Internet Voting
Possibilities and Perils

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MIT/Caltech Voting Technology Project

MIT Media Lab

5/21/04

Internet Voting Outline

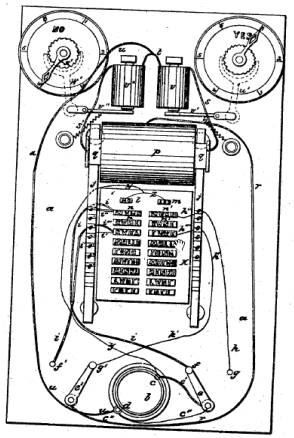
- ✓ Part 1: Historical Voting/Security Practices
- ✓ Break
- ✓ Part 2: Perils.
- ✓ Break
- ✓ Part 3: Solutions, Techniques and Practices

Historical Voting Practices

- ✓ Significant differences in voting performance due to race, socio-economic status and disabilities.
- ✓ Non-Electronic processes lead to significant and sometimes systematic disenfranchisement.

A Brief History

- ✓ Greece: Stones
- ✓ Early US: Limited suffrage & non-secret ballots
- ✓ Edison: Electronic Voting Machine
- ✓ Lever Machines
- ✓ Punchcards
- ✓ Direct Recording Electric (DRE)

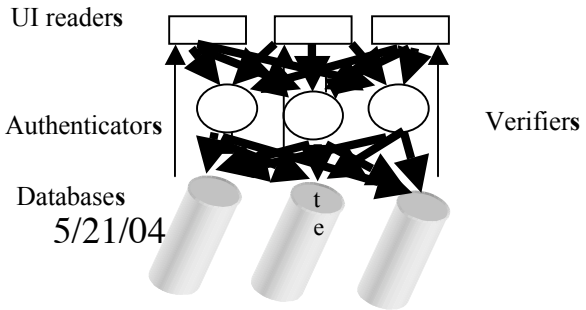


T. A. EDISON.
Electric Vote-Recorder.
No. 90,646. Patented June 1, 1869.

Technology is not the only problem

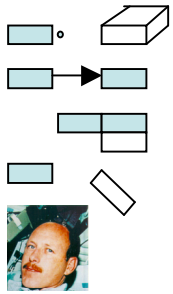
- Cook county card undercount variation .75 % to 39% , non random!
- Paper 1.8%
- Punch Card 2.5
- Optical Scan 1.5
- Lever Machine 1.5
- DRE 2.3

- States rely on many different technologies.
- Sometimes, technology is deployed differentially.



5/21/04

- Token
- Pointers
- Slider
- Check Lever
- Ecology



Many Sources of Lost Votes

The process has to want the votes

Confusing ballot 1 - 2 million

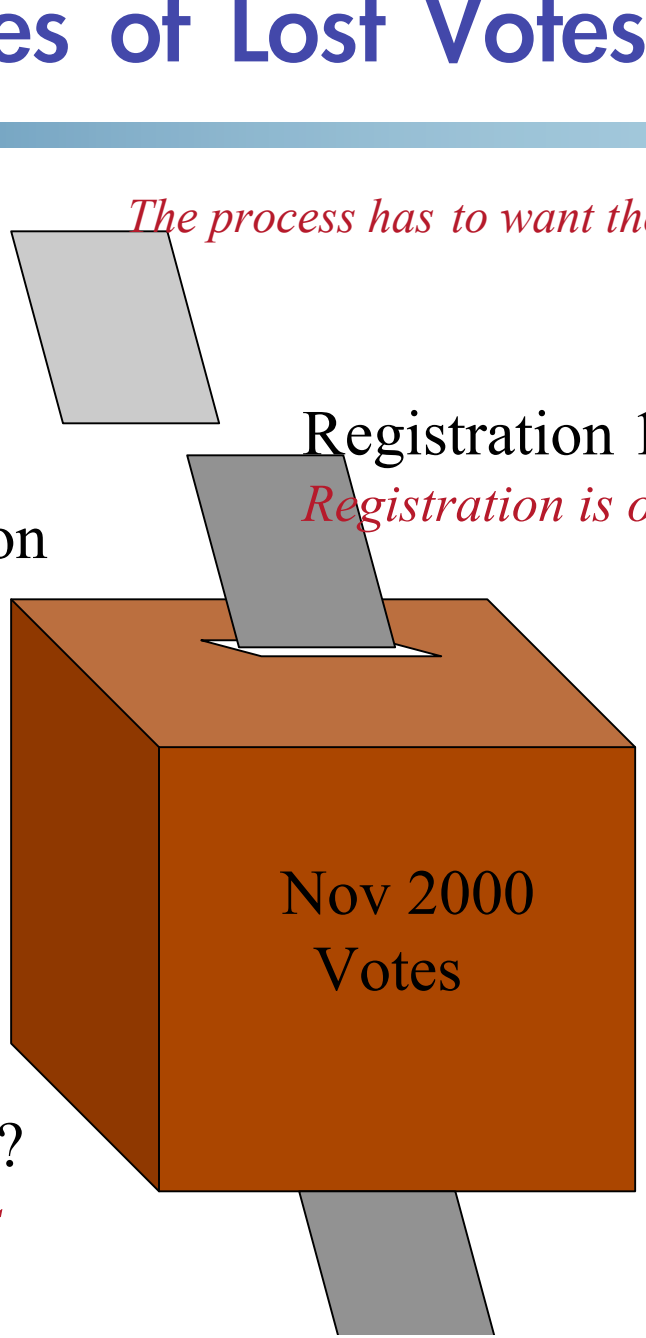
Incumbent top on ballot?

Registration 1- 3 million +

Registration is obsolete?

Polling place operations 1 million

Intermediaries improve confidence?



Absentee ballots ??

Rampant coercion?

Stolen or changed?

People make mistakes

Current Registration Practice

- ✓ Non-coordinated registrars
- ✓ HAVA "drive thru" registrations with DMV
  - ✓ No Registration
  - ✓ Paper Rolls
  - ✓ Databases
  - ✓ Some ID required, some ID prohibited
- ✓ **No Checks!**

Problems have not been voter verifiable

✓ Brevard 4000		Back end software
✓ Volusia 16022		Back end software
✓ Boone County 10000		Back end software
✓ Washington State		Altered paper ballots
✓ Dallas		Destroyed paper ballots
✓ Many places		Replaced paper ballots
✓ Georgia		Not close enough to recount
✓ Indiana	?	User interface (Straight vote)
✓ Recent Republican		Shown on UI
✓ Mail in Absentee		No secrecy

Coercion?

- *We* disagree so lets neither vote
  - ✓ 15 years later one spouse had been voting all along
- Ballot marking parties at churches
- *We* like this guy
  - ✓ Said a 45 year old child to their parent in a voting booth
- Nursing homes
  - ✓ *They* have a right to vote
- Palm cards
- Precinct Captain
- Ballot layout
- Order on Ballot
- Stand in voters

- Humiliation,
- intimidation,
- hand over hand voting
- Misinformation
- Parallax and other physical access
  - –(arm extension)

Reference Platform: Brazil

Renewed belief in government!!

