

Response to RFI for New Voting System

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Introduction

The direction the San Francisco Department of Elections is indicating with this RFI is interesting. You seem to embrace the call for an open source voting system, which the BOS and Elections Commission have been after for nearly 8 years, but the RFI reveals you are pursuing a proprietary system furnished by one of the three major vendors (with history of servicing jurisdictions the size of SF or larger).

The BOS resolution (#460-14) copied in your Attachment A specifically refers to an “OSI-approved license,” and that the CCSF wants “open source software and inexpensive commodity components.”

Yet, the RFI contemplates that a vendor will develop such a system, pay for testing and certification, and then sell it to CCSF. That is to say, business as usual. If the software was truly open source, why would CCSF buy it? It would be free, by definition. And, why would CCSF buy COTS hardware from an elections vendor?

The RFI appears to be clouding the definition of open source and not demanding COTS components. If allowed to proceed as outlined, CCSF will wind up with a proprietary system – maybe with some open source window dressing, but proprietary nonetheless.

I suppose the Department of Elections could claim that this RFI represents one of the “incremental steps” toward the goal. However, it would be such a small incremental step, and consume so much time and money, that it could not possibly be worthwhile.

I am responding with an alternate vision. Some of the wording in the RFI hints an alternative response could be considered.

You say,

Any RFP issued by the City may differ significantly in content from the requirements and services described in this RFI document.

And,

The Department strongly encourages each Responder to highlight and describe any requirements, features or services that the Responder thinks are necessary or advisable in addition to or in lieu of those specifically identified in this RFI.

The option of developing an open source voting system in-house has not been adequately considered. Clearly, existing Department of Elections staff are not qualified to undertake such an effort. However, if CCSF hired the right people, like me, for example, an open source voting system could be ready for use fairly soon.

I estimate that, for less than what it cost to procure the Sequoia system in 2007, CCSF could have a true open source voting system completed and certified by early 2016 – ready for trial use. Then with a year for further testing and improvements in 2017, it would be ready for full deployment for 2018 elections.

Due to time constraints, I will confine my response to items in the RFI I see as controversial. For example, I could write at length about “accessible to all voters to cast ballots in an independent and confident manner.” Clearly, we all want that, and any system should endeavor to accomplish this to as high a degree as possible. I just don't have time right now, and can only refer you to my past work.

Letter of Introduction

I'm sure many – probably millions – watching the debacle in NOV-DEC 2000 were thinking, “Our election technology is terrible! Why doesn't someone do something about it?” I was one of those. But a few people added that, “I don't see anyone stepping up with any good ideas I could support, so, I'll start a project to do it.” I was one of those, too.

I don't think there were many who made a concerted effort to build such a project, but there were a few. David Baltimore, president of Caltech at the time, was certainly one of them. The Caltech-MIT voting project is still around, but they have backed off considerably from their DEC 14, 2000 pronouncement that they would build a good voting system everyone could use.

While Caltech-MIT said they'd build it, I put together a team of scientists and engineers to develop open source voting and started demonstrating prototypes up and down the state.

Editorials

The opinion of the
San Jose Mercury News

THURSDAY, APRIL 8, 2004

The touch-screen holy grail

E-VOTE PROTOTYPE HAS RIGHT STUFF

An electronic voting system that's cheap, secure, accurate and easy to use. One that uses off-the-shelf hardware and publicly examinable software. One that voters can trust.

A prototype of such a system — the holy grail of election officials — was on display last week in San Jose. It looked like the real deal.

Had the federal government underwritten the research behind it years ago, such a system might now be making its debut in voting booths. Instead, the demonstration took place in a conference room at the county government building with its creators in search of financial backers and government grants.

The government unwisely ceded development of electronic voting machinery to private companies like Diebold Voting Systems, whose proprietary software is under electronic lock and key. The secrecy of the source code, a slew of malfunctions, and a lack of a paper copy that voters can look at have eroded confidence in touch-screen voting.

The founders of Open Voting Consortium, a non-profit group of software engineers and computer scientists, built the system in their spare time. It features open-source software, which means that the public can examine the software code to make sure there are no bugs or digital shenanigans built in. It also produces a paper version of the ballot cast, converted to a bar code, so that voters can privately verify that the choices they made on a touch-screen

are just as they intended.

California Secretary of State Kevin Shelley has mandated a voter-verifiable trail in all counties by 2006, but so far, the big voting-machine companies are not marketing machines that do that.

Open Voting Consortium's system has appeared too late for Santa Clara and other counties that have been plunking down tens of millions of dollars for touch-screens that lack some of the new system's virtues. But many counties that weren't under pressure to replace equipment have put off the decision, for good reason. For them, this next generation of voting systems may be worth the wait — if not too long.

Open Voting Consortium appears to have what it takes to inspire faith in electronic voting. Its system can't come to market soon enough.

In the 2005, US GAO report on electronic voting systems in the US, they cited two organizations for their work on **product development: Caltech-MIT and Open Voting Consortium.**

commission. As a result, it is unclear when the results of these initiatives will be available to assist state and local election authorities.

Nongovernmental Initiatives Are Intended to Improve Voting System Security and Reliability

In addition to federal initiatives, initiatives by various nongovernmental organizations nationwide have been established to address the security and reliability of voting systems. Professional organizations, academic institutions, and citizen advocacy groups have initiatives that affect several areas of the voting system life cycle, particularly product development, acquisition, standards, and management. Selected initiatives include (1) developing open designs for voting system products; (2) identifying issues and key questions to be considered by consumers of electronic voting systems; (3) defining international standards; and (4) supporting more effective management, including collecting, cataloging, and analyzing problems experienced during elections. Table 3 summarizes key initiatives.

Table 3: Nongovernmental Initiatives to Improve Voting System Security and Reliability

Initiative	Organization	Product or activity	Status
Product development			
Prototype for an open-source electronic voting application	Open Voting Consortium	Developed a prototype for an open-source electronic voting application that uses commercial hardware and operating system components and provides (1) an electronic voting machine that prints a paper ballot, (2) a ballot verification station that scans the paper ballot and lets a voter hear the selections, and (3) an application to tally the paper ballots.	Continuing to add functionality to prototype. No specific timetable.
A Modular Voting Architecture	Caltech/MIT Voting Technology Project	Proposed an approach for building additional security features into electronic voting systems through an alternative voting system architecture.	Completed August 2001. Available for implementation.
Acquisition			
A Framework for Understanding Electronic Voting	National Academy of Sciences' Computer Science and Telecommunications Board	Defining questions to help policy makers, election officials, and the interested public understand the technology, social, and operational issues relevant to electronic voting, including security issues.	Publication expected in fall 2005.
Relative performance of voting system classes	Brennan Center for Justice	Started an independent assessment of electronic voting system security and plans to develop a report describing the relative performance of each class of voting systems.	To be completed in fall 2005.



