A privacy attack on the Swiss Post e-voting system

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Université de Lorraine, CNRS, Inria, LORIA,
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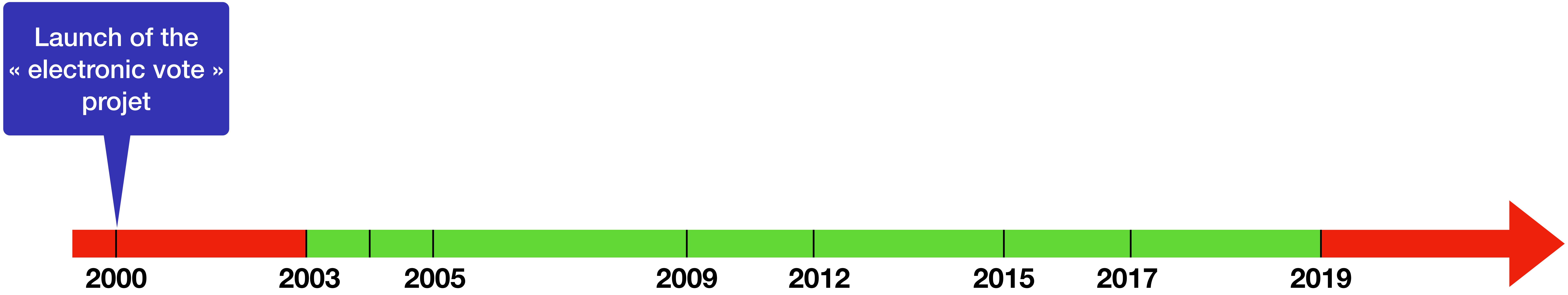
Amsterdam, April 13th 2022

A brief history



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

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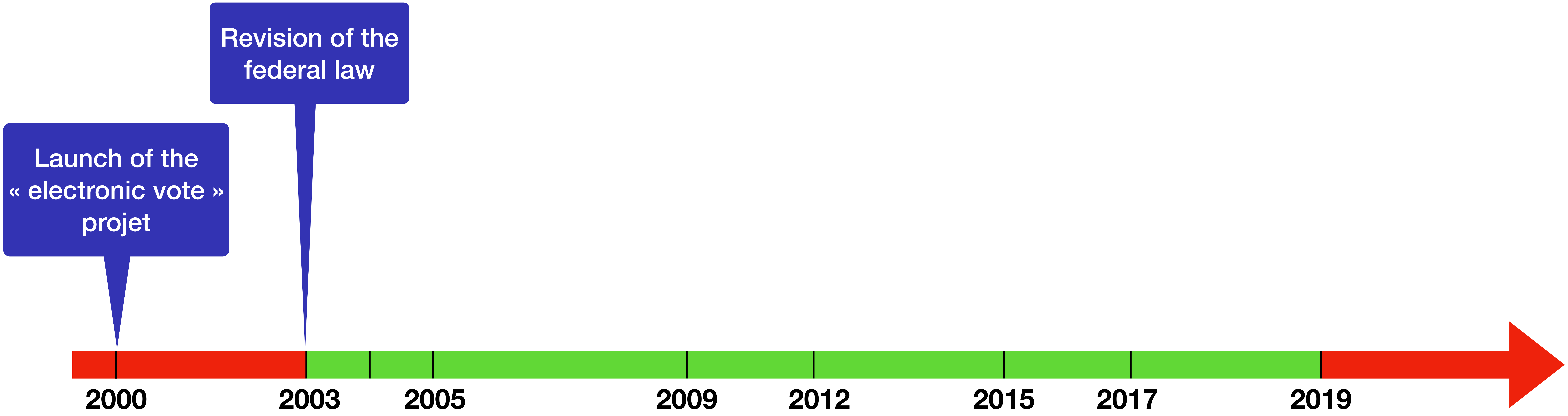

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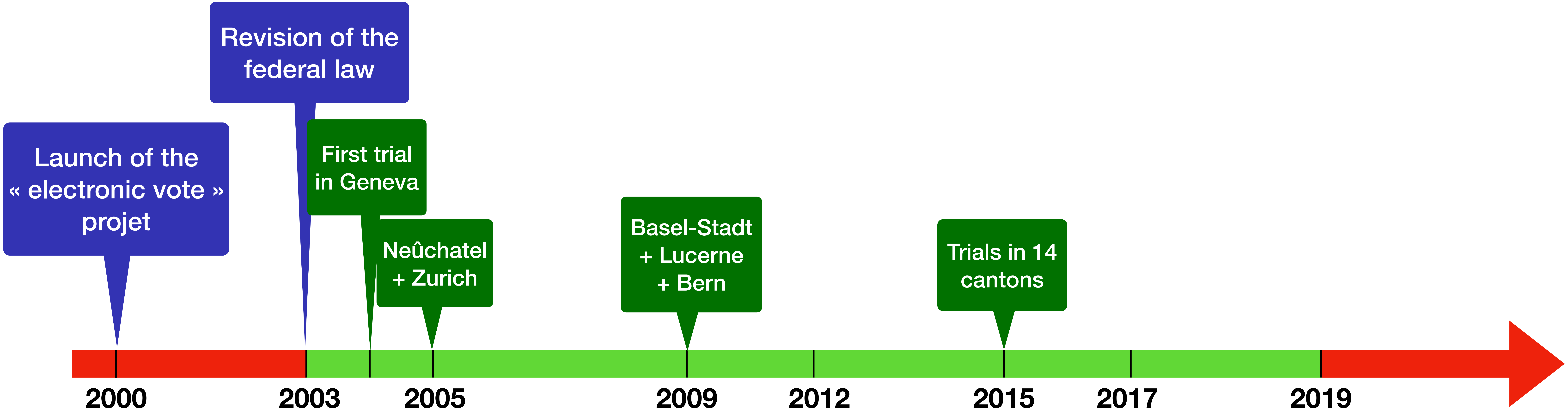

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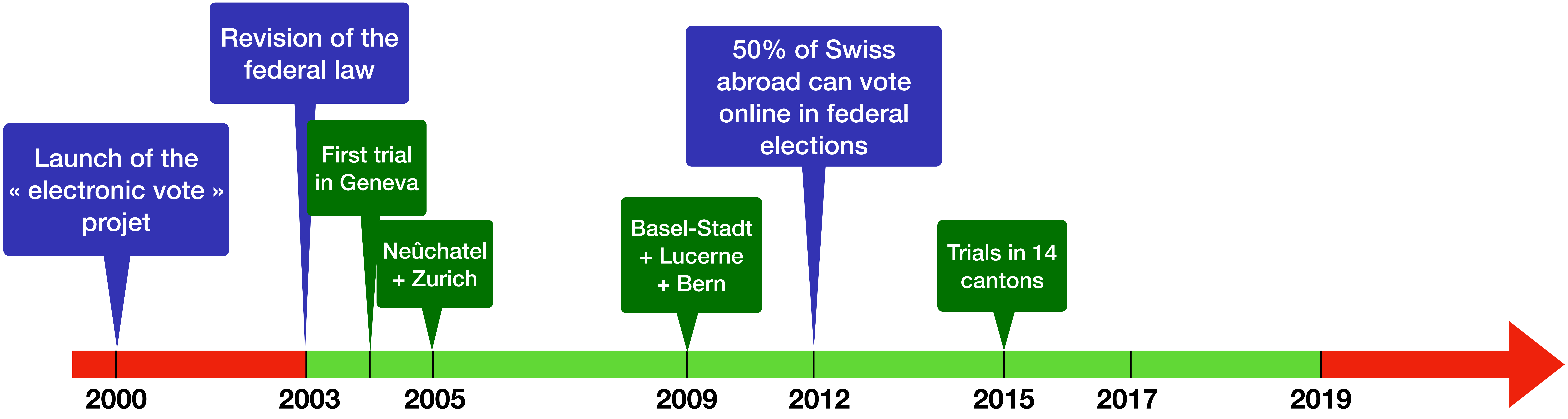

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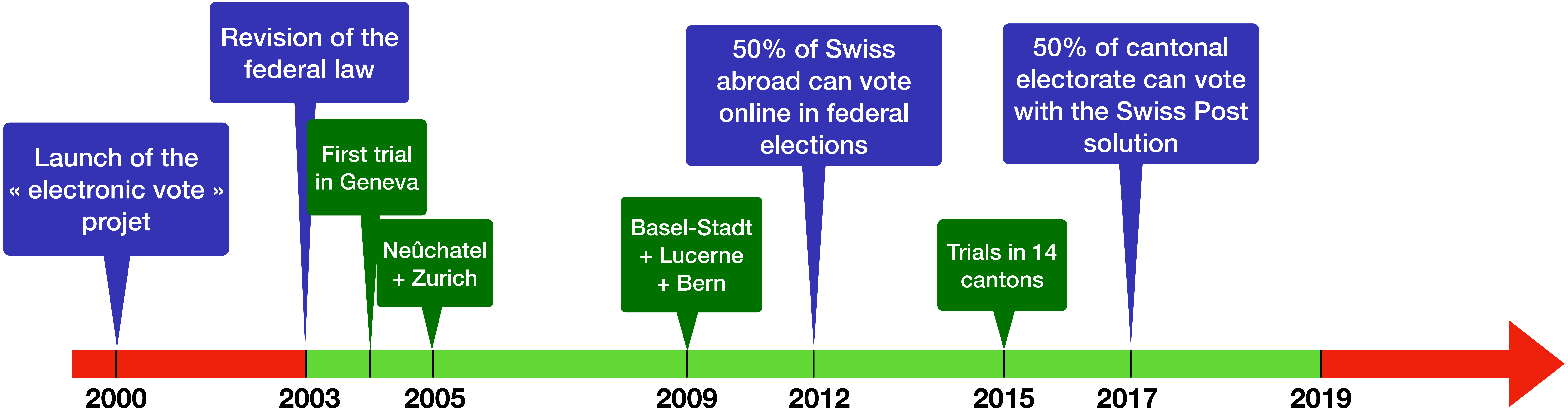

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Today… and tomorrow…

1 July 2018

Revision of the Federal Chancellery Ordinance on Electronic voting (VEleS)

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

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

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.

https://www.fedlex.admin.ch/eli/cc/2013/859/en
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1 July 2018 Revision of the Federal Chancellery Ordinance on Electronic voting (VEleS)

