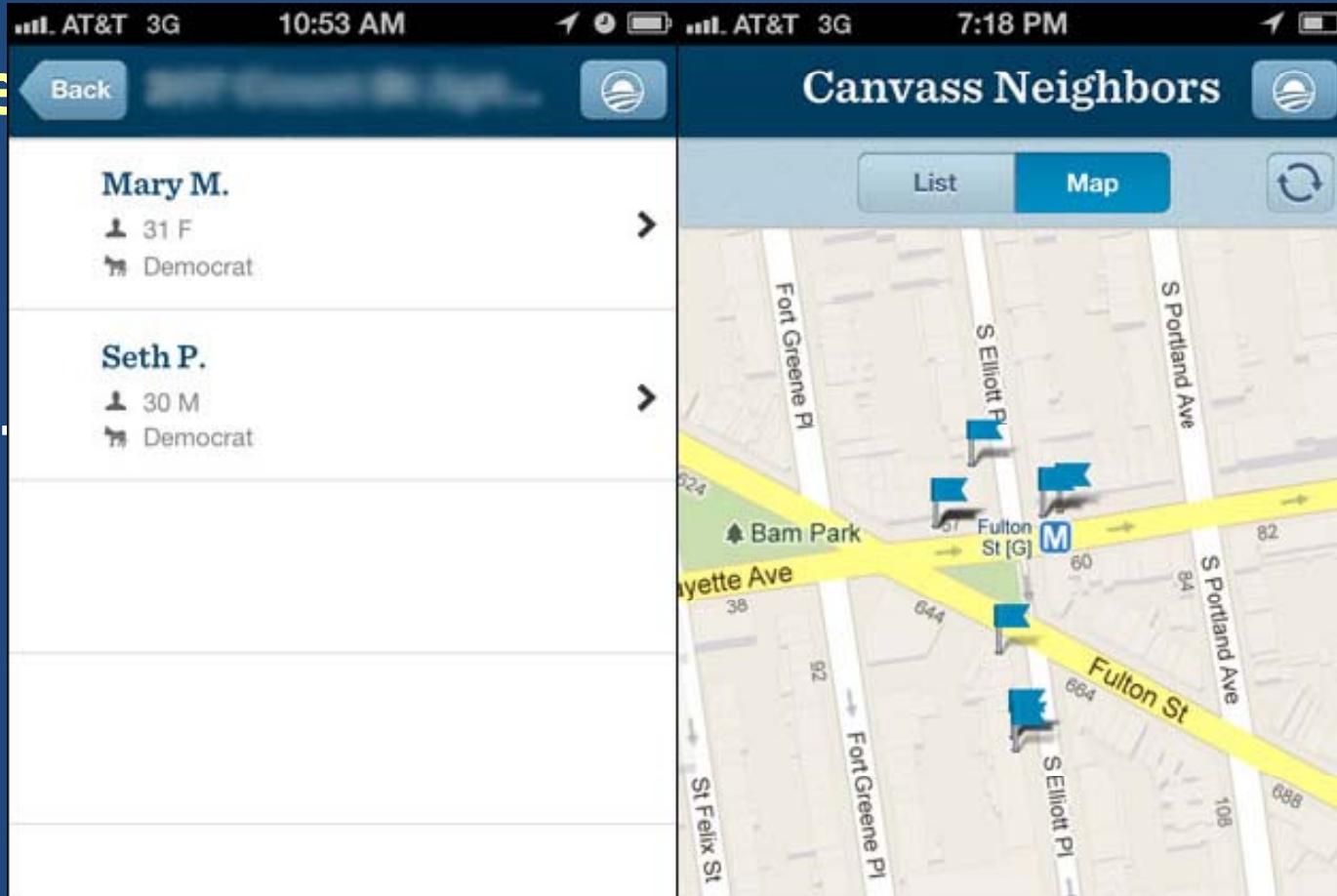
Mail this application to the address provided for your State.

5.1 Voter Registration

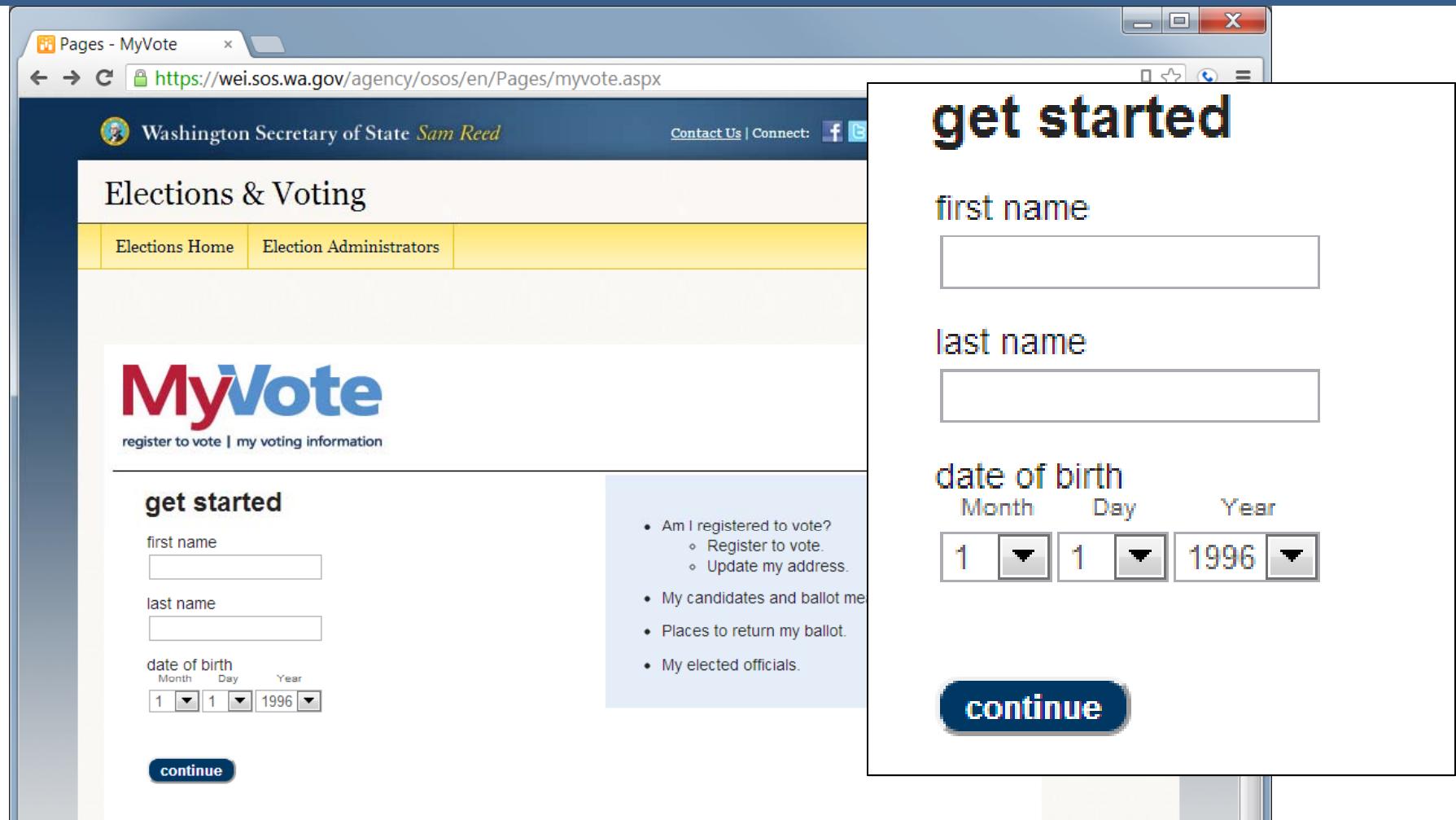
Securing Digital Democracy 

Vote

Au



5.1 Voter Registration



The image shows a screenshot of the MyVote voter registration website. The main page features a blue header with the Washington Secretary of State's name, Sam Reed, and a navigation bar with links for 'Elections Home' and 'Election Administrators'. Below this is a large 'MyVote' logo with the tagline 'register to vote | my voting information'. A 'get started' section contains fields for 'first name' and 'last name', and a date of birth input with dropdown menus for Month, Day, and Year, set to 1/1/1996. To the right of these fields is a list of services: 'Am I registered to vote?', 'My candidates and ballot me', 'Places to return my ballot.', and 'My elected officials.' A 'continue' button is located at the bottom of this section.

