

BEHIND THE BALLOT

The Tech That Makes Elections Work






Agenda

- Introduction
- Voting Equipment History
- Current State
- System Certification
- Polling Place Situations
- Security Concerns



Introductions

- Cody Davies
- Jake Ekdahl



"IN ALMOST EVERY COMMUNITY WHERE VOTING MACHINES ARE USED THERE IS SOME ELEMENT OF THE POPULATION OPPOSED TO THEIR USE, AND EAGER AND WILLING TO SEIZE ANY OPPORTUNITY TO OBSTRUCT THEIR USE IN THE FUTURE."

A (BRIEF) HISTORY OF ELECTION TECHNOLOGY

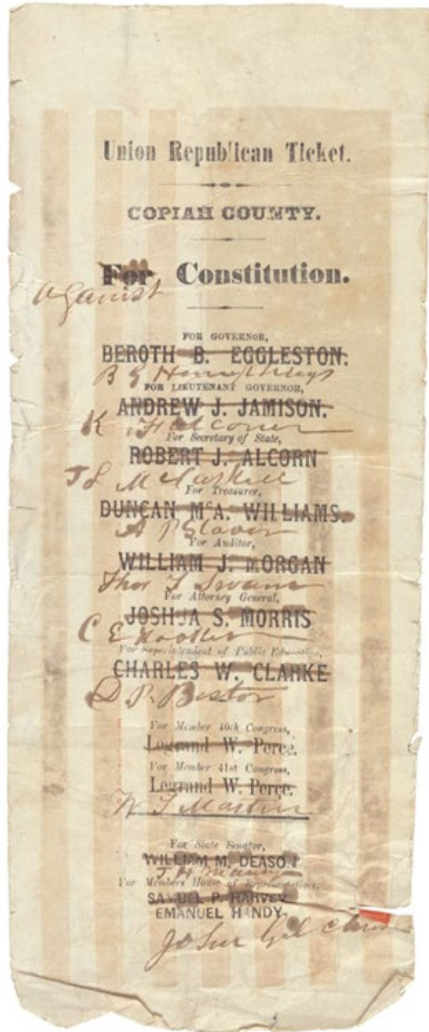
Early Days



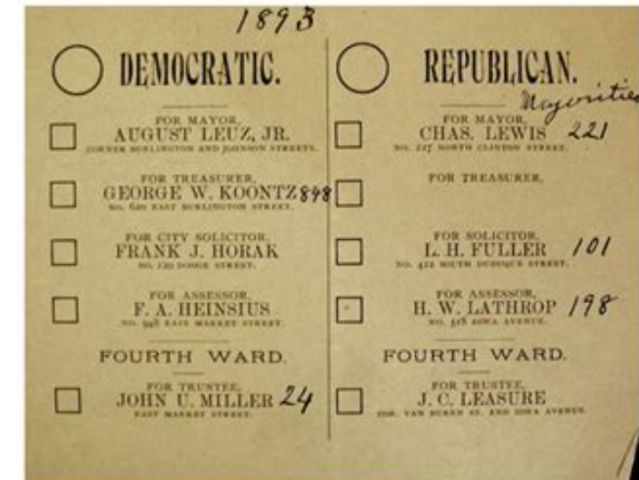
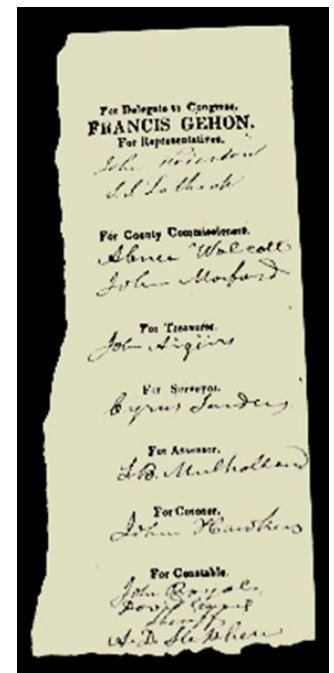
- Jars in Ancient Greece
- Viva Voce
- Applause-o-meter
- Many approaches, little consistency



Paper is Good



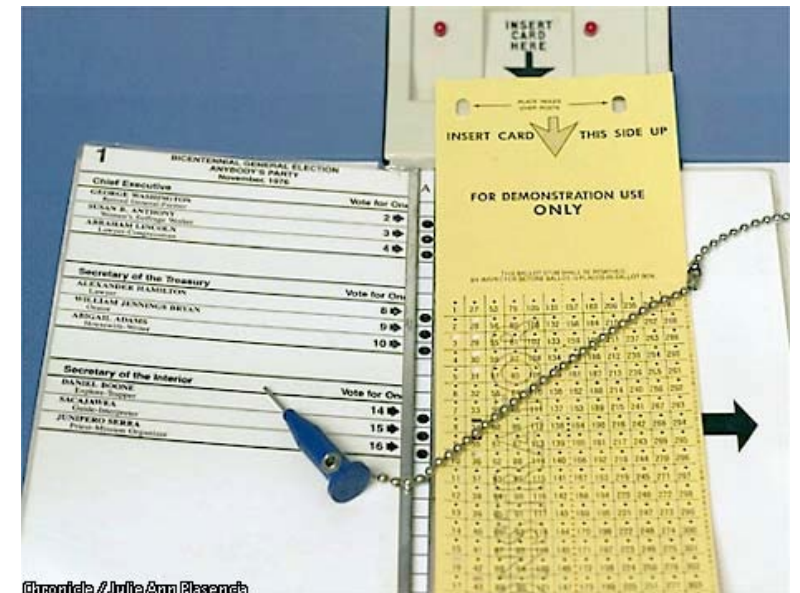
- First paper ballots? Rome 139 BCE
- Who prepares and prints ballots?
 - The government
 - Candidates
 - Maybe you?
- The Australian ballot, 1858
 - Radical concept
 - Standardized ballots printed at government expense
 - Voters cast votes privately