- **Electronic voting; 96, 98, 2000**
  - ✓ 96 Unisys 7% failure
  - ✓ 98 Procomp
  - ✓ 2000 Procomp .02% failure 106,000,000 votes
- **Trusted Scientific organization**
  - ✓ Create requirements
- **Trusted Technical organization**
  - ✓ Create reference platform
- **Companies (5)**
  - ✓ Create demonsratable products for bid
- **Government election officials**
  - ✓ Create open viewing and decision of vendor

Technologies to improve voting

- ✓ Electronic Security
  - ✓ SAVE: N-Version Architectures
  - ✓ Closed systems: (game machines with CD)
- ✓ Ballot Design
  - ✓ Orienting design with feedback
  - ✓ Knowledge based tool for improving ballot design
- ✓ Verification
  - ✓ Frog
  - ✓ Audio Verification
  - ✓ Analysis of VVPT
- ✓ Registration
  - ✓ Open information XML registration checker

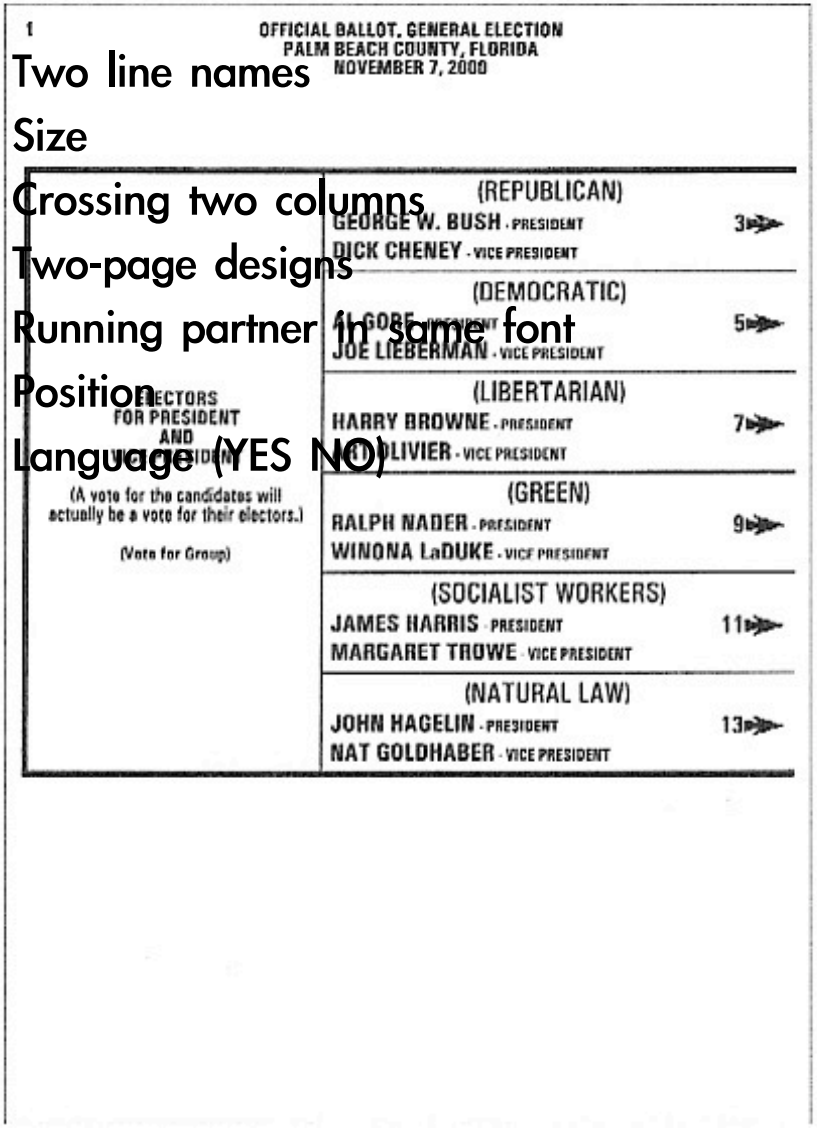
What Needs To Be Done

- ✓ Future of fraud prevention:
  - ✓ Policies
  - ✓ Practices
  - ✓ Architectures
- ✓ Polling places outdated?
- ✓ Voting information is changing
- ✓ New voting approaches are being explored
  - ✓ Cell phone, Interactive TV, Kiosk, extended hours, ***vote by mail***
  - ✓ Same day registration
  - ✓ Instant runoff
  - ✓ Compulsory voting
  - ✓ Direct democracy

"Bad ballot design gave highest error rates

etal

- Two line names
- Size
- Crossing two columns
- Two-page designs
- Running partner in same font
- Position
- Language (YES NO)



1

OFFICIAL BALLOT, GENERAL ELECTION
PALM BEACH COUNTY, FLORIDA
NOVEMBER 7, 2000

ELECTORS FOR PRESIDENT AND

(A vote for the candidates will actually be a vote for their electors.)

(Vote for Group)