21 Dec. 2020 Federal Council launches redesign of trials

05 July 2021 Federal government launches examination of new e-voting system

10 Dec. 2021 New legal basis for e-voting (to be finalized by mid-2022)

Sept. 2022 Federal elections including e-voting

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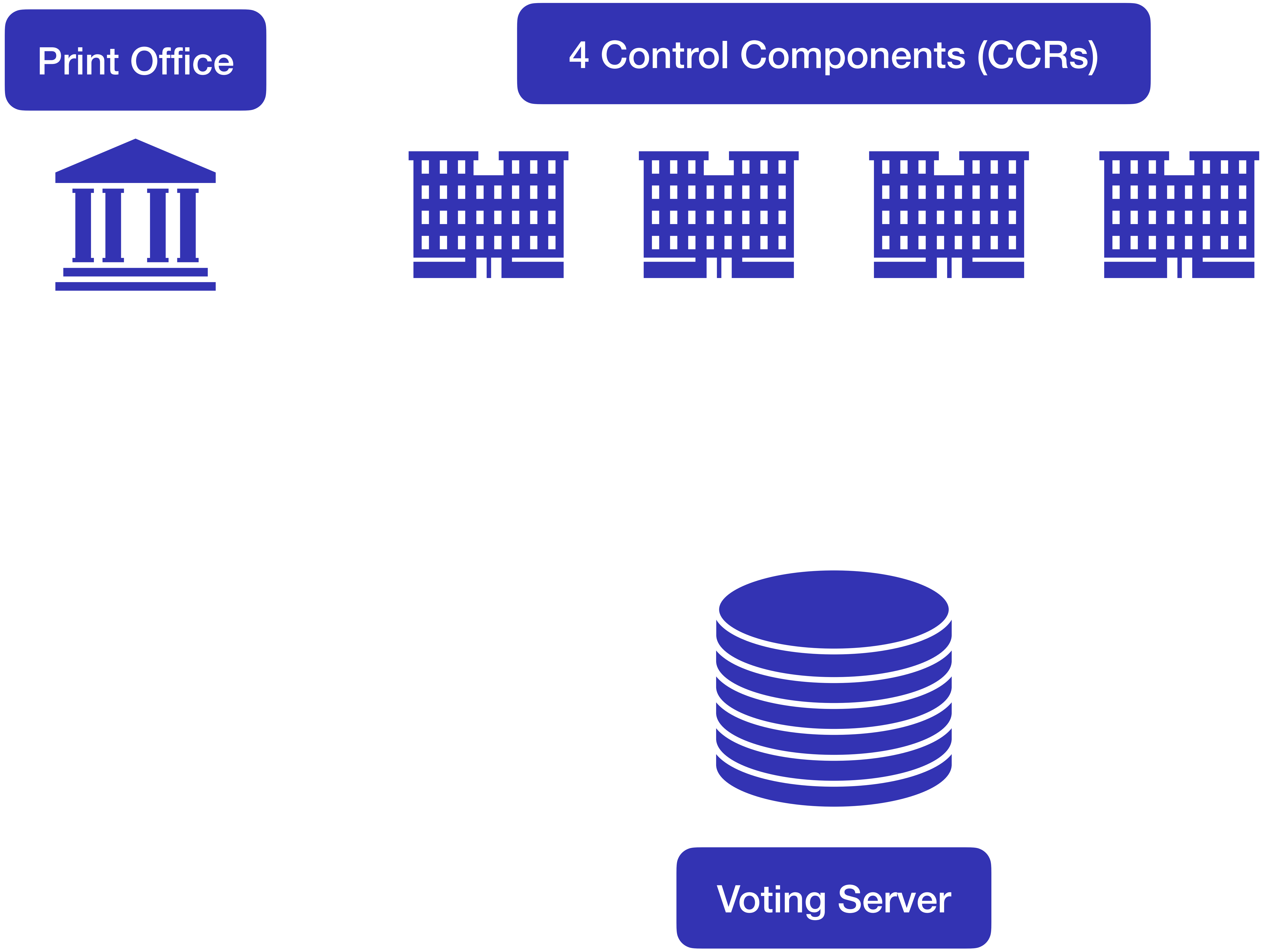
There is a vote secrecy attack: an attacker can learn the vote of everyone!

Overview of the system



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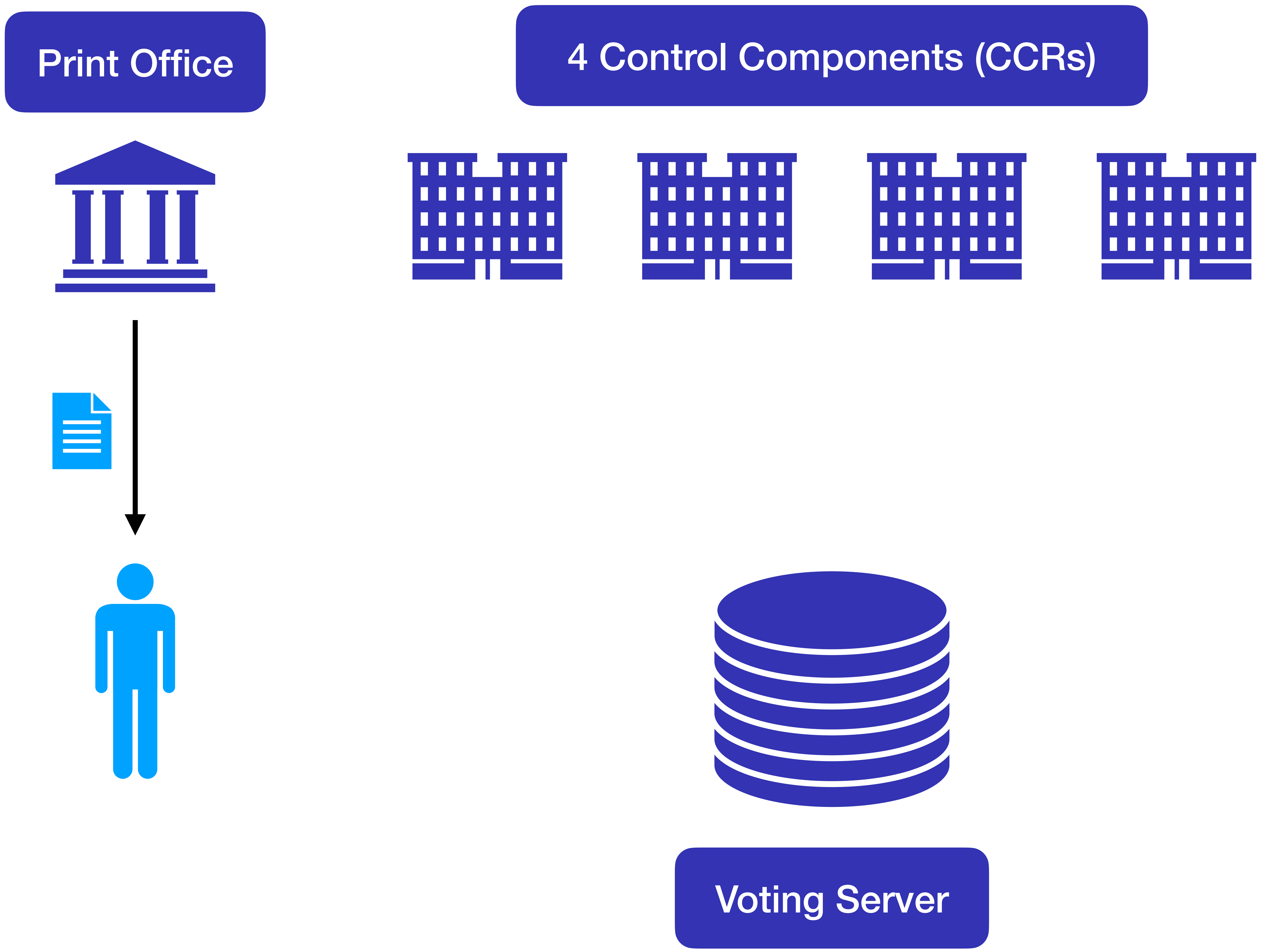

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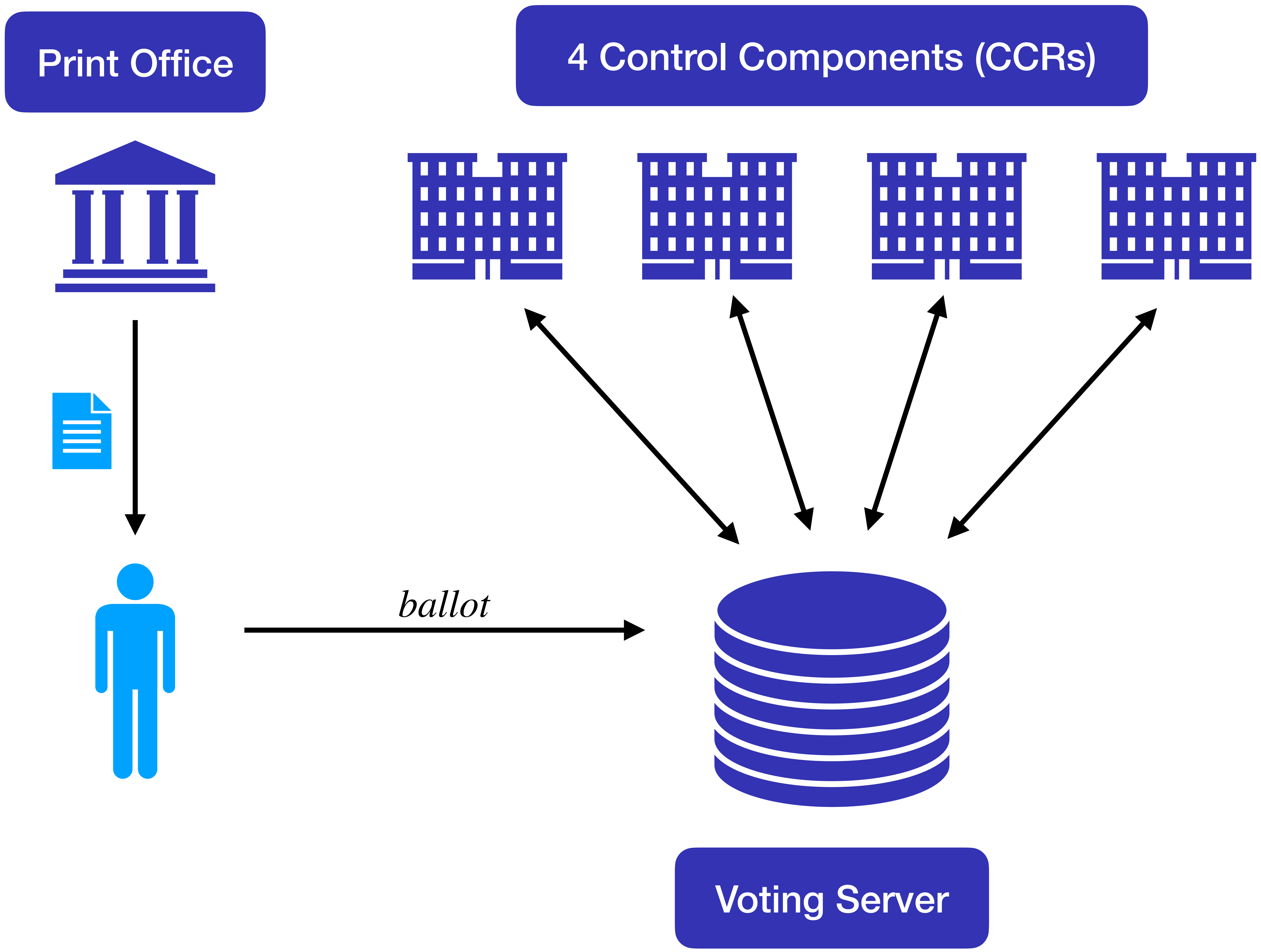