Mechanical Voting Machines



- **Lever voting machines**
 - Voter enters booth, closes curtain, and pulls levers
 - Levers record votes mechanically on internal counter and reopen curtain for next voter
 - "Built like bank vaults"
- **Punch card systems**
 - First widespread in 1960s
 - Blank, pre-scored cards with list of candidates and a target next to each
 - Voter punches card to indicate choice

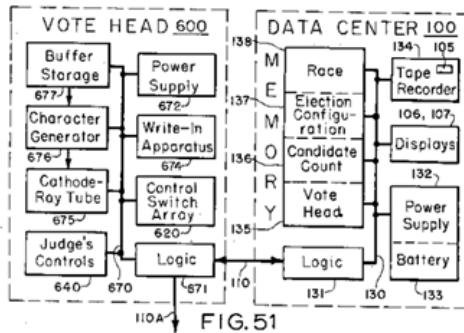
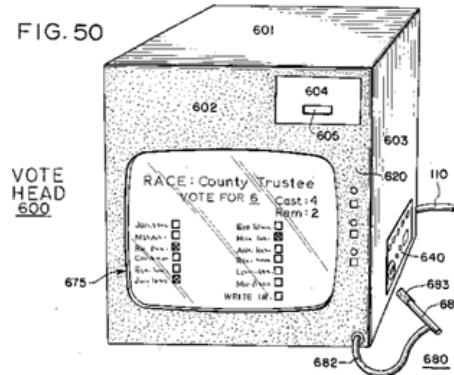


Chronicle / Julie Ann Plasenich

Fancier Voting Machines

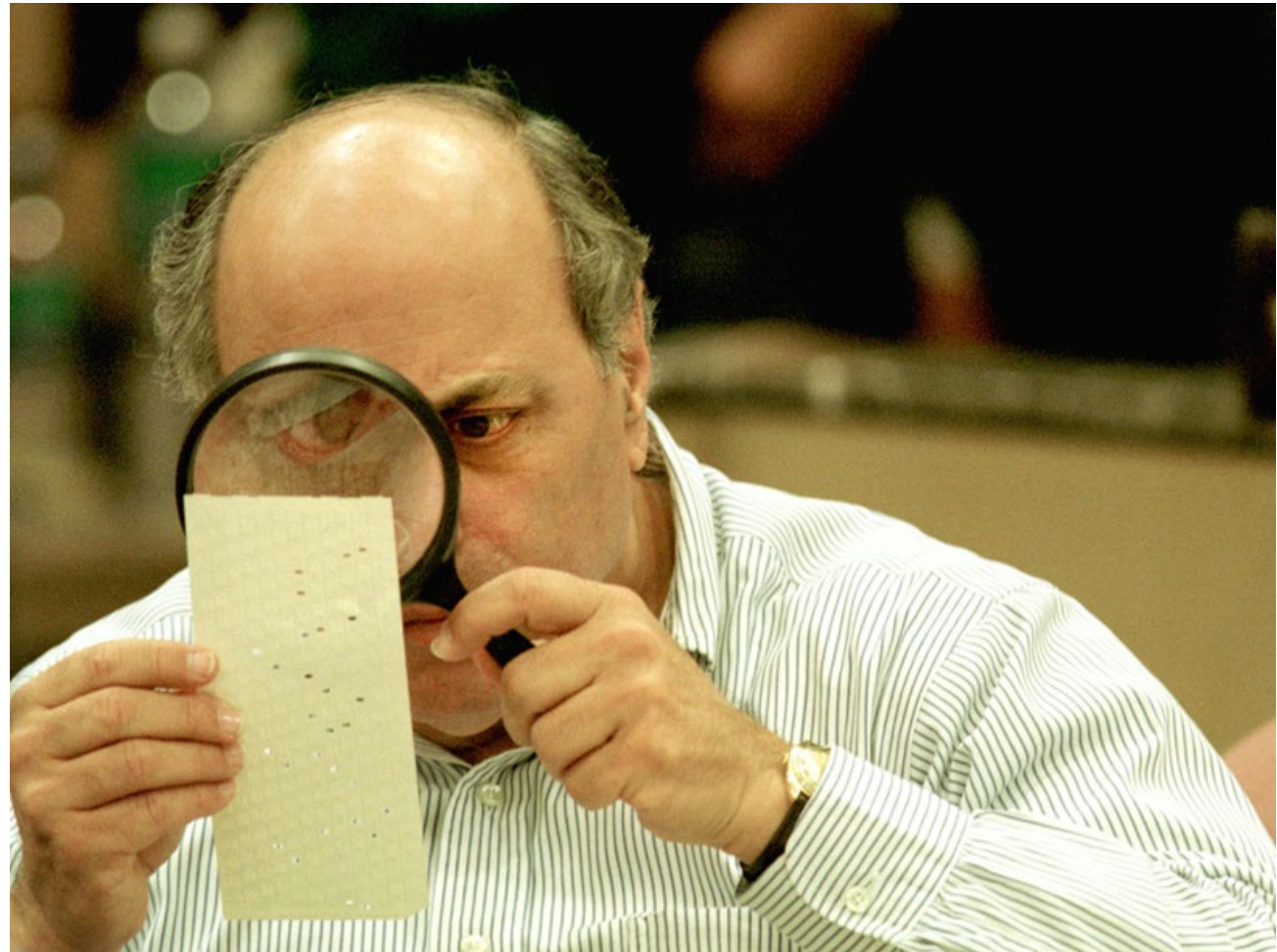
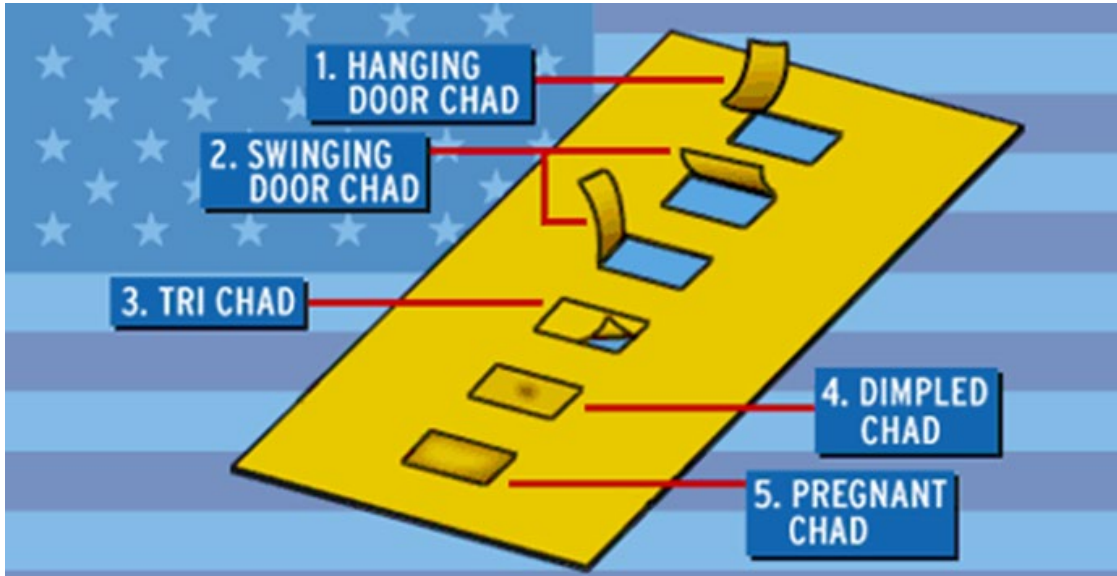
U.S. Patent May 24, 1977 Sheet 56 of 56 4,025,757