SF elections commissioner Gleason is partly obscured by Brent Turner in this picture taken during our 2008 demo at the Linuxworld conference at the Moscone Center. That's Commissioner Matthews watching the tabulation. The fellow on the right in the green t-shirt is Parker Abercrombie, one of our star programmers. He is now a computer engineer at NASA. Parker also gave our invited presentation at a NIST workshop on open data formats in 2009.

Commissioner Gleason had organized a forum a couple of years before this (MAR 2006) featuring open source voting and included me with several other panelists. In 2009, the Elections Commission president at the time, Joe Phair, invited me to give a presentation at a regular Elections Commission meeting. It was at this meeting that I amended the Dechert Design to include a computerized ballot box that would be attached to a bar code scanner so that when the polls close, the results would be available immediately and the tally sheet could be printed out.

At Linuxworld, we were closing the polls for a few minutes every 45 minutes, opening the ballot box, and showing people how the tabulation would work. At the 2009 Elections Commission meeting, Commissioner Matthews suggested that after the polls close in a real election, people want to go home. It's unlikely, he said, that people would want to stay (or return to the polls) to watch tabulation.

The Dechert Design is the result of many years of thinking about these issues and incorporating ideas from election officials as well as scientists and engineers. In fact, the bar code on the ballot was

suggested by assistant Placer County Registrar, Ryan Ronco. I immediately thought to print copies of the bar code along the long edge. This way, the ballot could be read by machine while still in the folder.

Later, Elaine Larson of Santa Clara County said if she was ever to use it, she would want the results on the tally sheet also bar coded. So, we included that on the tally sheet.

There were also many many suggestions made over the years that I did not take. At some point, you need someone who can make good design decisions. Many of the ideas going into the Dechert Design were my own ideas. But quite a few were from other people. I am capable of sorting out good ideas from bad. Not many can do that.

Going back to 2000, I was suggesting jurisdictions build their own systems with open source software and commodity components. Los Angeles County was one of the first to respond.

Recently, almost 15 years after first discussions with Los Angeles, Dean Logan announced they would be going open source. They've been working on building their own system for some years now, but had resisted saying definitively that it would be open source. Still, I don't know if he has specified the license he intends to use.

It's good to see some progress on something I've been pushing for so long, but the Los Angeles VSAP project is burning through tens of millions of dollars over a long period of time... with very little to show for it.

I have shown the ability to bring together scientists and engineers to work on projects. And, I've had the patience to prod election officials and elected officials to move things forward. I did these things with almost no money, and no real institutional support. If given the proper position and budget in San Francisco, I could accomplish what I set out to do in the first place, 15 years ago, much to the benefit of tax payers, voters, and officials in CCSF, California, and around the world.



Board of Supervisors County of Los Angeles

MICHAEL D. ANTONOVICH
MAYOR

March 22, 2001

TO: Conny B. McCormack
Registrar-Recorder/County Clerk

FROM: Michael D. Antonovich
Mayor, Los Angeles County

SUBJECT: CORRESPONDENCE FROM ALAN DECHERT

Attached for your review and consideration please find e-mail correspondence from Alan Dechert, concerning voting system reform.

Please contact Mr. Dechert at (916) 791-0456, or visit his website at www.go2zero.com/votereform.html, for additional information on his proposal, to determine it's feasibility to Los Angeles County, and respond directly to him, with a copy of your response to my office for review.

Thank you for your attention to this matter.

MDA:lh

cc: Alan Dechert

Incumbent Powers

When I decided to start my voting system project, I never thought it would be quick and easy. In my experience with organizations and movements, I've seen, felt, and heard the push back from incumbents.

Incumbents will fight with all their might to keep what they have. It is almost irrelevant to demonstrate that the incumbents are wrong. Incumbents have to be defeated.

The voting system is replete with incumbency and incumbents. Election officials at the state, federal and local level all fight to defend their territory. Voting system vendors also fight to keep what they have. And, the incumbent office holders – the politicians – tend to think the voting system is not so bad because it worked okay when they ran for office.

Besides all the people whose jobs involve voting in some way, there is another level of incumbent push back: intellectual property (IP) champions. They see open source as a threat.

In 2004, I worked closely with Assemblymember Jackie Goldberg on her resolution ACR 242, which OVC sponsored (credit to Richard Dawson for this idea). I testified for it. Opposition testimony from election officials and vendors was expected and ordinary. I was astonished by opposition from corporate types who were only tangentially involved in the voting system.

The resolution only called for the Secretary of State to look into the potential of open source for election systems and issue a report by JAN 1 2006. The IP champions went ballistic. They did not want to even hear the term “open source.”

This is from CompTIA's (a large industry consortium) opposition letter¹:

Therefore, CompTIA is requesting that the references to "open-source software" appearing on page 2 at lines 7 and 12 of the July 1 amended version of ACR 242 be stricken and replaced with the technology neutral term of "regardless of software platform."

Imagine that: CompTIA could support looking into open source for elections as long as we strike the term “open-source software.”

The resolution passed, but the IP champions were not done. The report was sandbagged. This opened the door for Debra Bowen, who was publicly supportive of open source.

Her hearing on open source for elections – the one Secretary of State McPherson refused to hold – was FEB 8th, 2006, followed by a hearing the next week on the certification process.

Senator Bowen wrote this note to me after the hearing.

1 A few more sample opposition letters: <http://www.openvotingconsortium.org/ad/242-opposition.pdf>

Alan Dechert

From: "Senator Debra Bowen" <senatorbowen@yahoo.com>
To: "Alan Dechert" <alan@openvotingconsortium.org>
Sent: Thursday, February 09, 2006 12:43 AM
Subject: Today's Hearing -- Progress!

Alan,

Thanks for your tenacity in pushing for the first ever hearing on open source software. The witness list was very respectable by any measure, and your introductions were critical. There is no way I could have met so many key people in such a short time without your contacts.