Pages - MyVote

Washington Secretary of State *Sam Reed*

Contact Us | Connect: [f](#) [t](#)

Elections & Voting

Elections Home Election Administrators

MyVote

register to vote | my voting information

get started

first name

last name

date of birth

Month Day Year

1 1 1996

continue

get started

first name

last name

date of birth

Month Day Year

1 1 1996

continue

5.1 Voter Registration

SP Sound Politics Washi x

www.soundpolitics.com/voterlookup.html

Sound Politics Washington State Voter Database

This service provides online access to a public release of the [Washington State Voter Registration Database](#) (February 29, 2012)

You may search for voters by county and street address or by name. Scroll down below the data entry form for instructions.

County: All Counties (select one county if searching by address)

Search by Address

House Number: (Show entire block?)

Prefix	Street Name	Type	Postfix
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

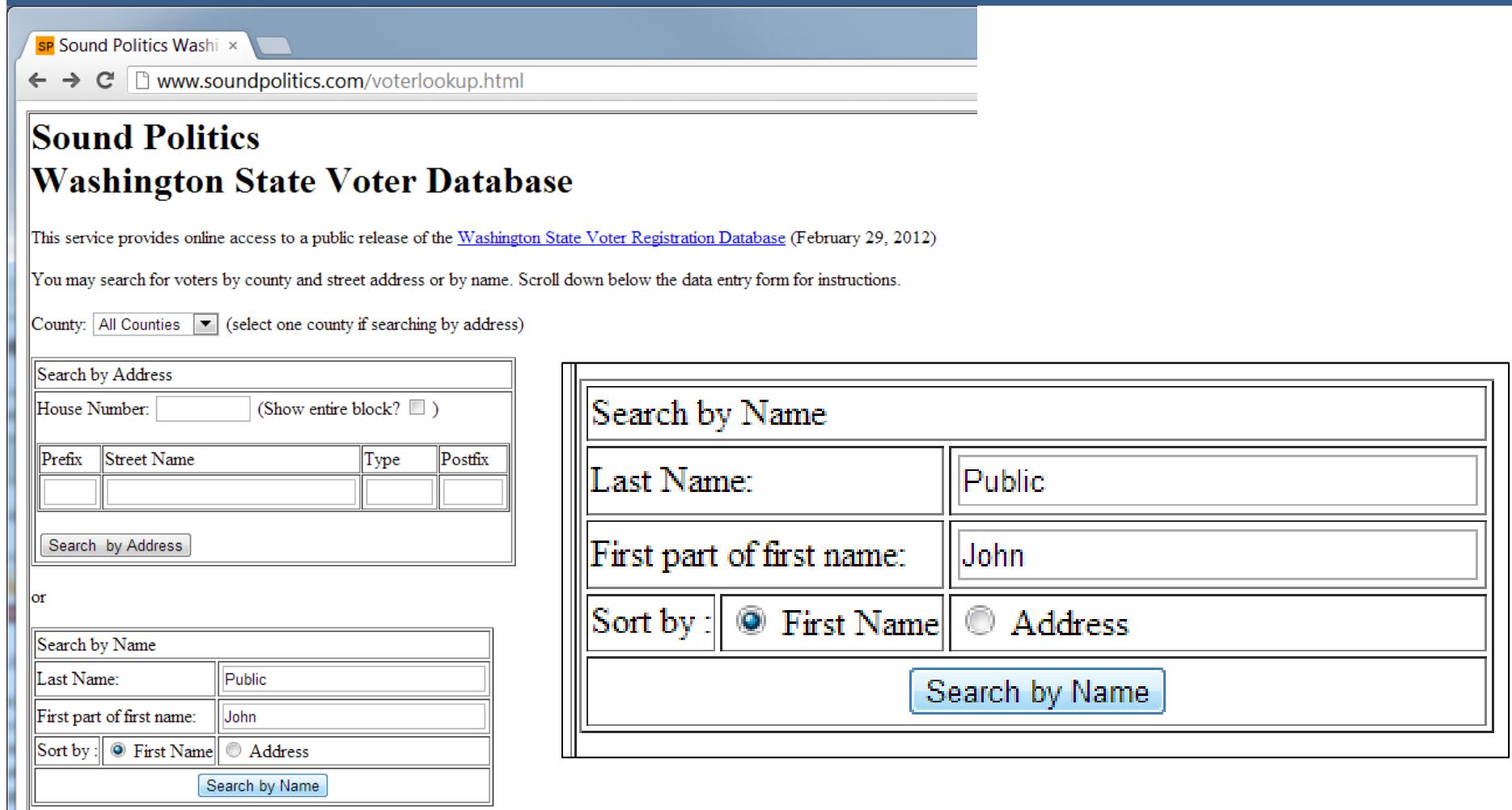
or

Search by Name

Last Name:

First part of first name:

Sort by : First Name Address



5.1 Voter Registration

Sound Politics Washi ×
usefulwork.com/cgi-bin/wavoterdb.cgi

Sound Politics Washington State Voter Database

County	Last Name	First / Middle Name	M/F	Number	Street	City	Last Voted	Birthdate	Registered	PAV	Status	Cong.	Leg.	Prec.
KI	PUBLIC	JOHN Q	M	100	MAPLE DR	REDMOND	2011-NOV-08	1950-JAN-01	1995-FEB-01	P	A	1	48	2790

Data is from [Secretary of State's Voter Registration Database](#) public release of Feb. 29, 2012

If this database is useful to you, [please make a contribution to help us cover our costs](#):

[Donate](#)

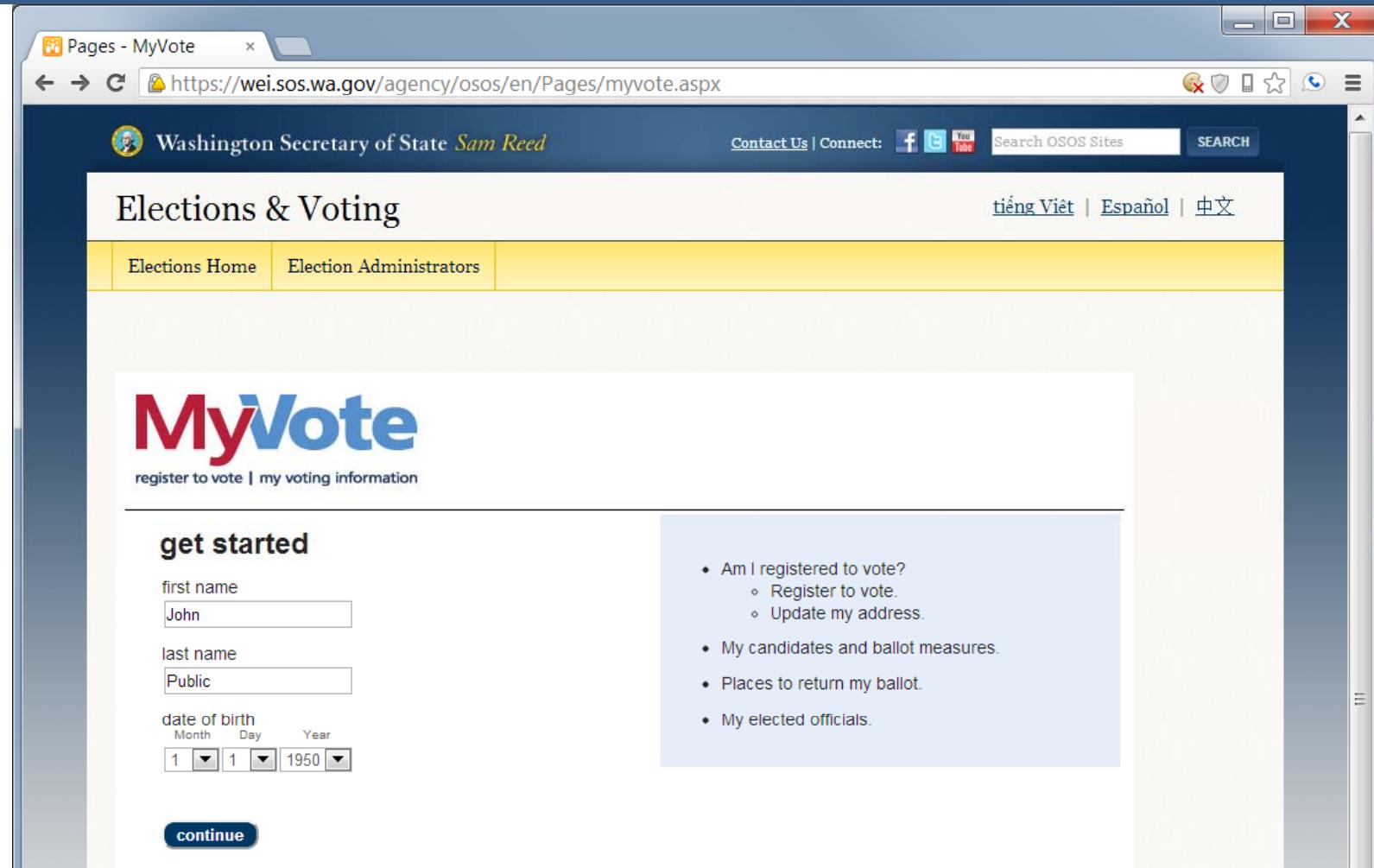
Sound Politics Washington State Voter Database

