Electronic Voting Protocols

How can we trust this technology?

Ecole Doctorale IAEM

Cyrille Wiedling – Ph.D Student in CASSIS at LORIA

Did you say « Protocols »?

Yes, we use **cryptographic protocols** which allow us to vote electronically using our computers or voting machines.

They consist in a list of predefined steps (like a cooking recipe) to accomplish a goal (in this case, to vote) which use different cryptographic related functions (such as encryption, electronic signatures, ...)

The everyday life provides us with a lot of examples:

Credit cards

Secured Internet (https)

Is it really more convenient?

There are several benefits:

You can sometimes vote directly from your home, a benefit which **can reduce the number of abstainers**. This « new » way of voting can motivate people, especially the youngest.

It is also **more efficient**. Computers count much faster (and with no mistakes!) the results. This prevents human errors in counting.

Sounds risky, no?

Indeed, your vote is **a sensitive data** that needs to be protected. To achieve this, there is a need of guarantees that come from different security properties.

One of the most important is **privacy**. It is better to be sure that there is no possibility (for someone else) to learn how you voted.

There is also **integrity**: The result of the election must accurately reflect all the votes that have been cast during the voting process.

Is it *really* safe?

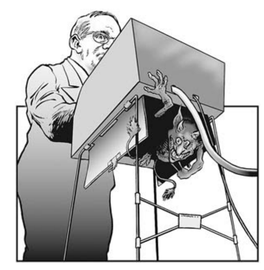
Yes and no… **Each system is different**. It depends on how it works and how they are implemented. Some are vulnerable:

- Machines Diebold (USA)

  (Attack by Candice Hoke, 2008.)

- Paperless Voting Machines (India)

  (Attack by A. Halderman, R. Gonggrijp, 2010.)



Others are safe and satisfies good security properties like Helios, Civitas, …

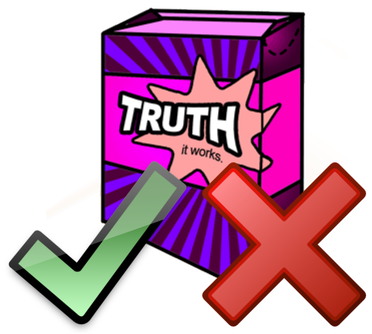
How can we prove that a protocol satisfies a security property?

To do so, you can use **formal analysis**, a symbolic study of your system and property. This mathematical approach and reasoning provides you with a proof describing if your system satisfies (or not) the property.

Here is how you can do it:

As a first step, you model the system and your property. This should be as precise as you can, to ensure the accuracy of your result.

Then, you perform a proof, a mathematical one, which looks almost like the others.



Finally, you have your answer: the system satisfies (or not) your property.

There exist some software tools (like ProVerif) which can do the proof for us, but they reach quite quickly their limits because e-voting systems are often very complex.

What is your thesis about?

In my thesis, Formal Analysis of E-Voting Protocols, I study the security of existing voting systems. (One of them was used to vote using Internet in Norway in 2012 and is still in use.)

I also develop a new software tool to deal automatically with these (often) complicated systems instead of doing all the proofs by hand by myself. It is always better to make a computer doing the hard work! (As I said before, there are less human errors. ☺)

What should I remember?

A non-verified system can be dangerous. You'll never use a poor safe to protect valuable assets, and prefer a safe that brings warranties. It should be the same with your vote and electronic voting in general. **We must ensure the security of a system before using it**, especially if it is deployed for important elections.

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