(REPUBLICAN)
GEORGE W. BUSH - PRESIDENT
DICK CHENEY - VICE PRESIDENT
3

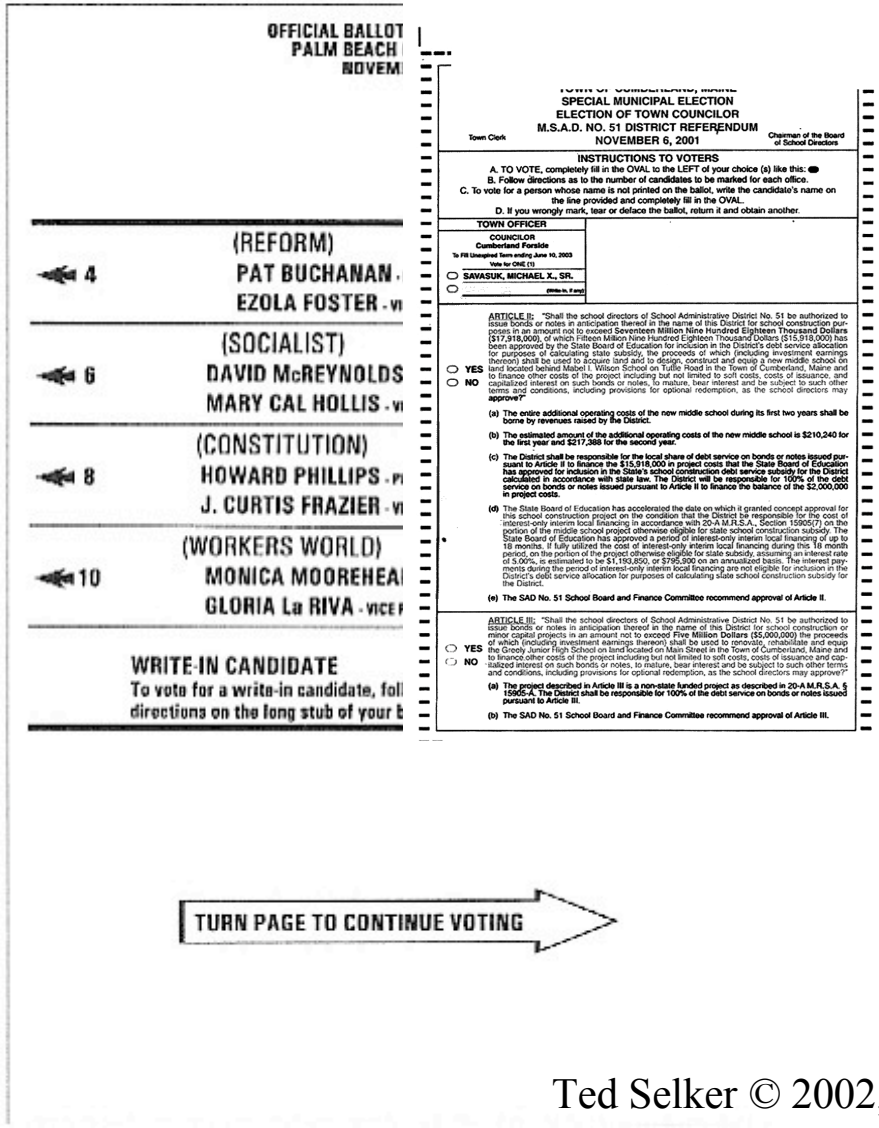
(DEMOCRATIC)
AL GORE - PRESIDENT
JOE LIEBERMAN - VICE PRESIDENT
5

(LIBERTARIAN)
HARRY BROWNE - PRESIDENT
[illegible] OLIVIER - VICE PRESIDENT
7

(GREEN)
RALPH NADER - PRESIDENT
WINONA LaDUKE - VICE PRESIDENT
9

(SOCIALIST WORKERS)
JAMES HARRIS - PRESIDENT
MARGARET TROWE - VICE PRESIDENT
11

(NATURAL LAW)
JOHN HAGELIN - PRESIDENT
NAT GOLDHABER - VICE PRESIDENT
13



OFFICIAL BALLOT
PALM BEACH
NOVEM

(REFORM)
4
PAT BUCHANAN -
EZOLA FOSTER - VI

(SOCIALIST)
6
DAVID McREYNOLDS
MARY CAL HOLLIS - VI

(CONSTITUTION)
8
HOWARD PHILLIPS - PI
J. CURTIS FRAZIER - VI

(WORKERS WORLD)
10
MONICA MOOREHEA
GLORIA La RIVA - VICE

WRITE-IN CANDIDATE
To vote for a write-in candidate, foll
directions on the long stub of your b

SPECIAL MUNICIPAL ELECTION
ELECTION OF TOWN COUNCILOR
M.S.A.D. NO. 51 DISTRICT REFERENDUM
NOVEMBER 6, 2001

Town Clerk — Chairman of the Board of School Directors

INSTRUCTIONS TO VOTERS
A. TO VOTE, completely fill in the OVAL to the LEFT of your choice (s) like this:
B. Follow directions as to the number of candidates to be marked for each office.
C. To vote for a person whose name is not printed on the ballot, write the candidate's name on the line provided and completely fill in the OVAL.
D. If you wrongly mark, tear or deface the ballot, return it and obtain another.

TOWN OFFICER
COUNCILOR
Cumberland Foreside
To Fill Unexpired Term ending June 10, 2003
Vote for ONE (1)
SAVASUK, MICHAEL X., SR.

ARTICLE II: "Shall the school directors of School Administrative District No. 51 be authorized to issue bonds or notes in anticipation thereof in the name of this District for school construction purposes in an amount not to exceed Seventeen Million Nine Hundred Eighteen Thousand Dollars ($17,918,000), of which Fifteen Million Nine Hundred Eighteen Thousand Dollars ($15,918,000) has been approved by the State Board of Education for inclusion in the District's debt service allocation for purposes of calculating state subsidy, the proceeds of which (including investment earnings thereon) shall be used to acquire land and to design, construct and equip a new middle school on land located behind Mabel I. Wilson School on Tuttle Road in the Town of Cumberland, Maine and to finance other costs of the project including but not limited to soft costs, costs of issuance, and capitalized interest on such bonds or notes, to mature, bear interest and be subject to such other terms and conditions, including provisions for optional redemption, as the school directors may approve?"

YES
NO

(a) The entire additional operating costs of the new middle school during its first two years shall be borne by revenues raised by the District.

(b) The estimated amount of the additional operating costs of the new middle school is $210,240 for the first year and $217,388 for the second year.

(c) The District shall be responsible for the local share of debt service on bonds or notes issued pursuant to Article II to finance the $15,918,000 in project costs that the State Board of Education has approved for inclusion in the State's school construction debt service subsidy for the District calculated in accordance with state law. The District will be responsible for 100% of the debt service on bonds or notes issued pursuant to Article II to finance the balance of the $2,000,000 in project costs.

(d) The State Board of Education has accelerated the date on which it granted concept approval for this school construction project on the condition that the District be responsible for the cost of interest-only interim local financing in accordance with 20-A M.R.S.A., Section 15905(7) on the portion of the middle school project otherwise eligible for state school construction subsidy. The State Board of Education has approved a period of interest-only interim local financing of up to 18 months. If fully utilized the cost of interest-only interim local financing during this 18 month period, on the portion of the project otherwise eligible for state subsidy, assuming an interest rate of 5.00%, is estimated to be $1,193,850, or $795,900 on an annualized basis. The interest payments during the period of interest-only interim local financing are not eligible for inclusion in the District's debt service allocation for purposes of calculating state school construction subsidy for the District.

(e) The SAD No. 51 School Board and Finance Committee recommend approval of Article II.

ARTICLE III: "Shall the school directors of School Administrative District No. 51 be authorized to issue bonds or notes in anticipation thereof in the name of this District for school construction or minor capital projects in an amount not to exceed Five Million Dollars ($5,000,000) the proceeds of which (including investment earnings thereon) shall be used to renovate, rehabilitate and equip the Greely Junior High School on land located on Main Street in the Town of Cumberland, Maine and to finance other costs of the project including but not limited to soft costs, costs of issuance and capitalized interest on such bonds or notes, to mature, bear interest and be subject to such other terms and conditions, including provisions for optional redemption, as the school directors may approve?"

