A privacy attack on the Swiss Post e-voting system

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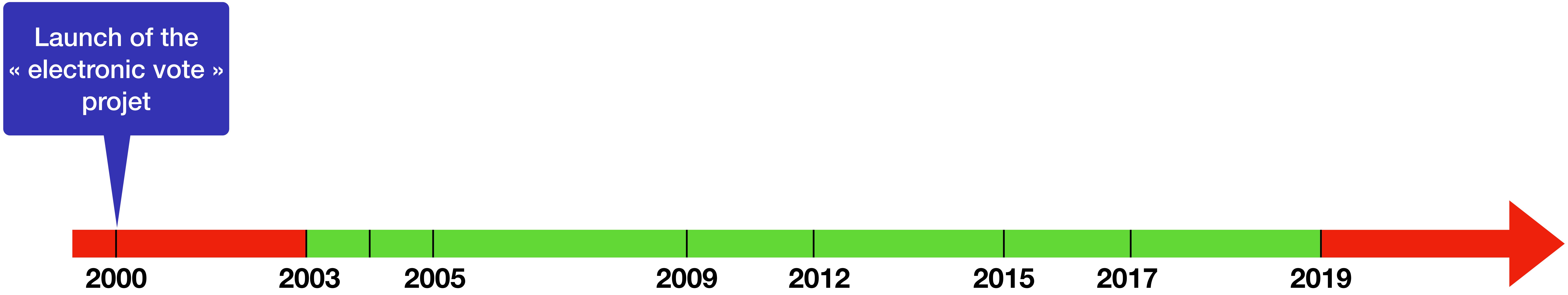
Laboratoire lorrain de recherche en informatique et ses applications

A brief history



https://www.bk.admin.ch/bk/en/home/politische-rechte/e-voting/chronik.html

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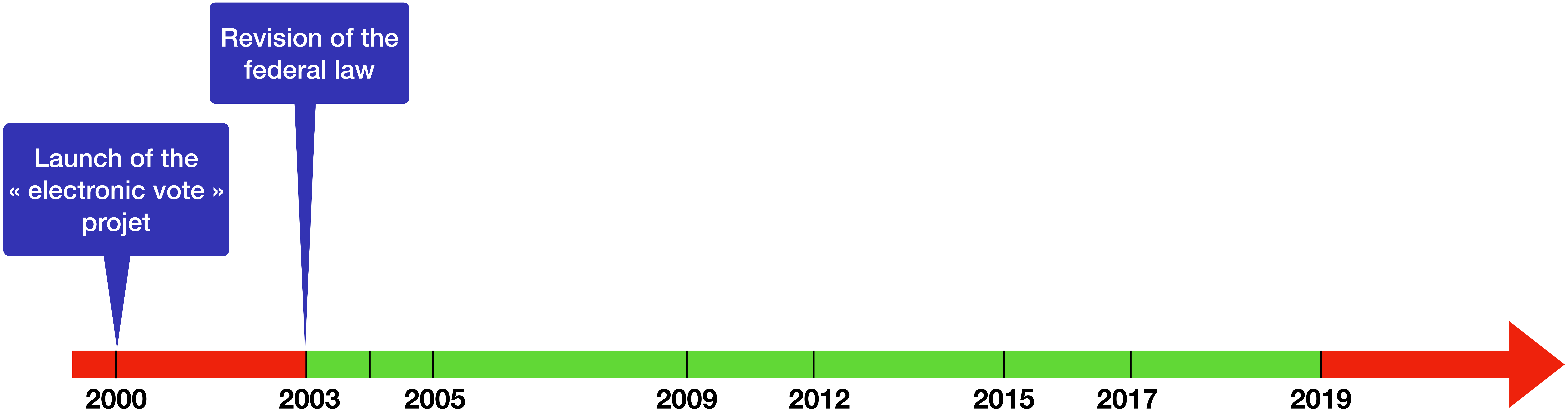

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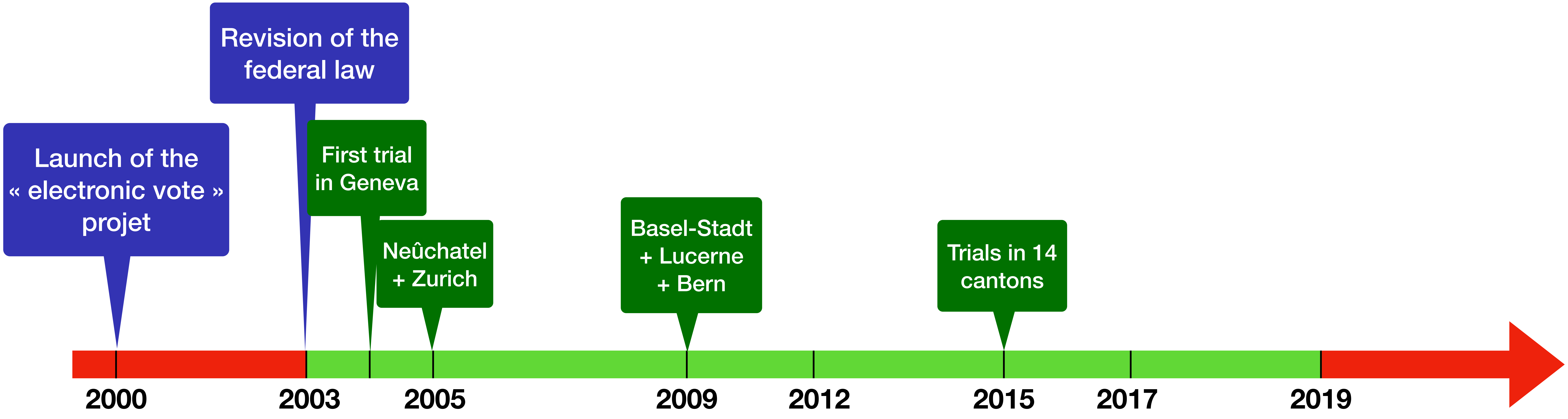

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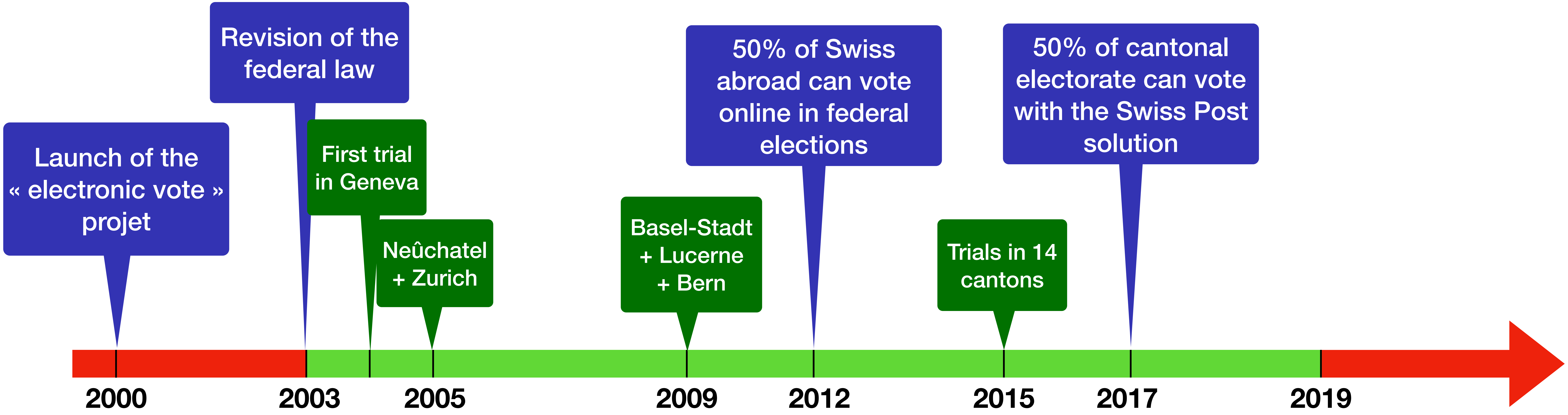

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Strategy of the Chancellerie

1. discuss with experts to:
   - define a very precise threat model
   - obtain audits the system
   - obtain formal proofs (symbolic and computational)

5.1.1	Examination criteria: The protocol must meet the security objective according to the trust assumptions in the abstract model in accordance with Section 4. In addition, a cryptographic and a symbolic proof must be provided. The proofs relating to cryptographic basic components may be provided according to generally accepted security assumptions (for example, the "random oracle model", "decisional Diffie-Hellman assumption", "Fiat-Shamir heuristic"). The protocol should be based if possible on existing and proven protocols.

2. push for public scrutiny: (especially since 2019)
   - public release of the specification and the code
   - organise public intrusion tests
   - prod companies to organise a bug bounty program

Art. 7a[4] Publication of the source code

[1] The source code for the system software must be made public.

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Target: re-introduce e-voting in September 2022

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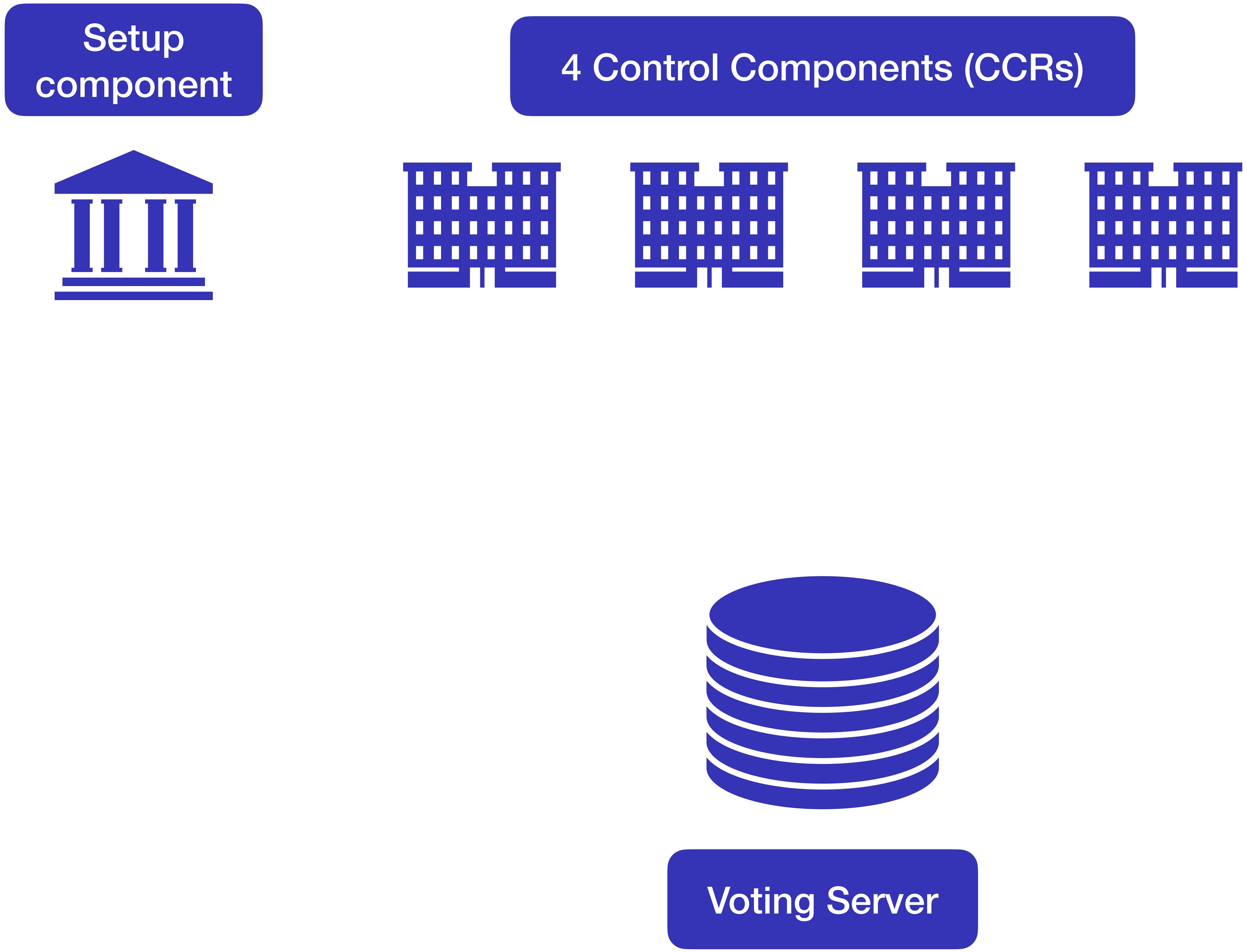
We have been contacted to update the symbolic proofs of the systems.