Speaking of your contacts ... spending time with Dr. Avi Rubin at Johns Hopkins in early January was extremely important. Thank you for that connection. It led to the the hearing I have planned next week on the testing process, where we can look behind the curtain at the weaknesses of the federal testing paradigm as applied to proprietary software, as well to the invitation for me to participate in the ACCURATE board meeting.

The conversation at today's hearing was excellent. We heard a great deal about the advantages of using open source software in general, and as we focus more and more on the application of voting, I believe the picture will become clearer. I know Dr. Rubin believes that voting software in particular should be open source, and we will learn the reasoning behind that next week.

Having Red Hat there was excellent, and I appreciate that introduction as well.

The breaking news that Diebold was considering jettisoning its DRE business highlighted the need for an alternative such as OVC presents. Several witnesses commented that with a relatively minor investment, we could have a robust, open source system.

It has been a long day. I'm having lunch with Michelle Kraus tomorrow, and I'll let you know how that goes. (another Dechert introduction!)

Arthur Keller is already very enthusiastic about working with a new Secretary of State (yes, that would be me) who understands the need for the open source solution.

Michelle and Arthur have been talking about doing a joint fundraiser for my SOS campaign and OVC; we'll know more about that tomorrow.

I'm sorry that I didn't begin to work with OVC sooner. But the momentum is there, with all the recent focus on problems with DRE's, as is the opportunity to create a system that can meet the challenge set forth in today's hearing -- provide a platform that will last for at least the next 100 years. What a legacy that would be!

Please thank the people who've kept the dream of open voting going in the last few years. Their commitment, and your commitment in particular, has been the basis of my work. Thanks!

Talk to you soon.

Best,
Debra

P.S. Thanks for the photo from the CDP e-board. You (or was it Patrick Higgins?) caught Mimi Kennedy and I with the most extraordinary smiles. It was a good night! I trust that OVC made many new friends. The combination of OVC and the Clean Money Campaign is powerful. Both are realistic solutions to extremely important problems!

(By the way, at the time, I asked Senator Bowen if I could share this letter, and she replied, "yes, show it to anyone you want.")

Some people read this letter and took it at face value – a great thing for the open source movement.

Others saw the letter as politically savvy but insincere. Shortly after this letter, she was quoted saying “Microsoft won't allow it,” in reference to open source voting. I challenged her on that, but it was really the beginning of the end. She got what she wanted from me, and didn't really want to hear from me anymore.

After eight years of the Bowen administration, the votes are in. She was insincere. We never got open source voting, despite getting a Secretary of State elected who was happy to proclaim support for open source voting.

Progressives provided great support for her but not much money. The big money came from the powers-that-be, and those are the ones she was most beholden.

Open source was an idea popular with her progressive supporters. She used this to help her get elected. During her eight years in office, Secretary Bowen never lifted a finger to help the movement for open source voting. The original wording of Senator Padilla's SB 360 included the term “open source.” She had it removed.

Incumbency has to do with paychecks. People want to keep their paychecks. They'll do anything to keep their paycheck. They may not see how they can fit into a new paradigm. They fear the new paradigm because they fear it means losing their paycheck.

However, smart people in the election vendor community can figure it out. If we move to purely open source voting, there will still be a need for election services. Election vendors would no longer sell hardware or software, but provide services needed to help run the elections.

The service model is different, but it works. The world is practically running on open source software today. Typical computer users see “Microsoft,” on their desktop, but most of the software running the web sites they visit is open source. Android is open source. One billion Android smart phones were sold in 2014.

Your RFI has incumbent DNA markers all over it. There are no arguments that I could make that could sway you. It's political. Can the incumbents push back on open source again?

The RFI says the new system should work with your DFM election management system

This is a major weakness in your vision for a new system. We should endeavor to drive the cost down throughout the voting system. One of the ways to reduce cost will be to pool resources and share the technology.

For an election administrator outside of San Francisco who might be interested in joining the effort, this requirement might be a show stopper. Does s/he have to have DFM too?

The election management system should be free open source software too, and integrate well with all other pieces of the system. If it's open source, we have the ability to make it do what ever we need it to do. Otherwise, we have to go to a proprietary vendor and try to get changes made. We have no control over that.

Another weakness Elections Department direction: assumption there will be no online voting for the foreseeable future.

While I agree that the present effort to get a new system for San Francisco should be for a paper ballot system, it's a mistake to assume there will be no paperless online voting in the future. Failure to see this coming could result in costly investments going to waste due to fast obsolescence.

Online voting must be embraced at the federal level before approval at the state level in California. In part, this is true because the wording of state law requiring voting system standards equal or better than federal standards.

Online voting – especially smart phone voting – may become a reality sooner than most people think.

In May of this year, I led a presentation² to the federal Election Assistance Commission (EAC), which was also attended by scientists and engineers with NIST.

Smart Phone Voting

Alan Dechert, Ted Selker PhD, Wayne Hayes PhD, Juan Gilbert PhD
May 8, 2015

Prepared for

Tom Hicks, Commissioner

US Election Assistance Commission

2 Link to slides used in May 8 conference call: <http://www.openvotingconsortium.org/ad/eac8may.pdf>

The response was generally positive. They would like to see more, and I'd like to be able to show them more. More recently, this month, President Obama, during an interview with with Fast Company editor-in-chief Robert Safian, was asked if online voting should be a priority. The President responded, "Absolutely."³

“Assigns the least restrictive software license so that third parties may also utilize the code. ”

This is one of the criteria (d) listed under Functionality under **B. Specific Criteria for New Voting System.**

It's difficult to understand the thinking behind the wording of this. This is not what anyone in the open source community would want or accept for an open source voting system.

First of all, it doesn't even mention open source. Maybe we should assume the author means “open source software license.” True open source software always allows third parties to utilize the code. This is part of the definition of what it means to be open source. It demonstrates that the author misunderstands the most basic facts about open source, or, perhaps, *does* understand but thinks no one will notice the implication of this.

Whether a license is permissive or restrictive or “least restrictive” has nothing to do with who can utilize the code. It has to do with *what* third parties can *do* with the code. For example, the Berkeley System Distribution (BSD) license is about as permissive (or least restrictive) you can find. Basically, anyone can do anything with the code as long as you maintain the copyright notice in the source and/or documentation.

For example, the Apple computer operating system uses quite a bit of BSD-licensed Unix code. That's good for Apple because they are able to use a lot of great work from a lot of great programmers. But the Apple operating system is not open source.