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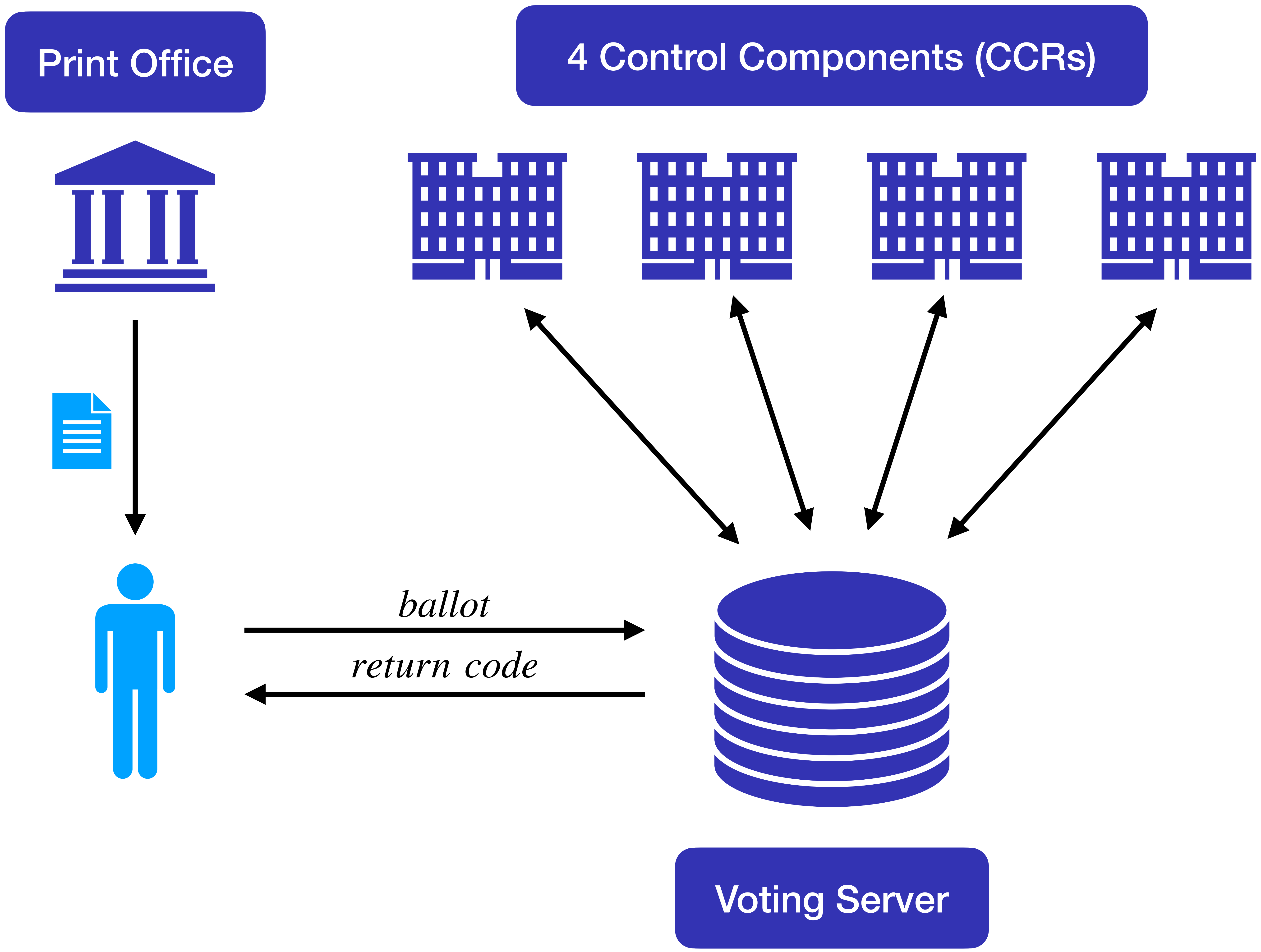

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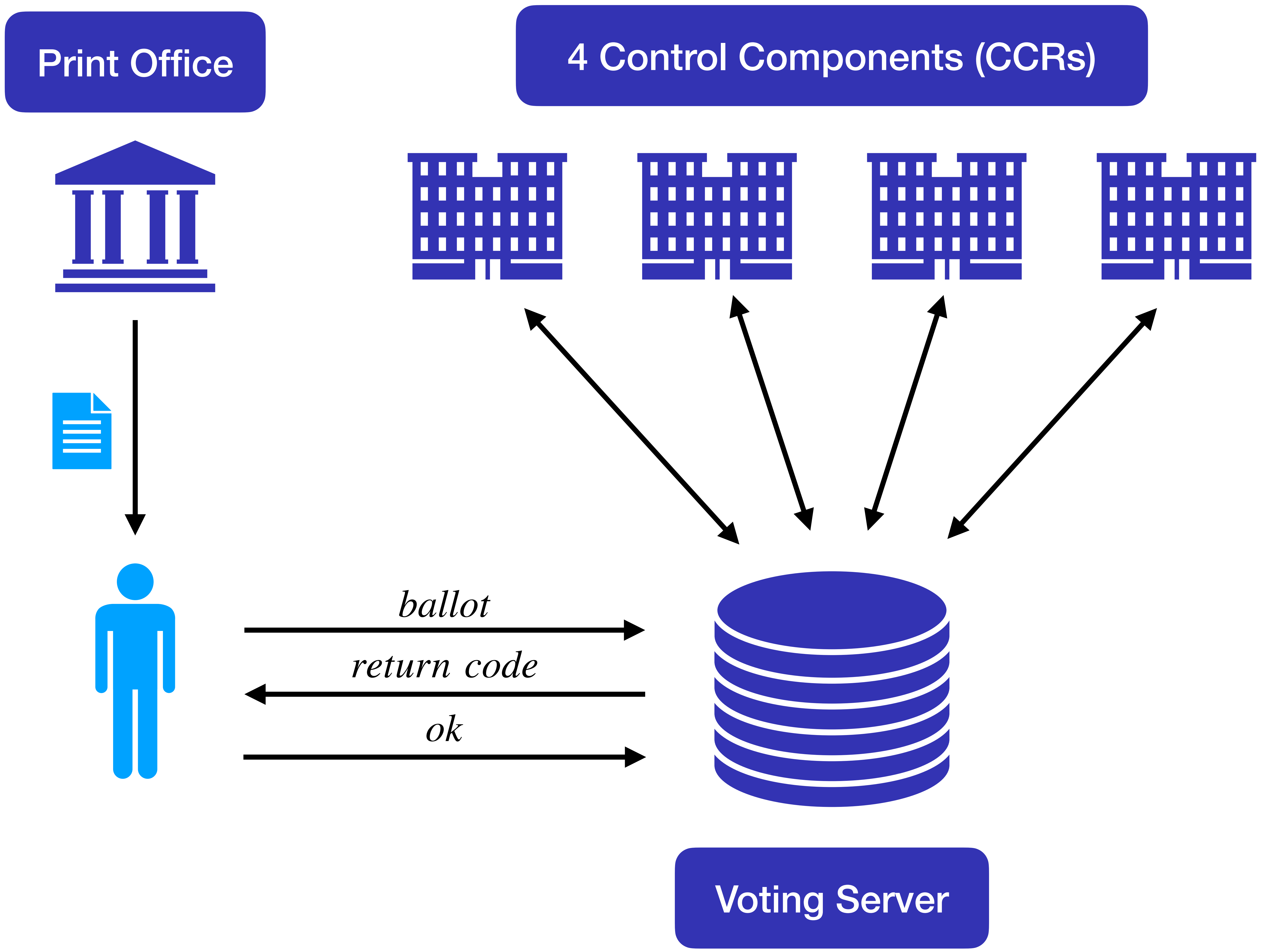