County	Last Name	First / Middle Name	M/F	Number	Street	City	Last Voted	Birthdate	Registered	PA
KI	PUBLIC	JOHN Q	M	100	MAPLE DR	REDMOND	2011-NOV-08	1950-JAN-01	1995-FEB-01	P

Data is from [Secretary of State's Voter Registration Database](#) public release of Feb. 29, 2012

M/F: gender
Number: May include a suffix such as APT to indicate whether the registration record indicates an apartment. Click on the link to see all voters registered at that street address.
LastVoted: The date of the last election in which the voter is credited with voting (or blank if never credited).

5.1 Voter Registration

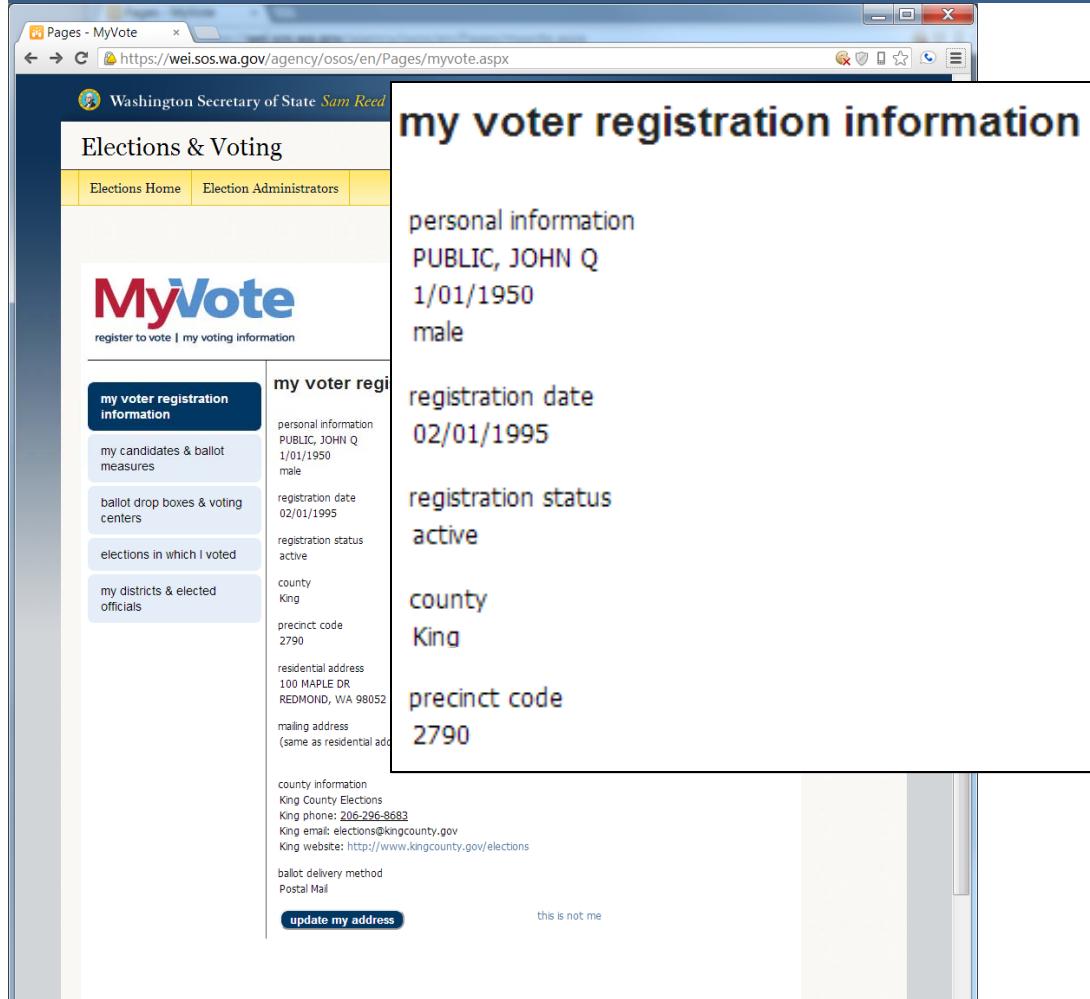


The screenshot shows a web browser window for the "MyVote" service. The URL in the address bar is <https://wei.sos.wa.gov/agency/osos/en/Pages/myvote.aspx>. The page header includes the Washington Secretary of State's name, Sam Reed, and links for Contact Us, Connect (Facebook, Twitter, YouTube), and a search bar. The main content area has a yellow header bar with "Elections Home" and "Election Administrators" buttons. Below this is a large "MyVote" logo with the tagline "register to vote | my voting information". A "get started" section contains input fields for first name (John), last name (Public), and date of birth (1/1/1950). To the right, a list of services is provided:

- Am I registered to vote?
 - Register to vote.
 - Update my address.
- My candidates and ballot measures.
- Places to return my ballot.
- My elected officials.

A "continue" button is located at the bottom left of the form.

5.1 Voter Registration



The screenshot shows a web browser window for the Washington Secretary of State's MyVote website. The URL is https://wei.sos.wa.gov/agency/osos/en/Pages/myvote.aspx. The page title is "my voter registration information". On the left, there's a sidebar with links like "Elections & Voting", "MyVote", and "register to vote | my voting information". The main content area displays personal information (name: PUBLIC, JOHN Q, date of birth: 1/01/1950, gender: male), registration details (date: 02/01/1995, status: active), and voting location (county: King, precinct code: 2790). At the bottom, there are buttons for "update my address" and "this is not me".

residential address
100 MAPLE DR
REDMOND, WA 98052

mailing address
(same as residential address)

