*Electing a University President
using Open-Audit Voting*

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The UCL president election

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Université catholique de Louvain (Belgium) sets new rules for the election of its president

- ▸ ≈ 25.000 potential voters
  - ▸ ≈ 30 members of the academic senate were voting before
- ▸ Voting operations conduced through browser/email
  - ▸ Large number of voters
  - ▸ Geographic dispersion of the voters
  - ▸ High familiarity level of the voters with the Internet
  - ▸ Low-coercion environment

Talk Outline

- UCL election specifics
- Helios 1.0
- Challenges and Deployment
- Lessons and statistics

Election specifics

- ▶ 1-out-of-n election
- ▶ Absolute majority is needed to win, two rounds maximum
- ▶ Vote is not mandatory
- ▶ Sophisticated vote weighting rules : *(simplified a lot)*
    - ▶ 4 categories of voters
      Faculty, **R**esearchers, **A**dministrative Staff and **S**tudents
    - ▶ **F** have 61% of the electoral votes
    - ▶ **R**, **A**, **S** receive 13% each
    - ▶ restrictions apply on sufficient participation rates
  ⇒ **the weight of each vote depends on the global turnout**

Election outputs (as in the bylaws)

- ▸ number of electoral votes received by each candidate
- ▸ number of voters in each category

- ▸ (results by category are secret)

How to make this work ?

Observations

- A university is a nice place to try something new
- Voters aren't necessarily computer scientists
- Voters have UCL email address, login/password, member card
- Open-source and free starting point system needed
  (trust, versatility, time frame)

Helios 1.0 [Adida 2008]

www.heliosvoting.org

Helios 1.0 [Adida 2008]

Principles

- ▸ Browser-only voting system
- ▸ Low-coercion elections
- ▸ Design kept as simple as possible :
    - ▸ Booth can be used as many times as desired
        - ▸ ElGamal encryption of $0/1$ for each choice
        - ▸ Benaloh challenge
          cast or audit, authenticate on cast
    - ▸ Sako-Kilian mixnet before decryption
    - ▸ Web bulletin-board shows votes and proofs for everything
- ▸ Deployed on Google App Engine

Key management

- Vote confidentiality relies on control of ElGamal private key

  Move to distributed ElGamal

- Trustees are not computer scientists

Distribute trust among experts
Use LiveCD, disk- and network-free laptops
Monitoring/Audit by independent company

Vote weighting

- ▶ Participation per category and weights are public
  But support of candidates per category is secret

⇒ We cannot open individual votes!

Move to homomorphic tally instead of mixnets

- ▶ Not enough to hide support of candidates per category...

$$w_{\mathbf{F}} n_{\mathbf{F}} + w_{\mathbf{R}} n_{\mathbf{R}} + w_{\mathbf{A}} n_{\mathbf{A}} + w_{\mathbf{S}} n_{\mathbf{s}} = n$$

... has ≈ 1 solution for UCL election parameters
(knapsack-style problem)

Use smaller, approximate weights
Careful choice provided $\approx 10^5$ sol. for $\approx 10^{-4}$ precision

Technical Challenges (3/3)

Audit complaints arbitration

- Voters invited to complain if WBB looks wrong
  DoS through complaints ?

  Give voters a way to prove things are wrong
  Timestamp/sign everything as evidence

- Voters usually not familiar with signature

  Signed pdf files seem most usable
  Signature through PortableSigner
  UCL Root certificate deployed on all UCL machines

Deployment Challenges (1/3)

Privacy matters

- ▶ Publication of privacy policies

  Help of law office

- ▶ Name of voters cannot appear on bulletin board

  Each voter receives an alias

- ▶ Google App Engine constraining : data sent out of EU

  Move to Django/PostgreSQL for free software stack

Deployment Challenges (2/3)

Usability

- Make voting process as straightforward as possible
  Keep information available for curious voter

  2-level interface : basic vs. curious voter

  /Q3tICMUkbwRhl+NcvfILWr15is @
  [imprimer]

Robustness and availability

- Each election round lasts 35 hours

  Use redundant in-house servers
  Use cloud computing (Amazon EC2)