FIG. 50



- **Optical-sense scanners first used in US elections in 1962**
- **Standardized tests/scantron ballots**
- **Direct-recording electronic machines first in use in the US by the 1970s**

A Cautionary Tale



A POST-2000 WORLD: HAVA AND THE EAC

Helpful Terms

TERM	DEFINITION
FEC	Federal Election Commission
HAVA	Help America Vote Act of 2002
EAC	Election Assistance Commission
VVSG	Voluntary Voting System Guidelines
VSTL	Voting System Test Laboratory

The Downstream Effects of the 2000 Presidential Election

- **Minimal voting system standards previously existed, as defined by the FEC**
- **The Help America Vote Act (HAVA) of 2002**
 - Replace punch card and lever-based machines
 - Create the EAC
 - Establish minimum election administration standards
- **VVSG 1.0 and 1.1 (Voluntary Voting System Guidelines)**
 - Formalized set of voting system standards
 - Primary focus areas:
 - Security
 - Accuracy
 - Usability and accessibility requirements
 - Testing protocols and certification processes
 - Applied to all new voting systems seeking federal certification
- **VVSG 2.0**
 - Major overhaul to 1.0/1.1 standards
 - Stronger security requirements
 - Focus on interoperability and future-proofing systems
 - Emphasis on risk management and modularity

WHERE ARE WE NOW?



Three Major Types of Equipment

- **Tabulator**
- **Direct Recording Electronic**
- **Ballot Marking Device**

Tabulators



- Paper-based voting system
- Used by voters and election inspectors
- General function:
 - Voter marks ballot
 - Ballot is inserted
 - Device interprets marks and stores data
 - Immediate feedback
- Results tape generated at close of polls
- Secure and auditable
- Used in 92% of Wisconsin municipalities
- Examples: DS200, ImageCast Evolution, ClearCast

High-Speed Scanners (Big Tabulators)



- Paper-based voting system
- Used in central count to process absentee ballots
- Depending on model, can process 300+ ballots per minute
- Examples: ES&S DS450, DS850, DS950

Ballot Marking Devices (BMD)



- Electronic system
- Helps voters mark a paper ballot
- General function:
 - Voter marks ballot on BMD
 - BMD offers multiple opportunities for review before ballot is printed
 - Ballot is inserted into tabulator or counted by hand
- BMDs do not tabulate votes (except for the EVT)
- Accessible for voters with disabilities, but usable by all voters
- Minimizes risk of overvotes, undervotes, crossover votes, etc.
- Examples: ExpressVote, ImageCast X BMD, ClearAccess

Direct Recording Electronic (DRE)



- **Electronic system**
- **General function:**
 - **Voter makes choices on a touchscreen**
 - **DRE offers multiple opportunities for review before ballot cast**
 - **Device tabulates votes, all of which are printed on a voter verified paper audit trail (VVPAT)**
- **Accessible for voters with disabilities, but usable by all voters**
- **Minimizes risk of overvotes, undervotes, crossover votes, etc.**
- **Examples: ImageCast X**

Who uses what? Where do they get it?

- 92% of municipalities in Wisconsin report using a tabulator either in the polling place or at central count
- 98% of municipalities use BMDs
- 8% of municipalities use DREs
- Vendors
 - Election Systems & Software
 - Dominion Voting Systems
 - Clear Ballot Group
 - Hart InterCivic



