Elections & Electronic Voting Machines
Technology, technologists and public policy

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A Center for Correct, Usable, Reliable, Auditable, and Transparent Elections

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Voting became technological in the 1890's

- First important patents
  - 1875 Spratt (1 race)
  - 1881 Beranek
  - 1889 Myers
- First use 1892
  - Myers machine
  - Lockport New York
- Dominant technology
  - Mid 20th century

(No Model.)

S. E. DAVIS.
VOTING MACHINE.

No. 526,668.

8 Sheets—Sheet 3.

Patented Sept. 25, 1894.
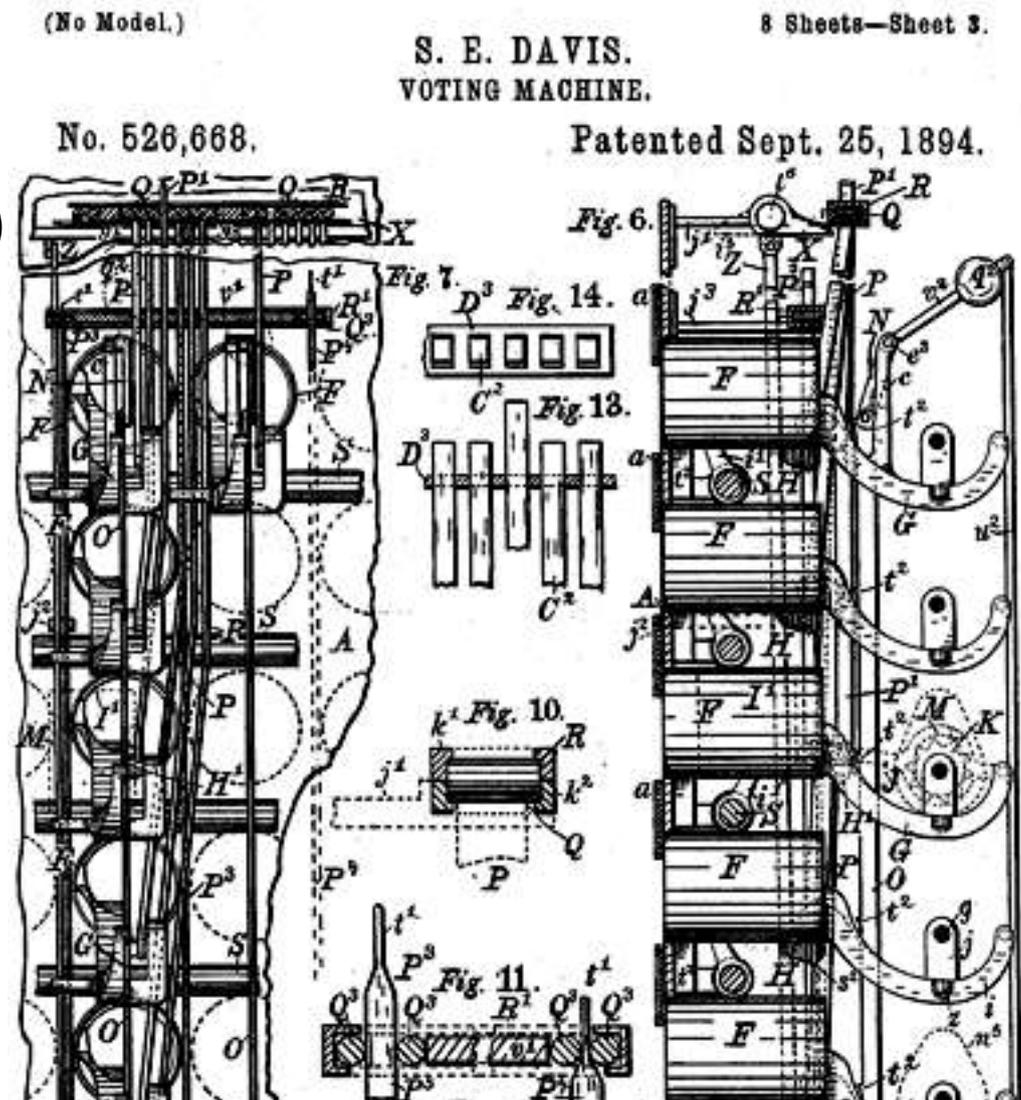
Voting became electronic in the1950s