There is a vote secrecy attack: an attacker can learn the vote of everyone!

Overview of the system



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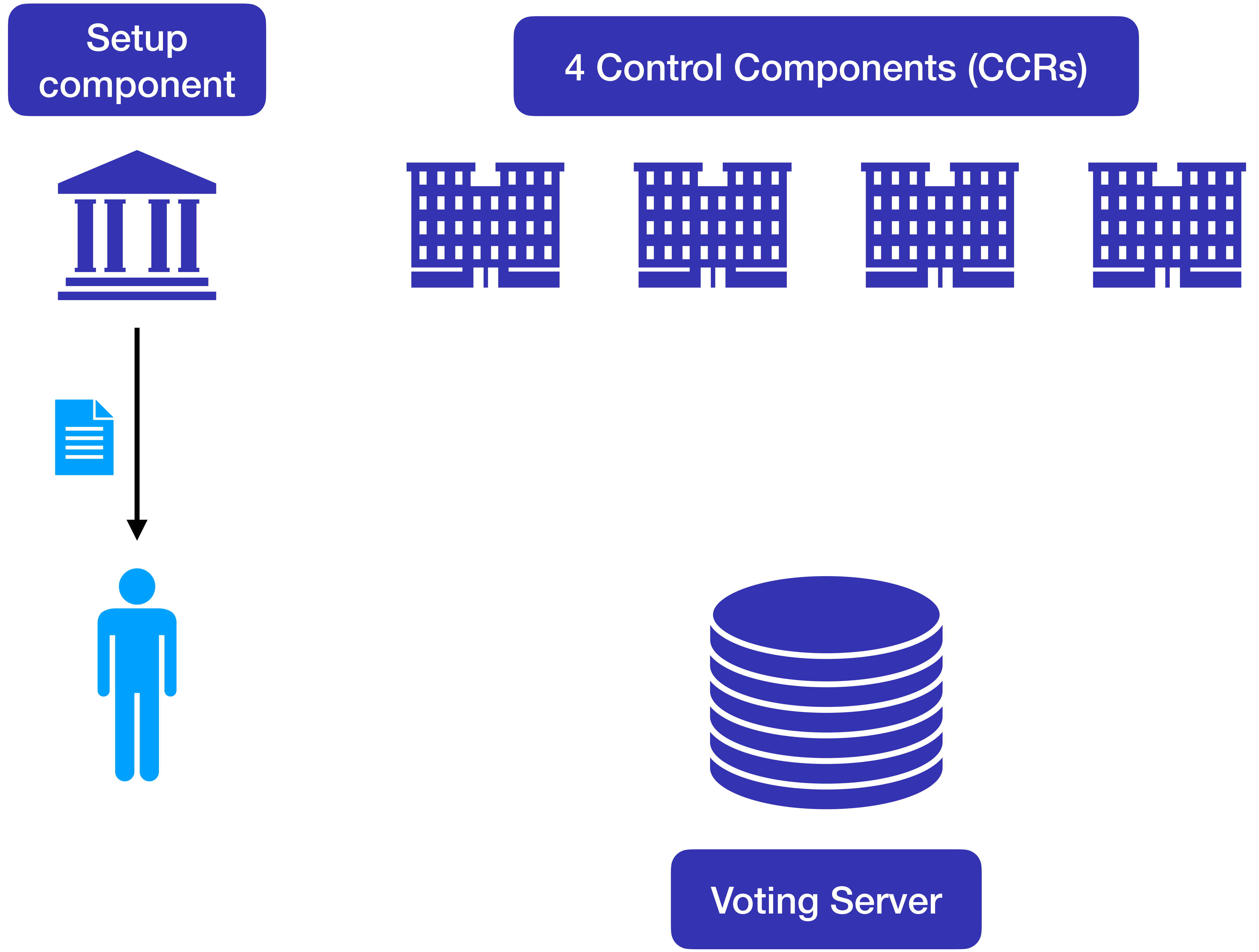

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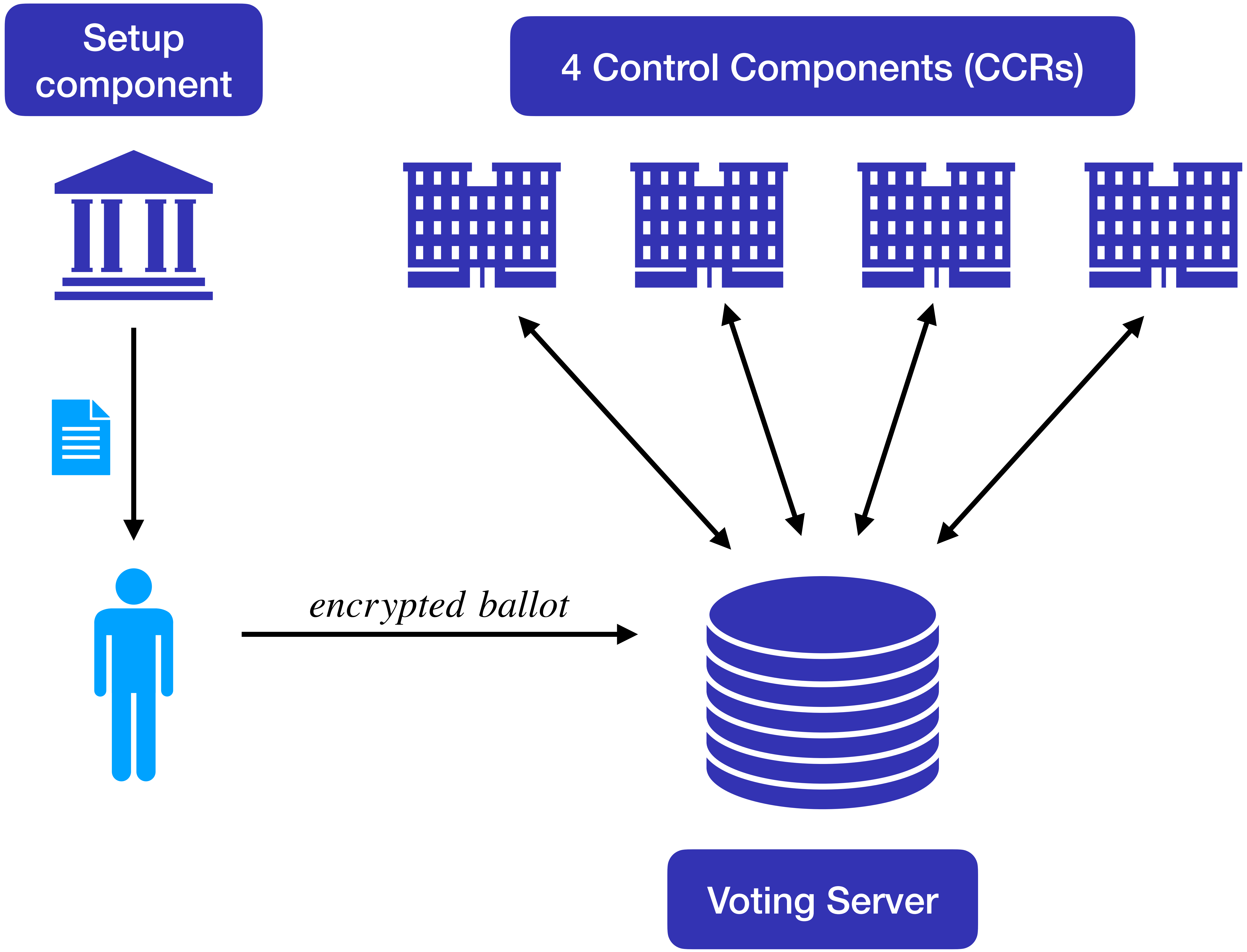