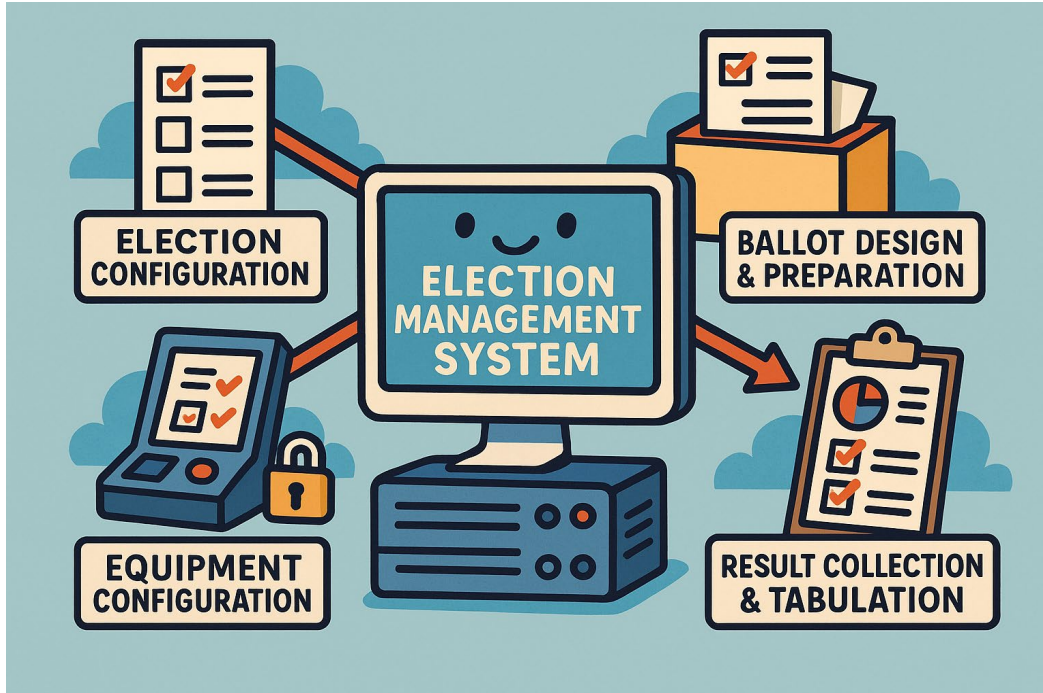
DOMINION
VOTING



ELECTION MANAGEMENT SYSTEMS

What does an EMS do?

- Specialized software and database
- Core functions:
 - Ballot design and preparation
 - Contest layout
 - Jurisdiction info/different ballot styles
 - Equipment configuration
 - Audit logs
 - Result receipt and consolidation
 - Report creation
 - Accessibility features like audio
 - Ballot images




BALLOTS

How do ballots work?

- Timing marks
- Barcodes
- What is a tabulator actually reading?

DANE COUNTY/WI
 22WIGEN
 11/01/2022
 WARD 1, WARD 1



PRESIDENT & VICE PRESIDENT -----
 WGR OLIVIA ORANGE / WALTER WHITE

ATTORNEY GENERAL -----
 NO SELECTION MADE

Ballot ID: 101427
 Ballot Style 2

Village of Mount Horeb Wards 1-4 (MHASD)

389

Official Ballot
 Partisan Office and Referendum
 and Special Election for Partisan Office
 November 3, 2020

Notice to voters: if you are voting on Election Day, your ballot must be initiated by two (2) election inspectors. If you are voting absentee, your ballot must be initiated by the municipal clerk or deputy clerk. Your ballot may not be counted without initials (see end of ballot for initials).

General Instructions	Statewide	Congressional
<p>If you make a mistake on your ballot or have a question, ask an election inspector for help (absentee voters: contact your municipal clerk).</p> <p>To vote for a name on the ballot, fill in the oval next to the name like this: ●</p> <p>To vote for a name that is not on the ballot, write the name on the line marked "write-in" and fill in the oval next to the name like this: ●</p>	<p>Attorney General Vote for 1</p> <p><input checked="" type="radio"/> Sally Circle (Republican)</p> <p><input type="radio"/> Steven Square (Democratic)</p> <p><input type="radio"/> write-in</p>	<p>United States Senator Vote for 1</p> <p><input type="radio"/> Rachel Rose (Republican)</p> <p><input type="radio"/> Thomas Tulip (Libertarian)</p> <p><input checked="" type="radio"/> Derek Daisy (Wisconsin Green)</p> <p><input type="radio"/> write-in</p>
<p>Federal</p> <p>When voting for President and Vice President, you have one of two choices:</p> <ul style="list-style-type: none"> • Vote for candidates on one ticket, or • Write in names of persons on both write-in lines <p>A write-in vote for only a vice presidential candidate will not be counted.</p> <p>President Vote for 1</p> <p><input type="radio"/> Patricia Purple / Roger Red (Republican)</p> <p><input type="radio"/> Gary Green / Lawrence Lavender (Democratic)</p> <p><input type="radio"/> Brian Blue / Yanni Yellow (Libertarian)</p> <p><input type="radio"/> Olivia Orange / Walter White (Wisconsin Green)</p> <p><input checked="" type="radio"/> Greta Grey / Marlon Magenta (Constitution)</p> <p><input type="radio"/> write-in (President)</p> <p><input type="radio"/> write-in (Vice President)</p>	<p>Secretary of State Vote for 1</p> <p><input type="radio"/> Timothy Triangle (Republican)</p> <p><input checked="" type="radio"/> Rudolph Rhombus (Constitution)</p> <p><input type="radio"/> write-in</p>	<p>Representative in Congress District 2 Vote for 1</p> <p><input type="radio"/> Donald Dahlia (Democratic)</p> <p><input type="radio"/> Isaac Iris (Constitution)</p> <p><input type="radio"/> write-in</p>
	<p>State Treasurer Vote for 1</p> <p><input checked="" type="radio"/> Hal Hexagon (Republican)</p> <p><input type="radio"/> Rex Rectangle (Democratic)</p> <p><input type="radio"/> Oscar Octagon (Libertarian)</p> <p><input type="radio"/> Paul Pentagon (Wisconsin Green)</p> <p><input type="radio"/> write-in</p>	

Continue voting at top of next column. Continue voting at top of next column. Continue voting on back of ballot.