If we want an open source voting system, we don't want an open source license that would allow a proprietary vendor to take the code and use all or part of the code in a proprietary closed-source system. This would defeat a good part of the motivation – transparency – for having open source code in election systems.

Google has released the Android operating system under a very permissive license (one of the “least restrictive”). It makes sense in this case since Google wants to enable developers to build on top of the operating system – 100s of thousands of apps, some proprietary, some open source... some free, some not free. This arrangement has worked well and has brought about a thriving technology ecosystem around the Android product. But is this an appropriate model for the voting application? Clearly, not!

3 Webroots article about it: <http://webrootsdemocracy.org/2015/08/13/obama-online-voting-should-absolutely-be-a-priority/> and link to original interview: <http://www.fastcompany.com/3046757/innovation-agents/president-barack-obama-on-what-we-the-people-means-in-the-21st-century>

If software code in the voting system changes, the system must be re-certified – a long and expensive process. Making it easy to add things to the voting application is not a good feature. Making the code available to developers who could then turn it into secret proprietary software is not a good feature, either.

Voting is a relatively simple process. Making it more complicated than necessary is not good. Keep it simple. Keep the software code as open and brief as possible.

The General Public License (GPL) requires that when a third party changes the code, the work remains under the GPL license. This is exactly the feature we want. Open Voting Consortium's code was released under the GPL license. This made it easy to incorporate code from Ka Ping Yee's PhD dissertation, which was also released under the GPL.

Anyone who uses this code is legally bound to keep it as GPL open source. That's what we want. Your "least restrictive" concept is exactly what we don't want.

One of the best explanations⁴ was given on the OVC discussion list in 2007 by Brian Behlendorf (Brian is from San Francisco and one of the most successful open source leaders in the world. His code is running on literally 100s of millions of servers all over the world):

In a properly run open source project, it's not only the code that is publicly revealed - the methods of development are also public, as well as all other artifacts such as requirements, test cases, architecture documents, anything else essential to development. Furthermore, questions by new users, asked publicly and answered publicly, form a knowledge base that help grow the ecosystem and ensure the project can survive no matter which developers move onto other endeavors, and no matter which companies drop their involvement. I personally place much more trust in code around which a healthy community exists, than even supposedly superior code built in isolation.

Given this, whether the public can read or make judgements on the code by itself matters far, far less than whether the public (or people they trust) can see that the project involves a broad number of participants, representing multiple interests, engaged at multiple levels, comprehending the code and stewarding it onwards to new features and greater reliability.

Mere publishing of source code, however, does not create this kind of community. It can even lead to confusion, as we've seen in this thread. Faced with a mandate to reveal their source code, any existing voting system vendor could simply release the end result of their development efforts, and the public would not, IMHO, be that much better off in terms of transparency, auditability, or giving precincts the freedom of choice that open source software is supposed to bring.

4 From an exchange with Hamilton Richards, see <http://gnosis.cx/voting-project/November.2007/0079.html>

- > So I ask all of my fellow proponents of open-source election
- > software: What would you do with it if you had it? Would you be able
- > to construct such a convincing argument for its correctness that
- > ballot printers could be dispensed with?

Heck no! The software should never be trusted to do the job correctly without failsafes and auditing. There's no way any citizen can ensure that the software running on the system is the software whose code they know to be trustable, let alone the potential for missed bugs or hardware issues. That shouldn't even be the goal of open source voting systems; instead, it's about creating a flatter and more competitive environment for the vendors, mitigating one source of distrust in the system, and giving precincts more options to run the systems themselves.

Trust should come from designing a voting and counting process that uses software to make it faster and easier to (optionally) mark and count paper ballots, with mandated hand-checking of results and retaining all paper to count in the event of a dispute later. Trust should not come from thinking the computer stored and tallied the results correctly, with no means to validate that result.

We want to create an open source voting community. The RFI is anti-antithetical to this goal.

Ranked choice voting

My design for ranked choice voter interface has been online since 2003 (see the last contest for “county commissioner” in this mock ballot). <http://user.it.uu.se/~jan/voting-project/ballot2.html>

Note that if the ranked choice contest was on a printed ballot looking similar to the way it looks on screen, a voter could fill in the bubble.

Software for running the tabulation called OpenSTV has been online for 10 years or so. <http://www.openstv.org/>

I don't see any major issue for implementing ranked choice with an open source system.

The main problem I see with having many rankings (as many as there are candidates) with hand-marked paper ballots is that the ballots could get messy with corrections. With the computerized interface, it's easy. If you decide to change rankings, you can just click “clear selections.” I don't envy anyone dealing with hand-marked ballots with many rankings. There are bound to be errors and messy corrections. Suppose you have 13 candidates but the voter has two of them marked with the 8th rank?

Votes for Writein candidates

If we accept that "Every ballot and every vote on every ballot must be handled correctly by the

system," all current voting systems must be condemned as unacceptable. Write-in votes are currently very inefficient for Registrars to process.

You say in the RFI that CCSF facilitates voting at City Hall starting 29 days before every election. However, qualified write-ins are not known until 14 days before Election Day. So, there is a problem.

Occasionally, this inefficiency results in a situation where the winning candidate does not match the will of the electorate. For example, Donna Frye ran for mayor of San Diego in November 2004 as a write-in candidate, and a plurality of voters wrote in her name. A controversy arose when she lost the election because a number of voters did not fill in the bubble next to her written name. If those votes had counted, Frye would have won the mayorship. Clearly, if the will of the electorate had been respected, Frye would have won.

The new system developed in this project could potentially become the only system that handles write-in votes efficiently. The RFI does not address this issue, however.

Currently, according to state law, a write-in candidate must be qualified in order to have his or her vote counted. A write-in candidate must file papers with the relevant officials. "Superman" and "Mickey Mouse" can never receive an official vote no matter how many people write them in.

Computerized voting interfaces (for example, Direct Record Electronic systems) currently do not contain information on qualified write-ins. One reason is that the data on qualified write-ins only becomes available 14 days before Election Day. Poll workers are supposed to have a list of qualified write-ins available at the pollsite, but often this list is not evident to voters.

The current absentee system does not even attempt to inform voters about qualified write-in candidates.