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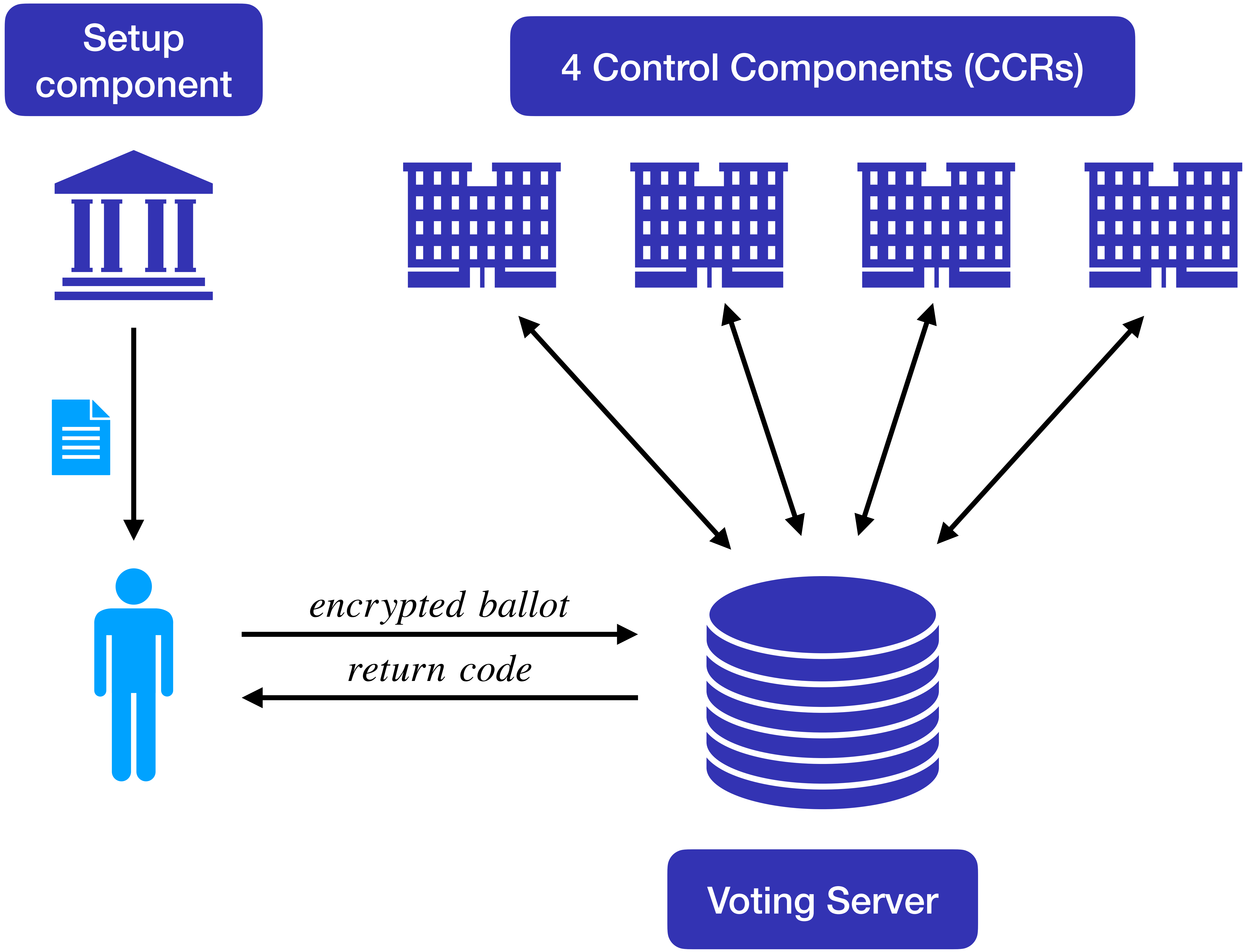

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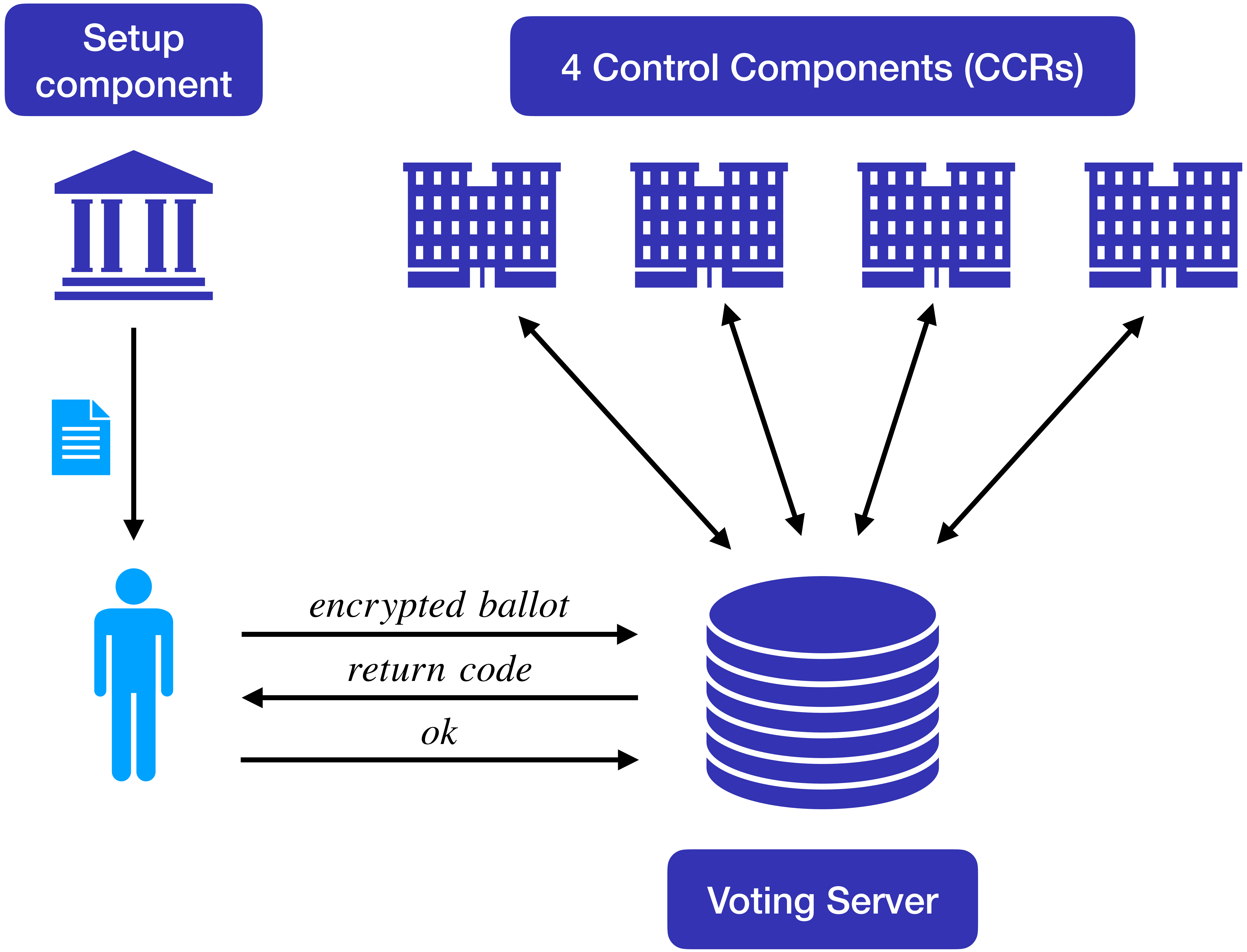

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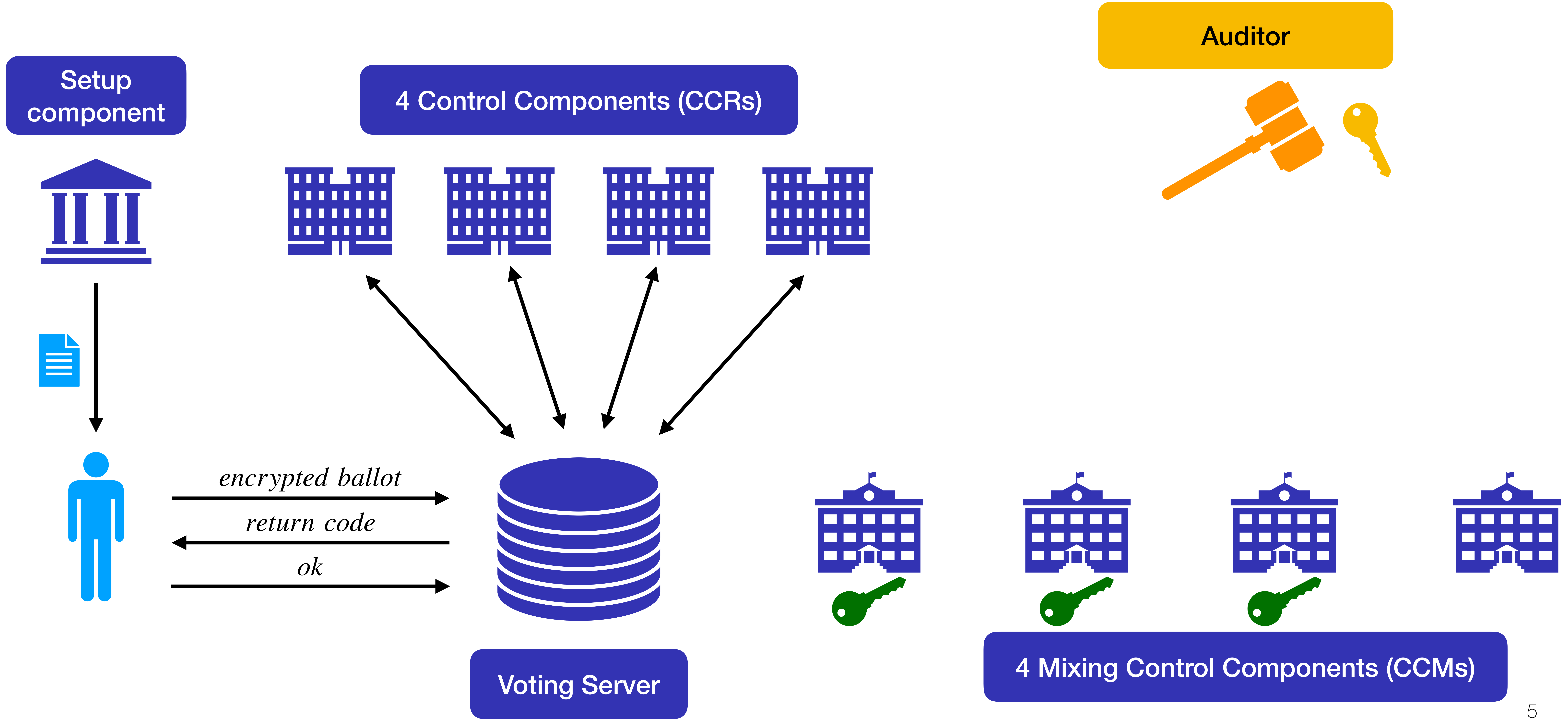

