

Overview of Voting Equipment Usage in United States, Direct Recording Electronic (DRE) Voting

Statement of

**Kimball W. Brace, President
Election Data Services Inc.**

to the

**United States Election Assistance Commission
May 5, 2004**

It is a pleasure for me to introduce the topic of today's public hearing—the security and reliability of electronic voting systems—by providing an overview of voting equipment usage in the United States, with a special focus on direct recording electronic (DRE) voting. I am Kimball Brace, president of Election Data Services Inc., a provider of redistricting and election-related products and services to state and local governments, including consulting assistance on the strengths and weaknesses of different types of voting equipment. Election Data Services is the only organization in the nation that maintains detailed historical information on the administration of elections in every jurisdiction in the U.S. Our databases contain contact information for state and local election officials and information on voting equipment usage since 1980, as well as election returns and voting statistics.

For over 30 years I have closely monitored developments in election administration, since founding Election Data Services in 1977 and before then as an associate editor of the biweekly newsletter, *Election Administration Reports*. One of the most significant events during those 30 years has been the development and implementation of electronic voting systems.

History of Voting Systems

For much of this country's history, voters have used paper ballots. As the country grew and became more urbanized, the task of counting paper ballots took longer. With the Industrial Revolution, a mechanical way was found to produce instantaneous election results—the lever machine. Mechanical lever machines were invented in the 1890s, and their use in elections grew rapidly over next 70 years. Lever machines combined the casting, recording, and counting of votes in one apparatus. And it is interesting to note in light of the current controversy over electronic voting that for all those 70 years, voters were not receiving, nor were election officials counting, physical ballots.

Precincts then tended to be smaller in size because the high cost of lever machines prevented election officials from placing large numbers of these devices in each precinct. By the middle of the 20th century, the main source of polling place judges, housewives, had begun moving into the workforce. As a result of this loss in manpower (or womanpower), election officials looked to cutting the overall number of precincts and increasing the size of the remaining polling places.

Punch card voting systems, first used in 1964, were a popular solution to this problem. Suburban and urban communities around the nation soon found that the cost of ten punch card devices was similar to just two lever machines, allowing election officials to create larger precincts. While bigger counties began to adopt punch cards, smaller counties needed a solution that would allow them to continue to use paper ballots, but tally election results more quickly. This led to the development of optical scan devices for voting in the 1970s.

With the advent of computers and the need to replace aging mechanical lever machines, the 1970s also saw the introduction of electronic voting systems. Early electronic voting devices looked much like lever machines, with push buttons replacing levers on a large panel. Newer DREs, resembling ATMs (automatic teller machines), had touch-screen panels and keypads for entering write-in votes. Voter preferences went directly into electronic storage, usually without a paper record of the voter's intent.

Voting Equipment Surveys

In 1980 Election Data Services was asked by the Federal Election Commission (FEC) to conduct a survey of voting equipment usage in the U.S. That 1980 survey showed just two electronic systems—Video Voter (Thornber Election Systems) and Votronic (ES&S — Election Systems and Software)—in use in seven counties. The seven counties, located in two states—California and Illinois, accounted for less than one percent of registered voters nationwide.

After conducting the FEC survey, Election Data Services began to track this information independently. Our most recent survey for 2004 showed that the number of counties using electronic systems has grown to 675. These counties, located in more than half the states, account for almost 50 million registered voters, or 30 percent of all registered voters. The most popular electronic voting systems today are AccuVote-TS (Diebold Election Systems), AVC Advantage (Sequoia Voting Systems), Microvote DRE and MV-464 (Microvote Corp.), Votronic and iVotronic (ES&S), and Shouptronic 1242 DRE (different vendors).

Our surveys categorize voting equipment by seven types: (1) DataVote punch cards, (2) other punch cards, (3) mechanical lever machines, (4) hand-counted paper ballots, (5) optical scan systems, and (6) electronic systems, which include touch screens as well as computerized systems with buttons or pointing devices. The seventh category, "mixed," is for jurisdictions using multiple systems. This category includes counties where elections are conducted at the township level and different systems are used.

