

Submission on eVoting by William Grogan

Overview

This document concerns itself primarily with possible changes to the system chosen by the Government that may be considered by the committee on foot of other submissions. I do not attempt here to cover all aspects of eVoting, e.g. the fact that the DREs are not networked reduces the risk of viruses and the loading of hacked programs.

I feel many of these “academically popular” submissions that you will get are flawed and attempt to rebut them in this document. I am convinced that many IT professionals are supporting these proposals without a critical analysis. They *can* appear somewhat sensible on first reading.

I am a computer Analyst & Programmer with 30 years experience. I am a director of a computer company based near London and my software is installed in over 200 companies in Ireland and the UK. I am an Irish national.

Introduction

VVAT (Voter Verifiable Audit Trail) is a proposal originally thought up by a Dr Rebecca Mercuri in the USA. I suggest that the need for such a system has not been proven, it would be very costly and even using the arguments of its proponents would solve nothing.

The proponents of VVAT are using the argument that computers are unreliable & insecure. We all know this. All voting systems are unreliable and insecure to some degree. The question is more what is the level of risk?

There is no doubt that much of the anti-eVoting sentiment comes from those that fear change & technology. This is a natural human reaction and is felt more by some people than others.

From a Systems Analysis point of view any solution to a problem that incorporates the problem itself is not an elegant solution. eVoting means electronic voting and not electronic and paper voting. It is intended to get rid of paper production, storage and counting. To incorporate this into the solution is obviously ridiculous. Talk about buying a dog and barking yourself!

Spoiled Votes

There is no mechanism in law for spoiled votes. They were an unintended consequence of the failings of the paper voting mechanism. As the Minister has said, “the purpose of an election is to elect a government”. All those familiar with voting in Ireland agree that the vast majority of spoiled votes are accidents. eVoting with its built in validation will solve this problem. Eliminating spoiled votes will return the franchise to the equivalent of the populations of Bandon & Clonakilty added together in each general election. There are many other more democratic ways of registering dissent than spoiling votes on purpose.

The lack of a recount myth

People have been arguing that there is no recount facility with the electronic votes. There never was *in the same sense* with the paper votes.

When we speak of a recount of the paper vote we speak of the need to **Count Again** the actual physical votes that we have to hand because of the inaccuracy of the counting mechanism (the humans). It is not a validation of the validity of the votes cast but just of the accuracy of the count. It cannot detect all invalid, illegal or unauthorised votes. It cannot for example detect a vote cast by someone who illegally voted twice. At each re-count votes that were determined as spoiled or valid can be reclassified. This mechanism is not relevant to electronic votes.

No such recount is necessary with a computer as it can count with 100% accuracy. When people demand the need for a recount with electronics they are mixing up two things, accuracy of the count and validity of the votes that are being counted. There is no parallel mechanism with paper and we had no problem. Why demand it with electronics?

The Flawed Argument for a voter “window” to see the printed vote

The “Rebecca Mercuri Method” insists that a vote must be printed and viewed through a glass window so that the voter can be assured that how they voted is what is recorded on the DRE. Proponents of VVAT say that this is to prevent bugs and to stop hackers loading onto the DREs programs that change what the voter enters to what the hackers wish.

There is however a complete flaw in this argument. If someone goes to the trouble of writing a program to corrupt the vote then they will obviously have to make the program print the ballot to look the same as what the voter entered, however the corrupt program can still store a different vote in the DRE’s memory. A bug could do exactly the same thing. The voter therefore is not guaranteed that what he entered is what is stored. Once voters are told this then they will obtain no extra assurance from checking the printed ballot.

Testing & VVAT

The proponents of VVAT say that no amount of testing of the systems will assure them and that they need a paper based ballot to ensure that the voting was fair. However they also say that there is no need to count all the votes just a “random sample”. This in itself is just another test. They can’t have it both ways. Either testing *is* good enough or else all ballot papers must be counted in every election for ever.

The Cost of VVAT

Just as we make decisions about what car to drive, what bottle of wine to drink, what restaurant to eat in, we must all make decisions on how many hospitals to build, how much the pension is etc.. You cannot just keep making eVoting more complex and more expensive because of irrational and exaggerated fears.

