Cost Benefits of Thin Client Voting Systems

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NSF-REU 2008

June 25, 2008

Abstract

While possible solutions to many arguments against electronic voting such as security and accountability have been proposed, the cost issue has largely remained unanswered. Thin client computing offers the possibility of an electronic voting system that is cheaper than paper from day one.

1 Introduction

The 2000 Presidential elections and the many problems brought about by Florida's punch card voting system and recount fiasco put the spotlight on voting technology. A heated debate still remains between the advocates of paper voting systems and those of computerized voting. Critics of electronic voting argue that such systems could never offer the security, accountability, and affordability of paper systems. However, while countless vendors and researchers have made great advancements in the security and accountability of computerized voting, the cost argument remains. Thin client, or dumb terminal, computing systems have gained in popularity as processing power has increased and the cost of memory has decreased. Many schools, businesses, and even banks have implemented dumb terminal systems which provide users with a full desktop experience while dramatically reducing hardware and maintinance costs. I believe the thin client model could be implemented into electronic voting systems reducing costs while still providing a secure, accountable system capable of holding fair, accurate, and auditable elections.

The battle rages between the paper voting and computerized voting camps. Opponents of electronic voting argue that the security, accountability and cost effectiveness of paper systems can never be offered by electronic systems. Those in favor of electronic voting affirm the security and auditability of such systems, and argue that they in fact offer greater security than paper systems. However, there has yet to be a valid response to the cost of electronic systems. According to Jeremy Epstein[1], "aquiring, maintaining, and operating election equipment at a low cost is paramount." In the year 2003 the state of Maryland officially switched from optical scan voting systems to electronic touchscreen systems built by Diebold. The state now

spends nearly 9 times more than they did in the year 2001[2]. This dramatic increase in spending is due in large part to the extremely high cost for the hardware and maintinance. Statewide, by the end of 2009 over $44,000,000 will have been spent on the hardware and $44,000,000 on maintinance, with another $23,000,00 still owed on the machines and at least $45,000,000 in maintinance costs by the year 2014[2].

2 Thin Client Voting

Thin client, also known as dumb terminal, computing has been around for decades. Early servers built in the 80s were based on the thin client structure, which envolves a single central server connected to multiple "dumb terminals" which boot directly off of the server. These terminals are refered to as thin clients because they consist of very simple hardware: small processor, minimal amount of ram, and input-output devices such as keyboards and monitors. The clients have no local hard drive, instead they boot from and store all data directly onto the server. The clients can be specifically designed for such a task, or outdated computers that are no longer able to run current software easily. Because of this, the cost per terminal is minimal. Because all programs are stored and run on the server, it is the only machine requiring up-to-date components. Additionally, any of the upgrading and almost all of the required maintinance must only be done at the server. Compared to the current machines which cost thousands of dollars each, the terminals are very inexpensive. If a terminal suffers a hardware malfunction, it will be more cost effective to simply replace it with a new one rather than hire a technician to first diagnose and then fix the problem. This will lower the maintinance cost dramatically as service will no longer be done to each individual machine.

Thin client computing offers a solution to the outragous cost of current voting systems. Current electronic systems such as the Diebold system used in Maryland use individual, self-contained voting machines in each booth. Each machine must run its own operating system and voting program, requiring powerful processors and large amounts of memory to operate. With the thin client model, all of the programs are run directly on the server. The terminals, therefore, have very little hardware requirments in order to operate. Based on the precinct information for the state of Maryland, and the cost stated by SAVEOurVote for their proposed optical scan system, I believe the hardware for a thin client terminal server system would be cheaper from day one.

3 Cost Analysis

SAVEOurVote, a voting advocacy group in Maryland, proposed an optical scan system in their "Cost Analysis of Maryland's Electronic Voting System." This is a very well made proposition describing, in detail, the cost and budget necissary to replace the state's current Diebold touchscreen system with optical scan machines. By the year 2014, Maryland will have spent over $67,000,000 to pay for the Diebold hardware. The article argues that hardware needed for an optical scan system could be purchased $18,300,000. They assume the state has 2,000 voting precincts with 10 booths each, which is approximately 10% more than precincts than the state has in order to allow for the purchase of spare machines.