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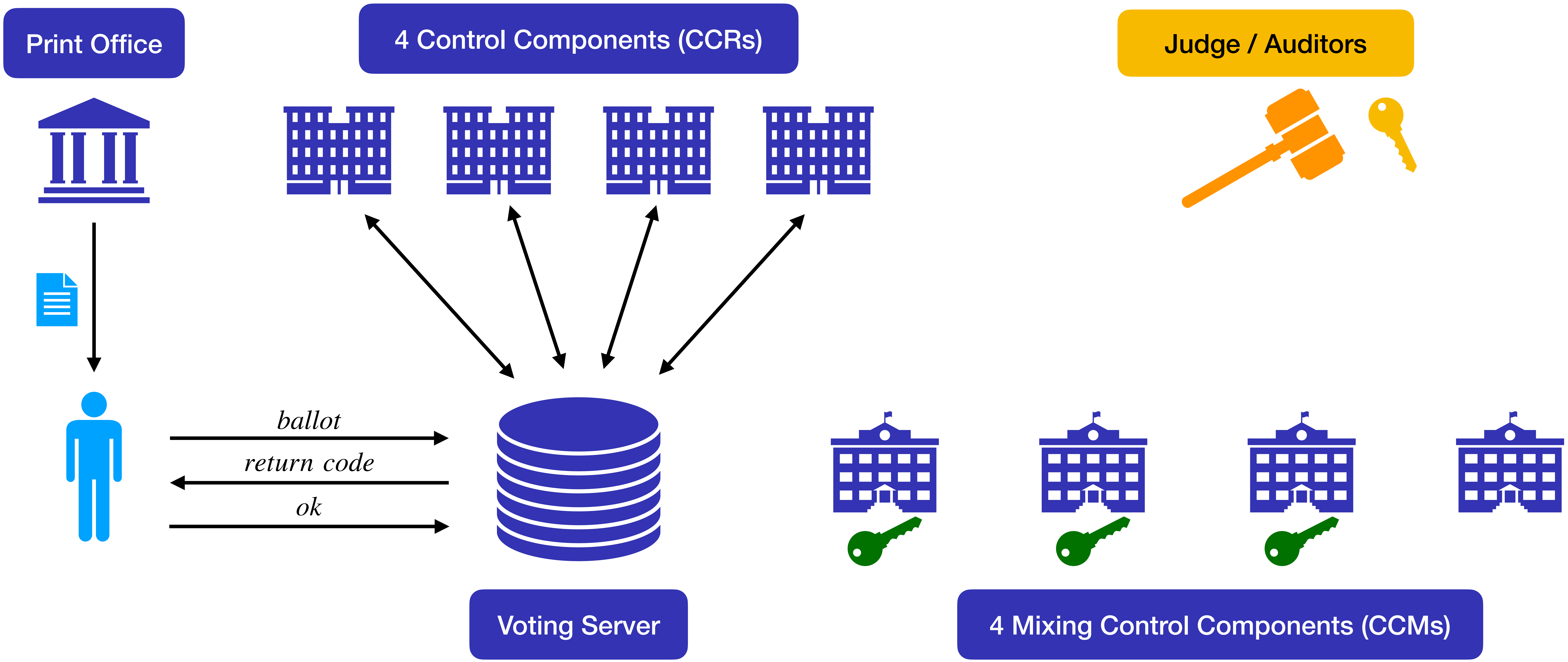

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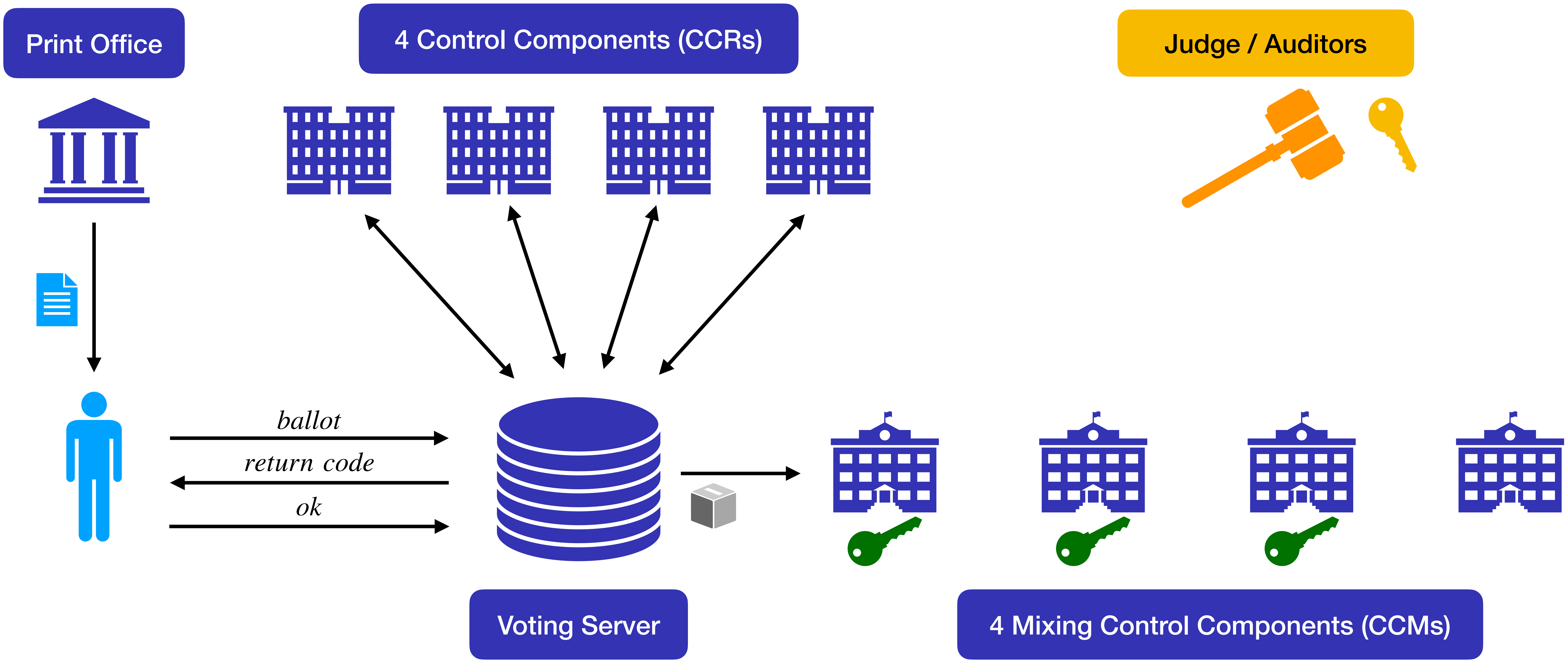

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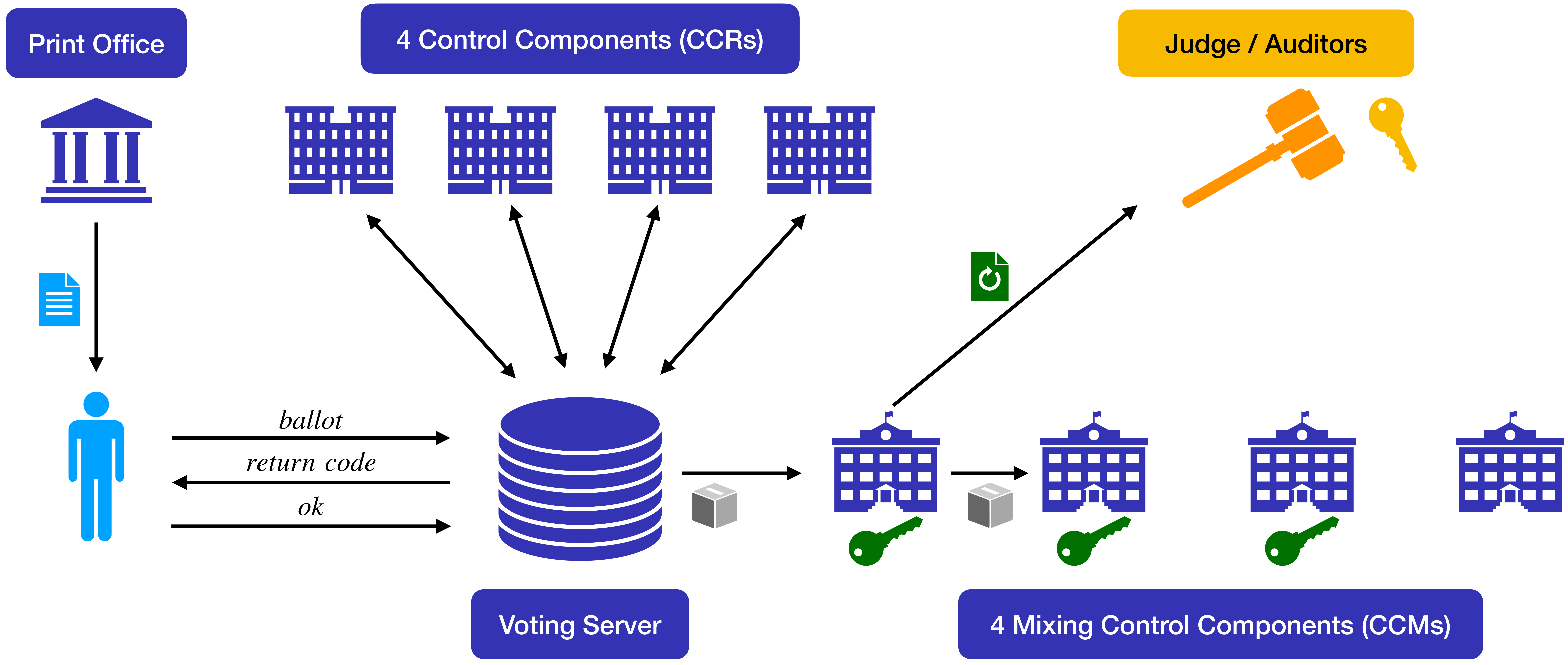