Storing data in two places

Ironically one of the major reasons to oppose VVAT is that it will store the votes on two media, electronically and on paper. With 7,000 DREs and printers and in excess of 1,000,000 votes there will be very little chance that the printed ballot papers would exactly equal the electronic votes in every election. Paper can jam, there are small probabilities that an electronic vote will be lost and when there are over a million votes and printed sheets of paper the sum of all these small probabilities will be some differences. But what do we do then? If one of the randomly chosen DREs has a small discrepancy do we count the lot? Is the election declared null? We have to accept that no voting mechanism devised by man can be 100% perfect. No voting mechanism that records the votes in two different places can have zero discrepancies.

Paper

There is an understandable gut feeling that a paper vote is “better”. Some have even said that the tactile feel of the ballot paper is important. However all of us are now moving more and more information to electronic media. It is estimated that only 0.01% of the world’s information is now on paper. I estimated that there would be a 500ft high column of paper produced by VVAT. I believe that calling for a paper audit trail is similar to what they did when cars first came out; they had a man walking in front of it waving a flag.

Technology & the fear of it

A paper based system cannot continue to get better over the years because the more complex it becomes the more it falls apart. This is not true of computer systems, they do evolve into better and better systems.

All systems are imperfect and that applies to computer systems but computer systems are many orders of magnitude more accurate than manual systems. However not withstanding this, those who are afraid of technology (GMOs, agri-business, medicine, vaccines, MMR, their tooth fillings (the Mercury Amalgam), etc.) demand a much higher degree of perfection with computer systems than they ever did with the systems they were replacing. An example I often give when I supply my own software is that the client often demands changes such as, "I want the "Quantity in Stock" displayed on the screen on line 14 and not 13 and on the right side and not the left side". However, if you purchased a €100,000 Mercedes you won't demand that the cigarette lighter be put two inches to the left of where it is.

No one campaigned against the paper based voting system which was at best 98% accurate and yet now demand a 100% guaranteed accurate computer system. This leads one to believe that the campaign has more to do with the fact that technology is being used and is not a manual system. All professionals who install computer systems see some degree of opposition. It is human nature to fear change and technology.

I do not remember an activist group starting up to campaign against computers in the breaking systems of cars, auto-pilots in aircraft, computer navigation systems, the Post Office's Random Number Generator that picks Prize Bond numbers, etc.. I'm not being frivolous; when I press the brake in my car I do not get a paper based audit trail that proves to me that the computer has correctly calculated the anti-skidding parameters and hasn't or will not make a mistake that will kill me. I trust the engineers. More to the point I think the computer based braking system IS more reliable than a manual system and the more computers in a car the safer it is up to and including fully automatic computer controlled cars. As someone remarked a few years ago, the day will come when humans will not be allowed drive cars on the road.

Accuracy

As well as spoiled votes and miscounted votes there are other inaccuracies in a manual system. A vote can actually be incorrectly filled out and still not be registered as spoiled. In a general election it is common, how common I do not know (I suspect more common than completely invalid votes), for people to put 1,2,3,3,4,5,6. This is a valid vote as far as the 1st and 2nd votes are concerned but for the voter his vote may effectively be useless as his 3rd onwards preferences are ignored and may have resulted in changing the result. The above cannot happen with the eVoting System because of its built in validation. How do I know that my vote was not accidentally spoiled or that I did not write 1,2,3,4,5,5,6,7,8,9,10? How do I know that it was counted by the humans that we know make mistakes because of the different results from recounts? In fact recounts almost never give the same result.

Overall I would argue that my faith that my vote was recorded as I intended and counted properly is only about 98% true with the manual system. I am confident that it will be far more accurate in the new system because it will be validated and counted correctly. Therefore I vote for the new system. (A recent poll in the USA showed 92% of voters were confident that their eVote was counted.) see HYPERLINK "<http://www.vvdailypress.com/cgi-bin/newspro/viewnews.cgi?newsid1080137542,90120>" <http://www.vvdailypress.com/cgi-bin/newspro/viewnews.cgi?newsid1080137542,90120>,

Is the pro-VVAT lobby anti-eVoting?