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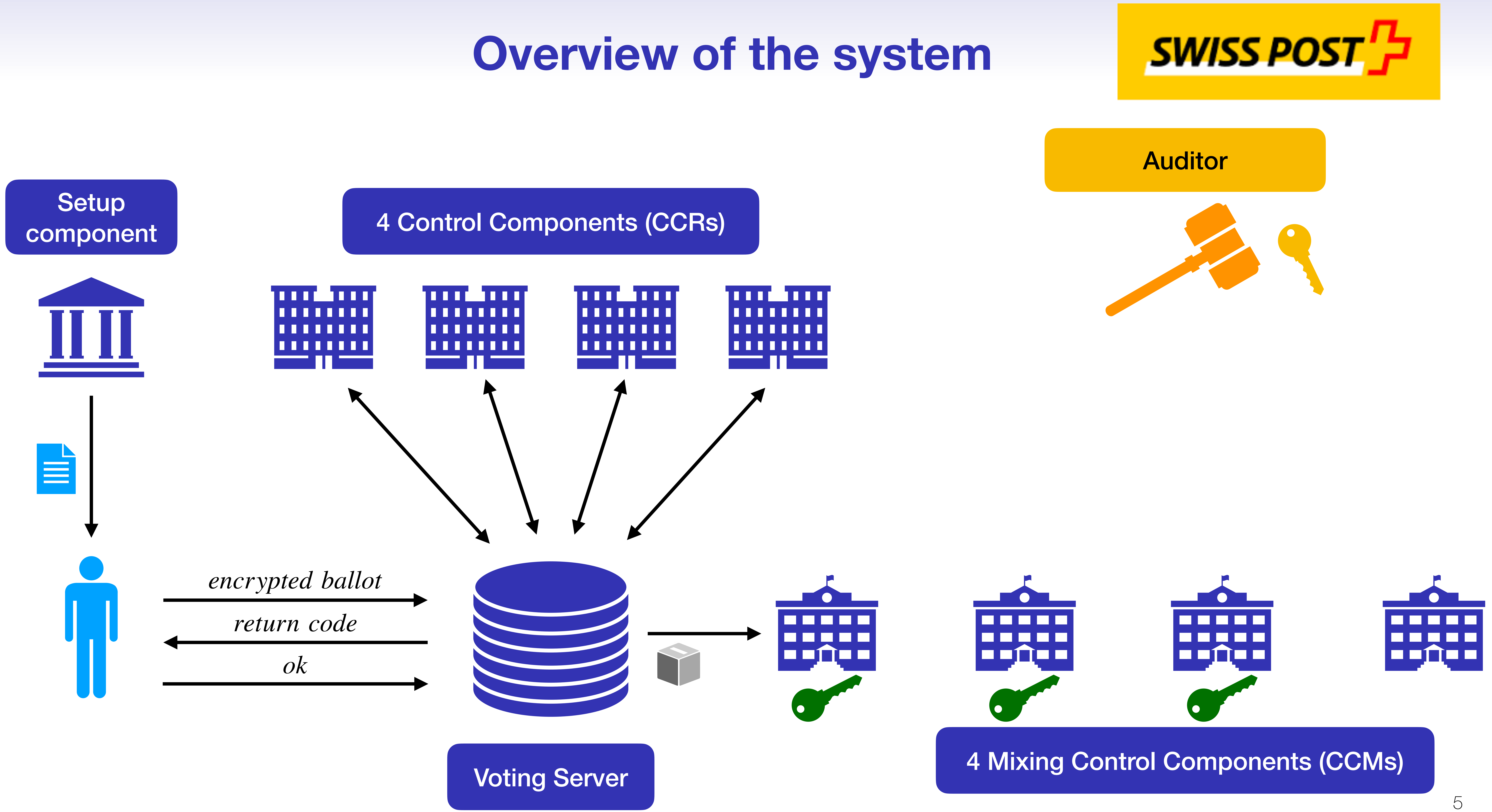

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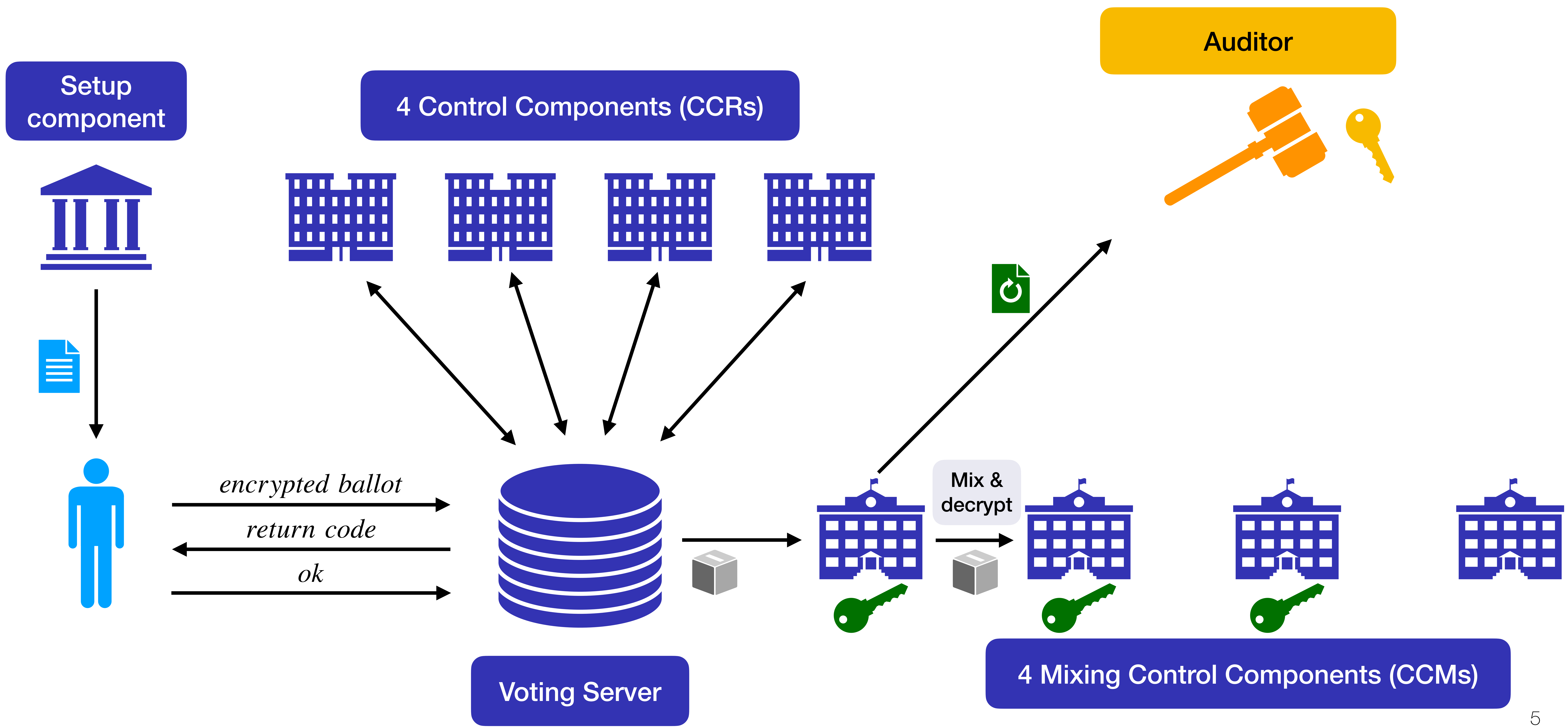

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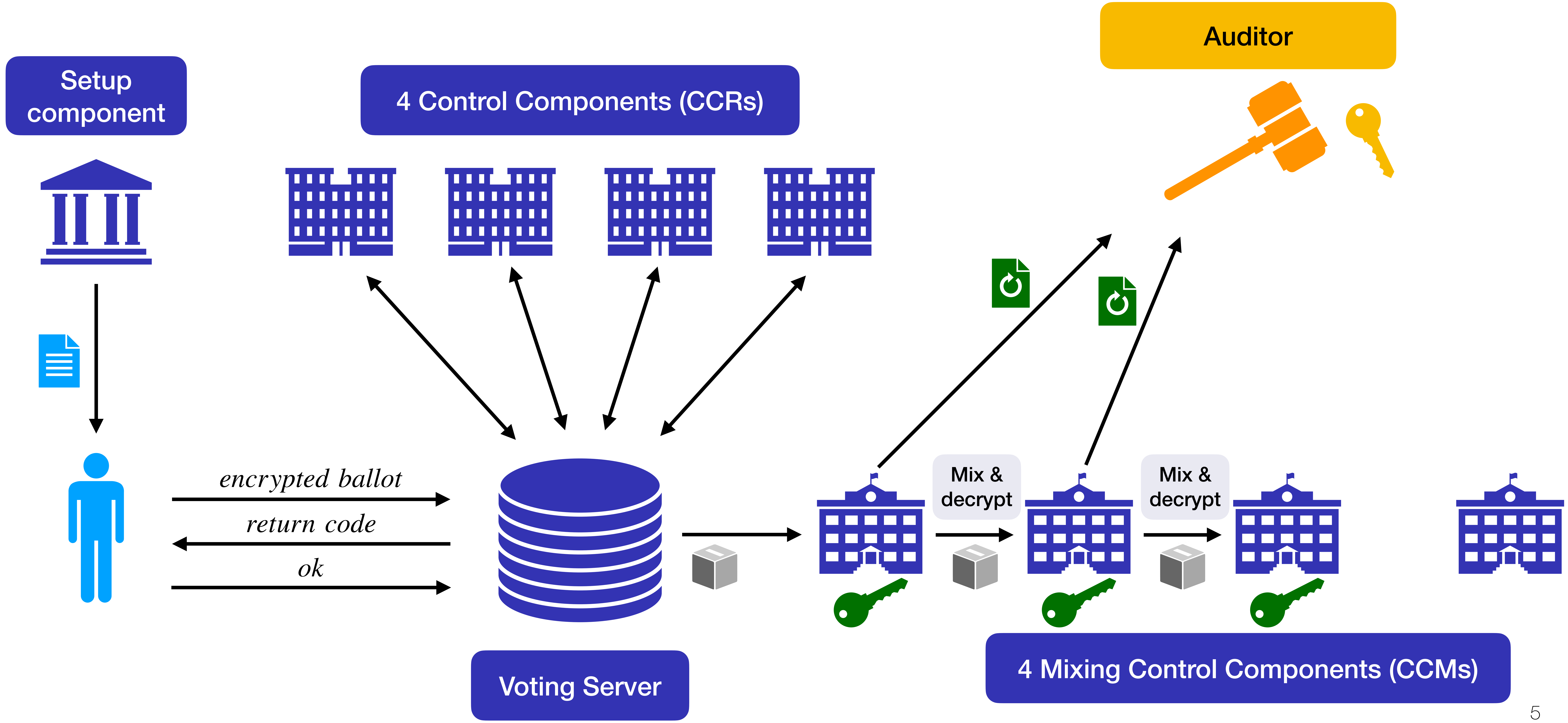