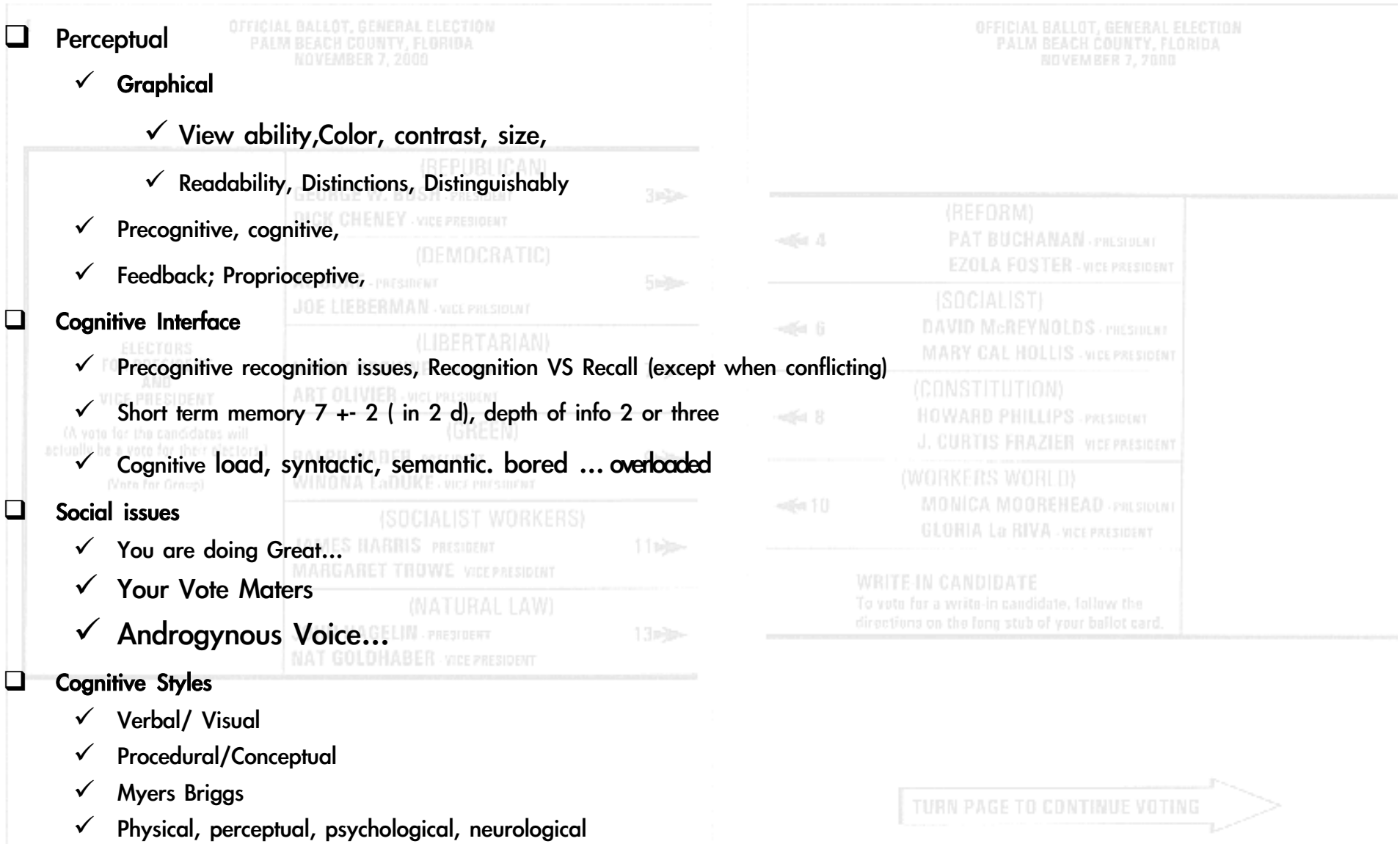
YES
NO

(a) The project described in Article III is a non-state funded project as described in 20-A M.R.S.A. § 15905-A. The District shall be responsible for 100% of the debt service on bonds or notes issued pursuant to Article III.

(b) The SAD No. 51 School Board and Finance Committee recommend approval of Article III.

TURN PAGE TO CONTINUE VOTING

- Perceptual
  - ✓ Graphical
    - ✓ View ability,Color, contrast, size,
    - ✓ Readability, Distinctions, Distinguishably
  - ✓ Precognitive, cognitive,
  - ✓ Feedback; Proprioceptive,
- Cognitive Interface
  - ✓ Precognitive recognition issues, Recognition VS Recall (except when conflicting)
  - ✓ Short term memory 7 +- 2 (in 2 d), depth of info 2 or three
  - ✓ Cognitive load, syntactic, semantic. bored … overloaded
- Social issues
  - ✓ You are doing Great…
  - ✓ Your Vote Maters
  - ✓ Androgynous Voice…
- Cognitive Styles
  - ✓ Verbal/ Visual
  - ✓ Procedural/Conceptual
  - ✓ Myers Briggs
  - ✓ Physical, perceptual, psychological, neurological



Software Testing Questions

- When to worry about what problems
  - ✓ Current processes uninformed and uneven
    - Code build to change ballot?
    - Bugs found/fixed within weeks of elections?
    - Machine rooms open, …
- Trust LEO chosen experts on software?
  - ✓ Don't know any
  - ✓ Don't take them seriously
- Do code reads really help
  - ✓ Hidden code?
- Does sharing product code with public help
  - ✓ Encourage hacking?

Severe Lack of Technical Oversight

- Some election companies have one technologist…
- Time on voting machines can be changed
- Standard Socketed EPROM's, cables without seals, …
- Reboot problems,
- Connectors effect vote
- Practice or real election?
- Training voters on live machines (Broward 2003)
- Optical scan
  - ✓ Alignment problems normal
  - ✓ Jamming normal
  - ✓ Security of ballots:
    - ✓ hands in box, exchange, storage, disposal, defacing

Will openness help short term = vs.- long term

- Diebold not alone in problematic programming practices
  - ✓ US Voting technology marketing driven
  - ✓ Economics of voting technology
  - ✓ Security Experts in demand elsewhere
- Election officials self taught
- Election companies are obvious consultants on elections
- Experts, peer review, (building and running)

Historical Questions

- ✓ What Historical precedents in Voting are important to keep and which should we change?
- ✓ How important is secrecy of the ballot? It was not always secret.
- ✓ How can we learn from fraud patterns in the past to perhaps yield improved detection?

Physical Security

- ✓ Machines now are not generally physically secure.
- ✓ Warehouses store thousands of voting machines
- ✓ Pre-Election testing is unable to find bugs/security breaches if hardware is compromised

User Interfaces

- ✓ Currently: Horrible
- ✓ However, they prevent things like overvoting
- ✓ Feedback timing
  - ✓ Currently often not immediate
  - ✓ Many voters ignore feedback

Disenfranchisement

- ✓ Large Text Ballots (low vision)
- ✓ Assisting in filling out (nursing homes)
- ✓ Physical disabilities

Internet Voting Perils

Internet Voting Perils

- ✓ Security of the Ballot
- ✓ Secrecy of the Ballot
- ✓ Coercion of voters
- ✓ Denial of Service
- ✓ Potential for large scale, undetected fraud
- ✓ **=> Loss of Confidence in System**

Ballot Security Issues

- ✓ Pre-submitted ballot
- ✓ Uncontrolled environment
- ✓ Uncontrolled equipment

Mistakes and fraud

Protection, detection & correction

- Observation, Confidentiality, Redundancy
- Universal verifiability
  - ✓Voter verifiable results verifiability
- COTS good or bad?

Secrecy of the Ballot

- ✓ If a ballot is on a remote machine, with no security, who makes sure that people do not know how a user voted?
- ✓ Internal threats: software/viruses
- ✓ External threats: tempest

Coercion Issues

Systemic Vote Buying

- ✓ Door to door grassroots vote buying
- ✓ Internet based vote buying
- ✓ Spouse/parent influence
- ✓ More nefarious influence (blackmail, intimidation)

Denial of Service (Voters)

- ✓ Individual machines can be targeted
  - ✓ Virus: mac only… mac owners more likely to be democrats…
  - ✓ Inexperienced users could not deal with a DOS attack
  - ✓ Experienced users may not be able to recover in time.
  - ✓ Proof of disruption to computer

Denial of Service (Servers)

- ✓ Voting collection/administration machines could be attacked
  - ✓ DOS attack prevents and frustrates voters
  - ✓ Undermines confidence in system

Consequences

- ✓ Electronic voting equipment is already getting a bad rep
  - ✓ Diebold
- ✓ Administrators jumping into new technology too quickly, resulting in a backlash.

The BIG Problem:

Large scale, undetectable fraud.

So what do we do?

What to do...

- ✓ Apply Technology, practice, and oversight
- ✓ Provide Voter Verification as a fallback, and as a confidence building measure
- ✓ Use the advantages of electronic voting such as fast tabulation, and usability improvements
- ✓ Use security techniques EFFECTIVELY
- ✓ Move slow enough to get it right

Technology and practices
Each useful in different situations

- Technology
  - ✓ Encryption, Public key, N-version, hardened systems…
- Practices
  - Secrecy
    - ✓ Military, Security industry, governments, banks,…
  - Oversight
    - ✓ Expert review
    - ✓ Redundancy
    - ✓ Open source

Verification goal = Air-Gapping

Alternatives:

Votemeter, modular architecture, encrypted votes, open source, process, standards, VVPT

- ❑VVPT — insecure
- ❑Audio — available now
- ❑Video — available now
- ❑Votematic — needs development
- ❑N-Version — needs development

Software problems have been routed in process

✓ Brevard	4000	Back end software
✓ Volusia	16022	Back end software
✓ Boone County	10000	Back end software
✓ Washington State		Altered paper ballots
✓ Dallas		Destroyed paper ballots
✓ Many places		replaced paper ballots
✓ Georgia		Not close enough to recount
✓ Indiana	?	User interface (Straight vote)
✓ Recent Republican		shown on UI
✓ Mail in Absentee		No secrecy

Voter Verification

Voter Verifiable Paper Trails

- ✓ Many experts, particularly outspoken are Rebecca Mercuri, David Dill and Avi Rubin, claim that Voter Verifiable Paper Trails (VVPTs) are the only means of ensuring that a vote is cast and counted properly
- ✓ A VVPT is a receipt produced by a DRE that records the votes in human readable and tangible form.