In discussions over the years with elected officials and election officials, some election officials feel that if the Dechert Design system can handle in a different manner, this would add value to our proposal. Some elected officials and their staff feel incumbents will not like such a system because it gives write-in candidates standing they don't deserve.

Qualified write-in candidates are considered "unlisted candidates." With the CAVO voter interface, when a voter skips the listed candidates and selects 'write-in,' a list of qualified write-ins should appear. This should be quite feasible even given the 14 day constraint because the Dechert Design can produce an updated ballot definition quickly.

We need to allow a voter to write-in whomever they want for spiritual joy and legal necessity but if a candidate is not qualified the voter should be informed that the choice will not be tabulated. In case the voter chooses to type in the name of an unqualified candidate, the voter should also be informed that state law prohibits writing in a candidate in such a way that could identify the voter (e.g., write-in candidate "John Smiths Ballot" is not legal and the whole ballot would be rejected).

The Dechert design as it exists today does not have this capability. The finished system will have this capability. Officials at least will have a choice to use it, whereas today no system has this capability.

The engineering issues need to be considered, but we do not believe this to be very difficult. There are

logistical and procedural issues to be investigated. There may be legal issues to consider as well. This proposed method for handling write-ins also has accessibility advantages and usability advantages. Simply put, it will be easier and clearer for the voter.

We also need to investigate attitudes and opinions of elected officials, election officials, and voters. We guess that over ninety percent of voters do not know that only qualified write-in candidates can receive votes. CCSF should find out what voters know about this and how they would feel about a system that handles this issue correctly.

Cost per ballot

A high cost per voted ballot is bad. It's bad because it represents wasted tax payer dollars that could be better spent on important things like health care, education, and infrastructure improvements.

It is a given that the system must have all the necessary security, accuracy, accessibility, etc., but we need to drive down the cost per ballot. All of the underlying technology is becoming cheaper and better. There is no excuse for such high costs as we have in California.

Los Angeles is the poster child for high-cost voting, reporting that the June primary last year cost \$60 per ballot.

The figures (\$100 million and \$10 per ballot in the LAFCo draft) are rough approximations. There isn't good data available from all the counties. If anything, it's probably way too low (CACEO has a project working on defining costs better... don't hold your breath). Dean Logan reported that the June 2014 primary alone cost \$38 million to conduct (LA has approximate one-fourth of the voters in the state).

Go to 4:40 into this interview with Dean Logan.

<https://www.youtube.com/watch?v=pMnIuRMXm4k&feature=youtu.be>

LA has been spending on their voting project as if money is no object. CCSF should not count on LA for lowering costs.

High election administration cost is also inherently anti-democratic. As president of OVC, I received many queries from all over the world – including those from poor or developing countries. They wanted to know if they could download our system and use it. I had to say, sadly, our system wasn't ready for that.

What if, over time, with CCSF pooling resources with other jurisdictions, we (or CAVO) could answer those queries with “yes, go to this link and you can find all the source code and instructions.” Open source voting could be a driver for democracy all over the world.

The Dechert Design

Text below was copied from the draft circulated by LAFCo in response to the request from the BOS for a report. An intern, Angie Lee, contacted me for information about open source voting. This is largely based on information I gave her. I'm not sure if I mentioned that this would include a new open source election management system.

AN OPEN SOURCE VOTING SYSTEM FOR SAN FRANCISCO

SUMMARY: This presents an approach towards a voting system for the City and County of San Francisco utilizing open source voting software and off-the-shelf hardware components. The San Francisco Department of Elections could staff with temporary election hires, or contract with an election company for trained personnel. Voters at polling places would cast their votes on tablet touchscreens, print and confirm their ballot. A poll worker would scan the ballot and deposit in a ballot box, which would be designed to enable scanning and recording the votes. Once the polls close, poll workers would deliver the ballot box with the scanned totals and all its printed ballots to the central counting facility where the scanned totals would be added to the vote counts and sampling and other due diligence security measures could take place.

The City would save the costs of a vendor providing hardware and software every election, and require only staffing support. One-page polling place ballots showing a voter's actual votes on inexpensive multipurpose paper would offer about \$400,000 savings in pre-election printing costs for each election. Multi-page preprinted ballots on heavy stock paper would be required only for those registered to Vote By Mail.

This report addresses the polling places, the City Hall counting center, additional verification of voting, AC power and batteries, ranked choice voting and the Open Voting Consortium and "Dechert Design" work on open source voting systems. Once developed, open source software would be free. Equipment costs for the system described below would total about \$2 million. This may be compared with the \$400,000 savings in pre-printed ballots for each election, and the costs of Dominion Election Systems services.

Links are provided for potential off-the-shelf hardware to give a sense of current availability and costs, but are not intended to be prescriptive. More detailed analysis would naturally be required before going forward with equipment purchases for an open source voting system.

John Arntz, San Francisco Director of Elections, has been very helpful in providing information about the current situation and the last election, which is much appreciated.

BALLOTS

The number of cards printed is based on the number of permanent vote-by-mail (VBM) voters and the total number of registered voters in the City.

Every permanent VBM voter receives a ballot for each election, and these ballots require several cards to cover all offices and propositions. Currently there are around 232,000 permanent VBM voters. For last fall's election, half the VBM voters received a four-card ballot, and others a five-card ballot (an average of 4.5 cards a voter) which means over one million VBM cards. The unit cost for a VBM ballot card is around \$.33 since VBM ballots require more handling than cards for the polls, for a cost of around \$345,000.

For the polling places, cards are printed for about 75% of all registered voters for those casting ballots at the polls. The current San Francisco registration count is 433,386, and 75% of this number is 325,000. Using the 4.5 cards per voter average, around 1.5 million ballot cards were printed for the polls. The unit cost for a ballot card printed for use at the polls is around \$.27, and the total cost was around \$400,000.

The total pre-printed cards for both types of voters was around 2.4 million in the last election.

POLLING PLACES

Each of San Francisco's about 570 Polling Places would have about six Voting Booths with privacy partitions, voting tablets and printers, and a Ballot Box with number of votes displayed on a monitor.

The Voting Booth

Voting Booth hardware would include a touchscreen tablet and printer. Optimally, both would be battery powered to guard

against power failures, and connect mechanically by USB or equivalent for security, without any wireless capability that could open the door to outside interference.

The cost of a touchscreen tablet depends largely on make and screen size. There are many possible choices, and an easily replaceable battery would be important. While a 7-inch tablet would be feasible, a 10-inch tablet with zoom-able interface would be more readable for people with poor eyesight, and require less scrolling. An audio interface could be implemented on the same tablet.