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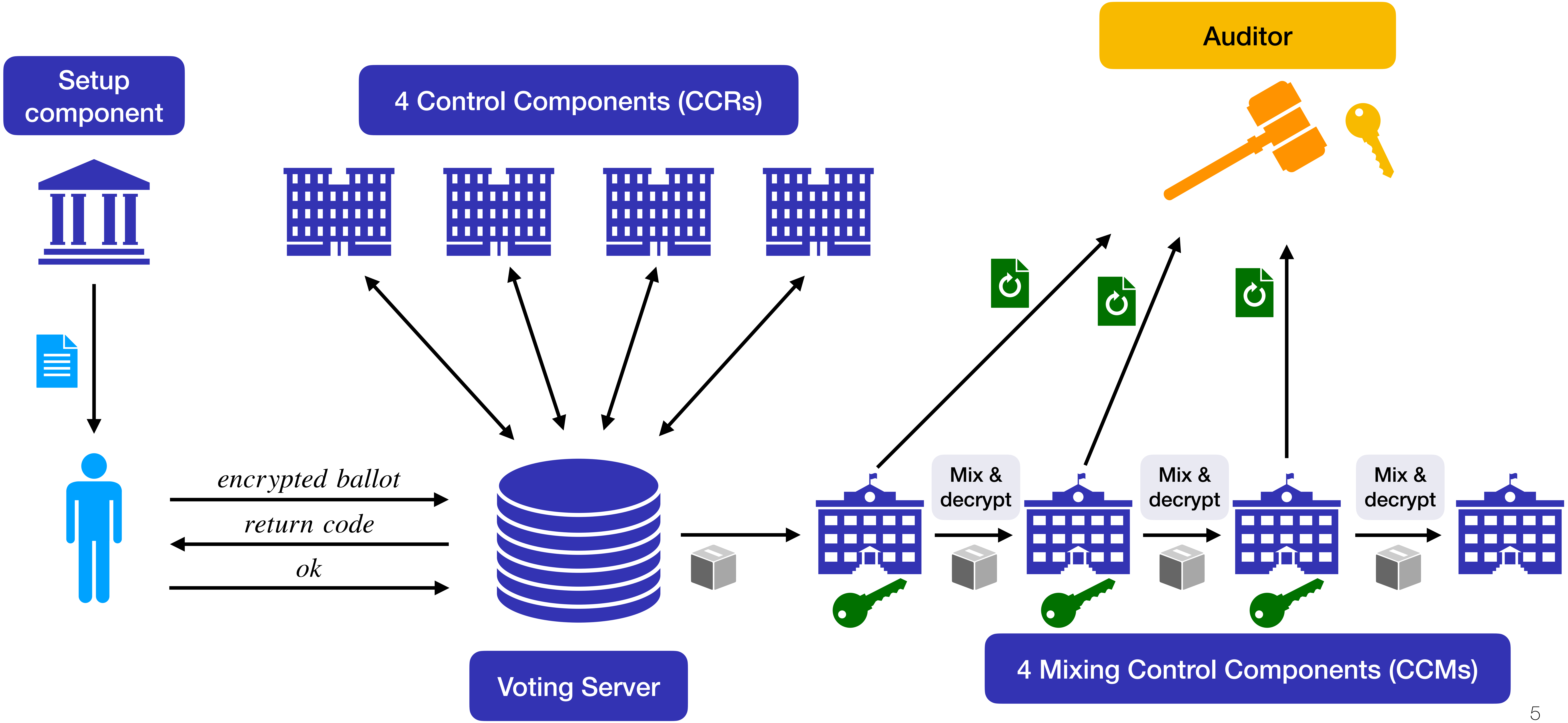

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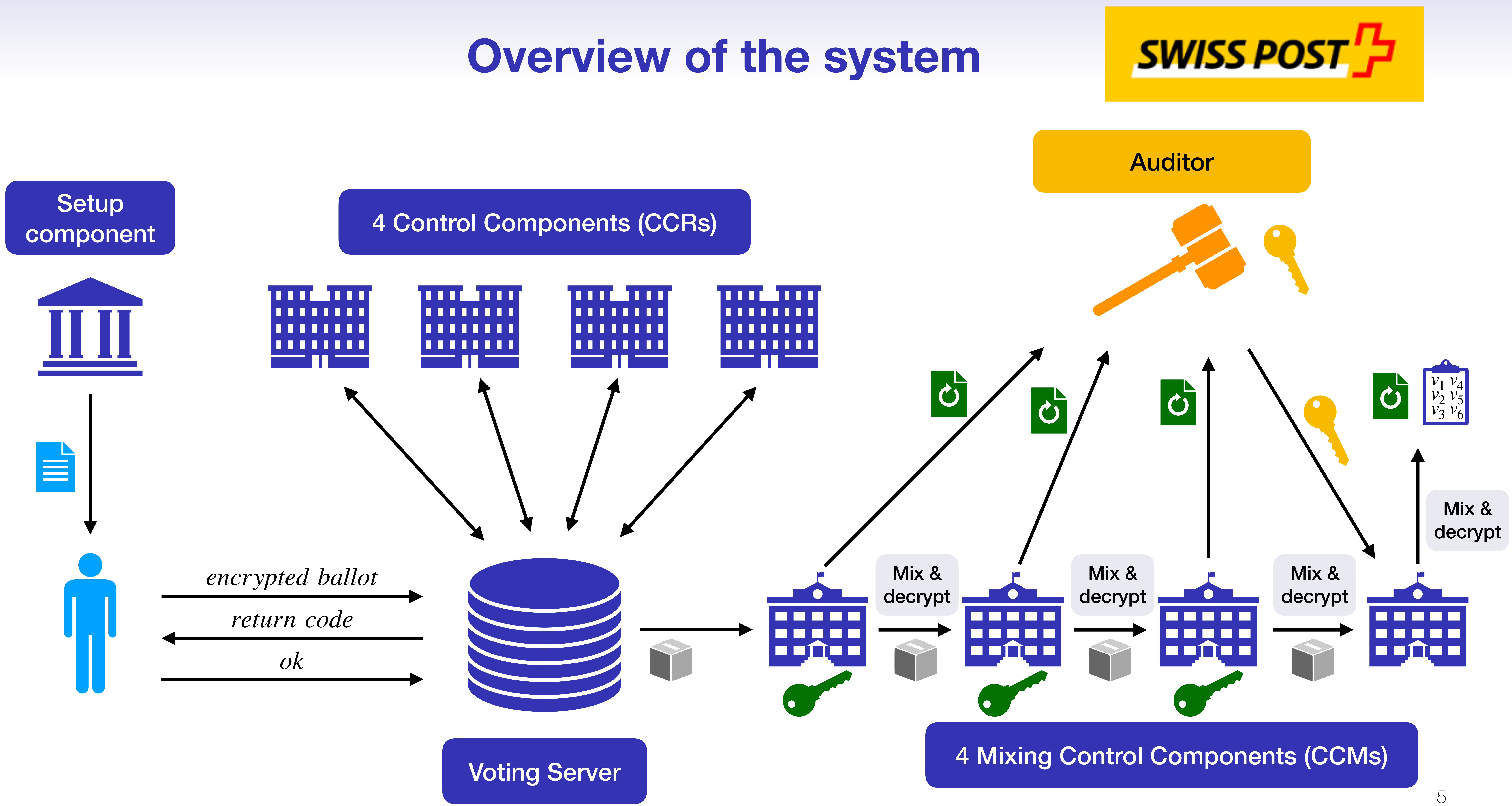
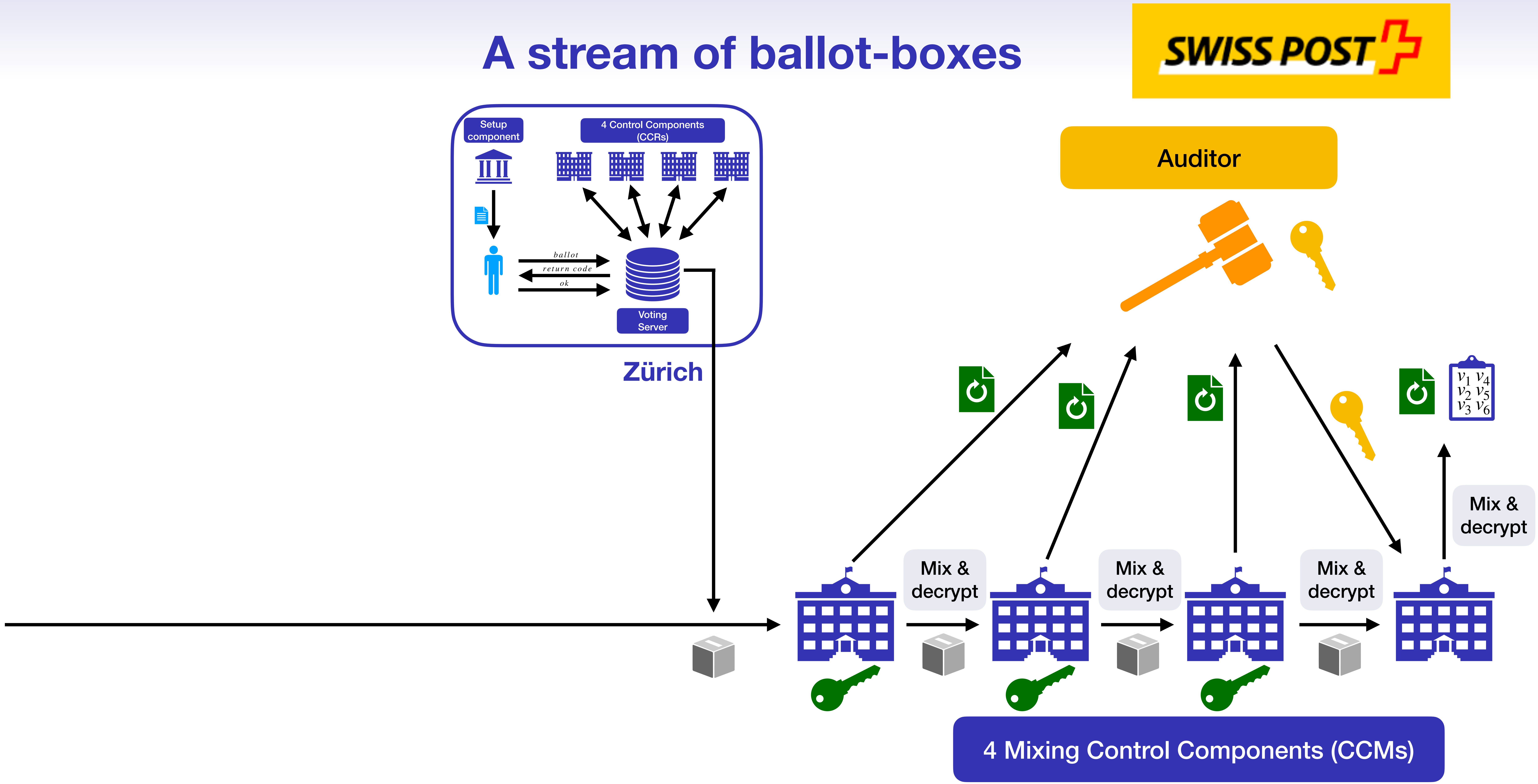