The "Buzz" on VVPT

- ✓ Many experts claim that Voter Verifiable Paper Trails (VVPTs) are the only means of ensuring that a vote is cast and counted properly
- ✓ Laziness aside (Chicago), VVPTs are confusing.
  - ✓ Delayed feedback is too late to do something about failures
  - ✓ Having to compare two potentially different looking documents is confusing
- ✓ Printers are prone to failure
- ✓ Fraud still possible

Problems with a separate paper trail.

People cannot verify their receipts: Chicago (2002, 2003)

- ✓ No way for ballot worker to help
- ✓ Connection broken
- ✓ Paper out
- ✓ Paper Jam
- ✓ Ink out
- ✓ Printer broken
- ✓ Paper looks different
- ✓ Different format than DRE
- ✓ Separate thing to look at

- ✓ Extra time & step for voting
- ✓ Lighting, readability
- ✓ Special needs (Dyslexia, ADHD, blind)
- ✓ Extra steps for ballot worker
- ✓ Collecting the ballots
- ✓ Ballots could be exchanged
- ✓ Re-voting a machine at end of day
- ✓ Rereading ballots

Hacking a VVPT

- Hack vote and print almost readable receipt 1 in 50
- 1 in 10 people that see that do anything (Chicago)
- 1 in 500 (one per precinct sees this problem)
  - ✓ Print again - it fixes itself
  - ✓ Call a judge - first time in the day at that polling place
    - ✓ They say print it again -it fixes itself
    - ✓ They come into the booth -!yikes they are arrested!
    - ✓ They shut down the booth -!yikes only a few machines

An Audio Audit trail

with today's DRE hardware

- Stored on a tape and spoken from it (built in integrity)
- Speaks each selection (perceptual not memory task)
- Advantages
  - ✓ machine verifiable,
  - ✓ improves user interface,
  - ✓ voting box integrity, storability, transportability

Camera Audit Trail

Can be done now

- Camera or video cable record screen as you do it.
- You see the feed on a non computer screen
- Record on a tape or CD
- Advantages to VVPT
  - ✓Ballot box integrity, verify as you go, machine readable

Votemeter audit trail

System would have to be built

- Separate machine with code from others
- Shows same ballot selections as made
- Records them separately
- Advantages
  - ✓Machine readable
  - ✓Ballot box integrity
  - ✓Usability

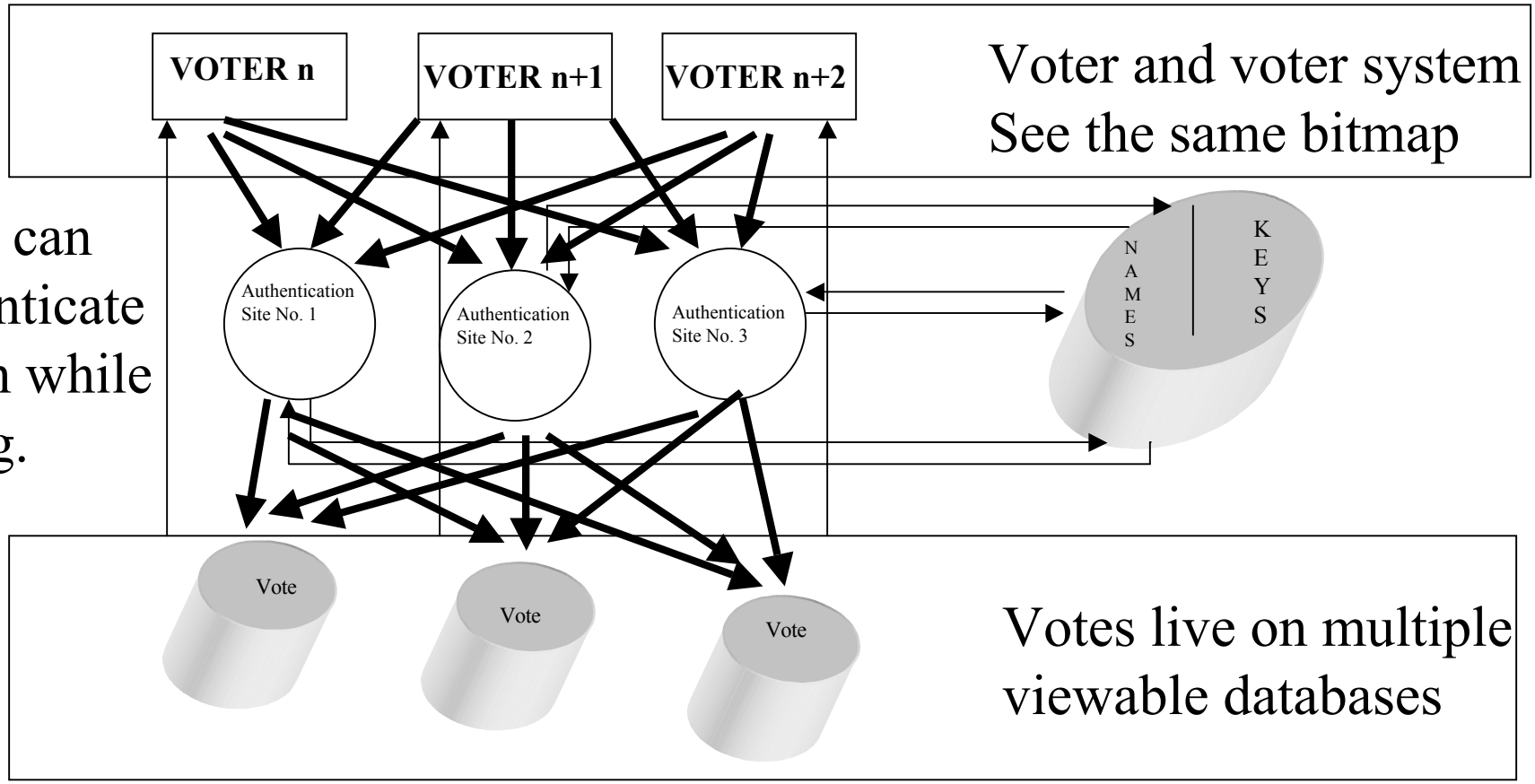
N-version audit trail

- Voter UI Client Software
  - ✓ Bitmap is the only shared thing in system
- Voter Authentication Software
  - ✓ Multiple competing authentication systems must agree
- Voter Aggregating Software
  - ✓ Multiple competing aggregating systems must agree
- Vote verification Software
  - ✓ While anonymous voter can view vote, later that it is there

Secure Architecture for Voting Electronically

No single anything voting

UI, registration, witness and aggregator layers…



Votes live on a viewable databases

Internet Voting Techniques

Two Forms of Internet Voting

1. True Vote from Home voting
2. Schoolhouse/precinct voting

Salient Advantages of IV

- ✓ Expanded opportunity for enfranchisement
  - ✓ More flexibility than precinct voting
  - ✓ More languages
  - ✓ More specific adaptations for disabilities:
    - ✓ Reading Disabled, Low Vision
    - ✓ Tactile Interfaces, Audio Interfaces

User Interface Questions

- ✓ What UI improvements can help
  - ✓ Level the playing field for candidates (drop off)
  - ✓ Reduce undervoting
  - ✓ Reduce disparities associated with socioeconomic status

Voting Security 101

- ✓ 1. Each eligible voter shall be allowed to vote at most once.
- ✓ 2. Every vote cast must be counted accurately
- ✓ 3. No vote cast must be traceable back to an individual.