Yes in my opinion. The pro-VVAT people claim that they are not anti-eVoting but they obviously are. See the web based video of one of their leaders Peter Neumann here, HYPERLINK "<http://www.stanford.edu/class/ee380/ay0001.html>" <http://www.stanford.edu/class/ee380/ay0001.html> look for Dr Neuman's name and click on 128Kb. This is approximately a 2 hour video but will give an idea how these people are thinking. My analysis of this video follows:

The speaker, Peter Neumann's entire career and the organisation he works for is based on the fact that computers are insecure, so obviously he pushes this agenda at all times.

He said that, "*people who advocate internet voting are out of their minds*".

He is totally pro-Rebecca Mercuri. One of his quotes was "*I was on the committee that oversaw Rebecca's thesis, I am very partial to this thesis, I think it's a wonderful thesis.*"

One of his stories to indicate voter fraud was a story about Edgar Alan Poe getting bottles of whisky for voting for a particular candidate!

He clearly says that even with Mercuri's mechanism that eVoting is unacceptable. He is clearly anti-eVoting. If this is how Mercuri also feels then pro-VVAT **IS** anti-eVoting. Regarding eVoting he says, "*We have created a monster*". He seems to advocate voting using pebbles to vote as some African tribes do!

He thinks that multiple physical keys are acceptable to protect the ballot box that holds the printed ballot papers but not good enough to protect the DRE's. His description of the purpose of the "Mercuri" window to guarantee that what you voted is what is recorded ignores the logical flaw that a bug or the hacked program could be programmed to do this.

Dr Neumann thinks computer security is "*impossible to solve*". Talk about bringing a mechanic to check out a second hand car! He used the word "magical" to describe how computers work on a number of occasions.

His “lack of a recount problem” is a red herring. The purpose of recounts with paper is to correct the classification of ambiguous votes as valid or not and the very common human counting errors. Of course you can recount the electronically recorded votes but it’s fairly pointless as computers don’t count incorrectly.

I think Neumann is actually anti-computer or at best thinks that they are a curate’s egg. He said, *“Computers are wonderful and can be used for the benefit of mankind but I have been cataloguing the risks for years and years and years and when you scratch the surface you find it’s not that easy.”*

We do agree on one thing, he said *“that the exit polls are extremely important”* as a check on the voting. Does this not solve the problem that detecting a fraud big enough to put the Monster Raving Looney Party into power will fail the Exit Poll Test and deter someone from serious hacking?

He said, *“Not matter how complex you build the system there will always be flaws in it”*. Therefore VVAT solves nothing.

Neumann also rejects “Formal Methods” because as he said it’s useless because such a program may not be the one running on the DRE as it’s been replaced by the hacker. So according to Dr Mercuri Open Source is no good and according to Neumann neither is Formal Methods. VVAT is also useless and promoted by those that think it is *“necessary but not sufficient”* because even using it is not sufficient to guarantee a 100% true election. If you are opposed to eVoting for a set of reasons then pushing VVAT is pointless for exactly the same reasons.

We know computer systems are not perfect but nothing is. Our only consideration is it better, more accurate and faster than paper and the answer is clearly yes, yes and yes.

I think that these academics are anti-eVoting from a philosophical position. Maybe they have taken Gödel’s Theorem too seriously? They argue against eVoting using the same logic as the anti-vaccination people do. No matter how small the risk it is unacceptable.

This entire anti-eVoting “movement” is an academic one that has no bearing on the real world where we all accept the lack of perfection. We couldn’t function otherwise. Neumann even said that most electoral fraud problems had nothing to do with the actual voting system.

Computers land aeroplanes, run the transfer of money internationally, handle the sales of all shares and now most businesses, allow robots to trundle around and explore Mars and will be successfully used for voting despite the doom mongers. There will be problems, just as there was with the Spirit Mars rover, but they will be solved and will be trivial.

The risks

Every system ever devised is fallible; cars, air traffic control systems, manual accounting systems, all the technology we use every day, the current manual voting system and the proposed eVoting system. However, we do not spend an inordinate amount of money or time trying to overcome this. We have to accept risk in everything we do. Unfortunately many people cannot sensibly measure or balance this and exaggerate the risks and consequences, particularly, of change.

