The Trouble with Triples:
A critical review of the triple ballot (3ballot) scheme. Part 1 (Draft V1.1 October 5 2006)

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This review concerns the voting method introduced and dubbed "triple Ballot" by Prof. Ron Rivest. Its debut paper circulated in the final week of September 2006. Partly in response to a draft of this critical review, Rivest's paper is undergoing revisions. The three ballot system as proposed has many variations so to offer here its irreducible components here to aid the reader.

1) Beside each candidate's name are 3 bubbles in a row
2) The voter marks one bubble to vote "against" the candidate
3) The voter makes 2 bubbles to vote "for" the candidate.
4) When inserted into a required "checker" machine, the ballot is validated if every candidate has one or two marked bubbles and no race has more than one candidate with two marked bubbles.
5) The checker, adds a red stripe to the bottom, and slices the ballot into three strips.
6) Once striped, the 3 ballot strips must be cast.
6) Each separate ballot strip has a different random ID number.
7) The checker gives the voter a copy of one of the strips (her choice which) to take home.
8) To cast the ballot, the voter inserts the 3 strips into a dumb optical scan machine which increments the tally of a candidate for each filled oval for that candidate.
9) All of the cast ballots and their ID numbers are published, accessible to everyone

A more elaborate description with variations can be found at Prof. Rivest's web site:
http://theory.lcs.mit.edu/~rivest/Rivest-TheThreeBallotVotingSystem.pdf

For clarity we note that Rivest's term "against" is a bit confusing when first encountered. It literally means filling in an oval to indicate you are not voting for a candidate. Notice that because an oval is filled in even for candidates one is not voting "for", the final totals for each candidate the tally machine reports is the number of "for" votes plus an overall offset of the number of voters. The latter offset can be subtracted-off if desired.

A few of the problem types 3ballots create

A major construction fault of the original 3ballot disclosure paper is that it presents a moving target for criticism; by presenting a myriad of sometimes mutually exclusive variations in different sub parts, it fails to hold up any one gold standard schema to deconstruct. So I will have to critique aspects of it knowing that I cannot address every possible permutation of the presented options. As a debate tactic, I will assert it was the author's duty, not mine, to present one self-consistent unflawed system as a straw man.

1) The schema does not do what it purports:
   a. It does allow people to triple vote.
   b. It actually facilitates vote selling.
   c. It does destroy secret balloting

2) It's extremely complex for the voter to actually use, let alone understand how the security is supposed to work.

   a. A modest sized 70 race ballot might need 360 marks to complete
   b. If just one mark is wrong, the entire ballot is must be redone.
   Unlike a conventional ballot which allows the voter to choose to cast an overvoted or under voted ballot by ignoring the mismarked race, this is not allowed for the 3ballot because the counter will count overvotes as extra votes and under votes as negative.

3) The complex mechanics required (machines tearing ballots, or the "shamos" engine) is assured to break down.

4) Unlike conventional paper ballots the voter cannot vote if the "checker machine" malfunctions, as voting machines have been known to do. The process stops.

5) It's got lots of ill-considered issues such as the logic bomb of write-ins, security issues from people escaping with marked but not cast ballots, and security holes caused by mixing 1ballots with 3 ballots.

I will now give example in these areas.

Technical problems aside, the 3ballot is dauntingly complex for the voter.

To vote a single 5-person race in a conventional ballot (a.k.a 1Ballot) requires one mark, and the voter can tell at a glance it was done correctly. Whereas a 3ballot for the same requires six marks and takes more than a glance to consistency check. A modest sized ballot with 70 contests and questions, say 10 five-way races, 30 four-way races, 30 three-way races, and 10 two-way, would require 360 marks instead of 70. (50+10+120+30+90+30+20+10)

On a conventional 1ballot, a casual observer might guess that it would be nearly foolproof for a voter to accidentally overvote since one is makes just a single mark per contest. Yet the reality is that voters routinely over and undervote. Some trustworthy estimates put the mean mis-mark rate on the order of 1%.