Cryptographic Security

- ✓ Public and Symmetric Key cryptography.
  - ✓ PKI: Smartcards for everyone?
  - ✓ AES? Not for our purposes
- ✓ Signatures
  - ✓ FIPS 186-2 Secure Digital Signatures
  - ✓ Secure Hashes (MD5, SHA-1)
- ✓ Blind Signatures
- ✓ Homomorphic Encryption

Public Key Cryptosystems

- ✓ RSA Standard:
  - ✓ Good key length 2048 bits
  - ✓ Not proven to be secure, but it has withstood scrutiny, with no known cracks (relies on the difficulty of factoring primes)
  - ✓ Slow
  - ✓ Depends on Public Key Infrastructure (PKI)

AES

- ✓ Advanced Encryption Standard.
- ✓ New, intense scrutiny, symmetric block cipher.
- ✓ Key material is symmetric so it is not a good idea to put that in voting equipment.

PKI & Smartcards

- ✓ Smartcards are credit card sized devices that contain a chip that contains a private signing key.
- ✓ All computation is performed ON the card, so you do not give out your key to other hardware
- ✓ Power analysis lets you read off the key in real time. (VERY BAD)

Blind Signatures

- ✓ Fujuoka, Okamota, Ohta Blind Signature Scheme
- ✓ Take a message, and a piece of carbon paper
- ✓ Put them into an envelope
- ✓ Sign the outside of the envelope
- ✓ Put the envelope in a bin
- ✓ Remove the envelope and the signature is on the message inside.

Crypto Weaknesses

- ✓ Key Length, while commonly considered vital, tends to be an easy problem to deal with
- ✓ Cipher mode : ECB/CBC VITAL
- ✓ Key Material: Good randomness
- ✓ Key security (physical security vital)

Coercion Solutions

UI - Coercion Detection

- ✓ Coercion is a huge problem for internet voting
- ✓ Can't have a person in every house ensuring no coercion.
- ✓ Solutions: Allow internet voting from monitored/public locations(schools, libraries).

Coercion - Fundamental Problem

- ✓ Coercion is a fundamental problem with mail-in balloting anyways, so we can not do worse.
- ✓ Solution impossible without differential information(which must be distributed to the voter directly, in person)

Digital Signatures

- ✓ Take a plaintext message
- ✓ Hash it (using a secure hash algorithm such as SHA-1)
- ✓ Encrypt the plaintext using private key
- ✓ Verification: decrypt signature and compare to hash of message.
- ✓ Message cannot change without disrupting the hash of the message and the signature is secure.

Chaum Method

- Specialized Printers
- Use a bitmap of ballot, encoded text.
- 2 sheets: keep one, it proves nothing (cryptographically), but can be used to verify vote in the final tally.
- Voter has a verifiable receipt that does not prove how she/he voted.

Frog Method

- ✓ Tangible votes
- ✓ "Frog" because the medium is not important
  - ✓ Discs
  - ✓ Paper
  - ✓ Smartcards
- ✓ People can see, feel, touch it.

The SAVE Voting System

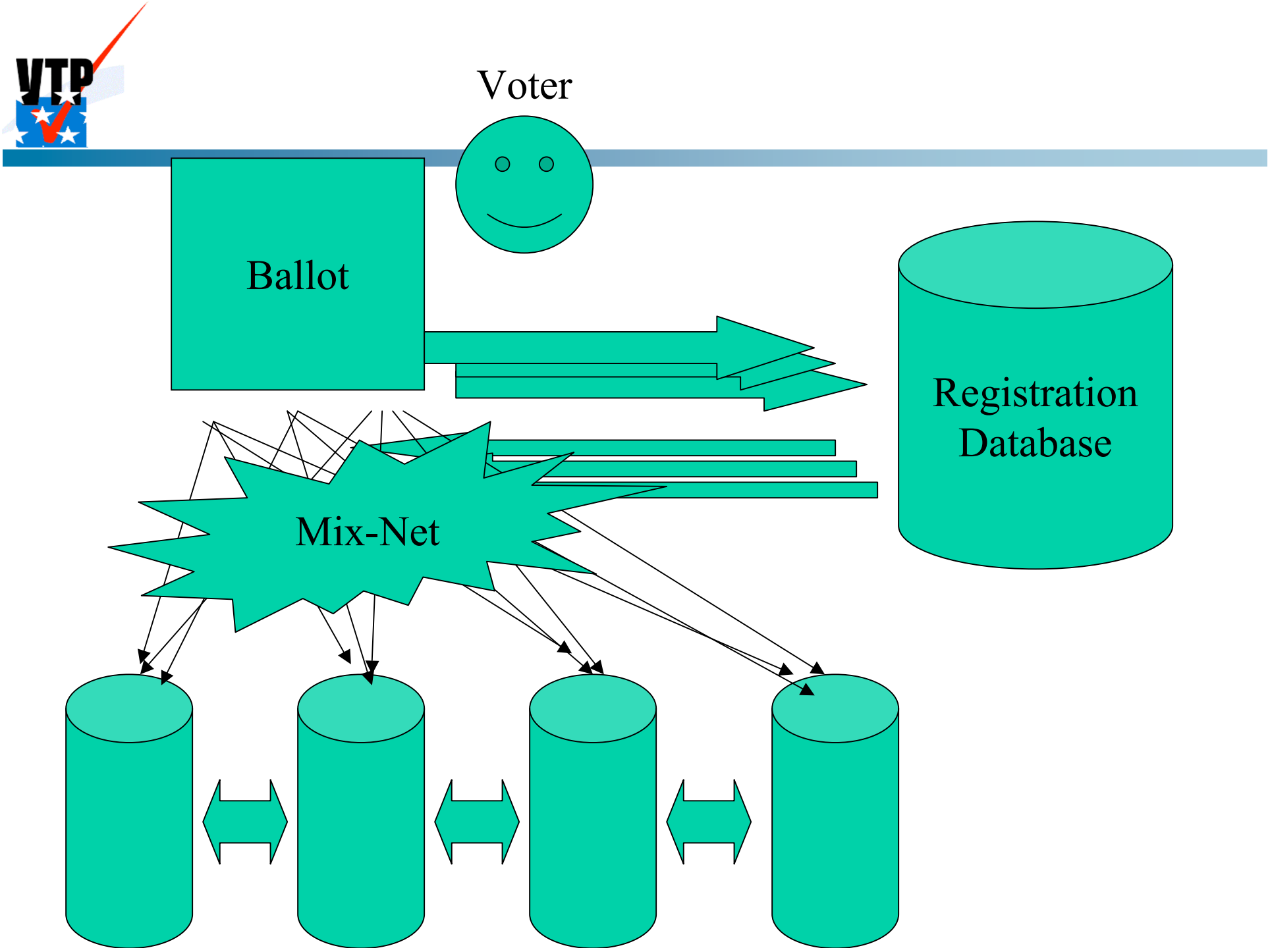
N-version programming + crypto

A Proposal for a Better System

- ✓ The SAVE (Secure Architecture for Voting Electronically) Architecture
- ✓ No Single point of failure voting (except the voter of course)

The SAVE Architecture

- ✓ N-version programming: do not trust any one company/group/person.
- ✓ Cryptographic protocols:
  - ✓ Blind Signatures
  - ✓ Public Key encryption
  - ✓ Mix-Nets (secure shuffle)


Voter
Ballot
Registration Database
Mix-Net

Voting

- ✓ 2 possibilities:@ home, @ precincts
- ✓ And 2 variants: PC / Playstation
- ✓ @ precincts is easier to secure
- ✓ @ home presents inherent problems of the untrusted myriad environments possible.
- ✓ System implemented could be either PC or "Playstation" model.