The battery-powered printer and battery-powered tablet should be able to go all day without recharge, but spare charged batteries should be on hand. Voting booths might average 30 to 60 voters, depending on turnout, each printing their one-page ballots after making their selections. These printers have a duty cycle of 500 to 1000 pages per month in business use, so this would be light duty.

The voting booths could have foam board partitions costing about \$5 per booth. The booths might look something like this: <http://www.openvotingconsortium.org/blog/2009-oct-08/california-democratic-council-voters-enjoy-ovc>

The ideal window would not require paging, and have the entire ballot on one screen no matter how many (zoom-able) contests. The print might be very small in some cases, but the contest title should always be clearly readable, e.g., if there were 10 candidates for US House, the print may be too small to read the names but by tapping on the contest title, the text would zoom up. Once a selection is made, it would zoom down. The selected candidate name would be readable while the unselected candidates may not. The entire ballot and the choices made, and the un-voted contests, would be readily seen on one page. This may be more easily done with a 10-inch tablet than with a 7-inch tablet, and warrants further investigation.

After making all selections, the voter would click the Print button and exit the Voting Booth, giving the ballot to a poll worker to scan and deposit in the Ballot Box (see Scanning Ballots, below)

Voting Booth Costs

For cost estimating purposes, Amazon sells in volume and their margins are low.

The printer decision is much easier than the tablet. The Open Voting Consortium has used the HP battery powered printer in its demos for about 4 years. Below is an HP link and links for a Canon printer and battery. As indicated above, links demonstrate availability of equipment and costs but are not recommendations regarding selection.

\$300 HP Printer http://www.amazon.com/HP-Deskjet-Printer-Battery-Included/dp/B000B658NC/ref=sr_1_2?ie=UTF8&qid=1422054349&sr=8-2&keywords=hp+portable+printer+battery+powered

\$170 Canon Printer http://www.amazon.com/dp/B00NV9LL9Q/ref=sr_ob_10?ie=UTF8&qid=1422054627&sr=8-10

\$83 Battery for Canon Printer http://www.amazon.com/Canon-LK-62-Rechargeable-Lithium-Ion-Battery/dp/B00161RTYM/ref=pd_bxgy_e_text_z

Tablet costs keep coming down. Current low-priced options include:

\$50 7-inch Tablet <http://www.amazon.com/dp/B00MXXJLTS?psc=1#productDetails>

\$110 10-inch tablet http://www.amazon.com/Dragon-Touch-A1X-Pre-installed-TabletExpress/dp/B00LM5WU96/ref=sr_1_8?s=electronics&ie=UTF8&qid=1422944529&sr=1-8&keywords=kitkat+tablet

The tablet should have a stand or cradle. There are many off-the-shelf options: <https://www.google.com/#q=tablet+cradle>

\$13 Akron Tablet Stand http://www.amazon.com/Arkon-Travel-Android-Tablet-Samsung/dp/B000CKVOOY/ref=sr_1_5?s=electronics&ie=UTF8&qid=1422934599&sr=1-5&keywords=tablet+cradle

Costs for each Voting Booth would total about \$475, based upon \$300 printer, \$110 tablet, \$15 tablet stand, \$5 partitions

and a 10% (\$45) contingency. Six Voting Booths per Polling Place would total about \$2850.

Consumables including paper, black ink cartridges, and spare batteries would be ongoing but minor, perhaps \$10,000 per election.

Some work should be done to figure attrition rate for tablets, based on some desired life span, perhaps 10 years. Enough spares should be purchased to cover lost, stolen, damaged or broken equipment. Printers should hold up fine as long as they are stored properly and not abused, with about a 10-year life.

Scanning Ballots and the Ballot Box

The voter would give the poll worker at the Ballot Box their ballot, and the poll worker would scan the ballot barcode and deposit the ballot in the Ballot Box. The ballot count would display on a monitor, and increment as each ballot counted, with ballot an audible beep. If the poll worker scanned the same ballot a second time for some reason, the ballot count number would not increment and the display would say "ballot already counted." The tabulation of votes would not be displayed on a screen. Once the polls close, the tabulation routine with the recorded votes would be terminated and the tally sheet printed. One would be posted at the polling place and one would go in the Ballot Box with the ballots. Any number of tally sheets could be printed and distributed to anyone upon request. The tally sheet would also exist in electronic form.

Ballot Boxes with the data files and tally sheets would be delivered to the City Hall counting center by the poll workers. The data could be extracted from the tally sheets and integrated in a matter of minutes after the poll workers arrive. The Ballot Box data files, paper ballots and tally sheets could be checked to ensure they all match. Before announcing results, some checking could be done to ensure that all have come in as expected and been counted.

Ballot Box and Monitor Costs

The Ballot Box would be a lockable custom computer with low-power/battery-powered system inside.

A small system board would be mounted in the upper right (or upper left) rear corner.... something like the following, which is about \$100 not counting the battery which would be about \$50.

\$100 Pico-ITX System Board (in quantity) <http://www.embeddedworks.net/empc572.html?gclid=Cj0KEQIA6JemBRC5tYLRwYGcwosBEiQANA3IB3Prz8ZiPBFHBOyo96TC35BxyXT6tVdsQ98IHINblQwaAv4Y8P8HAQ>

The system board would be mounted so that the HDMI (or mini HDMI) port would be accessible from outside the Box (rear or side). The Box would also have a hole for a 2D barcode scanner's USB cable. It would have a clamp inside so that once the cable is routed into the Box, it would be clamped into place and could not be pulled out while the Box is locked. Perhaps the 2D barcode scanner would stay connected all the time depending on whether the 2D barcode scanner might have other uses between elections.

\$200 2D Barcode Scanner http://www.amazon.com/Motorola-DS4208-SR-Handheld-Omnidirectional-Barcode/dp/B00MMXO9WI/ref=sr_1_1?ie=UTF8&qid=1422941954&sr=8-1&keywords=2d+scanner+usb

The top lid of the Ballot Box would be hinged with a lock. The Box would have a slot in front for depositing the ballots (see Open Source Consortium Demonstration at LinuxWorld, below, with link to LinuxWorld video).

For startup with the Ballot Box open, a keyboard and mouse would be attached and some secure media with the election data and software would be loaded. When all is checked and ready, the keyboard and mouse would be removed, the barcode scanner plugged-in and the Box closed and locked.