- First important patents
  - 1956 Keith
  - 1960 Fechter
- First use, 1961
  - Norden machine
  - Orange County, CA
- Dominant technology
  - Late 20th century
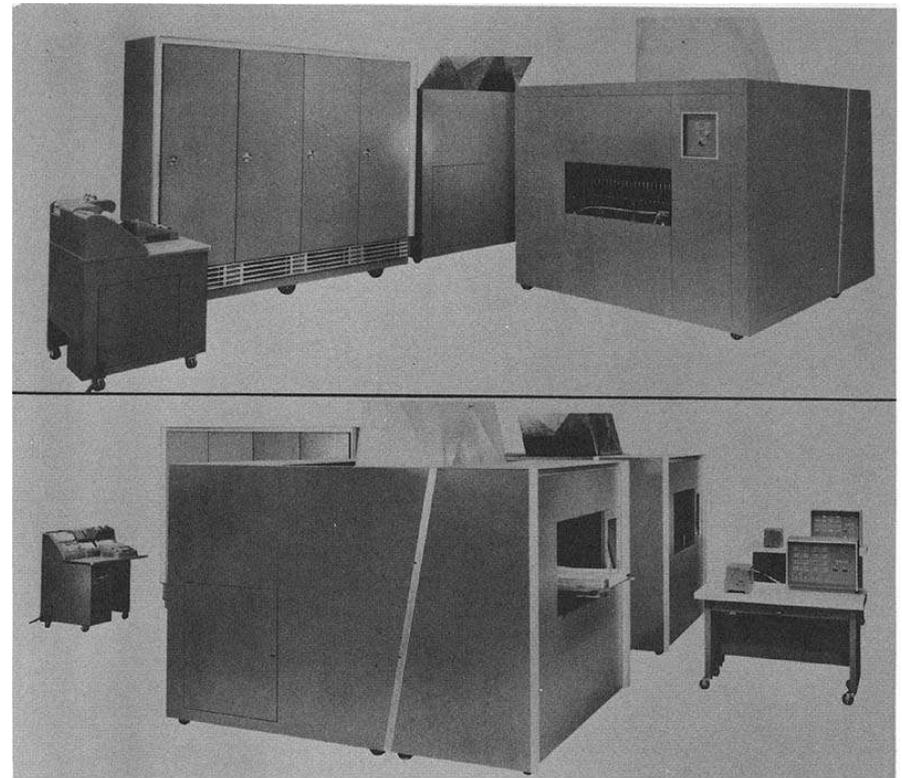
Administrative Context

- Historically, voting regulation by states
    - Counties administer elections
    - Counties own and operate machinery
    - States control what machinery counties may buy
- Federal involvement limited by constitution
    - Civil rights law, since the Civil War
    - "Voluntary" voting system standards since 1990
    - The Help America Vote Act of 2002 (HAVA)

E-voting in the 1980's

- Major technologies
  - Punched card   central (precinct)
  - Optical mark sense   central & precinct
 - Direct recording electronic   precinct
- Major modalities
  - Precinct count – tabulated at the precinct
  - Central count – tabulated at the county building