Trends in Voting Equipment Usage

Attached to this statement are maps and tables from the 1980 and 2004 surveys that show major changes in voting equipment usage over the past two and a half decades. Two timeline charts are also attached. One shows percentages of counties using the seven types of voting systems; the other shows percentages for registered voters. A comparison of information on the two charts at any point in time provides important insights on election administration in this country. Information from our most recent 2004 voting equipment survey is summarized below.

Expected Voting Equipment Usage in 2004

Type of Voting Equipment	Counties		Registered Voters	
	Number	Percentage	Number	Percentage
Punch Card	281	9.02%	19,381,176	12.31%
Punch Card – DataVote	25	0.80%	2,262,256	1.44%
Lever	269	8.64%	21,893,531	13.91%
Paper Ballots	299	9.60%	1,038,800	0.66%
Optical Scan	1,415	45.44%	53,085,381	33.72%
Electronic	675	21.68%	48,412,015	30.75%
Mixed	150	4.82%	11,360,189	7.22%
Total	3,114	100.00%	157,433,348	100.00%

Source: Election Data Services Inc. survey, as of May 4, 2004.

The slightly more than 48 million registered voters who are expected to cast ballots this fall on electronic equipment compares to 53 million voters who will use optical scan systems and 22 million who will still use punch cards. About the same number of voters, 22 million, will use lever machines, while only one million voters will use paper ballots. Voters using paper ballots represent only two-thirds of one percent of all registered voters. However, those million voters reside in 299 counties, which represent 9.6 percent of all county election jurisdictions, an indication of the small size of jurisdictions using paper ballots. In 1980, some 1,275 counties, or 41 percent of counties used paper ballots. Although there have been many changes in voting systems since funds for replacing lever and punch card voting machines became available from HAVA (Help America Vote Act of 2004), 74 percent of voters in November 2004 will be using the same type of voting systems that they used in November 2000.

Voting System Error Rates

As the sole repository of historical information on voting equipment in the United States over the past 25 years, Election Data Services has provided information for many academic studies, including recent efforts that have been critical of the security and reliability of electronic voting systems. Our nationwide database of voting statistics is often paired with information on voting equipment usage to analyze what some people have called the “error rates” for different types of voting systems. But I believe “error rates” is a misnomer.

Many have assumed that when people go to the polls, they will vote for all offices on the ballot or at least the offices at the top of the ballot. Empirical evidence shows that neither of these assumptions is correct. Academic studies have shown that people experience “ballot fatigue” as they move down the ballot, not voting for everything. This phenomenon has been called many

things, but I refer to this as “drop-off.” Drop-off is usually derived by subtracting the total vote cast for all candidates for a particular office from the actual turnout, if turnout statistics are available. This is often converted into percentages. In states that do not compile or report voter turnout, drop-off is sometimes derived from the total votes for candidates for the highest office on the ballot—president or governor, for example. Drop-off is equivalent to the “residual” vote measures used by some recent studies analyzing the reliability of electronic voting systems.

Our studies have shown that electors don’t always vote for the highest office, a common misconception. Research by Election Data Services for the Congressional Research Service going back to 1948 shows that some degree of drop-off occurs even for the office at the top of the ballot, such as president, or in a non-presidential election year, governor or U.S. senator. Over time, drop-off rates have been in the 1.5 to 2.6 percent range in presidential-election years, and 2.3 to 4.3 percent range in non-presidential years. A table of electoral drop-off rates is attached to this statement.

The problem here is that not all states report the actual number of persons who went to the polls on Election Day. While availability of this data has improved over time—just 17 states reported actual turn-out in 1948, there were still ten states that did not compile this information for the 2002 general election: Alabama, Arkansas, Maine, Mississippi, Missouri, Oklahoma, Pennsylvania, Tennessee, Texas, and Wisconsin.