Page 1 of 2-sided ballot. Ballot continues on other side. →

Dane County State of Wisconsin WI25GENLEVS 6500

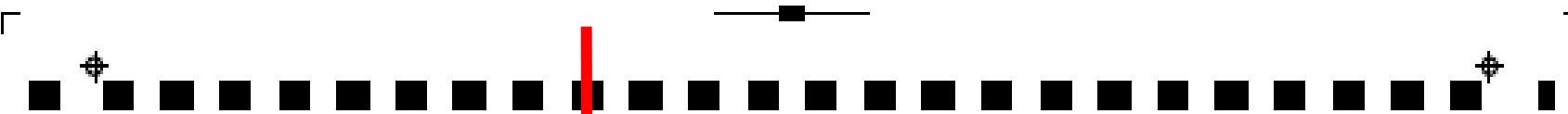
Official Ballot
 Partisan Office and Special Election for Partisan Office
 November 04, 2025

Notice to voters: If you are voting on Election Day, your ballot must be initiated by two election inspectors. If you are voting absentee, your ballot must be initiated by the municipal clerk or deputy clerk. Your ballot may not count without initials (See end of ballot for initials).

General Instructions	Statewide	Legislative & State
<p>If you make a mistake on your ballot or have a question, ask an election inspector for help (Absentee voters: Contact your municipal clerk).</p> <p>To vote for a name on the ballot, fill in the oval next to the name like this: (●).</p> <p>To vote for a name that is not on the ballot write the name on the line marked "write-in" and fill in the oval next to the name like this: (●).</p>	<p>Secretary of State Vote for 1</p> <p><input type="radio"/> Timothy Triangle Republican</p> <p><input type="radio"/> Rudolph Rhombus Constitution</p> <p><input type="radio"/> Write-in</p>	<p>Representative to the Assembly District 80 Vote for 1</p> <p><input type="radio"/> Jane Jasmine Republican</p> <p><input type="radio"/> Victor Violet Democratic</p> <p><input type="radio"/> Peter Peony Wisconsin Green</p> <p><input type="radio"/> Write-in</p>
<p>Federal</p> <p>When voting for President and Vice President, you have one of two choices:</p> <p>1. Vote for candidates on one ticket, or</p> <p>2. Write-in the names of persons in the write in box. A write in vote for only a vice presidential candidate will not be counted.</p>	<p>State Treasurer Vote for 1</p> <p><input type="radio"/> Hal Hexagon Republican</p> <p><input type="radio"/> Rex Rectangle Democratic</p> <p><input type="radio"/> Oscar Octagon Libertarian</p> <p><input type="radio"/> Paul Pentagon Wisconsin Green</p> <p><input type="radio"/> Write-in</p>	<p>County</p> <p>Dane County Sheriff Vote for 1</p> <p><input type="radio"/> Fred Fern Democratic</p> <p><input type="radio"/> William Willow Libertarian</p> <p><input type="radio"/> Write-in</p>
<p>President & Vice President Vote for 1</p> <p><input type="radio"/> Patricia Purple / Roger Red Republican</p> <p><input type="radio"/> Gary Green / Lawrence Lavender Democratic</p> <p><input type="radio"/> Brian Blue / Yanni Yellow Libertarian</p> <p><input type="radio"/> Olivia Orange / Walter White Wisconsin Green</p> <p><input type="radio"/> Greta Grey / Marlon Magenta Constitution</p> <p><input type="radio"/> Write-in</p> <p><input type="radio"/> Write-in</p>	<p>Congressional</p> <p>United States Senator Vote for 1</p> <p><input type="radio"/> Rachel Rose Republican</p> <p><input type="radio"/> Thomas Tulip Libertarian</p> <p><input type="radio"/> Derek Daisy Wisconsin Green</p> <p><input type="radio"/> Write-in</p>	<p>Dane County Clerk of Circuit Court Vote for 1</p> <p><input type="radio"/> Zeke Zinnia Democratic</p> <p><input type="radio"/> David Daffodil Constitution</p> <p><input type="radio"/> Write-in</p>
	<p>Statewide</p> <p>Attorney General Vote for 1</p> <p><input type="radio"/> Sally Circle Republican</p> <p><input type="radio"/> Steven Square Democratic</p> <p><input type="radio"/> Write-in</p>	<p>Legislative & State</p> <p>State Senator District 27 Vote for 1</p> <p><input type="radio"/> Laura Lily Democratic</p> <p><input type="radio"/> Martin Marigold Libertarian</p> <p><input type="radio"/> Barry Bluebell Constitution</p> <p><input type="radio"/> Write-in</p>

Continue voting at the top of the next column. Continue voting at the top of the next column. Ballot continues on other side.

Ward 1 Page 1 of 2 Typ:01 Seq:0001 Spl:01



11	Dane County	State of Wisconsin	WI25GENL EVS 6500
<p align="center">Official Ballot Partisan Office and Special Election for Partisan Office November 04, 2025</p> <p>Notice to voters: If you are voting on Election Day, your ballot must be initialed by two election inspectors. If you are voting absentee, your ballot must be initialed by the municipal clerk or deputy clerk. Your ballot may not count without initials (See end of ballot for initials).</p>			
21	General Instructions	Statewide	Legislative & State
<p>If you make a mistake on your ballot or have a question, ask an election inspector for help (Absentee voters: Contact your municipal clerk). To vote for a name on the ballot, fill in the oval next to the name like this: (●). To vote for a name that is not on the ballot write the name on the line marked "write-in" and fill in the oval next to the name like this: (●).</p>	Secretary of State Vote for 1	Representative to the Assembly District 80 Vote for 1	
	<input checked="" type="radio"/> Timothy Triangle Republican	<input type="radio"/> Jane Jasmine Republican	
	<input type="radio"/> Rudolph Rhombus Constitution	<input type="radio"/> Victor Violet Democratic	
	<input type="radio"/> Write-in	<input type="radio"/> Peter Peony Wisconsin Green	



ELECTRONIC POLL BOOKS

E-Poll Books

- **Electronic system that replaces paper poll books**
- **Used to check in and register voters**
- **Streamline the voter check-in process**
- **Helps eliminate possible election administration errors**
- **Jurisdictions in 41 states used e-poll books in the 2024 General Election**
- **While some states use vendor-based solutions, many states (including us) have developed their own e-poll book systems in-house**