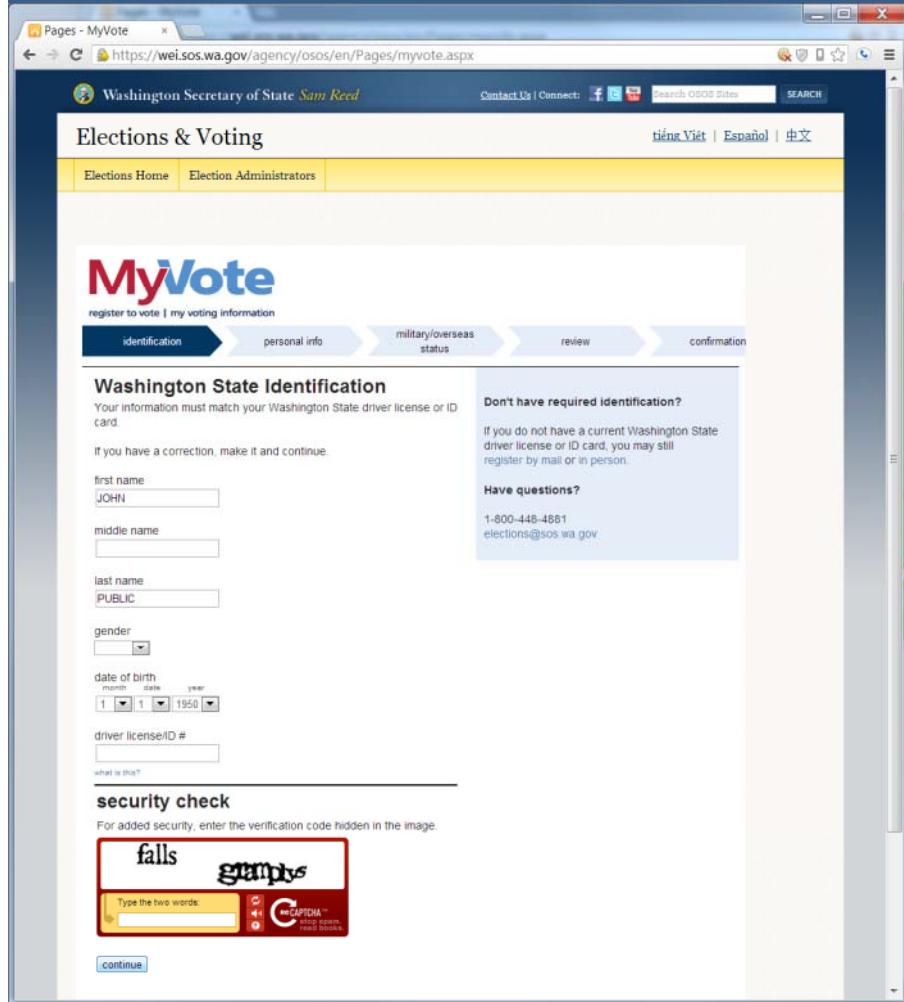
county information
King County Elections
King phone: [206-296-8683](tel:206-296-8683)
King email: elections@kingcounty.gov
King website: <http://www.kingcounty.gov/elections>

ballot delivery method
Postal Mail

update my address

this is

5.1 Voter Registration

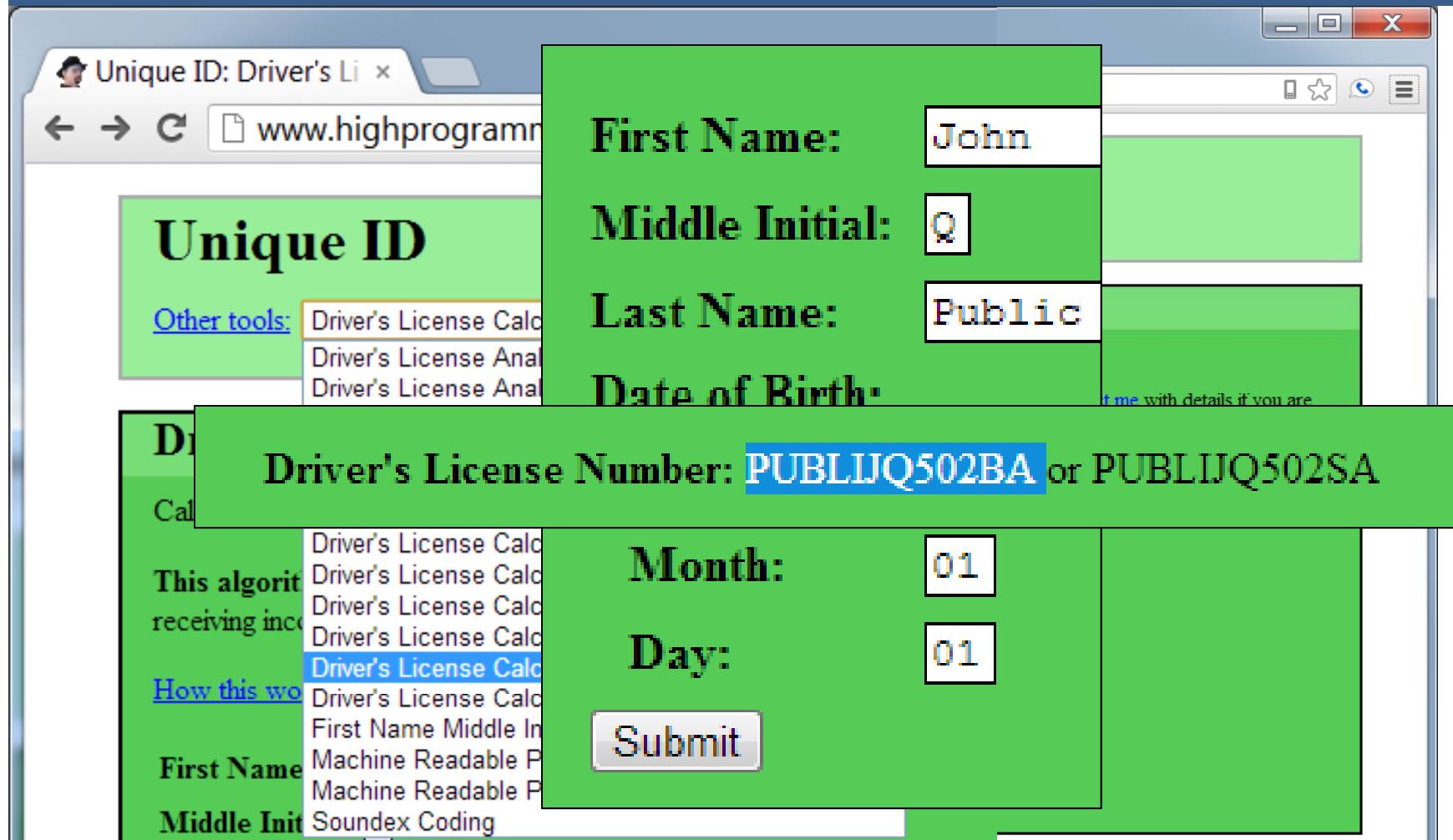


The screenshot shows the "MyVote" voter registration page. The user has entered "JOHN" for first name, "PUBLIC" for last name, and selected "gender" from a dropdown menu. The date of birth is set to January 1, 1950. A CAPTCHA challenge displays the words "falls" and "gmplys" in a distorted font. Below the CAPTCHA, there is a text input field labeled "Type the two words." and a "CAPTCHA" button.



The screenshot shows a voter registration form with fields for first name (JOHN), middle name (redacted), last name (PUBLIC), gender (dropdown menu), date of birth (1/1/1950), driver license ID number (redacted), and a "what is this?" placeholder. A large yellow starburst graphic with the text "WHAT COULD GO WRONG?" is overlaid on the right side of the form.

5.1 Voter Registration



The screenshot shows a web browser window with the following details:

- Address Bar:** Unique ID: Driver's Li
- Title Bar:** www.highprogrammer.com
- Left Sidebar (Unique ID tool):**
 - Other tools:** Driver's License Calc, Driver's License Anal, Driver's License Anal
- Main Content Area:**
 - First Name:** John
 - Middle Initial:** Q
 - Last Name:** Public
 - Date of Birth:** [Field partially visible]
 - Driver's License Number:** PUBLIJQ502BA or PUBLIJQ502SA
 - Month:** 01
 - Day:** 01
 - Submit** button

5.1 Voter Registration

The screenshot shows a Windows desktop application window titled "Pages - MyVote". The URL in the address bar is <https://wei.sos.wa.gov/agency/osos/en/Pages/myvote.aspx>. The window title is "MyVote". The main content area is titled "Washington State Identification" and contains the following fields:

- first name: JOHN
- middle name: Q
- last name: PUBLIC
- gender: male
- date of birth: 1/1/1950
- driver license/ID #: PUBLIJQ502BA
- what is this? (text input field)
- security check:
 - Text: falls gramplys
 - Type the two words: falls gramplys
 - CAPTCHA: falls gramplys

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Washington State Identification

Your information must match your Washington State driver license or ID card.