Drop-off is the combination of “overvotes” and “undervotes” for a particular office. Overvotes occur when electors cast more votes than they are allowed for an office. For example, they may have voted for two candidates, when only one is allowed; or they may have voted for five candidates when instructed by the ballot to “Vote for 4.” Our experience has been that voters are much more likely to cast overvotes in multiple-vote contests. Just two months ago, Commissioner DeGregorio and I observed an election in Illinois and found a large number of overvotes had occurred for delegates to the national convention, where voters were asked to cast up to seven votes. In many instances, overvotes result from improper ballot design.

On the other hand, undervotes occur when voters cast fewer than the allowed number of votes for an office. These could be where contests are left blank or where a voter chooses just three candidates in a “Vote for 4” contest. “Bullet voting” for specific candidates is another form of undervoting. Undervoting is much more likely to be intentional than overvoting. Often if voters do not have enough information about the candidates, they may skip the contest. Offices where candidates are unopposed or where candidates have just minor opposition are other instances where one would find a higher than normal amount of undervoting.

If the data is available, a normal election will usually produce a drop-off rate that is generally composed of 90 percent undervotes and 10 percent overvotes. Unfortunately, in many election jurisdictions across this country, overvotes and undervotes are not reported. In fact, I have been in offices on Election Day and have overheard vendors specifically discouraging officials from producing reports with overvotes and undervotes. This is a shame for both the American public, as well as the election official. If an election official does not study the results of the election, the official is no better than an ostrich with its head in the sand. Looking for abnormal voting

patterns or unusual overvote and undervote relationships are available steps in everyone's research effort. If available, mapping out the results on a geographic information system (GIS) can help spot subtle differences.

As a result of our experience, I would recommend that the Commission under take the following steps. One of the greatest problems with evaluating different types of voting systems is the lack of data. My recommendation to the Commission would be to collect more data, and specifically:

1. More detailed information on voting equipment in use around the nation
2. Actual number of persons who voted in each election (voter turnout)
3. Precinct-by-precinct election results, including overvotes and undervotes, to enable a detailed analysis of returns from all precincts in a county
4. Copies of sample ballots for all ballot styles for post-election analyses to allow a search for possible clues in perceived differences in what voters might have observed
5. *Data files*, not just print files, from electronic voting systems (vendor requirement). The availability of data files would facilitate the analysis of drop-off (residual) vote statistics, including the capability to map data with geographic information systems to see where problems might be occurring.

I congratulate the Commission for undertaking this important hearing on voting systems and I would be happy to take any questions.

Attachments

Voting Equipment Usage Map, 2004

“Type of Voting Equipment by County – 2004” (compiled 05/03/2004)

Voting Equipment Usage Map, 1980

“Type of Voting Equipment by County – 1980”

Voting Equipment Usage Table, 2004

“Voting Equipment Summary by Type, as of 11/02/2004” (compiled 05/04/2004)

Voting Equipment Usage Table, 1980

“Voting Equipment Summary by Type, as of 11/04/1980”

Voting Equipment Usage Timeline, 1980–2004

“Percent of Counties” (compiled 05/03/2004)

Voting Equipment Usage Timeline, 1980–2004

“Percent of Registered Voters” (compiled 05/03/2004)

Drop-off Table

“Electoral Drop-off Rates, 1948–2002”