Punched Card Voting
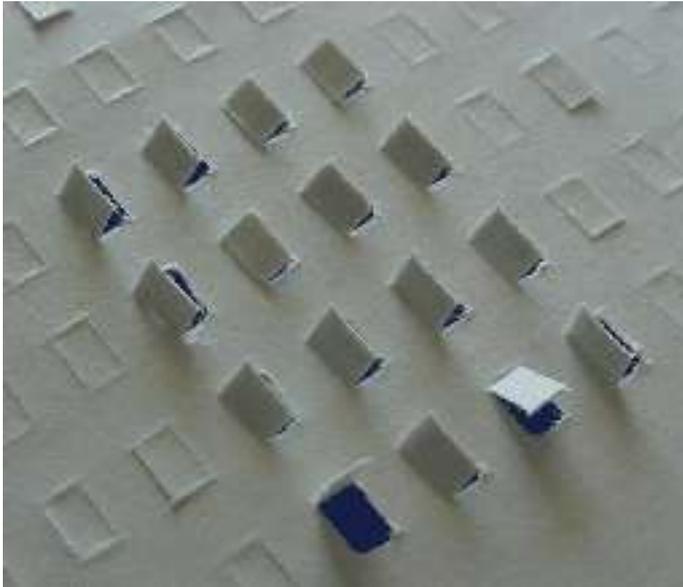
Developed by Joseph Harris

• Patented 1965

• First use: 1964

   – Monterey and San Joaquin Counties, CA

   – DeKab and Fulton Counties, GA
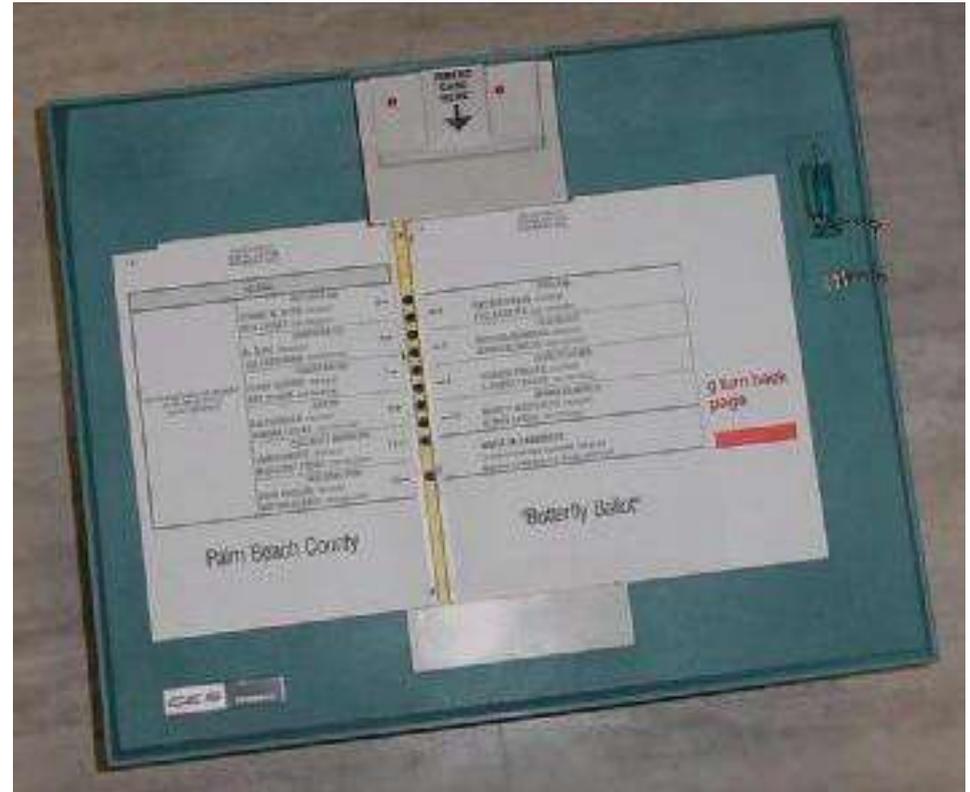
Optical Mark Sense Voting