If you have a correction, make it and continue.

first name

JOHN

middle name

Q

last name

PUBLIC

gender

male

date of birth

month date year
1 1 1950

driver license/ID #

PUBLIJQ502BA

what is this?

continue

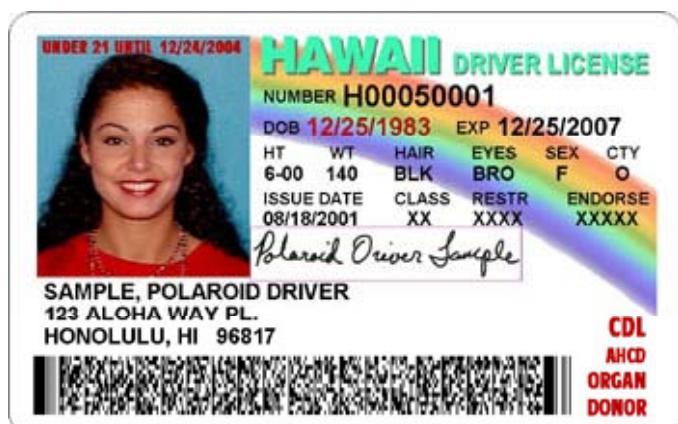
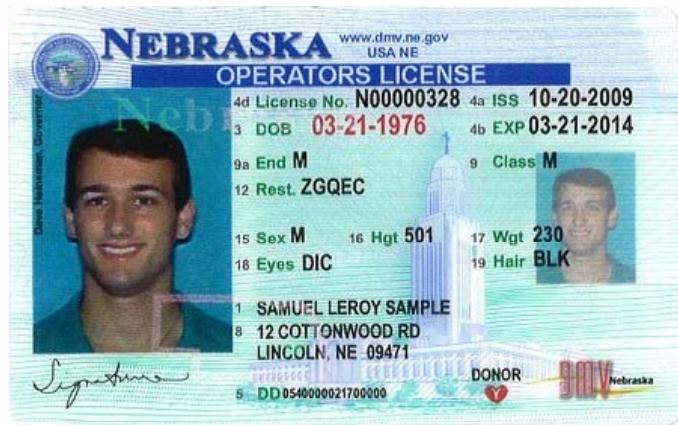
Voter Authentication

5.2 Voter Authentication



(left) Public domain image from Wikimedia Commons, http://en.wikipedia.org/wiki/File:Mustermann_nPA.jpg
(right) Image by DNI Electronico via Wikimedia Commons, <http://en.wikipedia.org/wiki/File:Dnielectronico.jpg>
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5.2 Voter Authentication

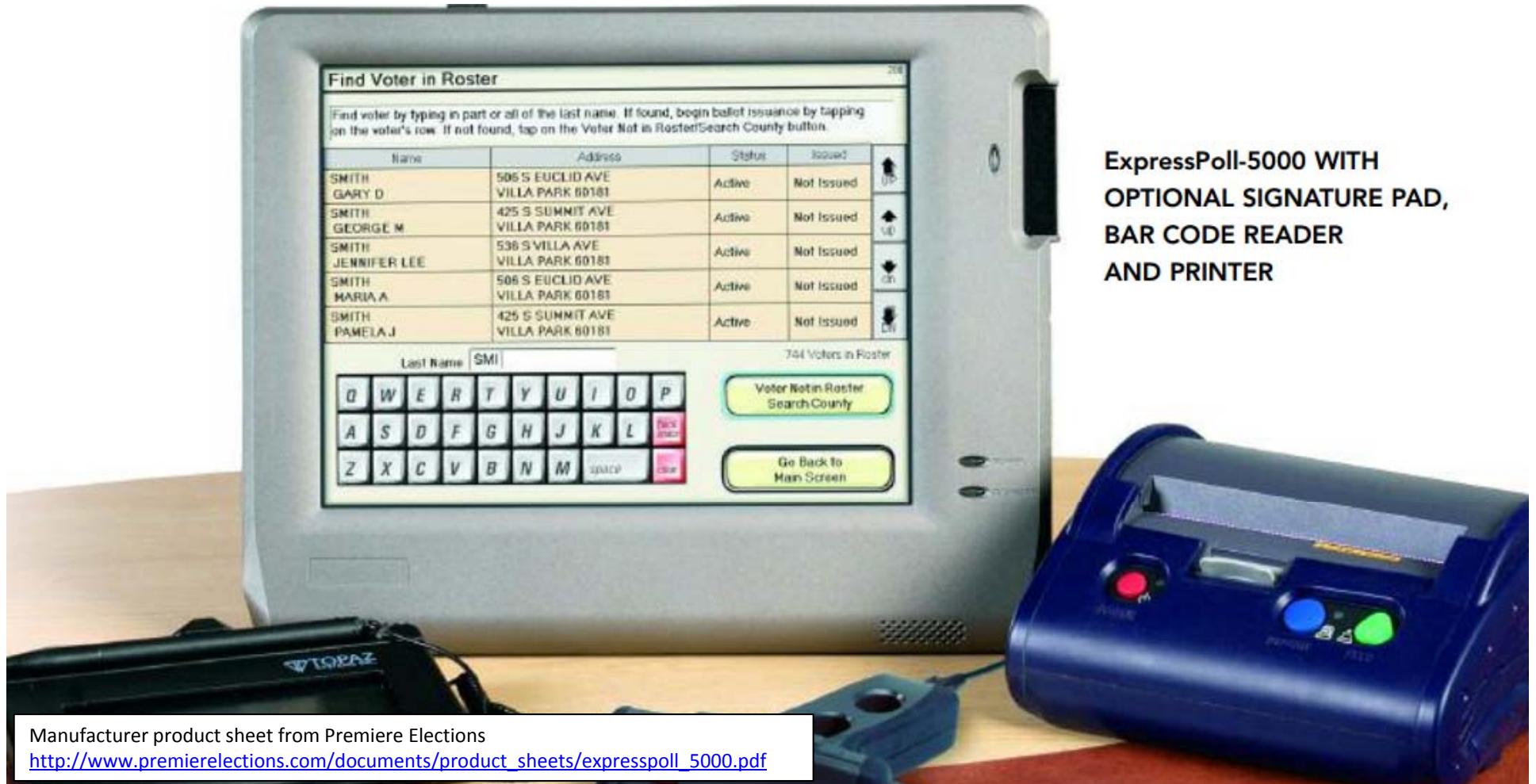


5.2 Voter Authentication

ROSTER OF ACTIVE VOTERS AFTER COUNTING SIGNATURES, PLACE INSIDE FRONT COVER OF ROSTER-INDEX							
RESIDENCE	VOTER ID	AFF #	PARTY	REG. DATE	SIGNATURE	VOTER NAME	
3751 HARRISON ST 201	01S340862	DEM	10/21/03	*** ABSENTEE VOTER ***		VAL LEE	BLAKELY
3798 HARRISON ST 1	7GE158290	GRN	10/13/06	*** ABSENTEE VOTER ***	ADDRESS :	LAUREN CATHERINE	BOOTH
567 OAKLAND AVE 111	59D021682	NP	3/30/92	*** ABSENTEE VOTER ***	ADDRESS :	JACK H	BOWMAN
645 EL DORADO AVE 104	01M741300	NP	10/2/06	*** ABSENTEE VOTER ***	ADDRESS :	FRANCINE	BROADNAX
142 MOSS AVE 8	01L657067	NP	5/22/06	*** ABSENTEE VOTER ***	ADDRESS :	TESSA DIAHANN	CHRISTENSON
555 OAKLAND AVE 2E	65A808348	DEM	10/23/06	*** ABSENTEE VOTER ***	ADDRESS :	MICHELLE CHANTAL	CHUN LEROY
567 OAKLAND AVE 302	FAP062097	REP	10/17/06	X	ADDRESS :	LORA C	CROSSLIN
3798 HARRISON ST 3	600500451	DEM	10/23/06	X	ADDRESS :	MITZI	DEARING
645 EL DORADO AVE 208	01S507170	DEM	10/23/06	X	ADDRESS :	SUSAN MARY	DUFFY
3768 HARRISON ST 307	01K609739	NP	9/14/99	*** ABSENTEE VOTER ***	ADDRESS :	RAYMOND KENNETH	FARRIN
561 EL DORADO AVE	67F450650	DEM	10/13/06	*** ABSENTEE VOTER ***	ADDRESS :	LAWRENCE WILLIAM	FASANO
Total : 11							
GENERAL ELECTION TUESDAY, NOVEMBER 7, 2006				225400	THE HARRISON LOBBY 3933 HARRISON ST OAK		
				RT711.05	Page 1 of 5		
				225400			

Image by Joe Hall (Flickr user joebeone), licensed under a Creative Commons Attribution license, <http://www.flickr.com/photos/joebeone/292549434/>

5.2 Voter Authentication



VoterID?