One can only imagine how difficult it would be not to make a single mis-mark on the 3ballot. Indeed, even if the 3ballot's mark error rate were as low as it is on a 1ballot, it would be statistically unlikely that most people could ever complete a practical 360-mark 3ballot without a single error. In reality, I would assume that the mark error rate with such complex and hard to

eyeball patterns would be drastically higher and thus compounding the problem geometrically (literally by the factorial, if we assumed mostly uncorrelated errors).

The 3ballot requires complete perfection of every mark

On a conventional 1ballot, in the event the voter overvotes and the ballot is spit out with a beep, it's a matter of a moment to find the offending race. Finding the offending logic bomb on a 3ballot would be a matter of study, quite possibly beyond the grasp of many voters.

Moreover on a 1ballot if the voter has made an under or overvote, the voter has the expedient option of simply casting the over/under marked ballot and simply having the offending race ignored but the rest of the ballot tabulated. Indeed many, if not most, voters undervote deliberately. This is not a possible option on the 3ballot. If the races are not marked consistently the voter is not allowed to vote ANY of the ballot since it would allow the voter to vote 3 times for any candidate. Thus all 360 marks must be made with complete perfection. That's a hideous burden.

Likewise if the critical ballot-checker malfunctions no one can vote with the 3ballot and the election stops. It's not safe to separate the ballots before approved by the vote-checker. That would allow triple voting. If one mixed emergency 1ballots with the 3ballots security holes appear.

I have not even mentioned the confusion of races where one can vote for several candidates in a race (e.g. common for choosing county council races) will cause on the 3ballot. It also pretty much forecloses any simple method for implementing the most desired forms of ranked preference voting.

If it were implemented on current and legacy optical scan machines confusing technical glitches will ensue. For example, because current machines only have three scan heads, the 3ballot layout cannot have multiple races spread horizontally since all the heads are in use for each race. This will effectively triple the number of ballot pages. With present machinery, anything longer than 2 pages is a serious complication in practice both for voter complexity, and for simple accounting in the voting machine (e.g. what happens if page 1 is accepted but page 3 is rejected). With ballots shredded into strips for the triple ballot a new problem arrises. For example, imagine a ballot that has passed the "checker machine" and is then fed, all 3, 6 or 9 strips, into the ballot counting machine. However if the ballot counting machine is slightly more sensitive and it rejects some but not all of the strips as being over-voted (perhaps induced by stress in the ripping process), how does one correctly revote?

Why the scheme does not even do what it claims.

The paper asserts that someone cannot sufficiently prove his or her vote in order to sell it. And the paper asserts that a coercer could not reconstruct a ballot sufficiently to threaten a person. Both of those seem to be incorrect

I'm not a big fan of coercer-type arguments since they tend to rely on what one considers far-

fetched or not. But since I live in a community where it really goes on (indeed folks are charged with it in just the last election) my threshold is perhaps lower than others.

How to coerce a vote:

To coerce someone's vote, perfect reconstruction is not necessary; it only necessary that the vote reconstructed is sufficiently plausible as to warrant a threat to the voter's ballot secrecy.

Scheme 1

The 3Ballot system security requires that the ballot must be cast after the red stripe is painted on it by the "checker" machine. Thus there is a time when the voter still possess the striped but not yet cast ballot. Therefore a camera-phone photo of such a ballot is a perfect proof of vote.

Scheme 2

The voter writes down all three ballot-ID numbers. These can then be looked up on the web to obtain the vote. Note that the voter cannot simply make up some random numbers because the probability those ID numbers would form a correct ballot triple is too low. Nor can they feign forgetting the numbers because they won't get their reward, or alternatively escape punishment without them.