Projected Cost of Optical Scan System [1]

Item	Unit Cost	# of Units	Total
Scanner	$4,200	2,000	$8,400,000
Ballot Marking Machine	$4,950	2,000	$9,900,000
Total			**$18,300,000**

This is a dramatic decrease in hardware costs compared to the current Diebold system. Initial hardware costs would decrease by 73% , however this does not take into account the cost of the paper ballots themselves. Maryland has approximately 3.2 million registered voters; with each ballot costing roughly $0.25, the state must pay $800,000 per election for ballots alone. While voter turnout can be assumed to never 100% , a ballot must be available for every registered voter. The number of elections varies from year to year, however if three or four elections were held in the same year the state could spend as much as $3,200,000 for ballots.

Projected Cost of Thin Client System [2]

[3]

Item	Unit Cost	# of Units	Total
Server	$1,500	2,000	$3,000,000
LTSP Terminal	$285	20,000	$5,700,000
Touchscreen	$205	20,000	$4,100,000
Total			**$12,800,000**

[1] Numbers based on SAVEOurVotes' projected costs
[2] hardware requirements based on Linux Terminal Server Project (LTSP) recommendations[3]
[3] Server + backup server + 16 port gigabit switch

The chart above shows the projected cost of a thin client voting system based on 2,000 precincts with 10 booths each. Note that the estimated server cost includes a back-up machine, a necessary precaution in the event that the main server suffered a hardware malfunction. The hardware specifications and requirements are listed below. The Linux Terminal Server Project provides recommended hardware specifications for the server and each terminal. These recommendations are based on day-to-day office use, including the use of Firefox, Open Office, e-mail clients, etc. These programs require much more memory and processing power than a voting system requires, thus the requirements are more than applicable.

Recommended Server Specifications[3]

Ram	256MB + (50MB * number of terminals)
Processor	Multiple CPUs or Dual Core processor, 3GHz good for 30 users
Switch	Gigabit between server and switch, 100mbps between client and server

Recommended Terminal Specifications[3]

Processor	400 to 800 MHz
Ram	32MB minimum

Based on these hardware recommendations, a search of online retailers such as BestBuy.com and Newegg.com provides hardware within the previously stated projected thin client cost while exceeding all hardware recommendations. Sample hardware is listed below, however this is solely used to show that hardware can be found to fit the projected cost and not to infer that off the shelf hardware from a retail store would be used to build a voting system. All products listed below are listed at retail cost and has profit vendor profit built into the price that would not be present when buying directly from the manufacturer. The sample also does not include software and possible licensing expenses as these are completely at the descretion of the particular vendor and can not be accurately predicted.

Sample Hardware Cost per Precinct

Item	Quantity	Cost	Total
HP Pavilion Server [4]	2	$529.99	$1059.98
DLink 16-Port Gigabit Switch	1	$199.99	$199.99
LTSP 1220 PXE Terminal [5]	10	$285.95	$2859.50
NEC AccuSync 15" Touchscreen [6]	10	$205.69	$2056.90
Total			**$5176.37**

4 Conclusion

While the arguments still rage between the proponents for paper voting systems and those of electronic voting systems, little has been said to refute the high cost of current computerized systems. The state of Maryland switched from an optical scan system to a Diebold touchscreen system in the year 2003 and their election expenses have increased by as much as 9 times since 2001. Current computerized systems place separate, self-contained computers in each booth which require a large ammount of memory and processing power to reliably operate. Also, each machine must be maintained individually. If a thin client has some kind of technical difficulty, it can simply be replaced to avoid having to spend hundreds or thousands of dollars to have the machine diagnosed and fixed. The state will not have to spend millions of dollars a year on ballots either, as opposed to an optical scan system which could cost Maryland as much as $800,000 per election to print ballots. Thin client computing will be cheaper than paper systems, not ten years down the road, but from the day the system is implemented.

References

[1] J. Epstein, "Electronic Voting," *Computer*, vol. 40, no. 8, 2007, pp. 92-95.

[2] SAVEOurVotes, "Cost Analysis of Maryland's Electronic Voting System," Februrary 2008, pp. 1-15, http://www.saveourvotes.org/legislation/packet/08-costs-mdvotingsystem.pdf.

[3] Linux Terminal Server Project, "LTSP Server Sizing," November 2006, http://wiki.ltsp.org/twiki/bin/view/Ltsp/ServerSizing.