Those that earn their living studying risks, such as Peter Neumann & his student Rebecca Mercuri, exaggerate the risks the most.

The probability that a professionally constructed eVoting computer system that is adequately tested fails more often than a manual system is very remote. The current manual system is at best no more than about 98% accurate (1% known spoiled votes and say 1% of the 1,2,3,4,4,5,6 and other wrong but non spoiled types).

Elaborate parallel systems are not always necessary or better. Parallel systems themselves cost money and can even make systems more complex and prone to error.

The actual collection and counting of votes is a very trivial computer problem, far simpler than even the most basic accounts package.

(As an example, some years ago I took to carrying a full spare fuel can in my car. I ran out of petrol far more often during this period, so I gave up carrying the spare can and stopped running out of fuel again.)

To say we should consider the possibility that cosmic rays will change zeros to ones is nonsense. Mad hackers with magnets are no more likely than mad fire bombers bent on destroying paper votes. Jail is an obvious deterrent as is adequate physical security to those considering committing electoral fraud. Even the problems in Florida during the last election were caused by paper and not by electronics.

The people demanding the VVAT, paper based parallel system, which is a worldwide movement, are of the same class as the activists that oppose water fluoridation, amalgam tooth fillings, the Cassini Mission to Saturn (because it might crash back onto Earth), the MMR vaccine and all the other silly illogical "anti" groupings.

The evidence for computer failures in eVoting

The web abounds with anecdotal evidence of the failures of eVoting equipment but when these stories are investigated there is rarely any substance to them.

New Scientist (NS) magazine and many web sites carried a story about eVoting and referred (in NS an entire paragraph) to a story that at first read indicated a problem but when investigated turned out to have nothing to do with the equipment. "134 Votes went missing in Florida poll", says the headlines. However they never mention that when voters went to the polling machine they discovered there were no Democratic Party candidates in that particular election and simply walked out without voting.

In the USA there was a "surprise" result when after 128 years a Republican was elected instead of a Democrat. This is put about as evidence of failure of the voting equipment. But it was not a big surprise, the Democratic candidate put his foot in it a few days before the election by attacking President Bush over the war in Iraq and even the losing candidate's campaign manger clearly said that the election was fair and valid. His words are never quoted. I had to trawl through newspaper web sites to find them.

A file was found called "Rob-Georgia" on an eVoting company's web site and the anti-eVoting web sites claimed evidence of a conspiracy. However what they don't tell you is that there was a programmer called Robert from Georgia and it was his file they stumbled across.

Another story is that someone loaded an unauthorised program onto a voting machine. What they do not say was that he was an employee who was a programmer of the company that supplied the machine and had a valid program and reason to load it but broke the rules regarding how he went about doing it. He was wrong but hardly evidence of hacking.

Many of the quoted "failures" turn out to be related to human errors of the type that occur in manual systems as well and are not related to the equipment or software.

Many of the stories of "eVoting failures" relate to security breaches when voting in the USA on relatively trivial matters such as school boards, primaries, the election of judges, sheriffs, local by-laws etc. where security would be very light.

Take all reports of equipment failure with a grain of salt unless you get to the bottom of the story because they are generally exaggerated, slanted or lie by omission. There are many reports of eVoting going extremely smoothly and quotes from elections officials gushing about how great it was and how easy it was but the anti-eVoting lobby never print these stories and there is no pro-eVoting lobby.

Practical Problems with the Rebecca Mercuri VVAT Mechanism

This drawing below is the actual system proposed by Dr Mercuri

INCLUDEPICTURE

"http://www.boards.ie/vbulletin/attachment.php?s=&postid=1457186" *

MERGEFORMATINET

Anyone who trains people to use computer printers, uses them themselves or in particular maintains them will know that there are many problems associated with using printers.

I will assume that the printer is a tractor/continuous feed dot matrix type as this seems the only practical solution, (and also seems to be the one used in the Mercuri drawing and the one currently attached to the DRE chosen by the Irish Government). A similar but slightly different set of problems will crop up with Inkjet & Laser printers.

The first problem is that to successfully use printers you do need to know the little tricks and knacks that ensure they work smoothly. Officials who use these machines for one day on average every 18 months will not know the problems or solutions and will not have the necessary dexterity or experience.