Any monitor with DVI or HDMI could be used (presumably plugged into its own UPS power). The Ballot Box would be in a safe location and continually monitored and staffed. The monitor would display the ballot count in a large font which could be seen from anywhere in the room. Anyone in the room should be able to witness that a ballot was scanned and

deposited and that the display number increased by one.

\$100 20-inch monitor http://www.amazon.com/Dell-Computer-E2015HV-20-Inch-LED-Lit/dp/B00M1C47EU/ref=sr_1_14?s=electronics&ie=UTF8&qid=1422942632&sr=1-14&keywords=computer+monitor

When the polls close, the Ballot Box would be unlocked and a printer from one of the Voting Booths plugged into the system board for printing the tally sheets (multiple copies of one tally sheet, letter or legal sized). The barcode scanner would be unplugged and keyboard and mouse plugged-in. The Ballot Box data files and tally sheets would be delivered to the City Hall counting center and added to the overall vote counts.

The Ballot Box could be made for around \$300 (not counting barcode scanner and monitor which may be available from City inventory), with \$50 battery and \$100 system board. A \$200 barcode scanner and \$100 monitor would bring the cost to \$600.

Total Polling Place Costs

With six Voting Booths at \$2850 and the Ballot Box, Monitor and Phone at \$600, total costs per Polling Place would be about \$3450. With 570 Polling Places, $570 \times \$3450 = \$1,966,500$.

CITY HALL COUNTING CENTER

The City Hall counting center would not need anything purpose-built or dedicated to handle polling place ballots -- just ordinary computers, printers, and scanners. However, representative equipment and costs are indicated below if new purchases are considered.

The tally sheets would have the precinct data encoded in a bar code, and much of the vote would be accumulated by scanning the bar codes on the tally sheets for other than ranked-choice votes. Ranked choice votes are more complicated, and discussed under Ranked Choice Voting, below.

The election materials from the polling places should come in sealed Ballot Boxes and sealed Envelopes. The counting center checks everything in, uploads the tally sheet information and electronically tallies all the polling place votes, and compares numbers. The Ballot Box would have the electronic file and voted paper ballots. The Envelopes should have the:

- test ballots
- tally sheets
- media with which the Ballot Box computer and the Voting Booth tablets were loaded
- USB stick or other media on which the results were copied from the Ballot Box
- chain of custody data with signatures
- signatures of witnesses

Spot checks include:

- comparing number of voted paper ballots from a polling place with number reported in the tally sheet
- check individual ballots to ensure only a single representation exists in the tally sheets and master spreadsheet.
- check tally sheet against corresponding range of cells in master spreadsheet
- manual recount of votes from a polling place and check against tally sheet
- scan some individual ballots and run software to verify that the text matches the bar code representation.

The last check is important because there's a persistent question: "How do we know the bar codes are right?" The short answer is: "This is verified at the counting center before the results are published."

Once all the ballots have been uploaded to master spreadsheet, results are calculated and the spreadsheet is published so anyone can download and check.

Vote By Mail Ballots could be scanned with 10 new off-the-shelf high-speed flat bed scanners using open source software to tabulate the votes. These new scanners could replace four older Dominion Voting System's Model 400-C scanners originally costing about \$75,000 per scanner, and would provide a much faster VBM count.

Canon \$4239 scanner <http://www.scantastik.com/hardware/canon-scanners/canon-dr-g1100-scanner.html>

An inexpensive but powerful PC—8-core, 4 GHZ processor with 16GB RAM and SSD—could run (open source) Linux to process the scanned images. The following represents a possible hardware configuration, if an existing Department of Elections computer were not used.

Computer configuration

\$400 Acer 1440p monitor 27 inch
\$100 Radeon HD 7770 video card
\$175 AMD FX 8350 8-core processor 4GHZ
\$180 ASUS SABERTOOTH 990FX system board
\$130 Corsair 16GB RAM
\$80 Corsair CX Series 750 watt power supply
\$105 Crucial MX100 256 GB SSD

\$1,170

Add any case, mouse, keyboard from stock or buy these new (~ \$100)., and then assemble and install Linux and other free open source software.

monitor

http://www.amazon.com/Acer-K272HUL-bmiidp-27-inch-Widescreen/dp/B00JB6HCIC/ref=sr_1_1?ie=UTF8&qid=1423551782&sr=8-1&keywords=acer+1440p+monitor

Video card

http://www.amazon.com/Sapphire-DL-DVI-I-SL-DVI-D-PCI-Express-11201-12-20G/dp/B009O7YZA6/ref=sr_1_3?ie=UTF8&qid=1423551843&sr=8-3&keywords=radeon+7770

Processor

http://www.amazon.com/AMD-FD8350FRHKBOX-FX-8350-8-Core-Processor/dp/B009O7YUF6/ref=sr_1_1?ie=UTF8&qid=1423551916&sr=8-1&keywords=amd+fx+8350

motherboard

http://www.amazon.com/ASUS-SABERTOOTH-990FX-R2-0-Motherboard/dp/B008YDJHWM/ref=pd_sim_pc_4?ie=UTF8&refRID=1214NWP9Q5NKZ44ZQGVI

RAM

http://www.amazon.com/Corsair-Vengeance-Desktop-Memory-CMZ16GX3M2A1600C10/dp/B006EWUO22/ref=sr_1_1?s=electronics&ie=UTF8&qid=1423551990&sr=1-1&keywords=corsair+ram

Power supply

http://www.amazon.com/Corsair-Modular-Bronze-ATX12V-EPS12V/dp/B00ALK3KEM/ref=sr_1_1?s=electronics&ie=UTF8&qid=1423552039&sr=1-1&keywords=corsair+750+cx+750

SSD

http://www.amazon.com/Crucial-MX100-2-5-Inch-Internal-CT256MX100SSD1/dp/B00KFAGCWK/ref=sr_1_1?s=electronics&ie=UTF8&qid=1423552103&sr=1-1&keywords=crucial+mx100+256gb

The 10 high-speed flat bed scanners at \$42,390 and computer at \$1,170 would cost about \$43,500.

ADDITIONAL VERIFICATION OF VOTING

There are some options to provide additional voting verification if desired.