PC Model

- ✓ Software must be loaded on the PC(presently it would be the JRE, keys and the user interface)
- ✓ Steps must be taken to ensure that nothing on the computer can see what the user is doing(this is hard)

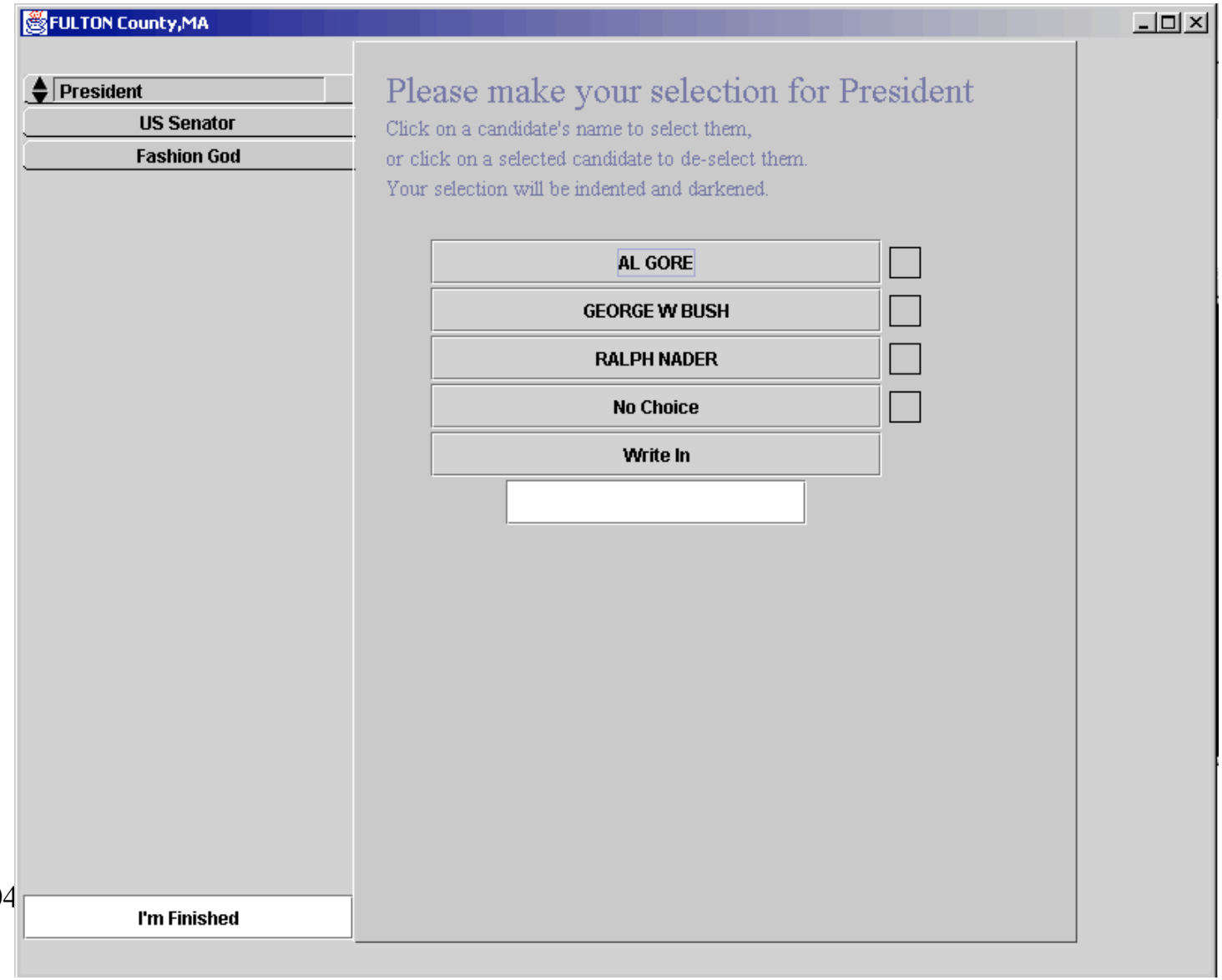
Playstation Model

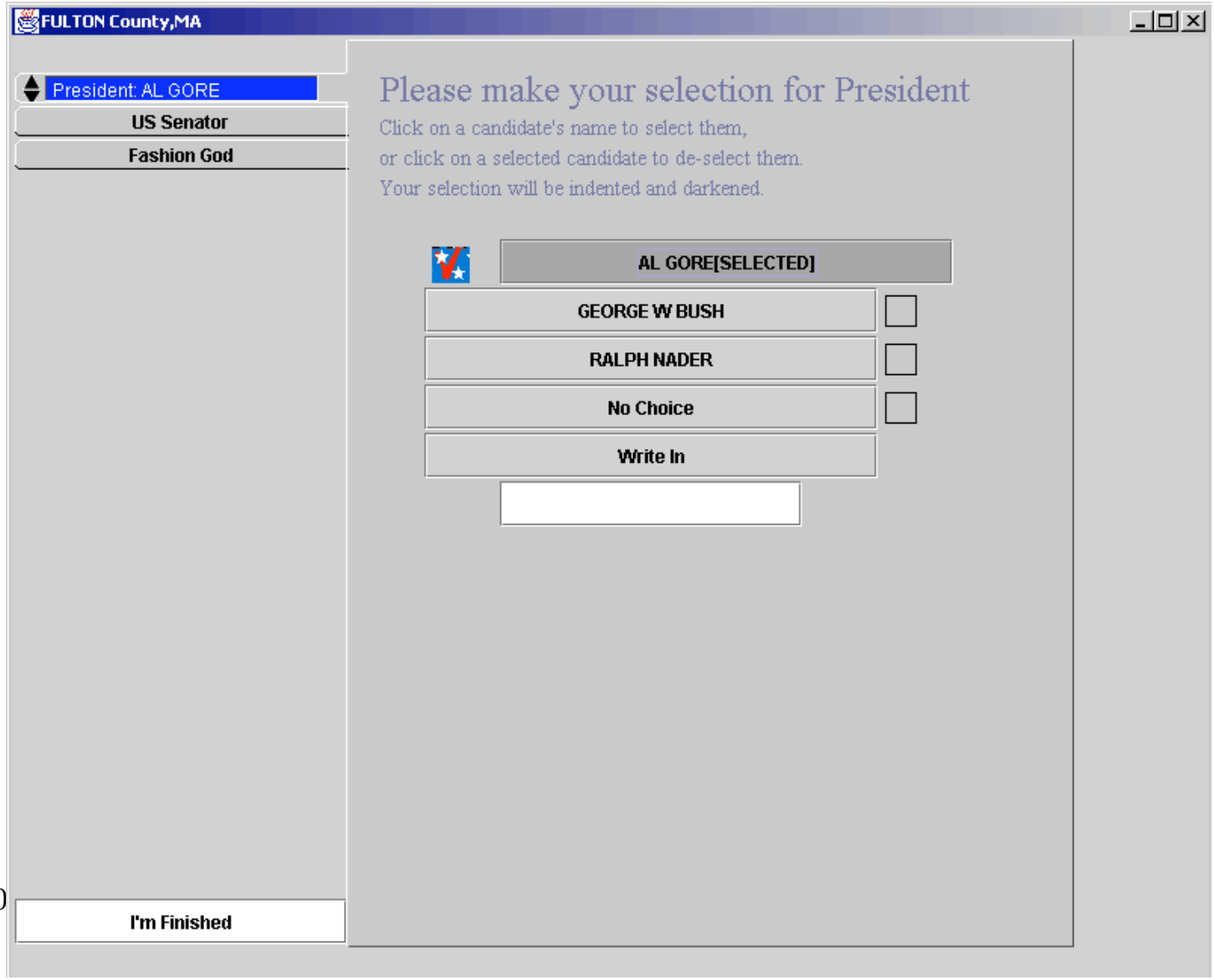
- ✓ Send out CDs that can be loaded into a playstation, now we can run without a real OS
- ✓ Perhaps we could do this for PCs?
- ✓ This approach is better for security, less likelihood for monitoring, but it could still be done.
- ✓ Introduces the problem of writing drivers for modems and other devices.