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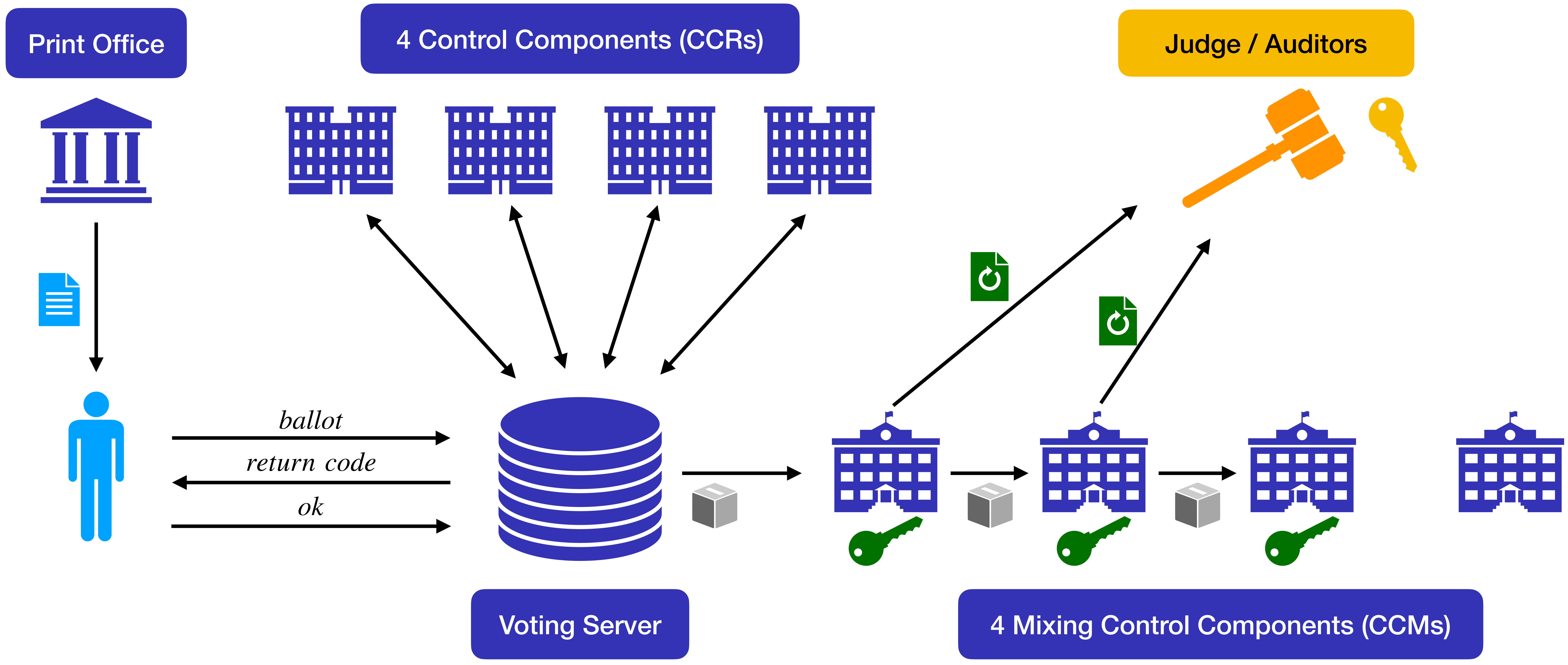

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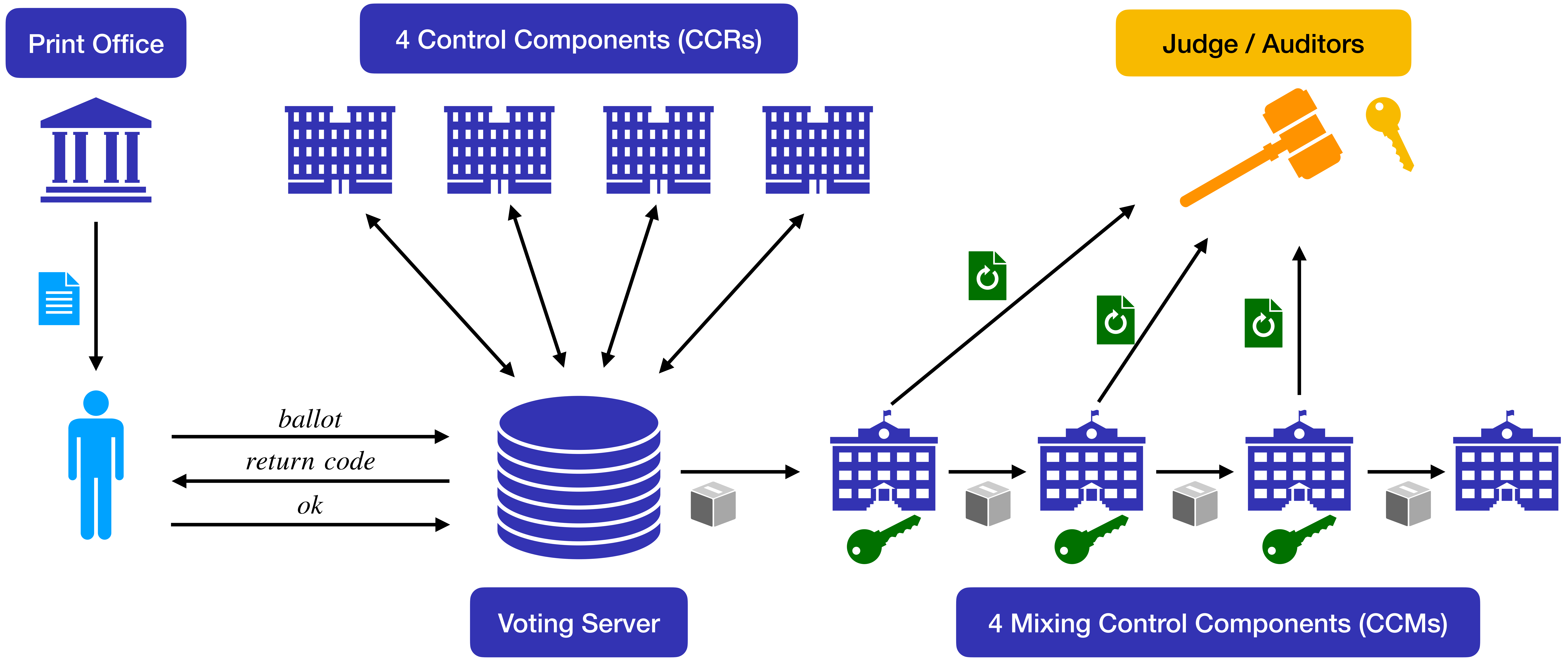

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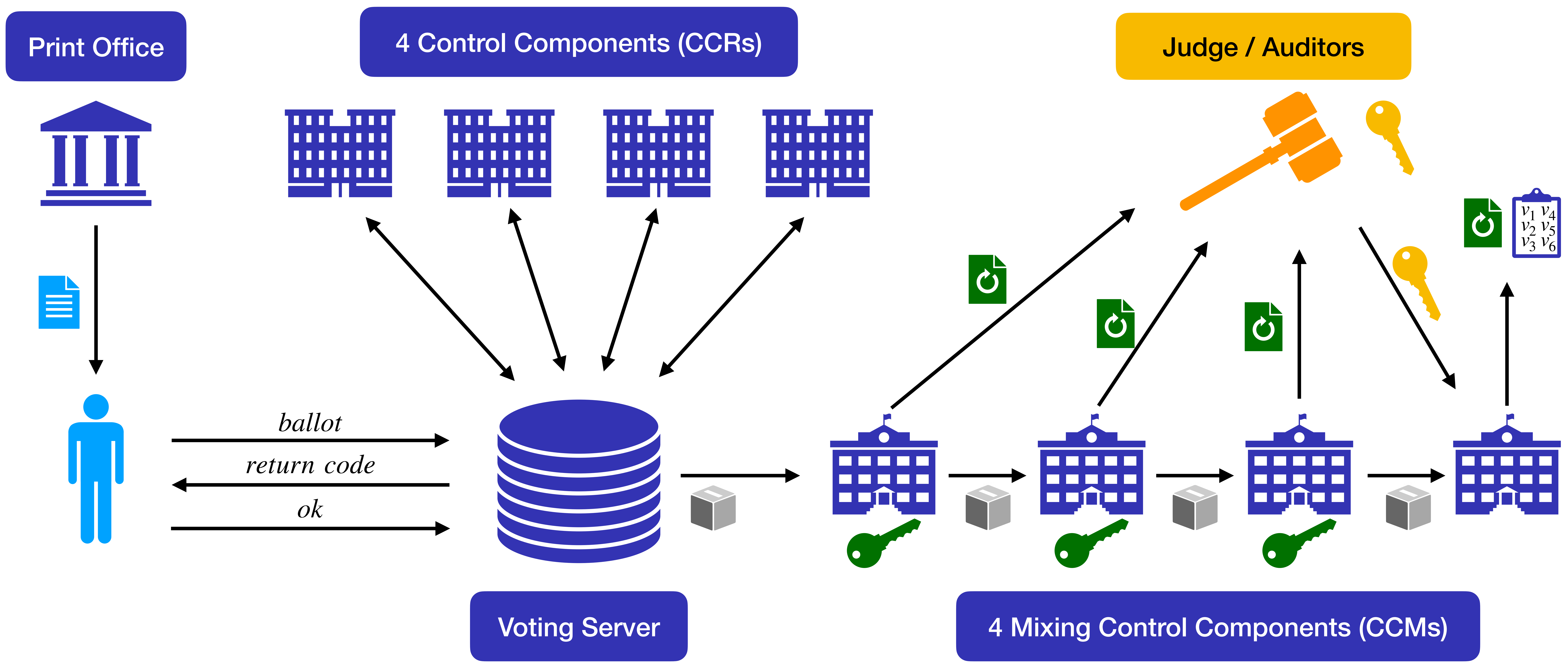

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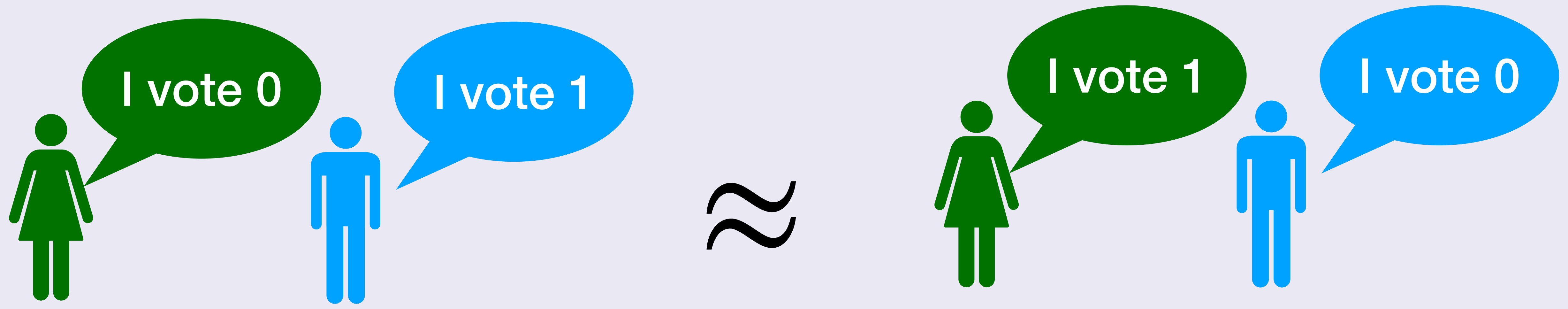
Vote secrecy - no one is able to learn who I voted for!