Communication

- Meetings/presentations
  - Election bylaws working group, Rector council, Academic council, Employees Union, . . .
- Voter education
  - University newspaper, lunch-time demos, screencasts, . . .
  - Test election (student projects, for university sponsoring)
- Support organization
  - Phone/email support by UCL IT Department
  - Voting offices, with election officers

Election Phases – Organization

Registration Phase

- ▶ Voters registration   *2 weeks*
    - ▶ registration website
    - ▶ generation of voters' aliases
    - ▶ generation of credentials
- ▶ Test Election   *same 2 weeks*

Voting Phases (Each two rounds)

- ▶ Voting period   *2 days, from 8am to 7pm the next day*
    - ▶ same interface as Test Election
    - ▶ credentials still accessible on registration website
- ▶ WBB Audit day   *1 day, next to the voting period*
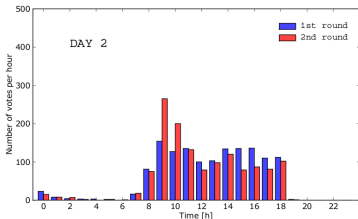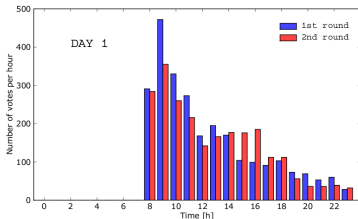   - ▶ voters check the web bulletin board (. . . and may complain)

Participation

- 5142 registered voters

  Very useful for credential negotiation
  Very useful for 1st bound on number of voters

- 10644 votes tallied
  - $\approx$ 3000 votes for test election
  - $\approx$ 4000 votes for each round
- max. 17 votes/minute, emails trigger vote

Election Phases – Lessons and Statistics 2/3

Voter behavior

- 1% vote more than once (last vote counts)

  Quite controversial, no strong impact

- 3% use voting offices

  Mostly people unfamiliar with PC
  Quite over-dimensioned on our side

- 30% check their vote on web bulletin board

  Quite high !
  Decreases on 2nd round

- 120 tickets raised by UCL support
  1. Credentials lost
  2. JVM missing, use of Win95, IE4, . . .
  3. Did I do everything correctly ?

     Importance of testing with broad spectrum of people. . .

Web Bulletin Board Audit days

- ▶ 7 complaints issued during 2 rounds
    1. I am just trying to vote after the deadline
    2. I want to test the procedure
    3. I switched my receipt with someone else in the printer

    Convenience of voting server with public data only

Tally

- ▶ 1st round leader was < 2 electoral votes from majority

    no objection, clear majority on 2nd round

Conclusion

- 1st significant-outcome, multi-thousand-voters open-audit election successful

Elections à l'UCL: un vote électronique vérifiable, "inédit" à grande échelle

L'élection ces 2 et 3 mars du nouveau recteur de l'université catholique de Louvain (UCL), au suffrage universel pondéré, se fait via un système de vote électronique d'une nouvelle génération qui permet à l'électeur de vérifier que le résultat de l'élection est correct, a indiqué l'UCL au premier jour du scrutin.

Bruno Delvaux élu recteur de l'UCL

Mis en ligne le 23/03/2009

Bruno Delvaux est né en 1954, il est marié et père de trois enfants. Il pratique le cyclisme et est passionné d'œnologie et d'histoire.

Il entrera en fonction le 1er septembre 2009. La commission électorale annonce, ce lundi 23 mars, les résultats du 2e tour de l'élection du recteur de l'UCL. 3 758 électeurs ont voté sur un total de 5 143 électeurs inscrits sur les listes électorales. Les résultats enregistrés au 2e tour sont les suivants : Bruno Delvaux : 53,83 %, Vincent Blondel : 42,45 %, Votes blancs : 3,72 %

- Open-audit elections allow moving
  - from election manipulation opportunity
  - to voter verification opportunity

- Each election is a significant project on its own
  Thanks to all the people at who supported it !
  UCL, Harvard, ENS Cachan, BlueKrypt, Google, Nexxit, . . .

Thank you !

https://election.uclouvain.be/test