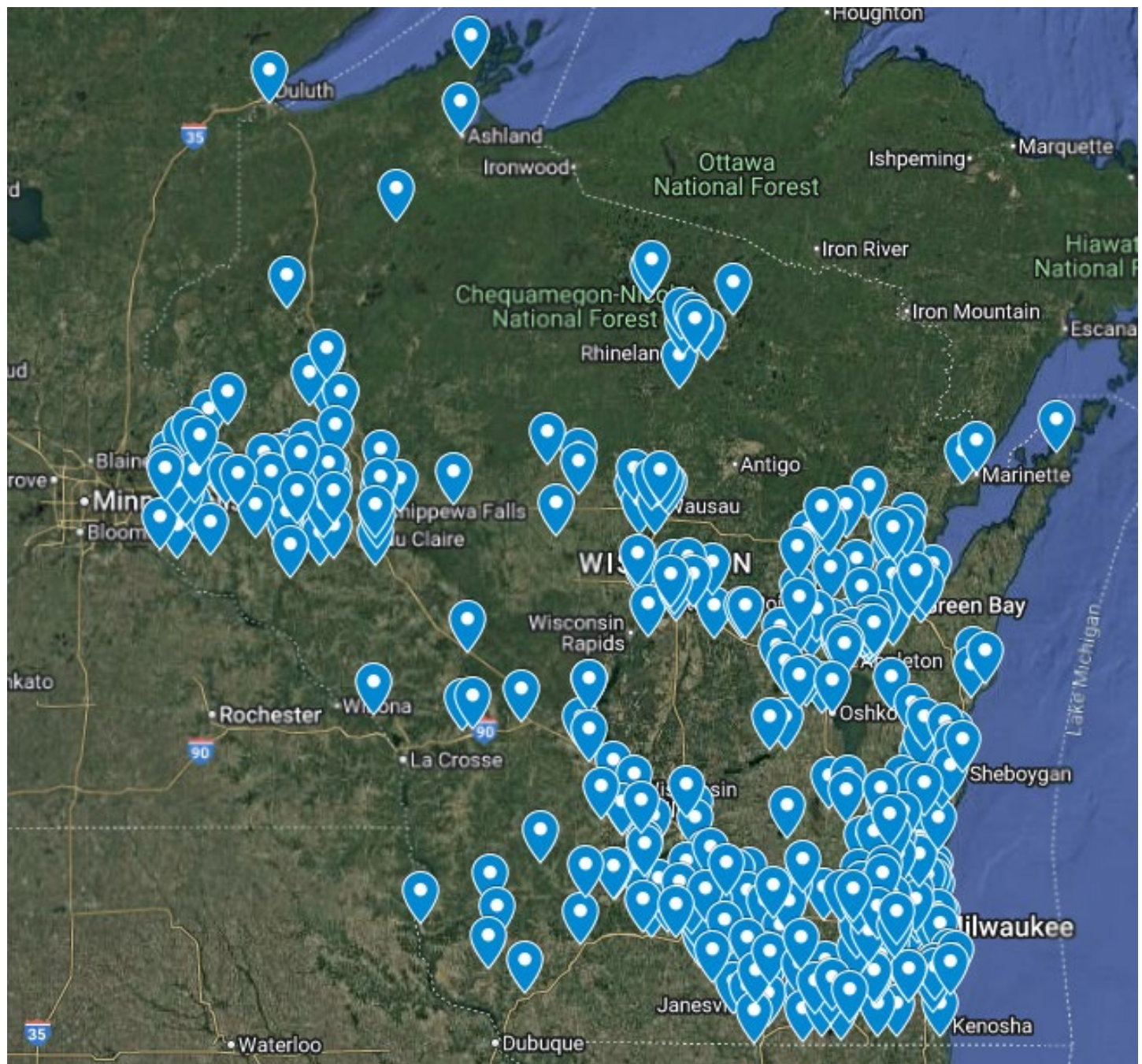


The Badger Book



- **The only electronic poll book approved for use in Wisconsin**
- **Processes absentees, checks-in and registers voters**
- **Originally developed by Commission staff in 2017 with eight municipalities being part of the initial group**
- **Soon to be over 400 users throughout the state**
- **No internet access**
- **Significant savings in time and labor for clerks**
- **Standardizes election administration tasks**







HOW DOES A SYSTEM GET CERTIFIED?

The Life and Times of ES&S EVS 6.0.6.0

EVS 6.0.6.0



7/30/2021:

ES&S
submits
application
to EAC

12/23/2021:

VSTL test
report

6/20/2022:

WEC
receives
application
for cert

6/1/2023:

WEC
approves
certification

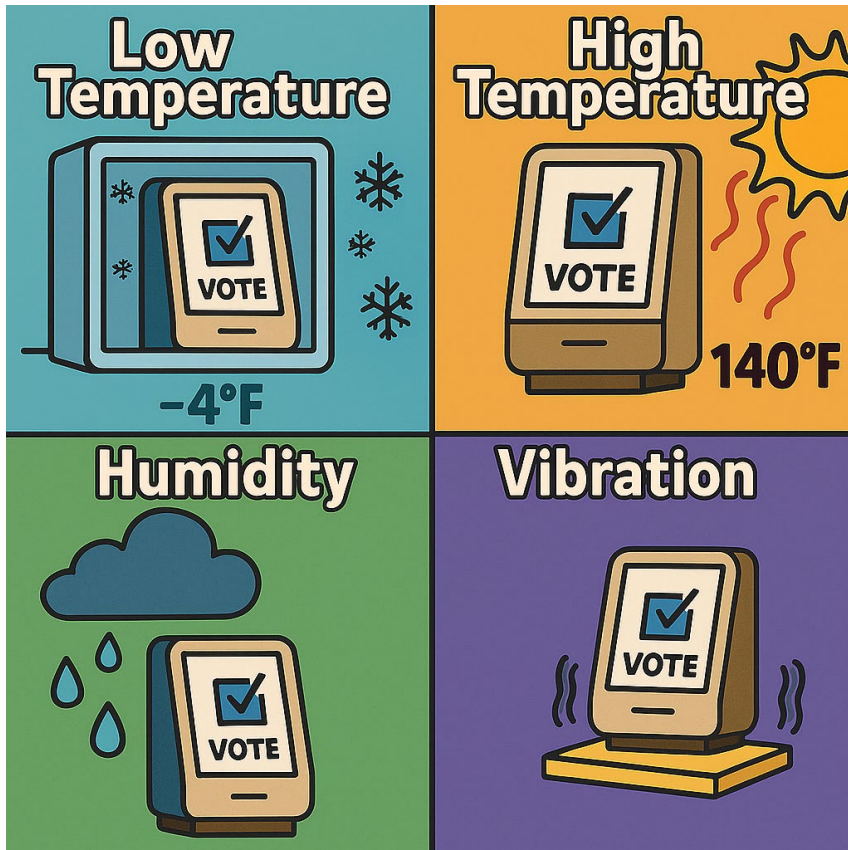
8/17/2021:
VSTL testing
begins

12/28/2021:
EAC
certifies
system

4/17/2023 –
4/21/2023:
WEC staff
functional
testing



VSTL Testing



- 6060 tested by a VSTL from 8/21 to 12/21
- Accuracy testing: no more than a single error in 1,549,703 ballot positions for first run cert
- Allowable: 1 in 500,000
- Ideal: 1 in 10,000,000
- Environmental testing:
 - Heat testing at 140°
 - Cold testing at -4°
 - 10 days of humidity cycling
 - 85 hours of temperature/power variations
 - Vibration tests
 - Drop tests

WEC Certification Testing



- All components of a voting system must be tested
- Three mock elections:
 - Partisan Primary
 - General Election with Presidential and Gubernatorial contests
 - Nonpartisan election with a Presidential Preference vote
- Errorless counts on all tabulation equipment
- Voting Equipment Review Panel
- Public demonstration
- Results transmission testing
- Memo to the Commission

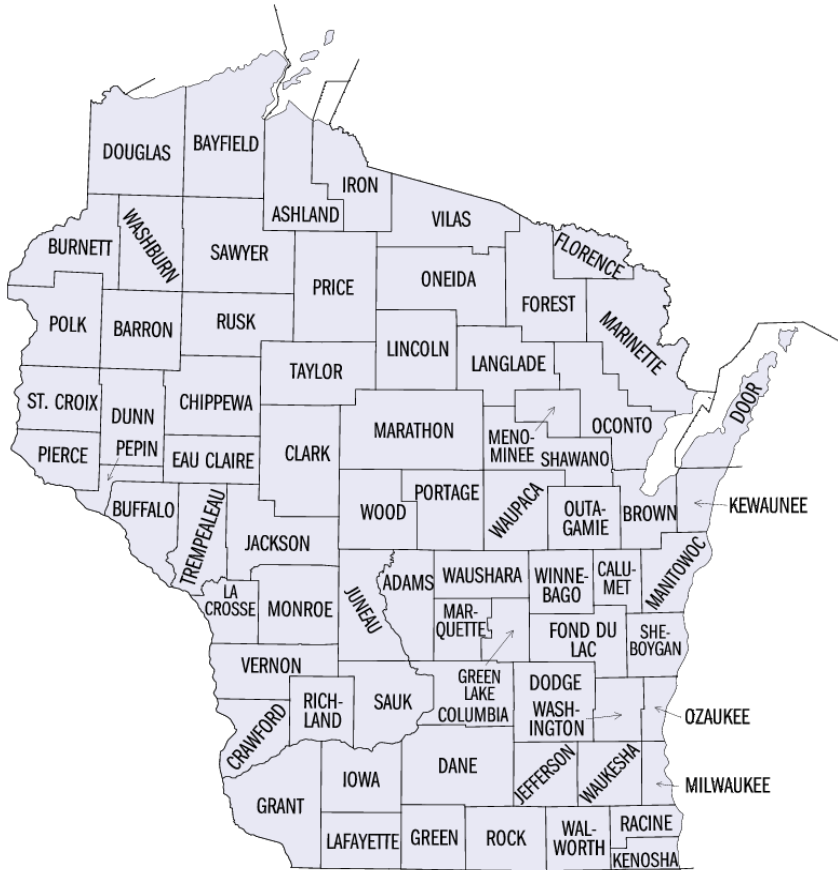
**WHAT IS (Y)OUR
ROLE HERE?**

State



- **Staff prepare ballot templates for each election**
- **Commission approves templates**
- **Prescribed format and language to be used on all ballots for each specific election**
- **Staff receive and proof sample ballots from the county, following up with recommended edits as necessary**

County



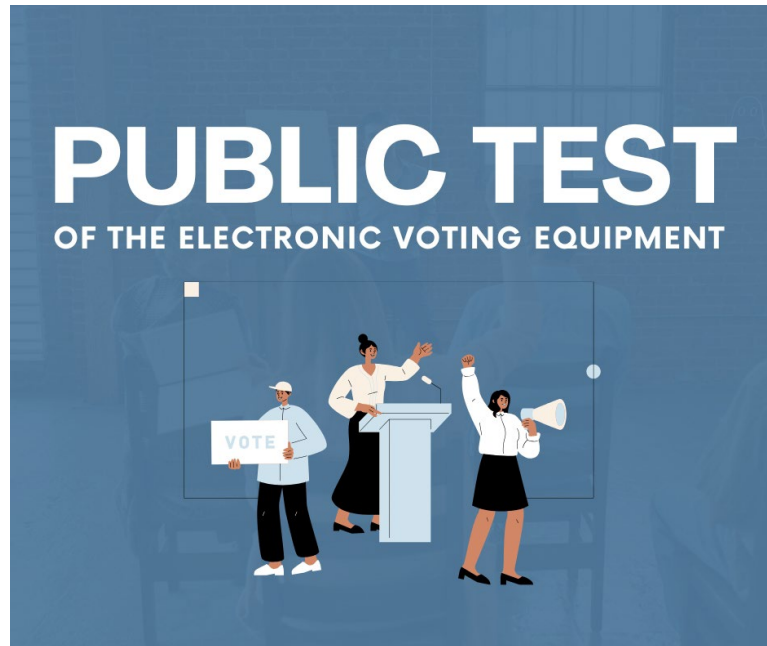
- **Prepare ballots for all national, state, and county offices, distribute to municipalities**
- **Program EMS or coordinate with vendor for programming**
- **Receive results transmission (if used) on Election Day**
- **Offer polling place support for ballot stock, etc.**
- **Receive and store election materials**