A stream of ballot-boxes



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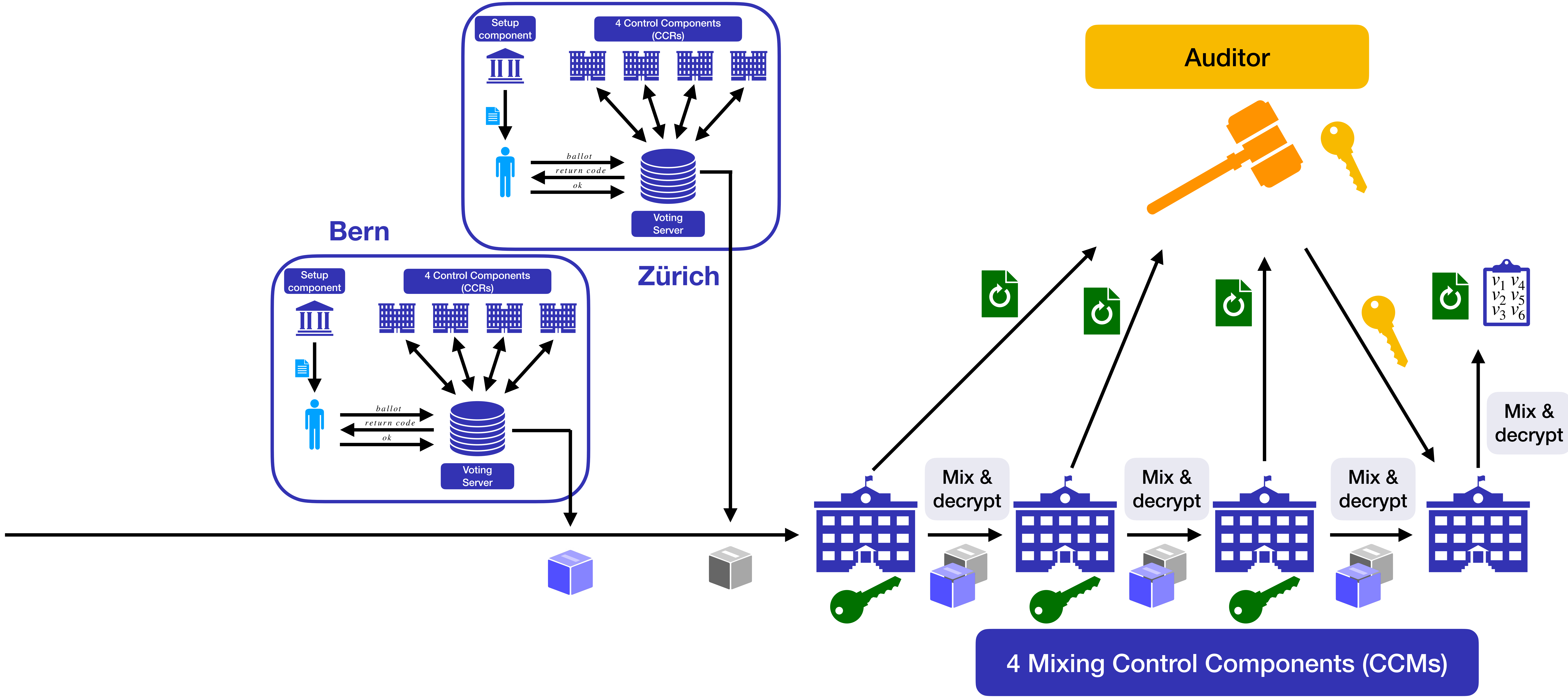

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Vote secrecy

Vote secrecy - no one is able to learn who I voted for!

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Federal chancellerie requirements:

2.9.3.1 The following system participants are regarded as untrustworthy:

- UT system
- three of four control components per group, leaving open which three they are
- a significant proportion of voters

2.9.3.2 The following system participants may be considered trustworthy:

- set-up component
- print component
- user device
- one of four control components per group, leaving open which one it is
- one auditor in any group, leaving open which auditor it is; Number 2.7.2 takes precedence

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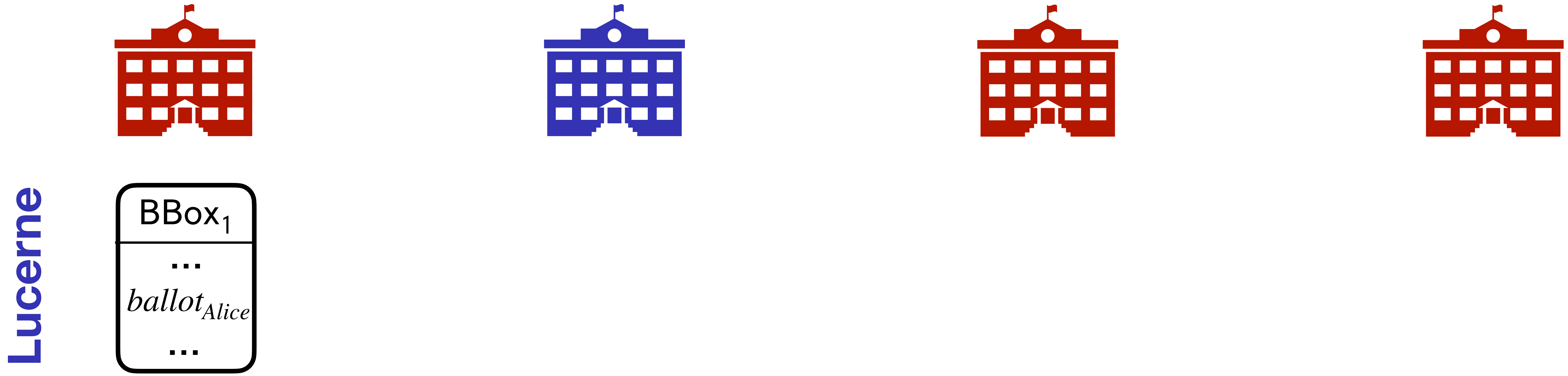

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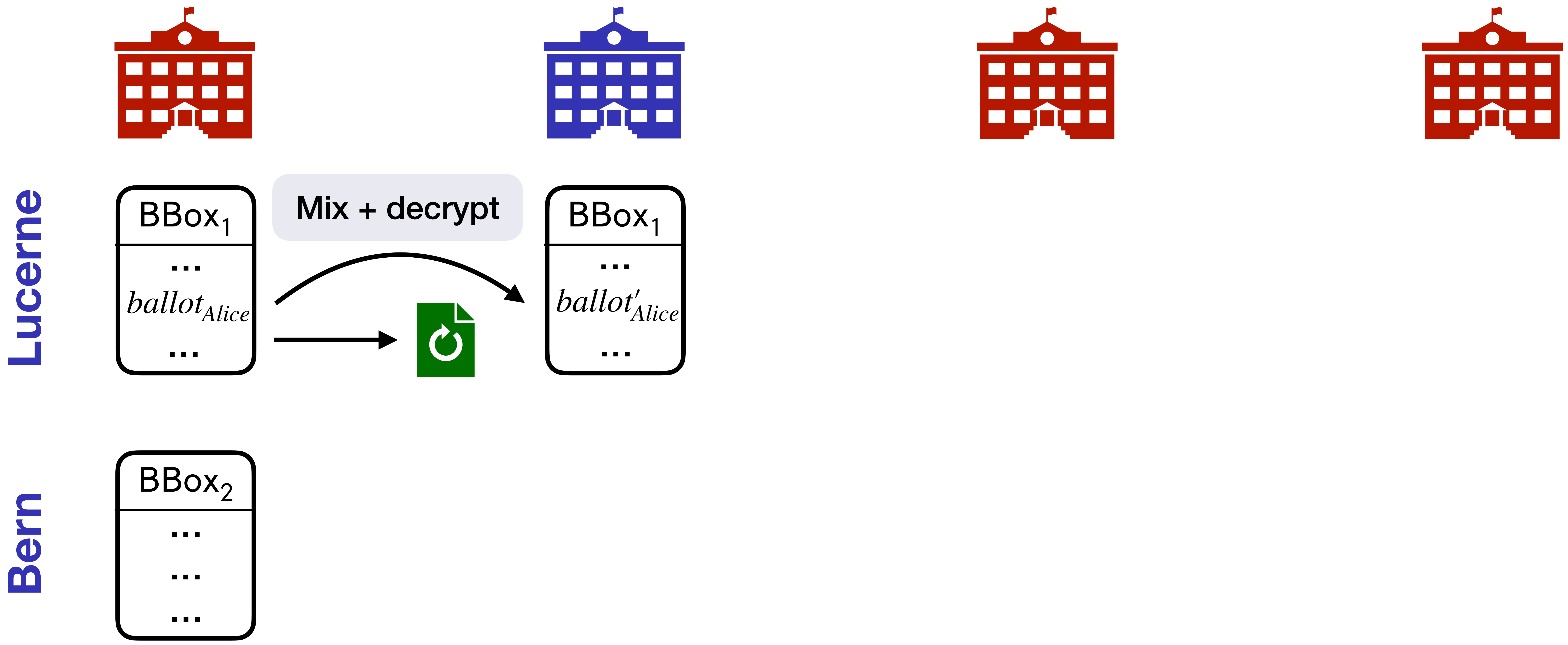

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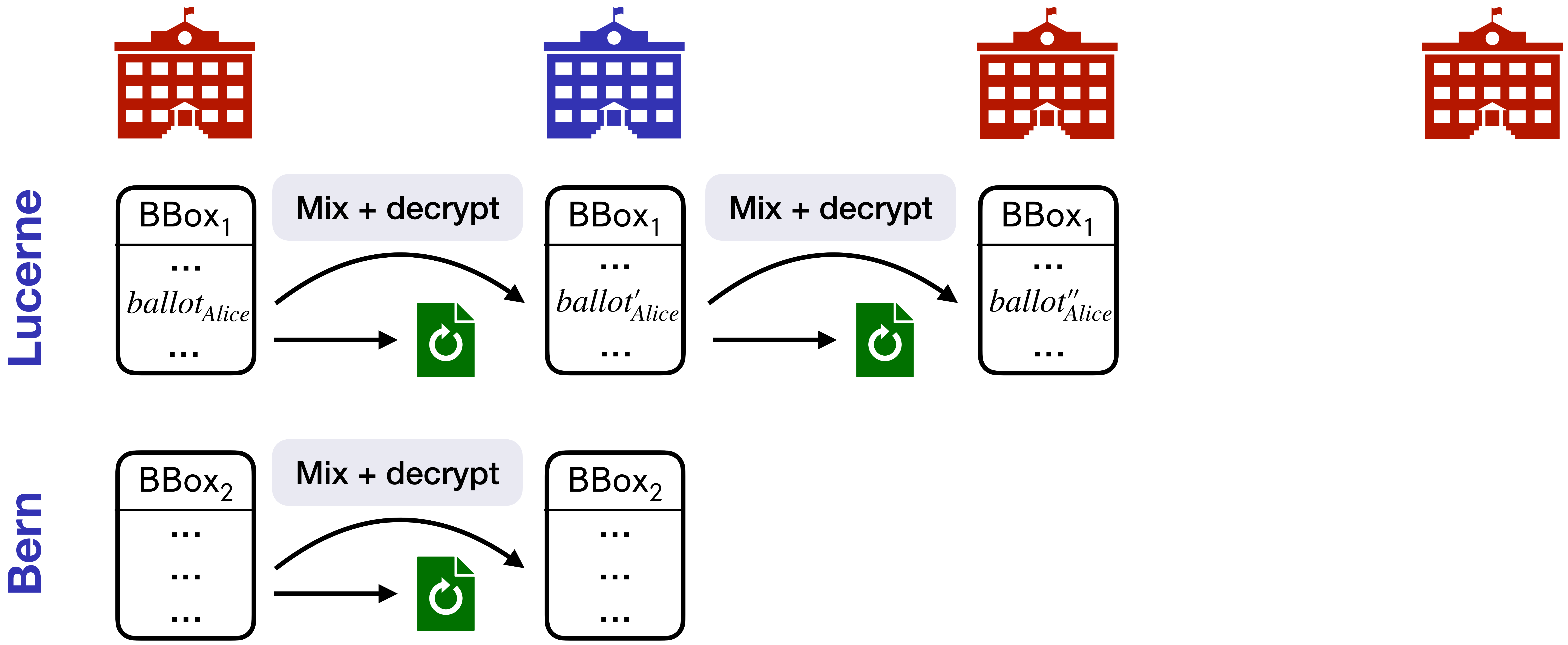