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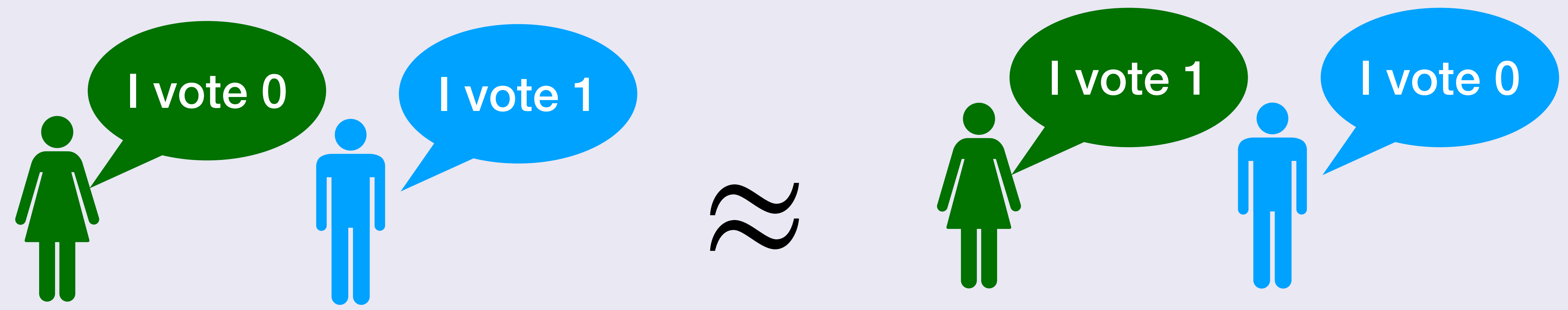

Federal chancellerie requirements:

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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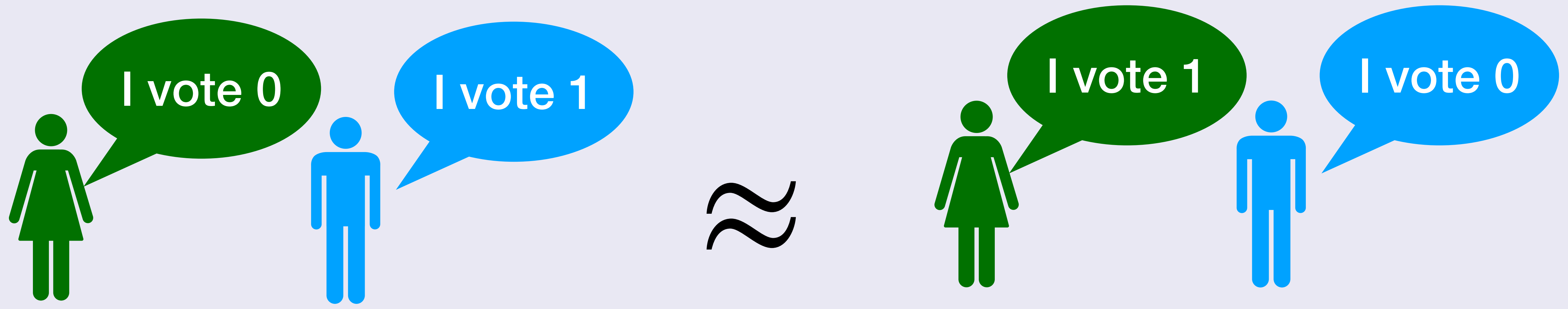

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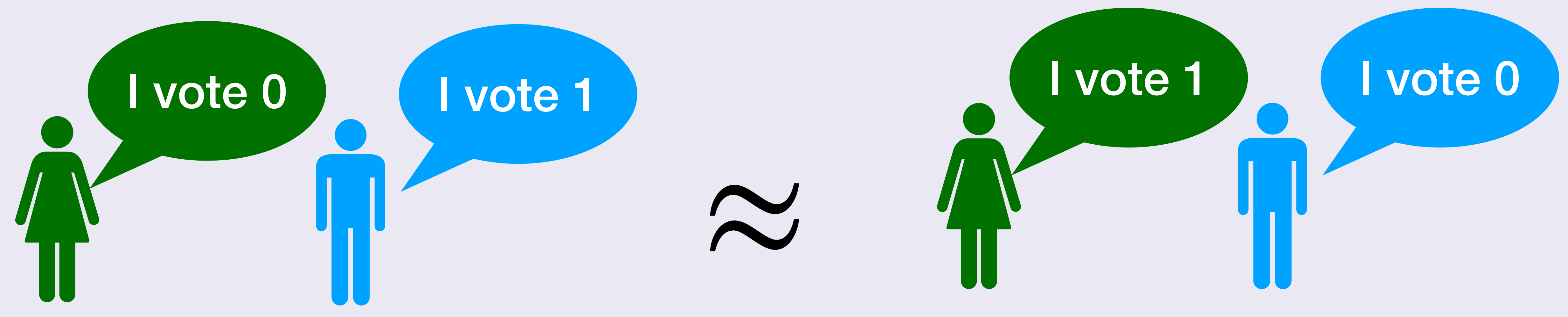

Federal chancellerie requirements:

Only 1 CCM is trusted

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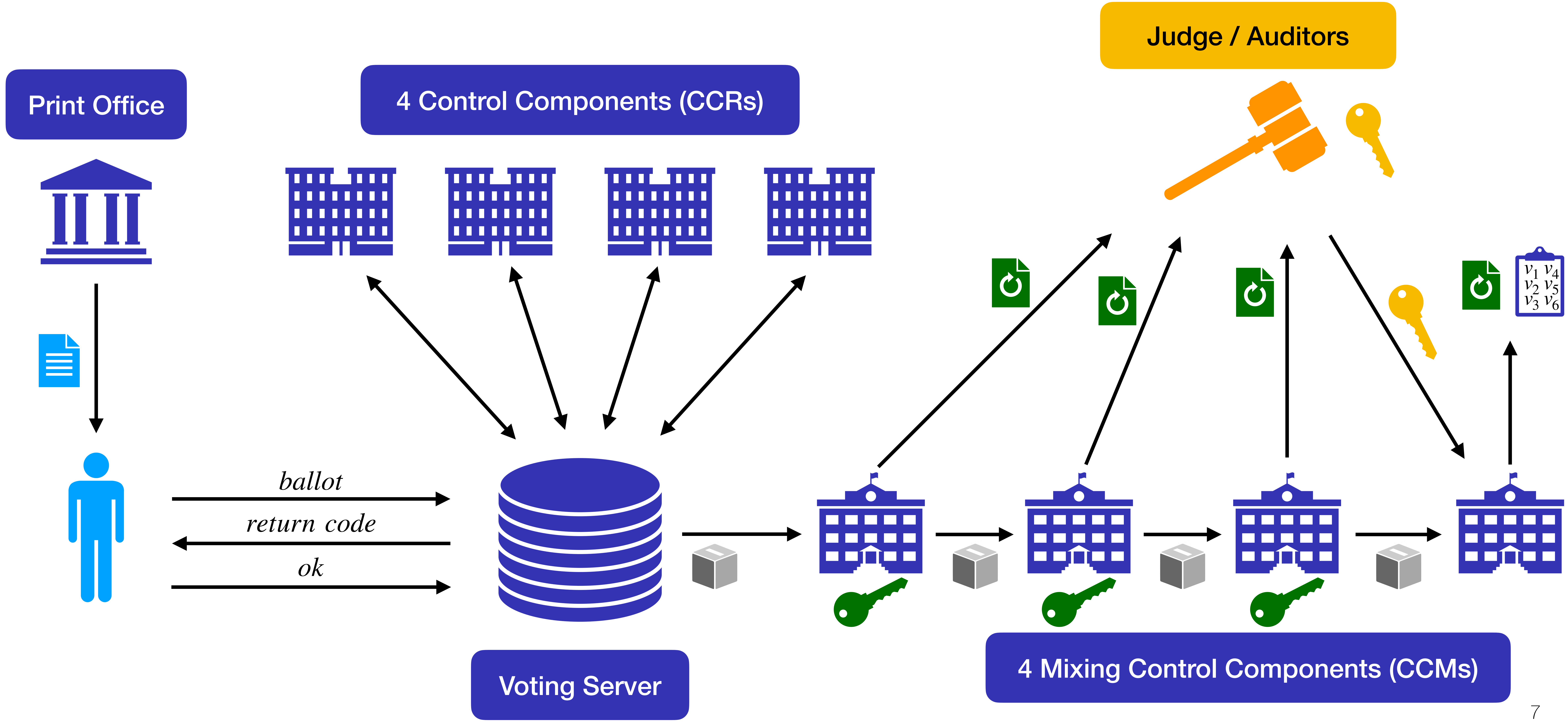

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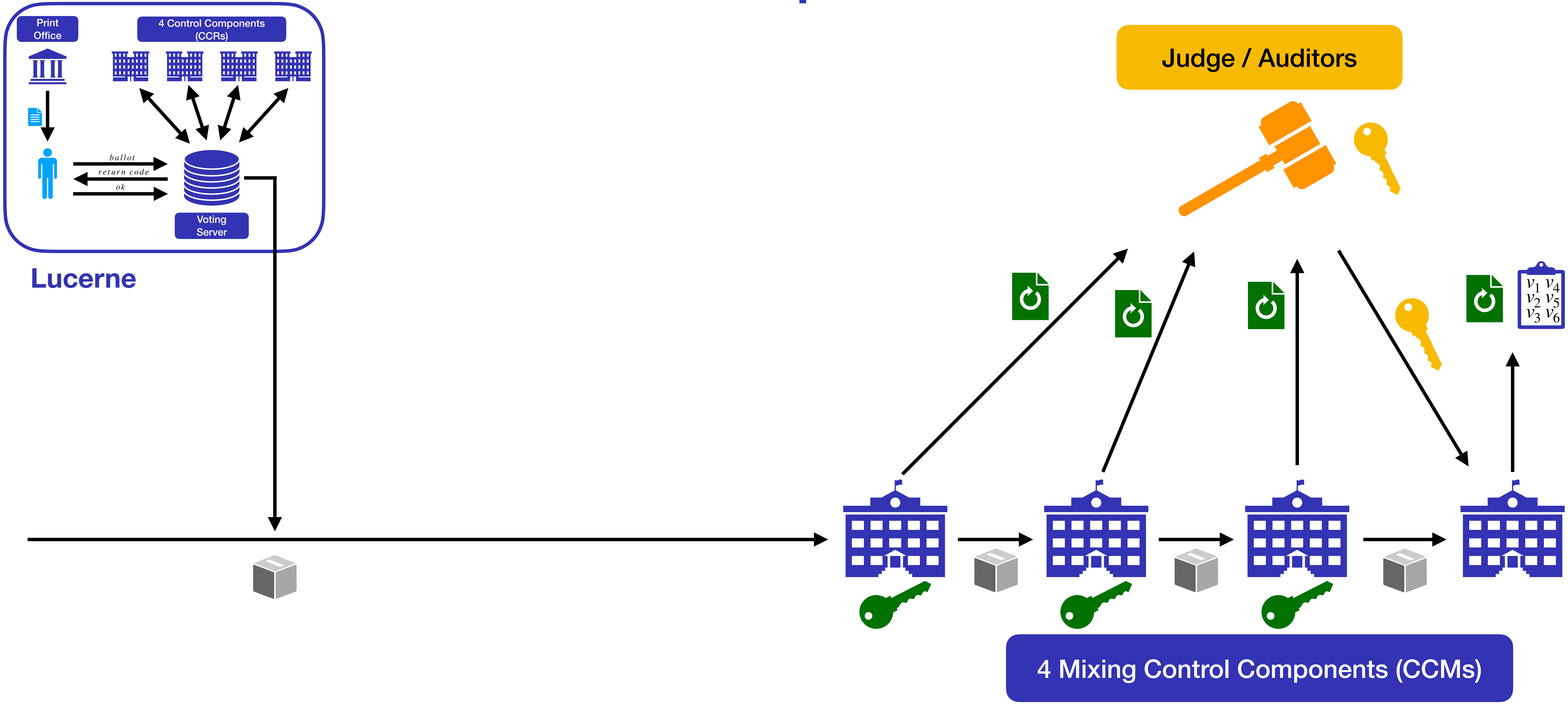