Municipality



- **Conduct public test of voting equipment ahead of each election**
- **Train poll workers how to use equipment and troubleshoot common issues**
- **Equip polling places, ensure all ballots and election materials arrive at the polling place**
- **Purchase and maintain voting equipment**
- **Prepare ballots for municipal elections**
- **Conduct the post-election voting equipment audit**

Public Test



- Required within 10 days of each election in which equipment will be used. Wis. Stat. § 5.84(1)
- Confirms accuracy of programming and tabulation
- Public tests must be noticed appropriately at least 48 hours in advance
- Public tests are public
- Procedure:
 - Feed pre-marked test deck of ballots into each device
 - Candidate results totals should vary within a contest to help identify possible errors
 - Verify results tape for errorless count
 - Any anomalies must be resolved before Election Day
 - If anomalies cannot be resolved, the equipment cannot be used

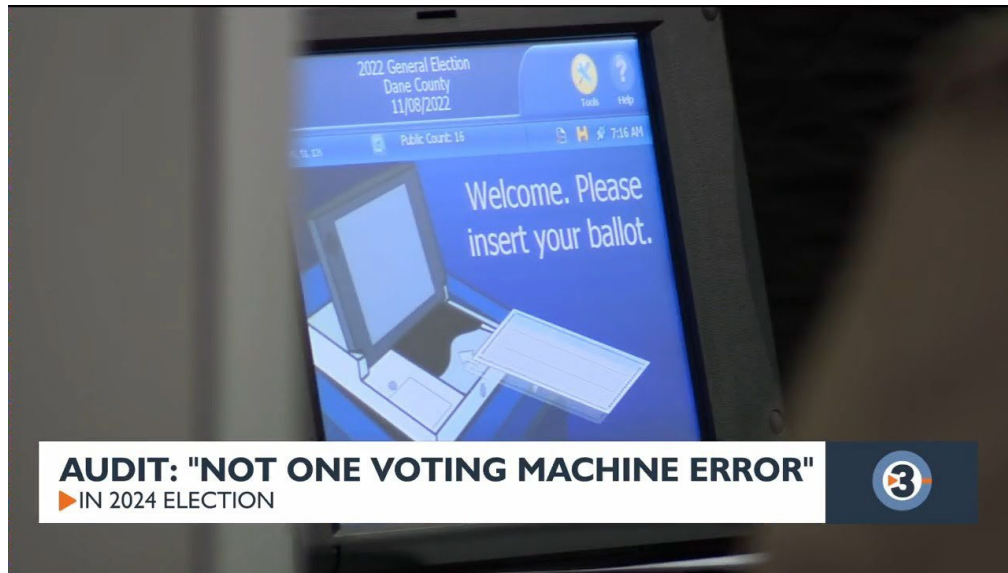
After the Public Test and Election Day Security



- **Secure equipment and memories devices with a tamper-evident seal**
- **Memory devices must be sealed in the equipment**
- **Maintain a chain-of-custody log for all access**
- **Verify serial numbers:**
 - **Before polls open**
 - **After polls close**
 - **Periodically throughout the day (if possible)**
- **Further document all memory device or equipment access on EL-104**

Post-Election Voting Equipment Audit

- Required after every General Election
- Assesses accuracy and performance of approved voting systems
- Public meeting, must be noticed at least 48 hours in advance
- Audit parameters set by Commission:
 - 10% of all reporting units in the state
 - At least five reporting units for each type of equipment used
 - At least one reporting unit in each of 72 counties
- Auditors compare results of hand count to election night results
- Any discrepancies must be explained or further investigated by WEC staff



SECURITY CONSIDERATIONS

Best Practices



- **Maintain strict chain-of-custody protocols and carefully track all equipment and media**
- **Utilize locks and tamper-evident seals**
- **Control access to areas where equipment or media are stored**
- **Control access to any credentials needed to access equipment**
- **Disconnect connected systems when not in use**
- **Have a contingency plan in place for what to do if you experience issues before, during, or after Election Day**
- **Engage with state, federal and local security partners like CISA, WEC, and law enforcement**
- **Only use equipment that has been certified for use in Wisconsin**

**HOW WOULD YOU
RESPOND?**



"Tabulators are flipping votes."

"Election night results are being hacked and changed before they get to the county office."




**"All of this equipment is
connected to the internet."**



**"This equipment wasn't tested.
How do you know it works?"**



"There is no way to verify the accuracy of voting equipment."



"Equipment vendors control elections and can manipulate results."

POLLING PLACE SITUATIONS



Ballot jam!



**The clock on the tabulator is off by
an hour!**



We're out of ballots!

**A voter insists that their ballot be
hand counted and won't leave until
you promise that!**



**A voter was given the incorrect
ballot style!**


**One of the tabulators got hit by a
basketball!**

WHY IS THIS IMPORTANT?



Why this matters

- Transparency
- Security
- Public trust
- Skepticism
- Effective election administration



"IN ALMOST EVERY COMMUNITY WHERE VOTING MACHINES ARE USED THERE IS SOME ELEMENT OF THE POPULATION OPPOSED TO THEIR USE, AND EAGER AND WILLING TO SEIZE ANY OPPORTUNITY TO OBSTRUCT THEIR USE IN THE FUTURE."

Election Administration in the United States

Joseph Pratt Harris

1934



CONCLUSION