The ink cartridge will dry up after a few months of storage. I would imagine part of the instructions on using the printer would be to replace the cartridge with a new one for each election. Changing an ink cartridge is not easy, even for experienced users. It has to be put in at a particular angle and into an exact place on the printer. The ribbon needs to exactly go between two pieces of metal/plastic that are less than 1mm in width. This probably eliminates any election official with poor eyesight or who is nervous about anything mechanical.

The tractor feed sprocket wheels need to be exactly the width of the paper sprocket holes. If they are misaligned then the paper will eventually roll off the sprockets. This will happen after between a few sheets and maybe a few dozen. The paper may also come off if it is not fed in exactly straight.

There is a very small lever that moves the print head back and forward that is needed to allow for different paper depth/number of copies. If this lever is too far back no print will appear on the paper or will be very faint, if it's too far forward the paper will get jammed. This setting is quite specific. It's a balance between print quality and the risk of jamming.

The printer cable has pins that when incorrectly forced into the female end can get bent and even broken. An inexperienced user may not even be aware there is a correct orientation of the cable head and try and force the male connections into the female and break one or more pins. A screwdriver is also needed to screw in the two screws that hold the cable in place. A really bizarre set of clips that exist as far as I know only on the end of printer cables clips the other end to the DRE. Maybe we could use USB but then there is the danger of breaking the silly little plastic thing that holds the cable in place.

The paper will have to be lined up horizontally and vertically correctly or the ballot will be printed incorrectly on every ballot from then on. Top of Form will have to be set and new software installed in the DRE machines to print test pages.

Paper will run out, get jammed etc. and have to be replaced in the middle of the voting. Under pressure the inexperienced officials may make matters worse. An inexperienced user of a printer could very well completely fail to get it to print even if it has no actual problem with it.

Continuous stationery does not happily fold or roll into a box. It also gets jammed at this point. This is often exacerbated due to dampness and static electricity. Paper gets damp when stored and is then more likely to jam in a printer.

All the above problems are magnified in each count centre because every DRE needs its own printer and "Mercuri cabinet".

If the paper printing mechanism fails this will lead to the failure and the taking out of service of the entire unit. I would estimate the failure rate of the units to be at

least 10 times greater with a printer than otherwise.

There are also problems with the physical nature of the Mercuri cabinet. I would estimate that the time and effort needed to erect the Mercuri cabinet as 10 times greater than the DRE itself. The storage space needed would also be several times greater. The expense of delivering, storing and erecting the cabinet would also be several times greater than the cost of the DRE machines.

The drawing of the proposed system seems to show that the voter must walk around the back (or is the side) to see the printout of their vote. This cannot be as others outside could then see how the voter voted. This whole contraption would have to be enclosed in a curtain that goes around the front the side and the back. I estimate the curtain length of 21ft (6+3+3+3+6). The floor space now becomes 54 sq ft.

I estimate that the cost of building the small shed that houses the printer and the glass window would be of the order of €5,000. (Even a basic printer sound proof box can cost €800, often more than the cost of the printer!

The Philosophy behind anti-eVoting and pro-VVAT

Academic researchers correctly point out that computer systems are not perfect. Other academics use Gödel's Theorem to prove nothing can be proved. All systems and logical arguments are flawed. I then think they get carried away and forget that in the real world imperfect systems must be used.

Academics opposed to the Irish Government's decision on which system to use are often in favour of what are called "Open Systems". These systems use programs that are in the public domain. They are generally not copyrighted and are often written by programming hobbyists. However other academics such as Dr Mercuri (who has said that, "*computer systems are fundamentally flawed*",) and who proposed VVAT, are opposed to Open Source which they claim adds no extra security. The same applies to the use of Formal Methods because software written using this more expensive method cannot ensure that the program has been replaced by a hacker. (Presumably the hacker's program which will print one thing and record another is not written using Formal Methods.)

Summary

In a nutshell the anti-eVoting and pro-VVAT lobby argue that computers cannot be trusted. They have clearly said that they are impossible to program to be completely accurate and above corruption. They then propose various solutions such as VVAT which they admit will not change this position. Therefore their advice should be ignored.