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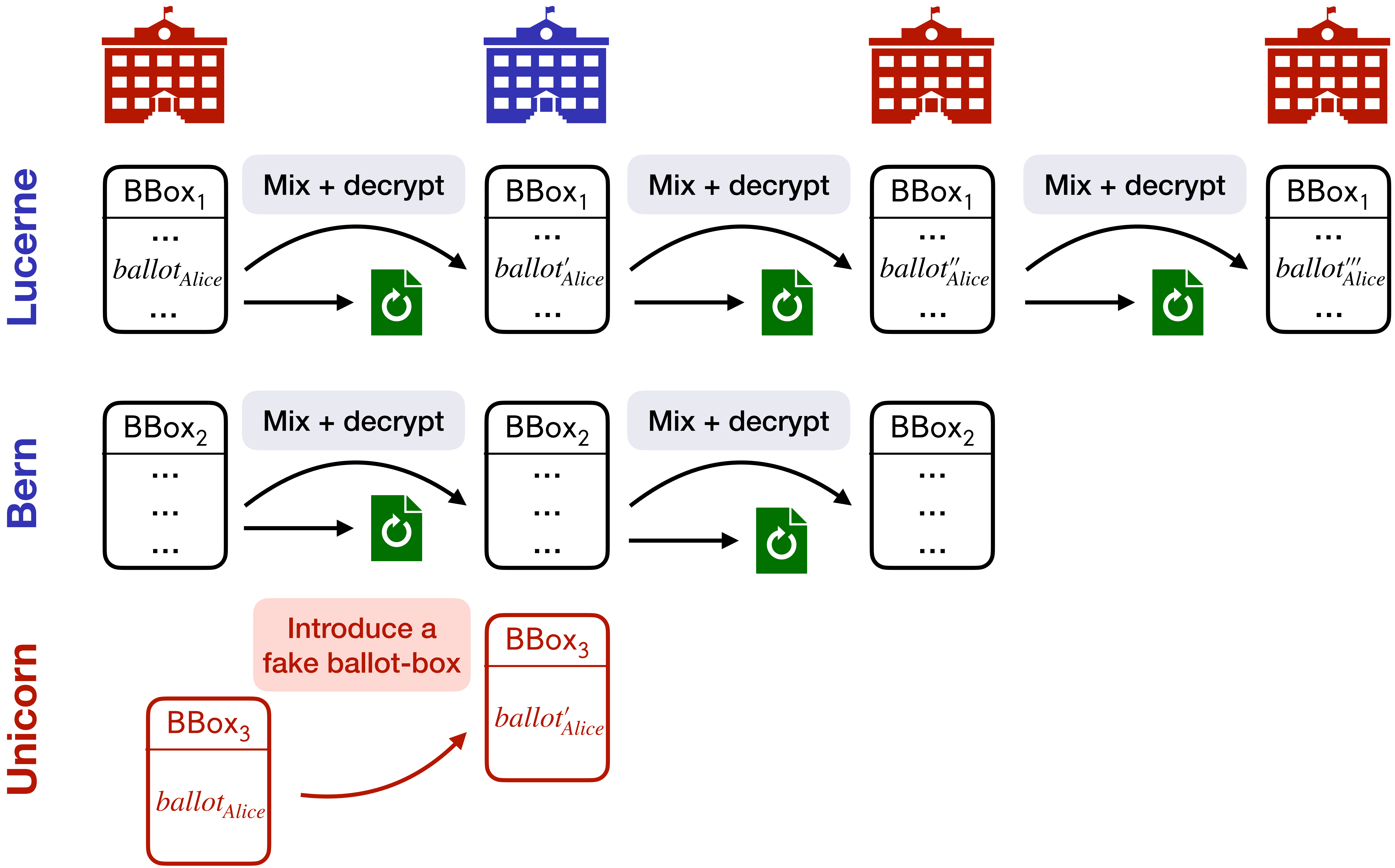

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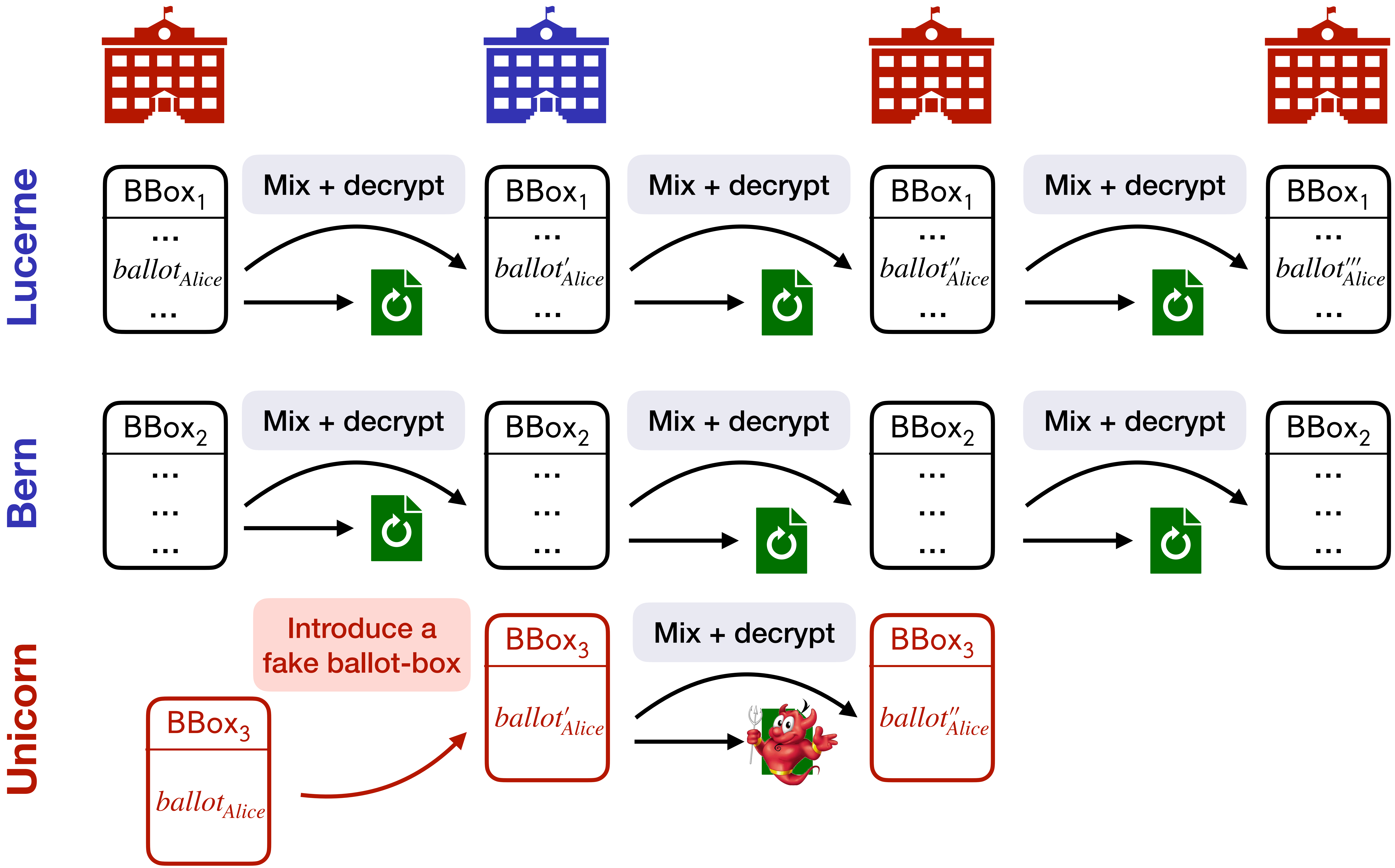