Precinct Count
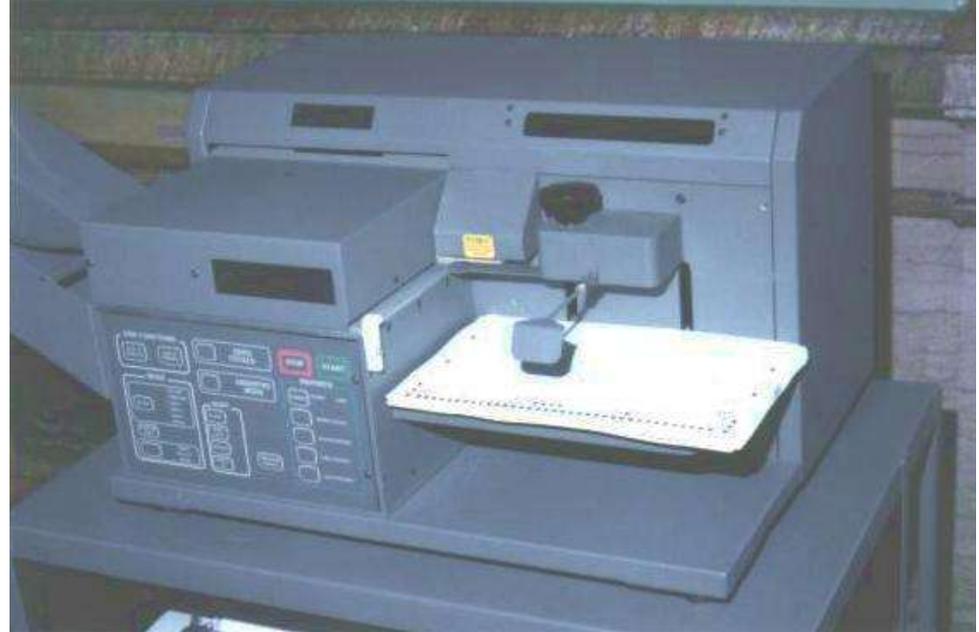
Central Count

Direct Recording Electronic Voting

- First significant patents

  - 1974 Martin

  - 1974 McKay

- First use

  - probably early 1980s
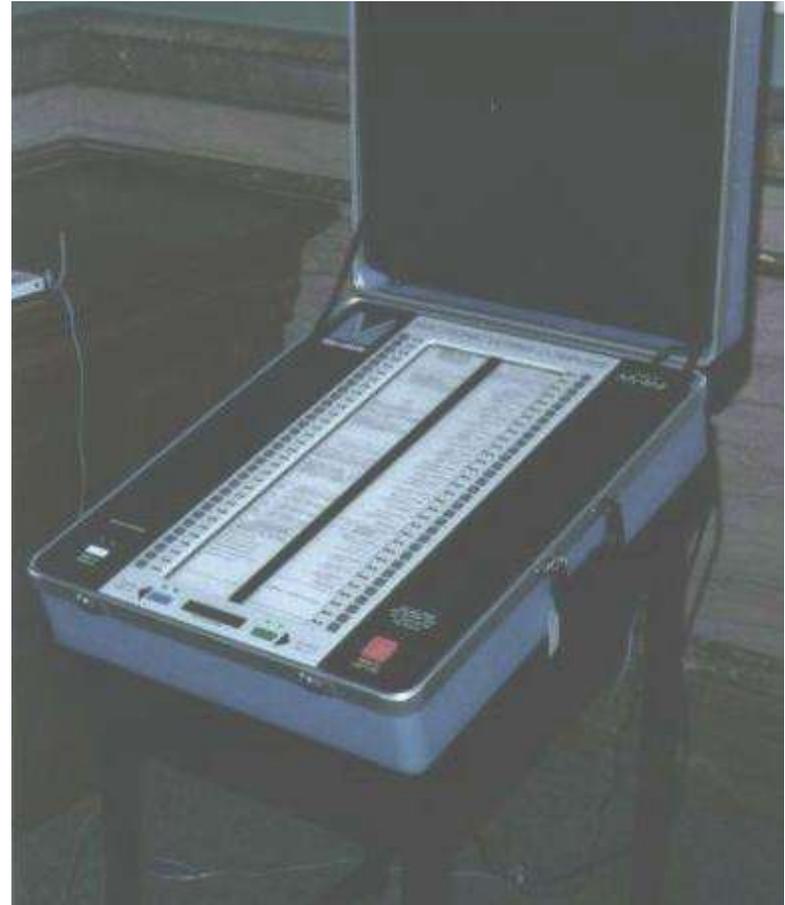
Voting-System Lifecycle