1) Before giving their ballot to the poll worker at the Ballot Box, the voter could use an audio ballot verification station to put on headphones and scan the ballot's bar code, verifying their votes by listening to the votes read back. This would be a further check on the votes recorded on the ballot. Equipment would include a computer, and roughly \$25 for headphones and another \$200 barcode scanner.

2) One-person one-vote at the polling place can be verified by witnesses at the polling place. When the ballot is scanned with the Ballot Box' barcode reader and inserted in the Ballot Box, the number of the votes increases on the monitor, and protocol could call for others in the room to announce the number and applaud. The poll workers could thank the voter and hand out an "I Voted" sticker. Everyone in the room would see that one person cast one ballot, and that voter would be recognized and applauded.

AC POWER AND BATTERIES

While assuming AC power connection normally, there would be a requirement for cases where no power is available. This would mean having spare tablets on hand and external chargers available.

If no AC power were available, for example, you could start with 10 units (for 6 Voting Booths) charged-up, booted-up, and ready to go. Poll workers would have to check the units from time-to-time. When the charge on a tablet drops below, say, 25%, the poll worker would swap out with a charged unit. Then they'd connect the discharged unit to a portable charger (these are readily available and cheap). Printers should have no problem getting through the day on a single charge, and it's a simple matter to swap the battery in case one does run out of juice.

Having a user-replaceable battery would be highly advantageous. Most tablets do not have user-replaceable batteries, and this could be a problem. It could make the difference between getting 10 years service out of the tablet, and having to replace them all in 3 years.

There may be an issue if the tablet sits for a year unused with the battery inside. Probably the battery will completely lose its charge and, if it sits for long like that, it may be damaged. If batteries are to be stored, they're supposed to be stored with some charge -- uninstalled.

http://batteryuniversity.com/learn/article/how_to_store_batteries

Battery problems have plagued DREs (Direct-Recording Electronic Voting Machines) for many years. One of the worst scenarios would be to spend a lot of money on tablets and find that the batteries are all bad after one year. If the batteries are not user-replaceable, it could be that battery replacement would cost nearly as much as buying all new tablets.

Before making a large purchase of tablets, the battery issues should be thoroughly understood. It may depend on the specific battery technology and the specific circuitry in the tablet, which may vary from tablet to tablet. The issue may be mitigated with some maintenance routines. For example, perhaps an employee would have tables set up so that 50 units (or some magic number) each day would be taken from storage and set up to run for a while then charged for a while. Continually cycling through the inventory would provide confidence that the units can hold a good charge.

RANKED CHOICE VOTING

The data from each ballot is needed, even for a preliminary count, and the file with the polling place data should include all the ballots represented in XML/EML format (tagged text). A range of cells would be dedicated for each precinct so that anyone with a printed copy of the original tally sheet could check to see the same results in the spreadsheet.

All of the data from the polling places would be uploaded to one master spreadsheet (a script would run to extract data from each precinct PDF file and plug the data into the spreadsheet). Each ballot would be represented in one row with the unique identifier in the first column and the choices for each contest represented in however many columns it takes. The spreadsheet would not have any formulae; rather, a computation routine would be run once all the data is uploaded.

OPEN VOTING CONSORTIUM & THE “DECHERT DESIGN”

Alan Dechert presented the “Dechert Design” approach for open source voting to the SF Elections Commission on September 16, 2009, as well as providing much of the information in this report. This link to the Commission’s Minutes leads to links to the documents submitted at that time. <http://sfgov2.org/archive.aspx?dept=305&sub=314&year=2009&dtype=319&file=111410>

Alan Dechert demonstrated the “Dechert Design” approach for open source voting at the August 2008 LinuxWorld Conference and Expo in Moscone Center.
http://www.openvotingconsortium.org/blog/2008-aug-29/success_at_linuxworld

Auxillary battery power to run the polling place equipment for at least two hours of continuous use

I think this is poor. For simplicity and security, the system should not depend on wall power at all. The Dechert design calls for battery power only. If necessary, spare batteries can be kept at the poll site, but all the equipment should be able to go through the entire day. Our 2009 demonstration showed off our moved to purely battery powered computers and printers (the foam board partitions are easily folded up and cost about \$3 per voting booth).



Delegates to the California Democratic Council conference September 26-27 in San Diego had a chance to try out Open Voting Consortium's Electronic Ballot Printing system. It's very simple: make your selections on a computer screen, and then print out your finished ballot. "When will this be in all the voting booths in California?" That was the typical response.

System Evolution

I envision CCSF becoming the leading jurisdiction for open source voting. As such, there may not be great savings in the short run, and CCSF should not depend on pooling resources with other jurisdictions right away.

Over time, as people see open source voting working, and that people like it, other jurisdictions will want to participate. I would recommend that CCSF join CAVO since they have the consortium model and have started to gain some support from many jurisdictions.

The system would be continually improved, with changes introduced perhaps yearly along with new certification. Initially, CCSF would probably pay the entire certification cost, but as other jurisdictions adopt, cost would be shared. So, at some point, CAVO would be obtaining the certification, and CCSF would be paying a part of it. As more jurisdictions join, CCSF's share of the testing and certification costs would go down.

The trend for hardware I would expect to use, especially portable printers, bar code scanners, tablets, high-speed flatbed scanners, etc., has been for better technology at lower costs.

When smart phone voting is supported by the EAC – especially if it's the model I have proposed – quality, accessibility, voter engagement, convenience, accuracy, reliability will all greatly improve. Costs will drop significantly because many voters will be using their own hardware to vote. We call the smart phone voting model I have proposed “Vote By Virtual Mail” or VBVM. The federal government becomes the virtual mail service. They do this by contracting with messaging service providers who connect with your election management system and deliver the blank ballot (or ballot definition files(s)) to the voters smart phone (a flag in the registration file will be set to show the voter wishes to vote by virtual mail with the ballot sent to the number on file).

The finished VBVM ballot will be an image file, delivered by the messaging service provider to the jurisdiction. As with physical mail, the virtual mail service provided by the federal government may involve some cost, but should be a small fraction of what it costs to deliver and return a paper ballot.

I estimate that five years from now, half of CCSF's VBM voters will have switched to VBVM (or smart phone voting). People who like voting at the poll site can continue to do that, although some poll site voters will also switch to VBVM.

At some point, in 10 to 20 years (perhaps sooner), paper ballot VBM will disappear. Pre-printed ballots will disappear. If we make a great poll site voting system that continually improves, it may continue indefinitely.