Scheme 3:

The voter is told the patterns to vote all three ballot channels and which channel to take home. Since all ballots are public record, the coercer simply looks up to see if all three parts of the ballot are present. The voter cannot count on the unlikely coincidence that another voter will vote in such a way that would supply the missing pieces in the public record. If they are absent he is punished. The coercer can up his odds of detecting misbehavior by giving the voter unusual channel sequences to use, or an unusual race selection in of major races (like voting both ultra-liberal and ultra-conservative parties, along with write-ins.) The desired patterns can be made virtually unique by the coercer.

Scheme 4:

It hardly needs saying that a large quantity voters, who have never heard of Exclusive-OR logic, will not understand how the logic of the process works to protect the secrecy of their vote. And indeed those folks are most likely concentrated in sub populations most prone to coercion through belief the receipts and web pages will reveal their vote. Moreover, they might even be right. How do I know that the printed or stamped ID numbers are not embedded codes linking my ballots? If stickers or barcodes are used how do I know the counting machine is not recording the sets?

How to sell votes.

Vote selling can re-cycle the first three methods above. It has the delicious added benefit that the 3ballot facilitates rather than hinders vote selling because with the 3ballot it's not needed to pre-arrange or even meet with the buyer since all the votes are published. For example, to sell your vote, just give the three ID numbers or the three vote patterns. They can be looked up on the web to see if the ID numbers form a valid vote triplicate or if the patterns exist. Indeed you don't even need to meet the buyer, just email the ID numbers to the offshore account in china, and a

third party e-mails you back a gift certificate for the Bruce Springsteen concert once the votes are published and they can validate your votes pattern. It's not even illegal for the buyer to offer this--no Chinese laws are broken.

The paper asserts that someone cannot vote "extra" times. This is appears to be incorrect.

How to make your vote count twice:

The voter fills out the 3ballot with a normal vote pattern. The "checker" checks the ballot, finds it good, paints it with a red stripe, and trisects it. Now the voter then simply fills in one more oval on each on his preferred candidates (so that now all three channels contain a vote for those people). These are then inserted as usual into the ballot counter which, as asserted in the paper, does not associated the ballots with each other but simply counts them. (Indeed that designed-in unawareness was the whole point of trisecting the ballot prior to casting the channels)

How to make your vote count triple:

Somewhat more laboriously, after receiving the red-stripe of goodness, the voter can also erase one oval from each candidate you do not wish to vote. Which in the dubious language of the paper would be recorded as two votes against the opposing candidates, which is net equivalent to two more votes for your candidate.

Another way to triple your vote

Despite a policy against it, it's going to be a practical impossibility to prevent people from leaving the polls with Red-striped but uncast ballots. Once a single one of these is in the wild, these can be used to triple a vote as follows. Put the purloined ballots in your jacket. Vote a legitimate ballot and get it red-striped. Then mix and match your ballot strips with the purloined one to obtain the desired vote-tripling combination for your favorite candidate. Take the 3 left over strips, and hand them to the next guy outside the poll and it's a self-propagating system. This is similar to chain voting coercion except here it's cooperative.

Round up of other issues:

The complex features of the system require more stringent controls on many other aspects of the voting and layers further complexity to provide this. In other cases false assumptions over the degree of execution of poll policies are assumed and consequently the promised claims are not deliverable in practice. Here is a sampler.

Vulnerabilities if ballots stocks are not kept in tight control

A large part of the security envisioned vanishes if voters give away their receipts in large numbers or if even one of the ballot stocks is in the wild. Since the proposed schema relies on administrative controls and voter education to control this, it’s important to question the validity of those assumptions.

Red stripe confusion and poll bolters:

The scheme requires the 3ballot is cast if a red stripe is on it. *("Once the red stripe is there, the multi-ballot must then be cast, as three separate ballots (This is enforced by procedures at the poll)".* Does anyone seriously think that if the voter spots an error on a red stripe ballot they would go through with casting it? Even if offered the enticing chance to mark all 360 choices yet again, they might simply bolt with ballot in hand. Even with conventional paper ballots, even though it presents only minimal hazards, voters are not supposed to leave the polls with an intact ballot, but in practice this happens all the time. You just can't stop them. Indeed this happens so frequently that Denise Lamb, the former head of NASED, used this in our debates exchanges as her (illogical) "reason" why paper ballots were bad compared to electronic voting.