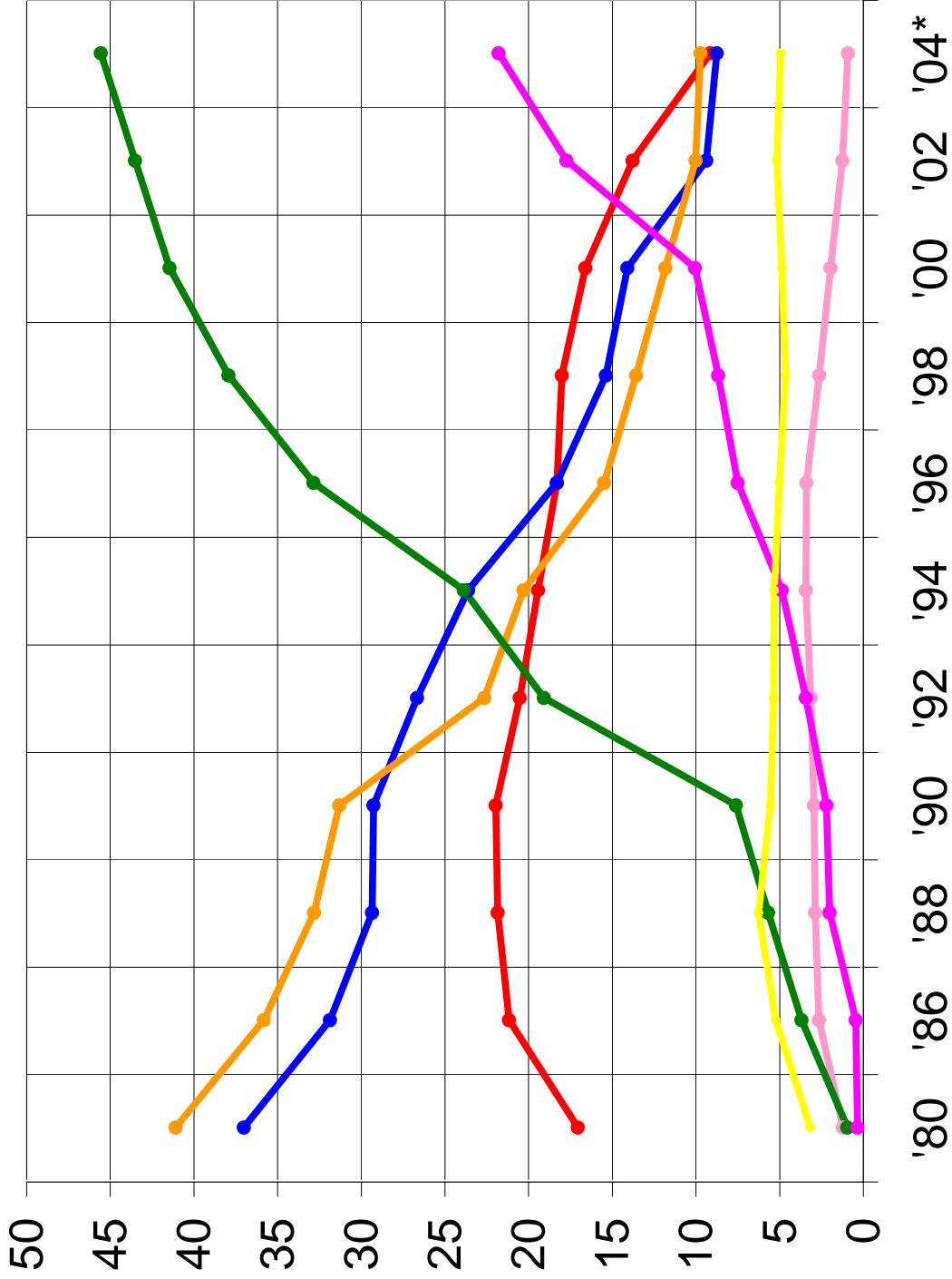
Voting Equipment Summary By Type as of: 11/02/2004