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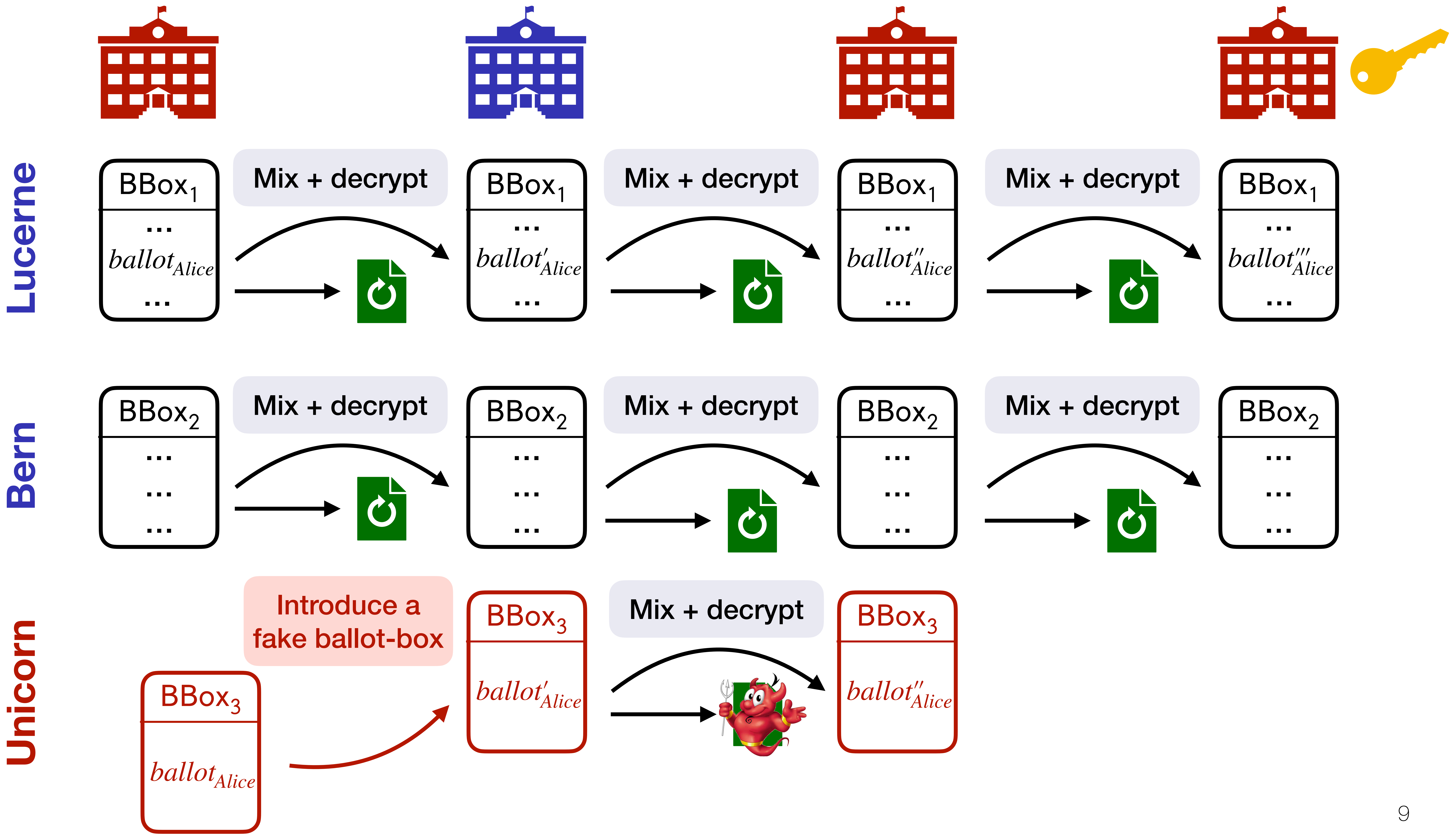

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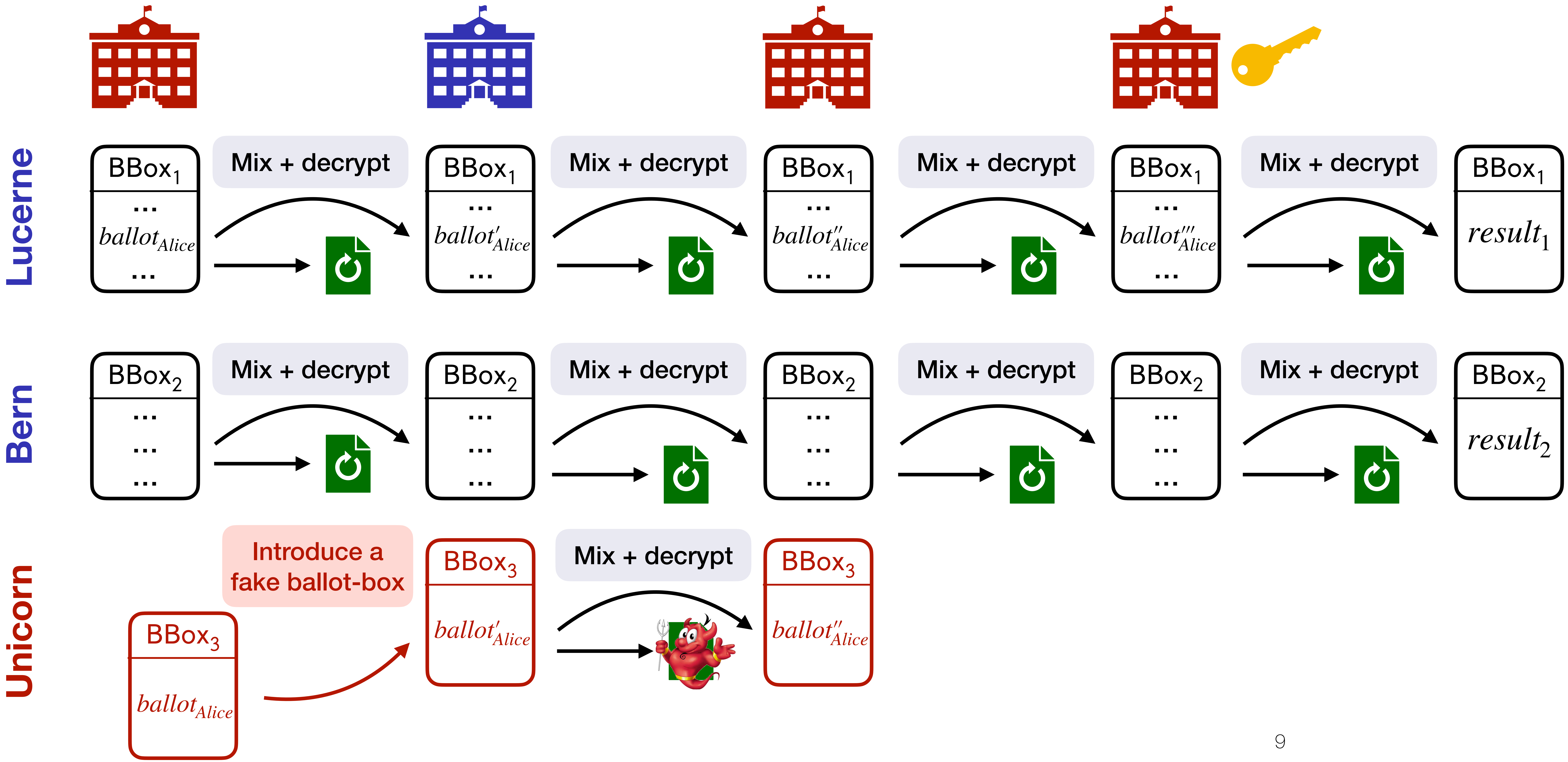

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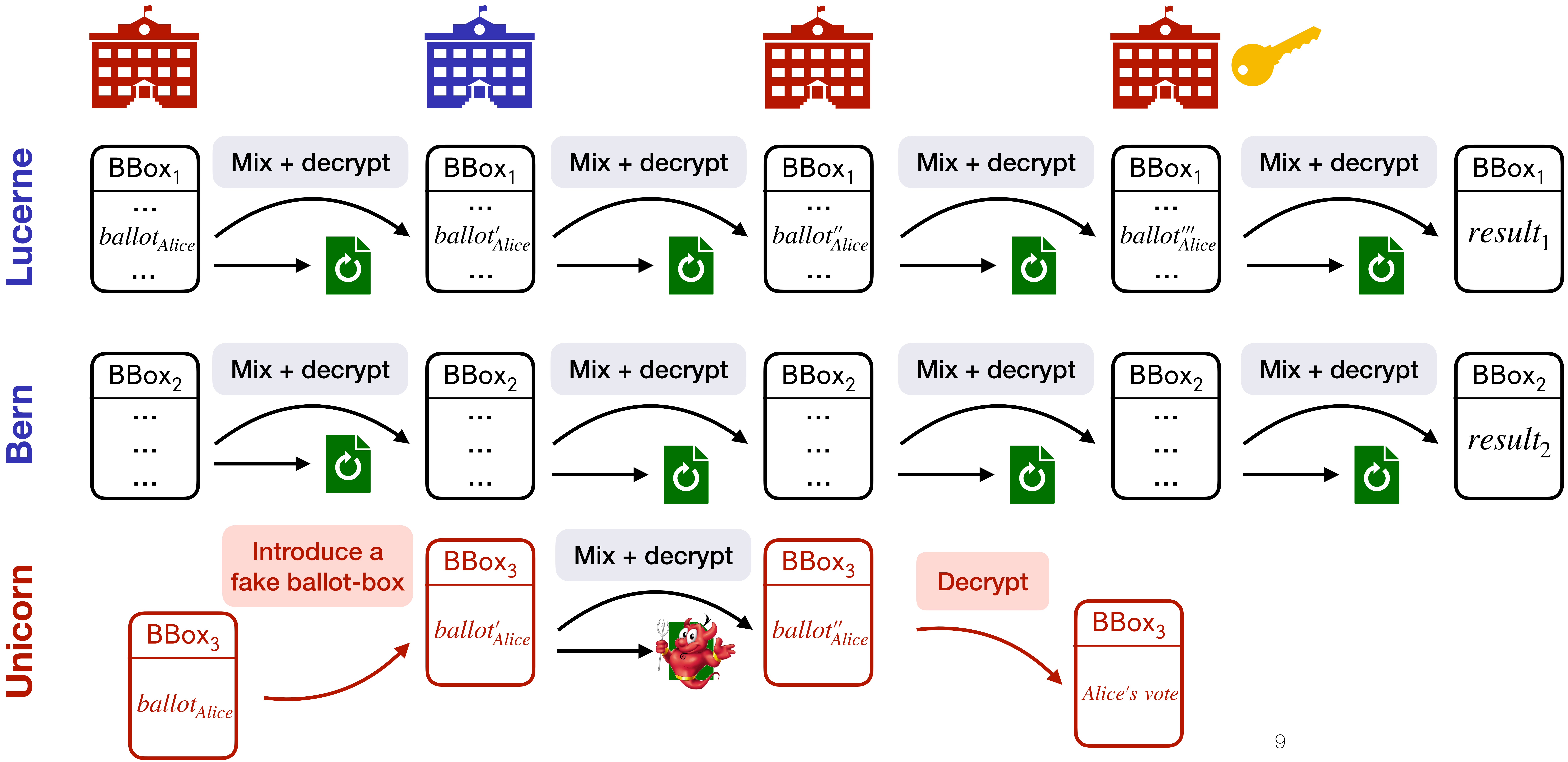

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We got a generous bounty

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➡ modify the infrastructure to let the CCMs compute the initial payloads

➡ these two requirements are quite expensive…

➡ add a delay before publishing the results

Conclusion

This attack will be fixed in a future release of the specification/implementation

Switzerland provides a solution with a high level of transparency and many audits by experts
(compared to other systems/countries)

Lesson learned

It is important to model all the specificities of the system when we do formal proofs (symbolic or computational ones)
e.g. multi ballot-boxes or elections scenarios

What about other e-voting protocols?

See you next year?

Since June 2021: a new requirement for vote secrecy!

> 2.9.3.3 If an entire group of control components is used by a private system operator, none of these control components is considered trustworthy.

In practice

Swiss Post operates the 4 Control Components, they mut be assumed untrustworthy

➡ it is difficult to externalize a component…

In theory

All the vote secrecy definitions (implicitly) assume verifiability

➡ the system is not verifiable with this requirement…

How can we make both meet? again…

a new definition, a (major) improvement of the system, a step in-between…?

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