An example trusted-system development cycle

- **Development**
  - Internal testing by vendor

- **ITA Certification**
  - Test against FEC (or EAC) standards

- **State Qualification**
  - 50 states, all do it differently

- **County or State Purchasing Process**
  - Typically involves sales demo of usability

- **Deployment**
  - Customer typically does acceptance testing

2 years for a rush job; 5 years is typical

An Election Cycle

- **Election Definition**
  - Define races, candidates, districts, precincts
- **Configure Voting Equipment, Print Ballots**
  - Geography makes each precinct different
- **Pre-Election Test**
  - Verify that everything is ready
- **Election Day**
 - Open polls, vote, close polls
- **Canvassing**
  - Compute and publish totals, archive results

We do this about 4 times a year in the US

Data Paths to Secure
The distributed system view
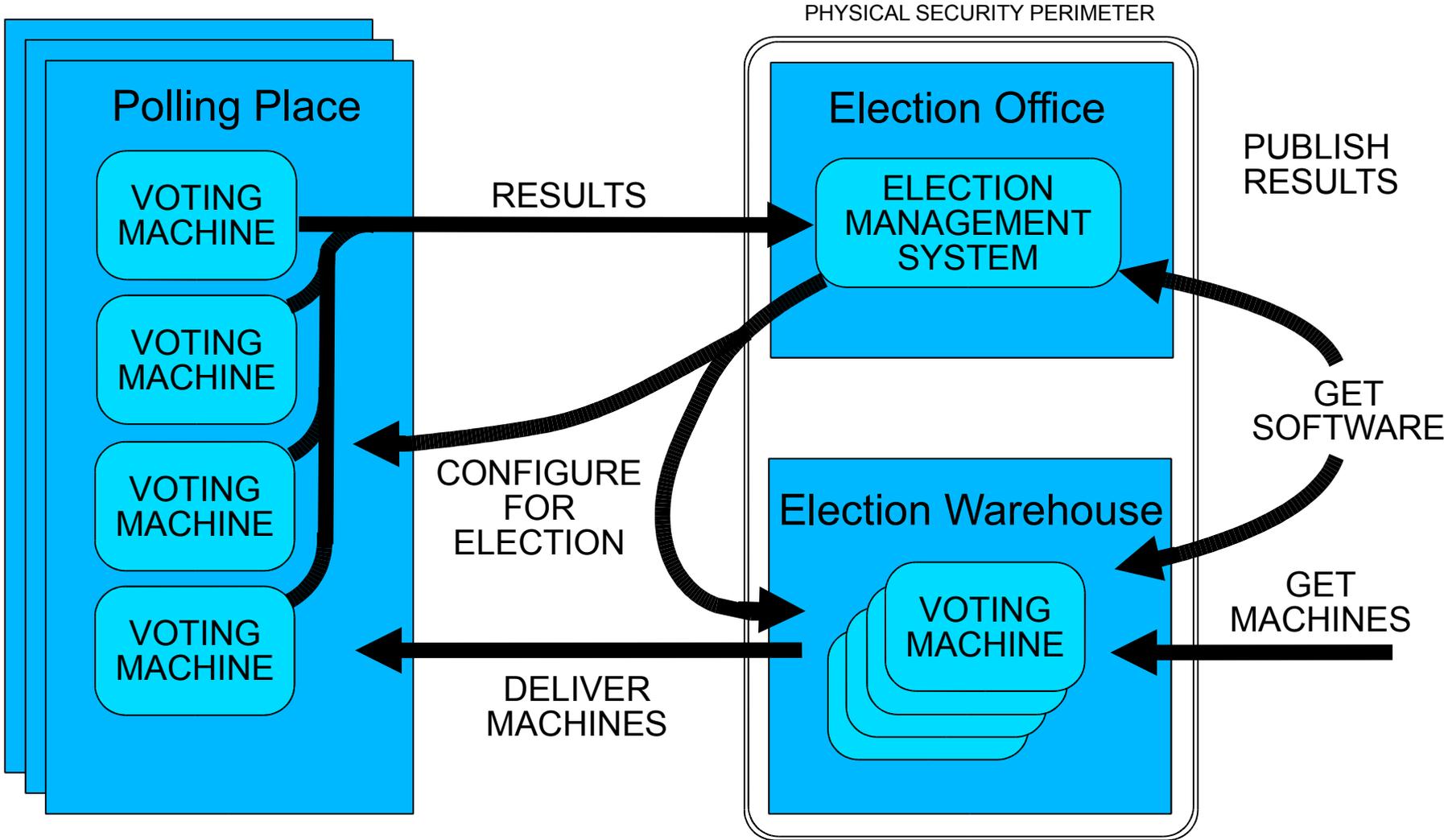
From Voter to Canvass: Mark Sense
Guarding the chain of trust