TYPE OF VOTING EQUIPMENT USED	NUMBER OF COUNTIES		NUMBER OF PRECINCTS		VOTING AGE POPULATION (2000 Census)		REGISTERED VOTERS	
		%		%		%		%
Punchcard								
BCCS Punch Card 228	10	0.32%	777	0.42%	632,693	0.30%	464,166	0.29%
CES Punch Card	25	0.80%	530	0.29%	721,368	0.34%	630,428	0.40%
ES&S Punch Card	3	0.10%	516	0.28%	283,513	0.13%	234,319	0.15%
Other Punch Card Systems	228	7.32%	19,853	10.77%	20,583,067	9.67%	16,396,054	10.41%
PBC (Precinct Ballot Counter)	4	0.13%	283	0.15%	834,344	0.39%	701,702	0.45%
Votomatic Punch Card	11	0.35%	778	0.42%	1,272,618	0.60%	954,507	0.61%
Total Punchcard	281	9.02%	22,737	12.34%	24,327,603	11.43%	19,381,176	12.31%
DataVote								
DataVote	15	0.48%	1,712	0.93%	1,739,595	0.82%	1,191,903	0.76%
PC-BT Voting System	10	0.32%	594	0.32%	1,222,094	0.57%	1,070,353	0.68%
Total DataVote	25	0.80%	2,306	1.25%	2,961,689	1.39%	2,262,256	1.44%
Lever								
AVM - Printomatics (Printer AVM)	204	6.55%	18,763	10.18%	18,613,409	8.74%	15,402,770	9.78%
IES Shoup Manual System	48	1.54%	7,004	3.80%	8,299,780	3.90%	5,909,743	3.75%
Other Lever Machines	8	0.26%	560	0.30%	514,997	0.24%	461,388	0.29%
Shoup Manual System	9	0.29%	104	0.06%	171,484	0.08%	119,630	0.08%
Total Lever	269	8.64%	26,431	14.34%	27,599,670	12.96%	21,893,531	13.91%
Paper ballot								
Paper Ballots	299	9.60%	3,465	1.88%	1,549,643	0.73%	1,038,800	0.66%
Total Paper ballot	299	9.60%	3,465	1.88%	1,549,643	0.73%	1,038,800	0.66%
Optical scan								
Accuvote ES--2000	14	0.45%	425	0.23%	482,112	0.23%	410,018	0.26%
AccuVote-OS Tabulator	179	5.75%	12,177	6.61%	13,482,558	6.33%	10,412,620	6.61%
Airmac card reader	2	0.06%	10	0.01%	12,916	0.01%	12,209	0.01%
AIS optical scan	110	3.53%	2,553	1.39%	1,913,061	0.90%	1,360,967	0.86%
ES--2000 Accuvote Voting System	3	0.10%	598	0.32%	523,388	0.25%	349,649	0.22%
GEMS (Global Election Mgmt S'ware)	3	0.10%	290	0.16%	343,899	0.16%	357,896	0.23%
Mark A Vote	8	0.26%	3,105	1.69%	2,465,595	1.16%	1,655,774	1.05%
Model 100 Optical Scan	31	1.00%	2,112	1.15%	3,014,811	1.42%	2,394,548	1.52%
Model 115 Optical Scan	70	2.25%	1,186	0.64%	1,237,922	0.58%	1,043,679	0.66%
Model 150 Optical Scan	95	3.05%	1,811	0.98%	1,351,053	0.63%	1,108,916	0.70%
Model 315 Optical Scan	31	1.00%	1,292	0.70%	1,952,751	0.92%	1,701,098	1.08%