Voter
Authentication  Enfranchisement

5.2 Voter Authentication

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The website features a prominent banner at the top with the text "Scans+UV Ink+Identical Holo Overlay= Best Fake ID Online You Can Buy!" and an image of a printer next to a real New Jersey driver's license.

Below the banner, there are several sections:

- Best Fake ID Online**: Shows a sample of a New York State driver's license.
- Templates and Finished Licenses**: Shows a sample of an Arizona driver's license with placeholder data (Number: 88888888, Expires: 00/00/0000, Date of Birth: 00/00/0000, Issued: 00/00/0000).
- Close up look**: Shows a close-up of a woman's face.
- You supply this:**: Shows a photo of a woman's face.
- We make you this:**: Shows a sample of an Arizona driver's license with a different photo of the same woman.
- CLICK IMAGES TO ENLARGE**: A button to view images larger.
- See more close up work of our templates and printed licenses**: A link to see more examples.
- Text at the bottom:** "We start with a real license and make the best cloned template with zero difference to a real license. We then make a clone of the hologram overlay for our supplier source to produce. We also laser-engage and perforate images for those states that have these features."

5.2 Voter Authentication



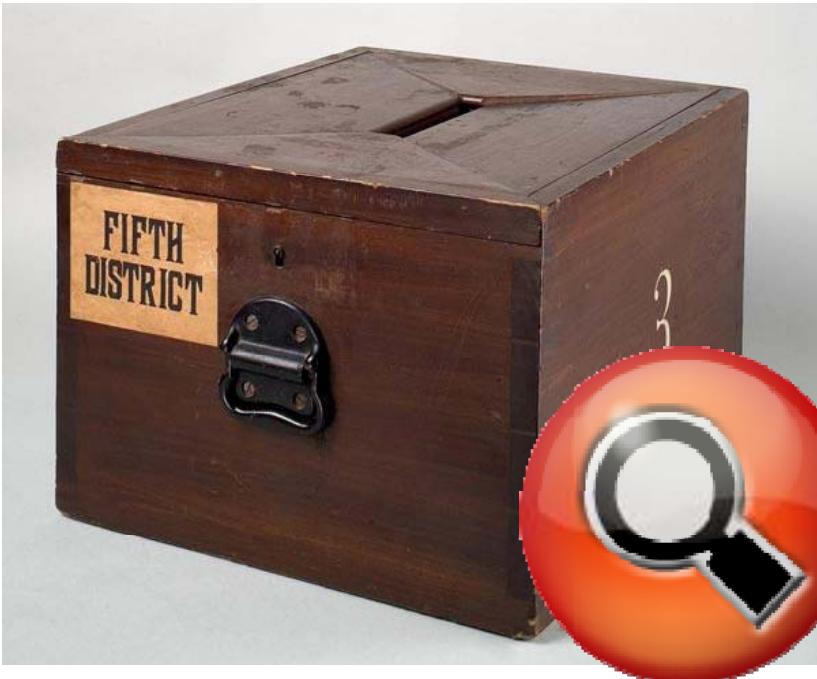
Image by Flickr user isafmedia, licensed under a Creative Commons Attribution 2.0 Generic license.
<http://www.flickr.com/photos/isafmedia/5007269322/in/photostream/>

Looking Ahead...

Guarding against Tampering

5.3 Guarding Against Tampering

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Between polling and counting



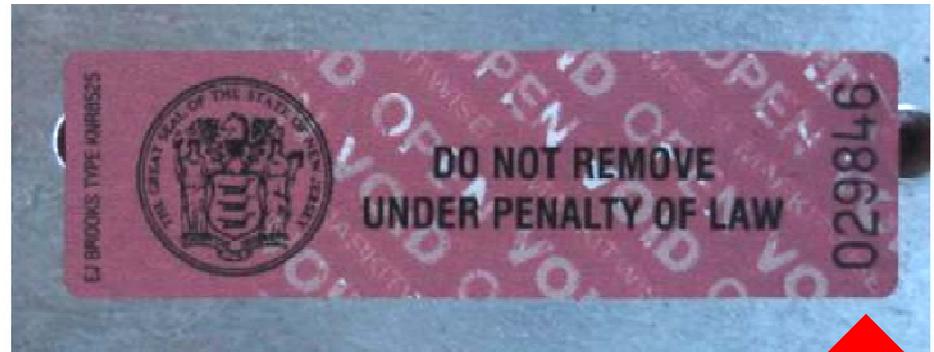
At all times!

5.3 Guarding Against Tampering



<http://www.cs.princeton.edu/~appel/voting/SealsOnVotingMachines.pdf>

Tamper-Evident Seals



<http://www.cs.princeton.edu/~appel/voting/SealsOnVotingMachines.pdf>

5.3 Guarding Against Tampering



Image from Argonne National Laboratory Vulnerability Assessment Team
<http://www.ne.anl.gov/capabilities/vat/seals/index.html>

5.3 Guarding Against Tampering



Results for 244 Seals

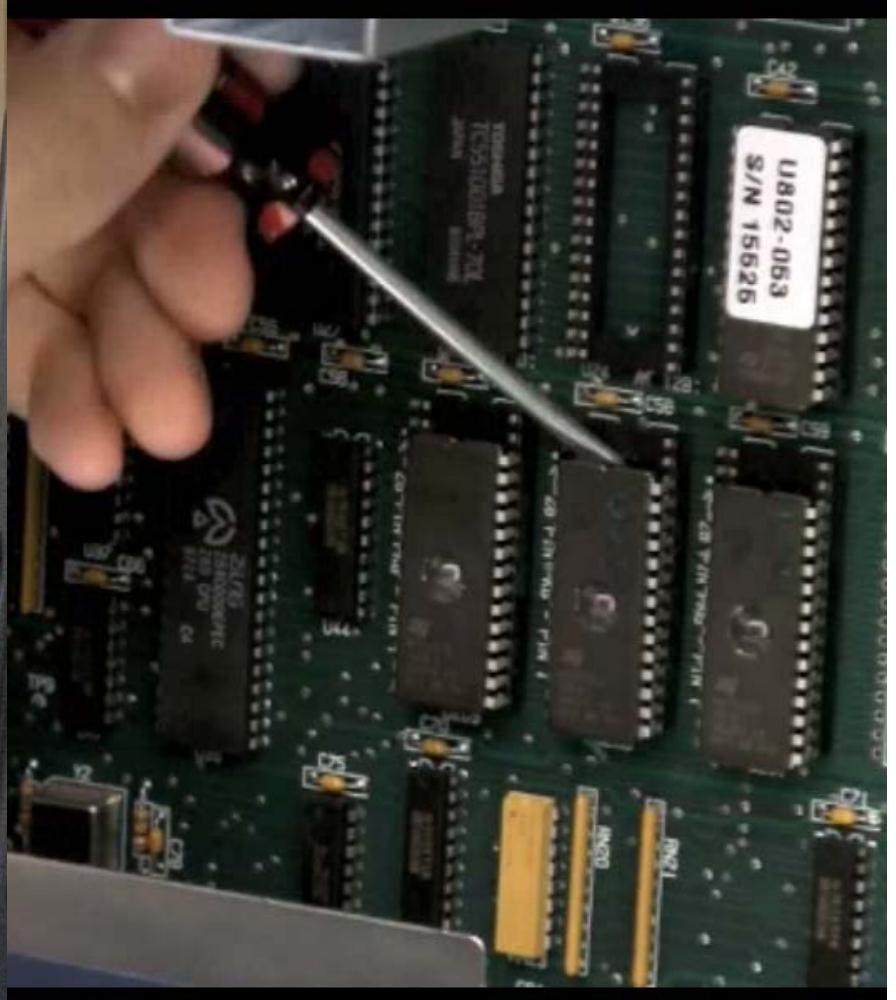
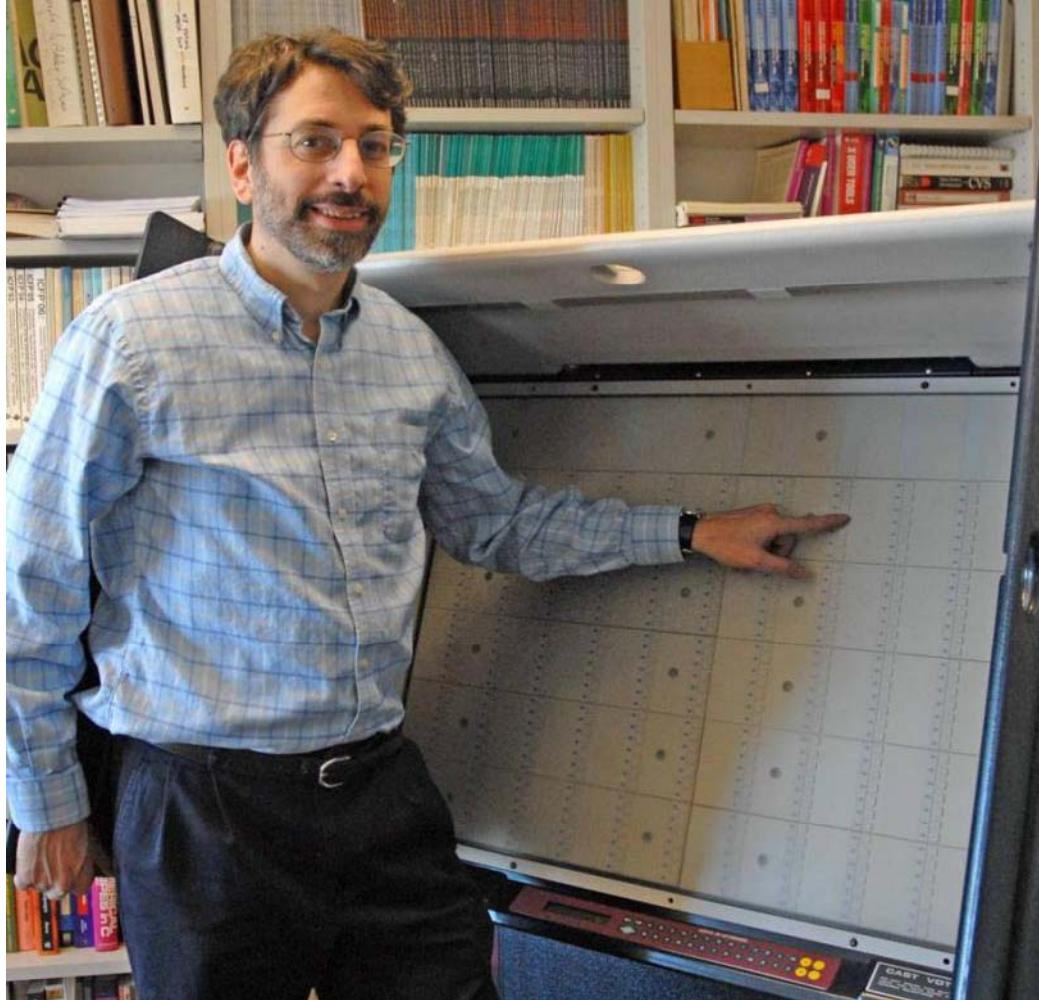
	Mean	Median
Defeat time for one person	1.4 mins	43 secs
Cost of tools/supplies	\$78	\$5
Cost per seal attacked	\$0.62	\$0.09
Time to devise successful attack	2.3 hrs	12 mins