Polling Place			Election Office	

VOTER'S INTENT ▶ **BALLOT** ▶ **BALLOT IMAGE** ▶ **BALLOT BOXES** ▶ **PRECINCT TOTALS** ▶ **DISTRICT TOTALS**

Voter

Mark-Sense Scanner

Electronic Count

Hand Recount

Published

ACCURATE FOCUS
USABILITY

ACCURATE FOCUS
VERIFIABLE DESIGN + CRYPTO

PUBLIC POLICY
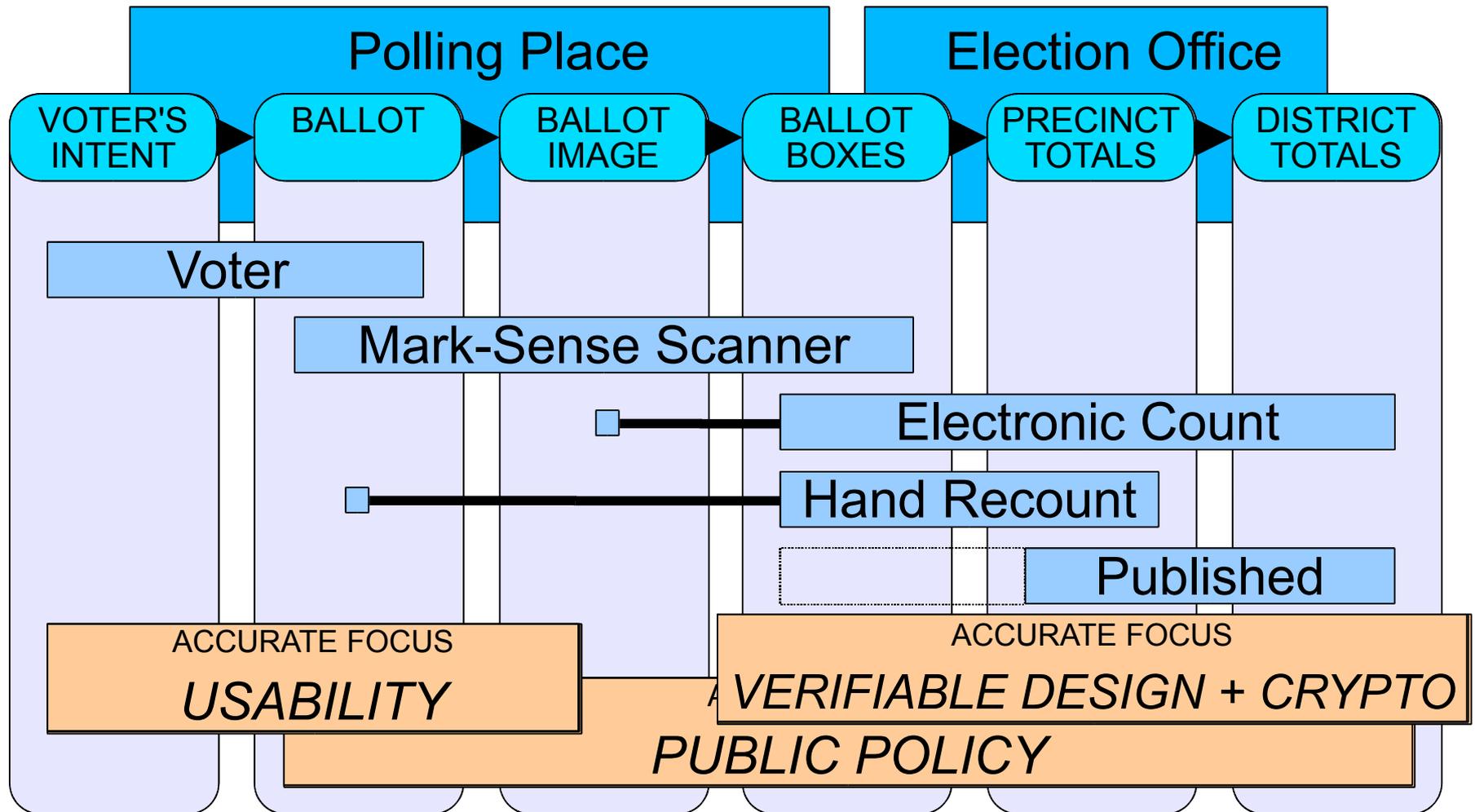
Voting System Standards

- First serious criticism of voting technology
  - Roy Saltman, 1975
- FEC Voluntary Voting System Standards
  - 1990, revised 2002
  - No legislative authorization, off budget
- EAC "Guidelines"
  - 2005 (several years later than expected)
  - HAVA authorized, late due to underfunding

Regulatory Capture

- Gamekeeper turns poacher, or at least, helps
  [The Economist]

- All government regulation faces this risk

  - Regulated industries have huge stake

  - Technical regulations are easiest to capture

- Regulatory capture can

  - Lock out competitors

  - Institutionalize bad design choices

- IEEE P 1583 is, sadly, a case study

Elections are Political!

- Election officials are elected
  - Secretary of state
  - County auditors
- Elected officials do not want to question the integrity of the machinery used to elect them
- Elected officials therefore
  - Resist research into election technology
  - Boldly assert the integrity of the status quo
    Delay in funding HAVA and EAC was to be expected

Elections are Technical

- Election officials are non-technical
  - Hire low-level technical help
  - Rely on consultants and contractors
- Vendors sell election support services
  - Provide contracting and consulting services

    Frequently more profitable than selling machinery
- Counties and vendors become partners
  - Counties hesitate to ask hard questions

    "what, risk damaging a good working relationship?"

Conspiracy Theorists and Luddites

- There is a very real lunatic fringe
- Voting system critics branded as loonies
  - By vendors defending products
  - By politicians defending their legitimacy
  - By election officials "invested" in vendors
- Voting system critics branded as partisan
  - Any affiliation with a vendor is suspect
  - Any affiliation with the "wrong" party is suspect

Voting Systems are Governed by Law

- Critics must deal with lawyers, intensively

- The law can be really bad

  - <u>Encrypted copy</u> means a scrambling of the programming code in which only the manufacturer of the program may determine the sequence of such code.

    [New York 2006 voting system standards, first draft]

- Problem definitions:

  - Software, firmware, ROM, configuration file, ...

A final note

- When I first volunteered in 1994
  - Elections looked simple
  - Embedded systems + Human factors
  - 1 + 1 + 1 + 1 + 1 ...
- Elections are extraordinarily complex
  - A minefield
  - Powerful interest groups
  - Unsolved technical problems