Voting Equipment Summary By Type as of: 11/02/2004

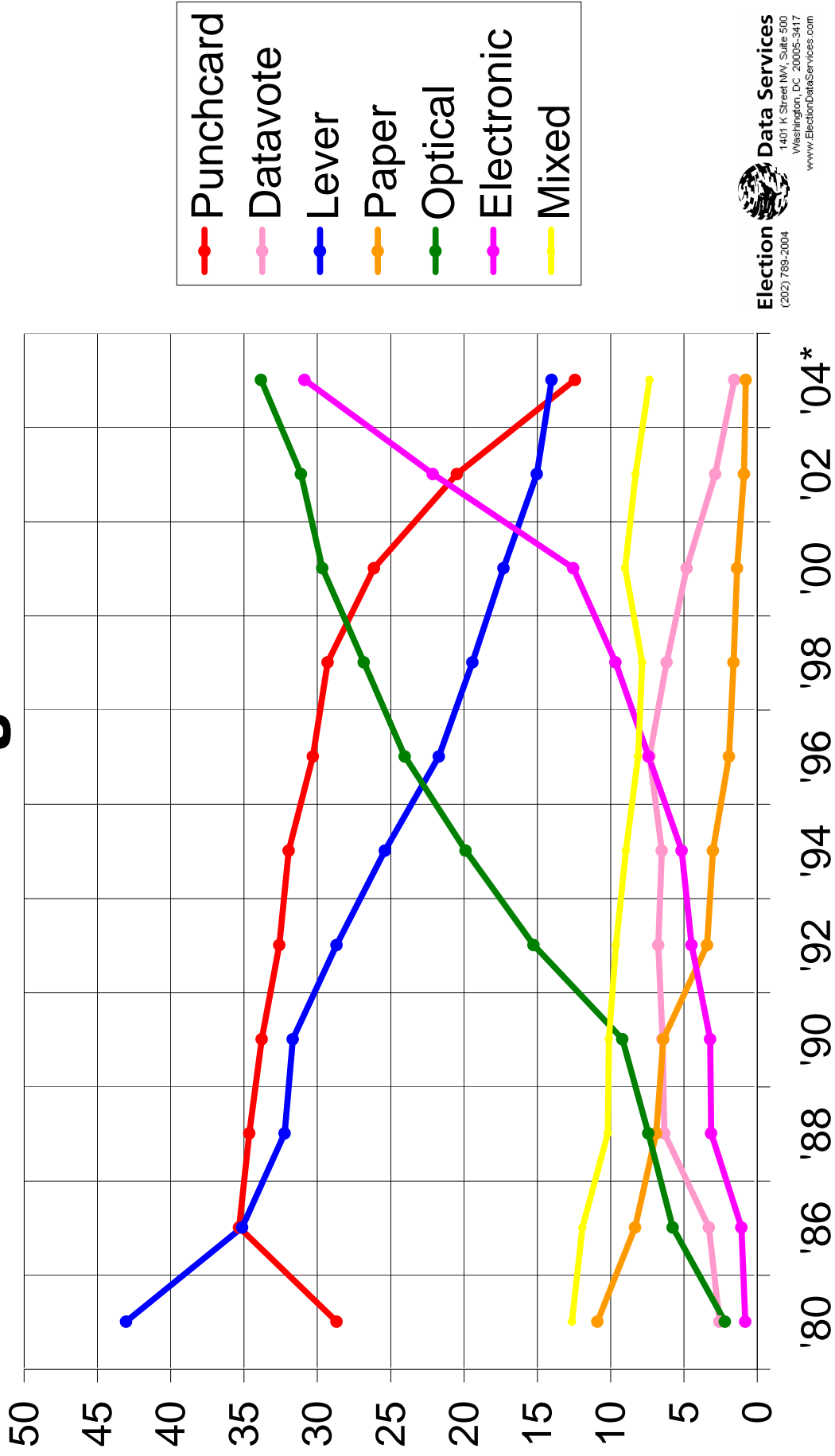
TYPE OF VOTING EQUIPMENT USED	NUMBER OF COUNTIES		NUMBER OF PRECINCTS		VOTING AGE POPULATION (2000 Census)		REGISTERED VOTERS	
		%		%		%		%
Model 550 Optical Scan	31	1.00%	1,457	0.79%	2,040,637	0.96%	1,717,921	1.09%
Optech	10	0.32%	252	0.14%	532,029	0.25%	383,919	0.24%
Optech Eagle	3	0.10%	183	0.10%	304,604	0.14%	277,305	0.18%
Optech II	9	0.29%	253	0.14%	339,742	0.16%	302,003	0.19%
Optech III-C	1	0.03%	11	0.01%	25,664	0.01%	20,261	0.01%
Optech III-P	5	0.16%	721	0.39%	1,328,350	0.62%	1,173,445	0.75%
Optech III-P Eagle	258	8.29%	9,774	5.30%	13,599,819	6.39%	10,025,062	6.37%
Optech IV-C	22	0.71%	1,200	0.65%	1,232,890	0.58%	970,908	0.62%
Other Optical Scan Systems	530	17.02%	26,214	14.23%	26,231,194	12.32%	17,407,183	11.06%
Total Optical scan	1,415	45.44%	65,624	35.62%	72,414,995	34.01%	53,085,381	33.72%
Electronic								
Accu-Touch Electronic Ballot Station	1	0.03%	300	0.16%	328,918	0.15%	333,710	0.21%
AccuVote-TS Ballot Station	194	6.23%	9,928	5.39%	15,189,088	7.13%	9,802,168	6.23%
AVC Advantage	67	2.15%	8,923	4.84%	10,101,656	4.74%	7,543,776	4.79%
AVC Edge	5	0.16%	3,760	2.04%	3,928,623	1.85%	2,295,261	1.46%
eSlate Electronic Voting System	5	0.16%	3,463	1.88%	5,271,122	2.48%	3,871,242	2.46%
EV 2000 (Electrovote)	2	0.06%	34	0.02%	23,385	0.01%	21,532	0.01%
iVotronic	2	0.06%	666	0.36%	1,014,965	0.48%	902,731	0.57%
MicroVote DRE voting system	80	2.57%	2,489	1.35%	3,508,903	1.65%	2,851,841	1.81%
Microvote MV-464	27	0.87%	1,943	1.05%	1,737,800	0.82%	1,522,658	0.97%
Other Electronic Systems	104	3.34%	11,349	6.16%	11,460,931	5.38%	9,299,269	5.91%
Patriot	5	0.16%	157	0.09%	229,778	0.11%	173,130	0.11%
Shouptronics 1242 DRE	142	4.56%	5,005	2.72%	6,188,860	2.91%	4,871,914	3.09%
Votronic	41	1.32%	3,916	2.13%	6,479,603	3.04%	4,922,783	3.13%
Total Electronic	675	21.68%	51,933	28.18%	65,463,632	30.75%	48,412,015	30.75%
Mixed systems								
Mixed (multiple systems)	150	4.82%	11,763	6.38%	18,591,677	8.73%	11,360,189	7.22%
Total Mixed systems	150	4.82%	11,763	6.38%	18,591,677	8.73%	11,360,189	7.22%
Total:	3,114	100.00%	184,259	100.00%	212,908,909	99.99%	157,433,348	100.00%