(19% use or in consideration for nuclear safeguards!)

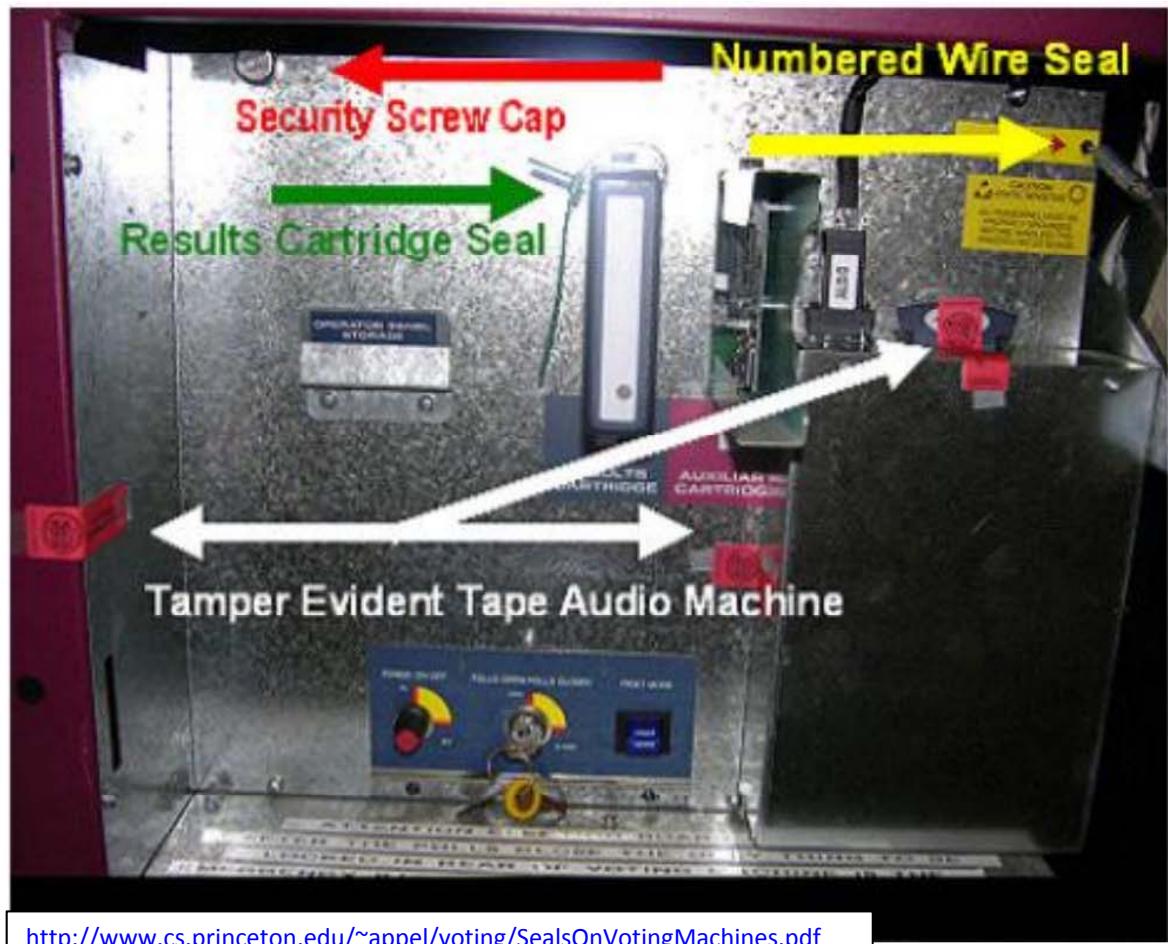
(left) Image from Argonne National Laboratory Vulnerability Assessment Team, <http://www.ne.anl.gov/capabilities/vat/seals/new.html>
(data) From Johnston et al., <http://www.ne.anl.gov/capabilities/vat/seals/index.html>

5.3 Guarding Against Tampering

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5.3 Guarding Against Tampering



TECHNICIAN'S INSTRUCTIONS ALL MACHINES

Security Screw Cap (upper left hand corner) Insert screw into back of cap. Place numbered cap over screw. Record number.

Numbered wire seal (upper right hand corner) Insert numbered wire seal. Lock seal and remove excess wire. Record number.

Results cartridge seal – Insert plastic numbered seal. Record number.