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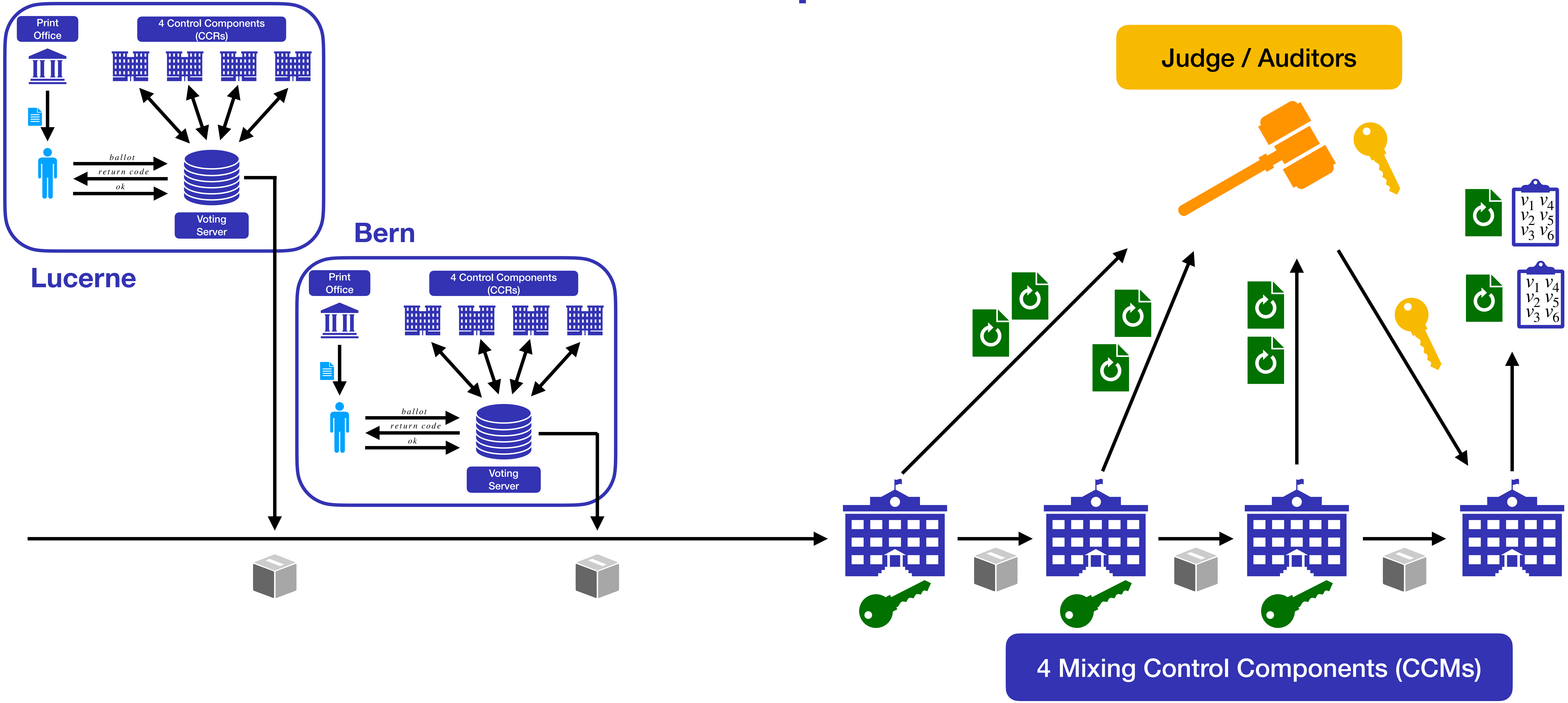

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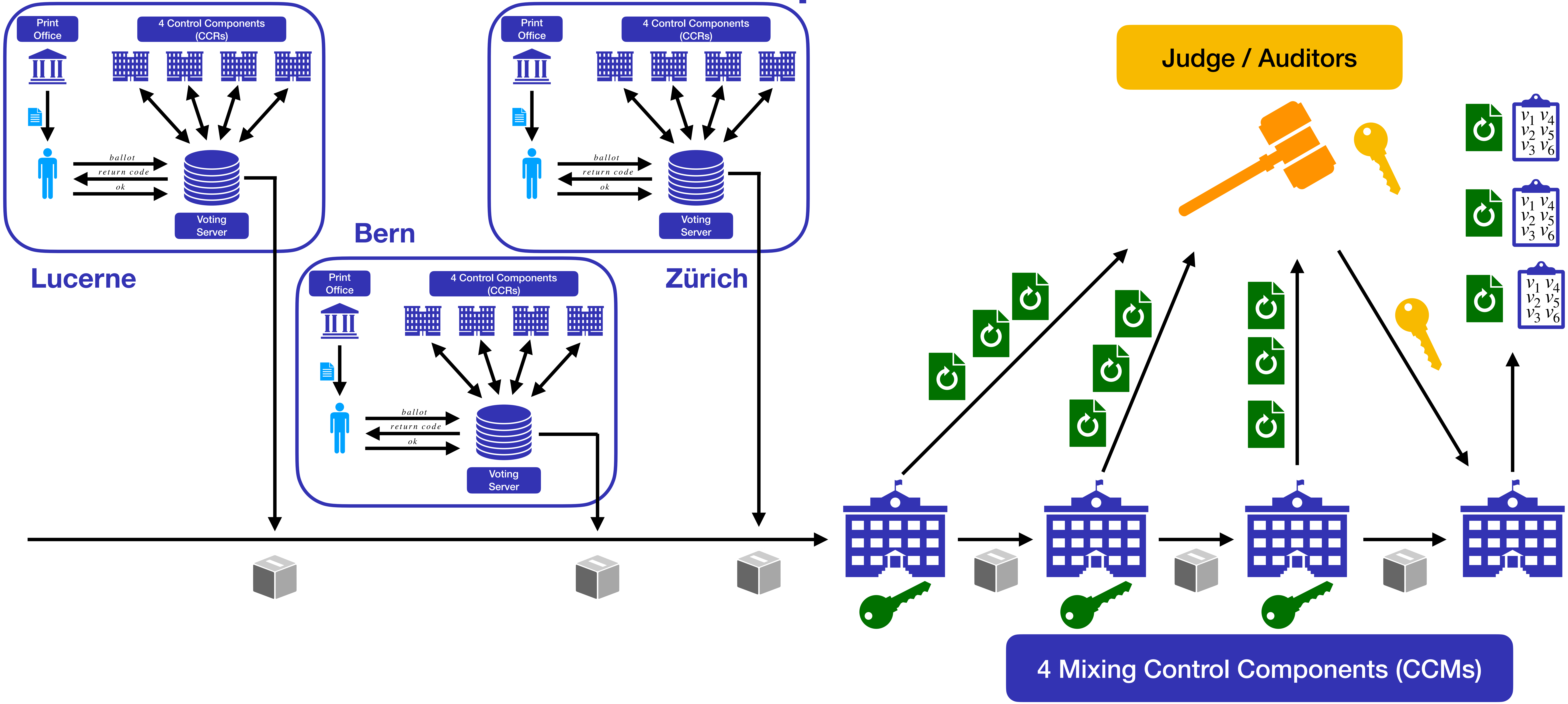