Voters giving away their receipts:

A large part of the security envisioned vanishes if voters give away their receipts in large numbers. To list just one threat modality: an evil-doer who had the ability to electronically manipulate the vote, could safely change the votes of people who had turned over their receipts without fear of detection. With many elections decided by a handfuls of votes that is not as far fetched a threat as it might seem. But would voters do it? I would wager that nearly every voter would hand over his or her ballot copy for a candy-bar, beer, or lotto ticket. This assertion has been well tested: people will hand over passwords for candy bars, and will plug USB sticks found on the floor into computer, even at banks, where presumably they have been cautioned like the voters were. One could almost certainly get plenty of ballots by dumpster diving any trash cans near the polling place.

Write-in complication

The paper says write ins would require the voter to write in the candidate twice on two of the ballots, and check both write in bubbles. 3Ballots write-in promotes chaos and legal problems.

First, it allows you to vote 3 times. It's well known that with 1ballots voters routinely forget to check the bubble next to the write-in candidate. In parts of California there are proposals (if not the law by now) that will require all ballots to be hand checked for write-ins missing their checked bubble because the assumption is that the voter intent is evident from the write-in. This won't work with the 3ballot since I could simply write-in the candidate 3 times, (while only marking two-ovals to get my red-stripe); during the hand-scan my third unchecked ballot would be found without it's bubble marked and by the voter-intent law I'd get my third vote.

Second, the supposedly simple voting rules (one mark = a negative vote, and two marks= positive vote) break down for write-ins, where an exception to the rule must be made. For example, what does one mark in the write-in 3ballot mean? A single vote or a negative vote? If you answer it means one positive vote then what happens if someone writes-in a candidate whose name is also one of the printed ones? Logically this breaks the pattern of a single vote being negative. You would have to require some additional logic, like if you vote at all for a write-in you cannot mark just one oval. Yes you can figure out a consistent logic--my point was that it breaks the vote pattern both for the voter and for any hand counting.

Third, it's illegal under present laws. Currently, despite what you might wish, the law almost

everywhere is you vote one full vote or none; you can't normally split a vote in a single choice race. Yet the write-in system where you vote on two ballots allows the voter to write-in different candidates on each channel, breaking this paradigm.

Ballot stuffing immunity is not enhanced

The paper asserts that it is somehow more immune to adding ballots than normal schema: *"An adversary can't increase the number of ballots on the bulletin board without simultaneously increasing putting more voter names on the bulletin board, which should be detected by someone, somehow. (Grandma, did you really vote? Weren't you sick that day?)"* Empirically, this has never been a barrier to any ballot stuffing.

First, most ordinary elections already maintain a poll book so the same duplication control is in place, yet ballot stuffing has been around since forever.

Second even with that poll book. If someone did notice grandma's name there's no concrete negative proof she did not vote. In real elections, Poll books contain numerous attribution errors, so even she could prove it, in all likelihood the vote is valid but the poll book is simply wrong. Election officials are wary of deleting votes, so when it occurs that there are more votes cast than entries in the poll book, they tend to assume the poll book was out of order, as that happens commonly.

Third, the sad thing is that in practice it's less effective a control than one might think. Whether it’s true or not, it's commonly believed that the graveyard sometimes votes: where I live, it appears that people do vote multiple times by impersonating others and don't get caught. For example, you can go right now to the New Mexico secretary of states web site and find multiple precincts with significantly more votes counted than cast and vice versa. The point is, not that this shouldn't be a big red flag, but the odd fact is that it simply isn't in today's world. Yet the paper assumes it may rely on this approach.

This is not a complete list of the problems. It's just a sample of the holes it leaves open. No doubt some are plugged by myriad variants, but then we have to deal with the layered complexity of those and their burden on the process.