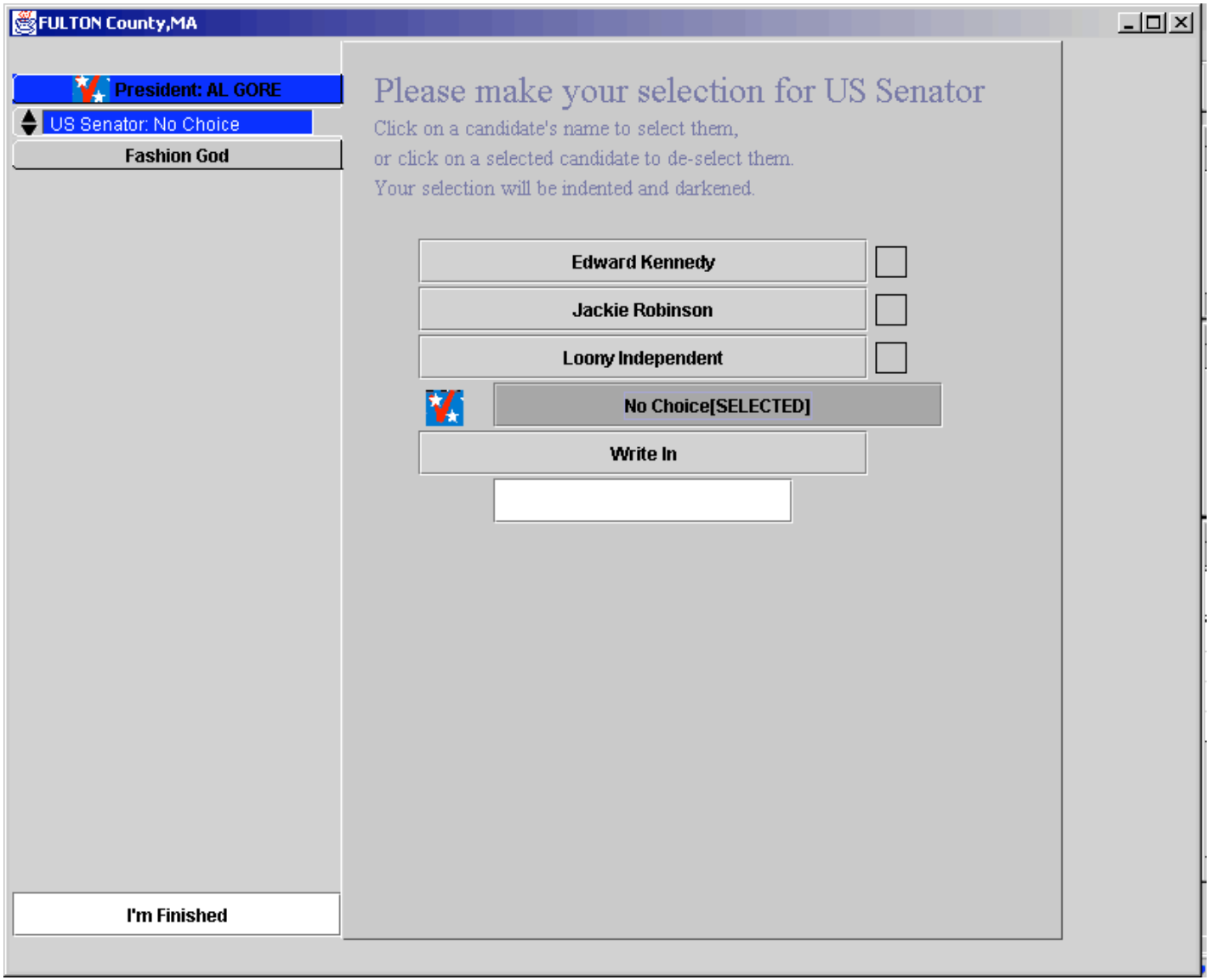
User Interface

- ✓ FEEDBACK!!!!!!!!!!!
- ✓ Visualize the State of the Ballot:
  - ✓ What has been done (including choices)
  - ✓ What has to be done
- ✓ Confirm Abstentions
- ✓ Review Ballot before Submitting

Tabs Indicate Selections




FULTON County,MA
President: AL GORE
US Senator
Fashion God
I'm Finished
Please make your selection for President
Click on a candidate's name to select them,
or click on a selected candidate to de-select them.
Your selection will be indented and darkened.
AL GORE[SELECTED]
GEORGE W BUSH
RALPH NADER
No Choice
Write In


FULTON County,MA
President: AL GORE
US Senator: No Choice
Fashion God
Please make your selection for US Senator
Click on a candidate's name to select them,
or click on a selected candidate to de-select them.
Your selection will be indented and darkened.
Edward Kennedy
Jackie Robinson
Loony Independent
No Choice[SELECTED]
Write In
I'm Finished

Authentication / Validation

- ✓ Aggregator servers' public keys and sent off along with the registration data to the registration server.
- ✓ Registration database must be kept on an accessible server, which can be queried from the outside.
- ✓ The Registration Servers should never receive a plaintext vote. Blind Signatures are the best solution.

Validation - Witnesses

- ✓ We allow for "witness" modules, that can be in the form of smartcards(preferable) or merely additional modules.
- ✓ Witnesses receive a hash of the ballot and produce a time stamped(to ensure uniqueness) digital signature for that ballot.

Aggregation

- ✓ Decrypt the outer ballot package.
- ✓ Verify the signatures of the registration server, as well as the witness signers.
- ✓ Decrypt the inner ballot package, which actually contains the plaintext ballot.
- ✓ Randomly verify hashes of the incoming ballots with other servers, but do a full verification afterwards.

Ballot Designer

- ✓ Automatic and Manual Rule-Based Layout
- ✓ Enforces legal requirements
- ✓ Ensure uniformity
- ✓ Account for cognitive differential correction.
- ✓ Standard language (BDL-XML) IEEE 1622

Conclusions

- ✓ Internet voting, in some form, is coming.
- ✓ Steps need to be taken to make sure that the first generation is done right
- ✓ Oversight, standards, and rigorous review are necessary to inspire trustworthiness

Our Recommendations

- ✓ Prohibit remote (home) internet voting
- ✓ Promote schoolhouse voting with an internet infrastructure
  - ✓ Redundancy
  - ✓ End to end security
  - ✓ UI advantages

Requiring Standards

- ✓ IEEE 1583 Voting Equipment Standard
- ✓ IEEE 1622 Voting Data Interchange Standard
- ✓ Incorporate data security standards as they improve or are proved insufficient
  - ✓ FIPS 186-2,3
  - ✓ ANSI X9
  - ✓ IETF
  - ✓ FIPS Key management standard under development


VTP

A "Friendly" Warning

We get one chance in a generation, or
we will be back to optical scan

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