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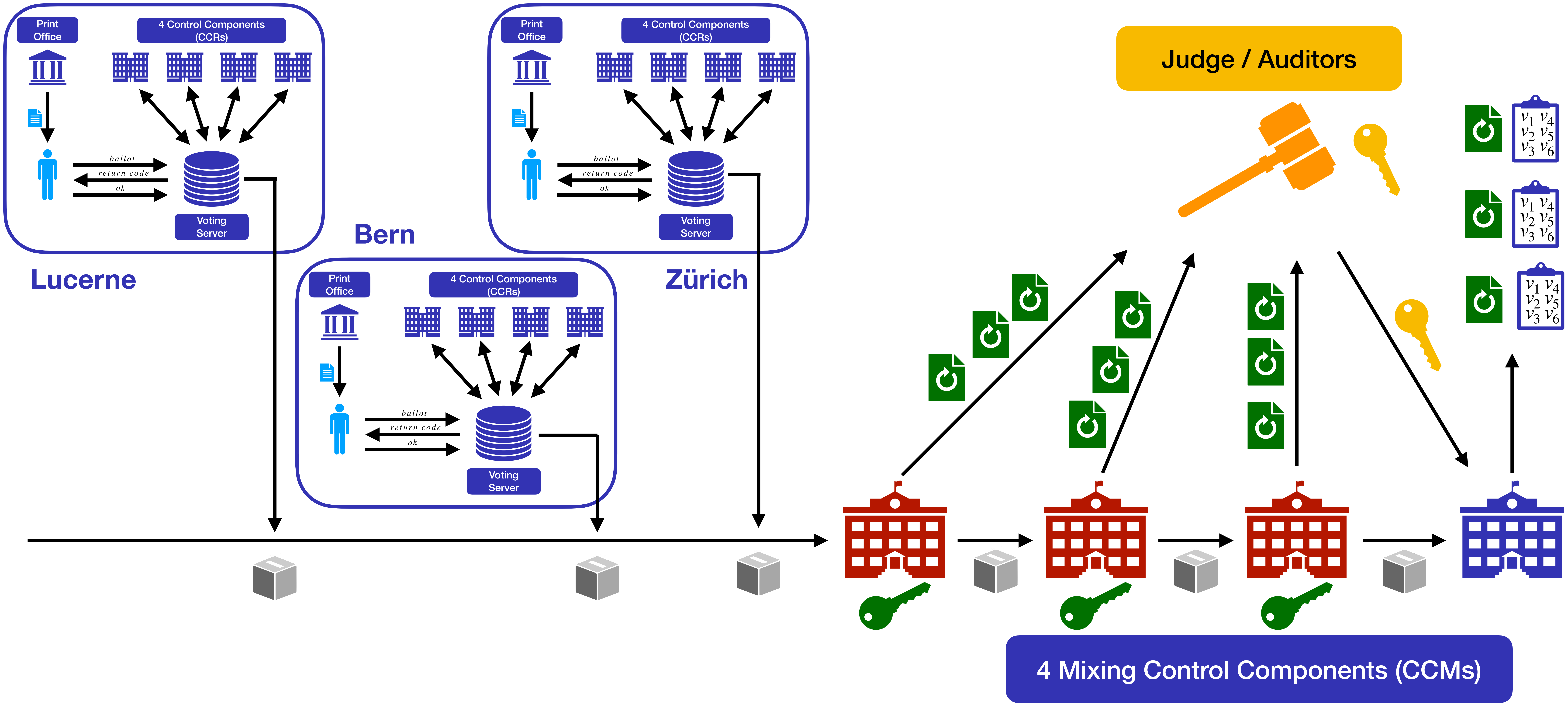

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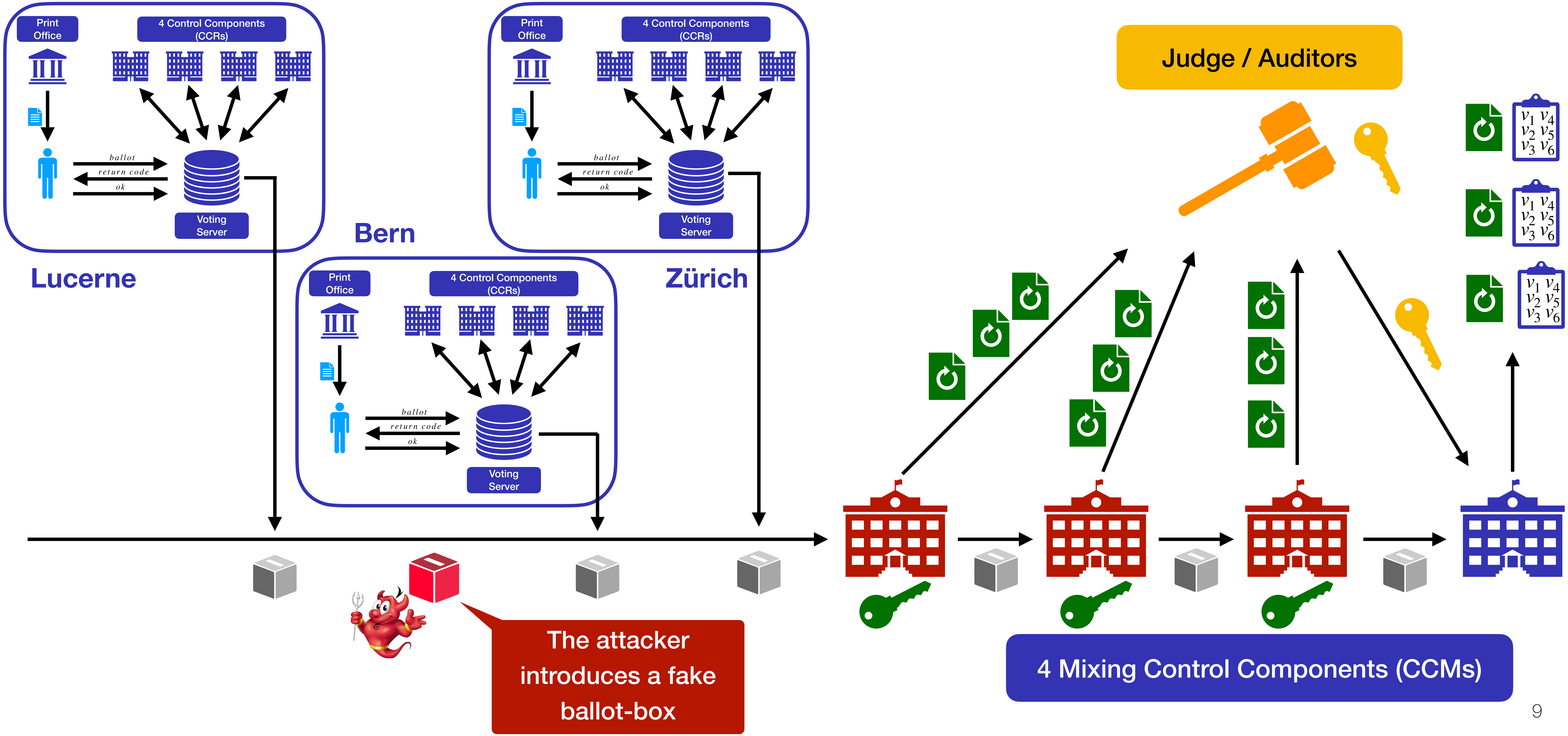

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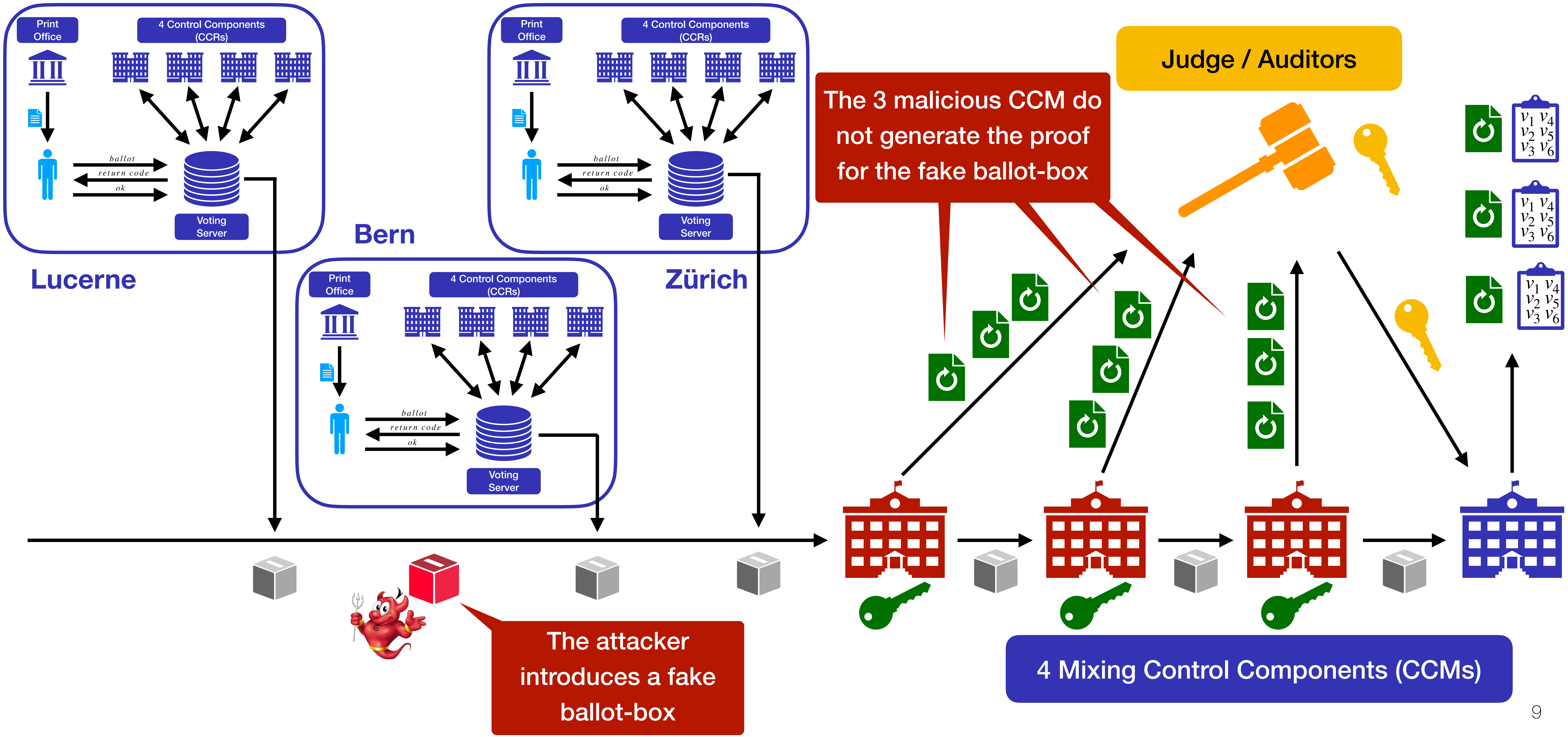

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According to Swiss Post and the Chancellerie: it is a critical flaw that must be fixed!
Many similar attack scenarios can be derived from ours.

How to fix the attack?

1. **A weak counter-measure:**

- set the number n_B of ballot-boxes as a public parameter of the election
- ensure that the CCMs check they decrypt at most n_B ballot-boxes
- ensure that the judge/auditor has received exactly n_B proofs before revealing the last key

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2. **A stronger counter-measure:**

- implement 1.
- require that each CCMs recomputes the initial payloads (i.e. the content of the initial ballot-box)
- require that each CCMs verifies all the previous proofs of correct mixing/decryption

➡ These two requirement are quite expensive…

Conclusion

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

Today, the Swiss Post solution provides a very high level of security.
with a high level of transparency, and many expert audits

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Lesson learned

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e.g. multi ballot-boxes or elections scenarios

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Future work

The Federal Chancellerie requirements will continue to evolve…
Let's keep on working to be sure that they remain coherent and that the Swiss Post solution (and others) satisfies them.