AUDIO MACHINES

Tamper evident tape (3 pieces)

1. Left hand side-place a piece of tamper evident tape from the e-box to the metal shroud horizontally.

5.3 Guarding Against Tampering



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Cup
Seal



<http://www.cs.princeton.edu/~appel/voting/SealsOnVotingMachines.pdf>

5.3 Guarding Against Tampering

Securing Digital Democracy 

**Padlock
Seal**



<http://www.cs.princeton.edu/~appel/voting/SealsOnVotingMachines.pdf>

5.3 Guarding Against Tampering



Tape Seals



<http://www.cs.princeton.edu/~appel/voting/SealsOnVotingMachines.pdf>

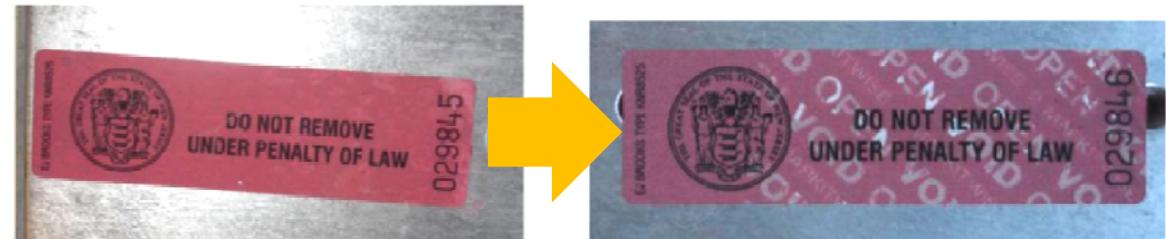
Evaluating a Seal Protocol

- Is the seal going to be in place when the attacker has access?
- Does the seal actually need to be removed to get in?
- Can the attack just remove it temporarily without leaving evidence?
- Can the attack replace it with a new seal without leaving evidence?
- Do election officials properly record seal numbers for each machine?
- Do election officials properly check the seal numbers later?
- Do officials inspect for evidence of tampering?
- If anomalies are detected, are they recorded and reported?
- Is appropriate action taken?

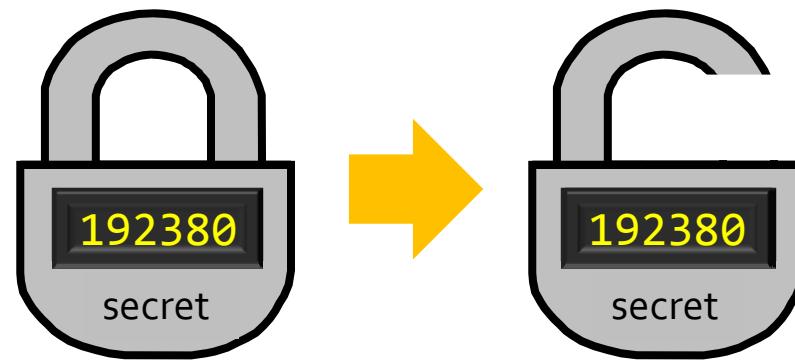
5.3 Guarding Against Tampering



Old way: Evidence

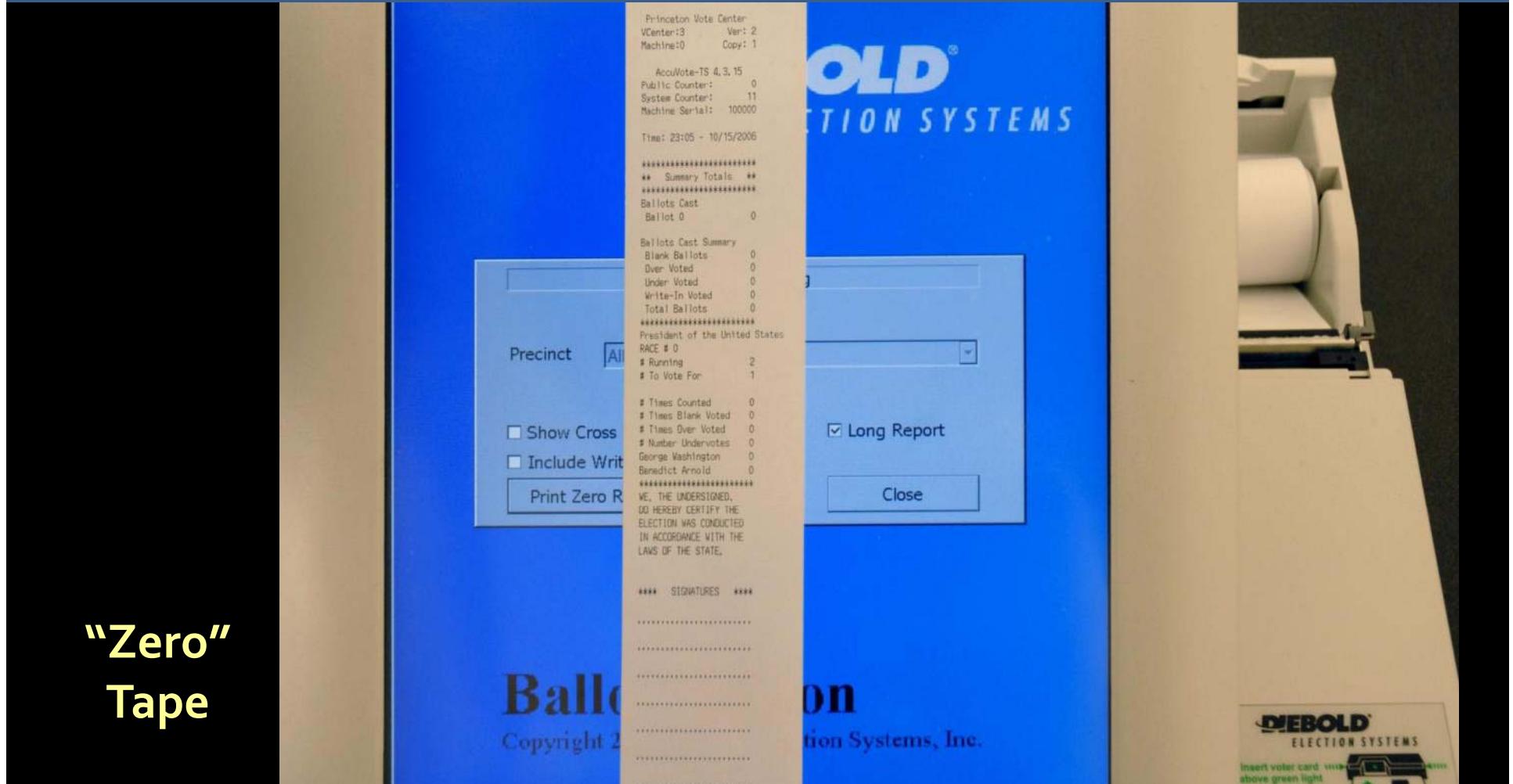


New idea: “Anti-evidence”



Field Testing

5.4 Field Testing



“Zero”
Tape

5.4 Field Testing



Logic & Accuracy
Testing

Pre-Election Testing Mode					
Election	September 1, 2006				
Steal This Election					
Vote Center	3				
Princeton Vote Center					
Unit	0	Version	2	Copy	1
Count	0				
Test Count		Reporting		Clear Totals	
View Ballot Results		Transfer Results		Set For Election	
Create Voter Cards		Accumulator		Supervisor Functions	
System Information					
SN	<input type="checkbox"/>		System Total	89	AC Online
					No Battery

5.4 Field Testing



Parallel
Testing

What if problems are found?

Automated Analysis of Election Audit Logs

Patrick Baxter

Clemson University

Anne Edmundson

Cornell University

Keishla Ortiz

University of Puerto Rico-Arecibo

Ana Maria Quevedo

Miami Dade College

Samuel Rodríguez

University of Puerto Rico-Mayagüez

Cynthia Sturton

University of California-Berkeley

David Wagner

University of California-Berkeley

Abstract

The voting audit logs produced by electronic voting systems contain data that could be useful for uncovering procedural errors and election anomalies, but they are currently unwieldy and difficult for election officials to use in post-election audits. In this work, we develop new methods to analyze these audit logs for the detection of both procedural errors and system deficiencies. Our methods can be used to detect votes that were not included in the final tally, machines that may have ex-

In the November 2010 U.S. elections, 33% of registered voters were using Direct Recording Electronic (DRE) voting machines [22]. Federal standards require that electronic voting machines generate detailed audit logs for use during post-election audits. Unfortunately, while the logs contain large amounts of data, it is not immediately obvious what sort of useful information can be learned from the data. Furthermore, even simple tallies are cumbersome, time consuming, and prone to human error if done manually. For these reasons, election officials do not regularly perform countywide post-election analysis of the log data.

<https://www.usenix.org/conference/evtwote12/automated-analysis-election-audit-logs>

Human Factors

Tracking Problems

Securing Digital Democracy

Lecture 5 | *Security Procedures*



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