Percent of Counties



* Expected for November 2004, based on information available as of 05/03/2004

Percent of Registered Voters



* Expected for November 2004, based on information available as of 05/03/2004

Electoral Drop-off Rates, 1948–2002

Year	States Reporting Voter Turnout	Actual Voter Turnout	Highest Office Turnout	Drop-off Rate
2002	40	62,219,507	60,795,899	2.29%
2000	40	82,563,022	81,059,934	1.82%
1998	40	57,597,179	55,856,233	3.02%
1996	37	70,638,630	69,216,868	2.01%
1994	39	55,805,112	54,313,318	2.67%
1992	36	73,974,912	72,629,643	1.82%
1990	34	44,890,326	43,409,816	3.30%
1988	33	58,081,471	56,668,654	2.43%
1986	34	42,197,435	40,400,221	4.26%
1984	33	58,509,636	57,113,439	2.39%
1982	32	45,713,433	44,314,060	3.06%
1980	34	55,797,469	54,670,075	2.02%
1978	29	37,827,229	36,520,648	3.45%
1976	29	49,489,395	48,377,768	2.25%
1974	26	31,624,018	30,604,755	3.22%
1972	26	42,582,628	41,458,146	2.64%
1970	25	32,836,937	31,973,277	2.63%
1968	24	37,968,112	37,389,644	1.52%
1966	23	31,645,227	30,952,233	2.19%
1964	22	37,724,809	36,995,735	1.93%
1962	23	30,439,966	29,813,476	2.06%
1960	23	38,670,435	38,076,980	1.53%
1958	19	28,893,207	28,075,937	2.83%
1956	18	33,935,458	33,250,227	2.02%
1954	17	23,986,530	23,395,912	2.46%
1952	17	31,467,386	30,985,652	1.53%
1950	18	24,614,402	23,883,751	2.97%
1948	17	28,121,161	27,485,591	2.26%