Improved Constructions of Anonymous Credentials From Structure-Preserving Signatures on Equivalence Classes

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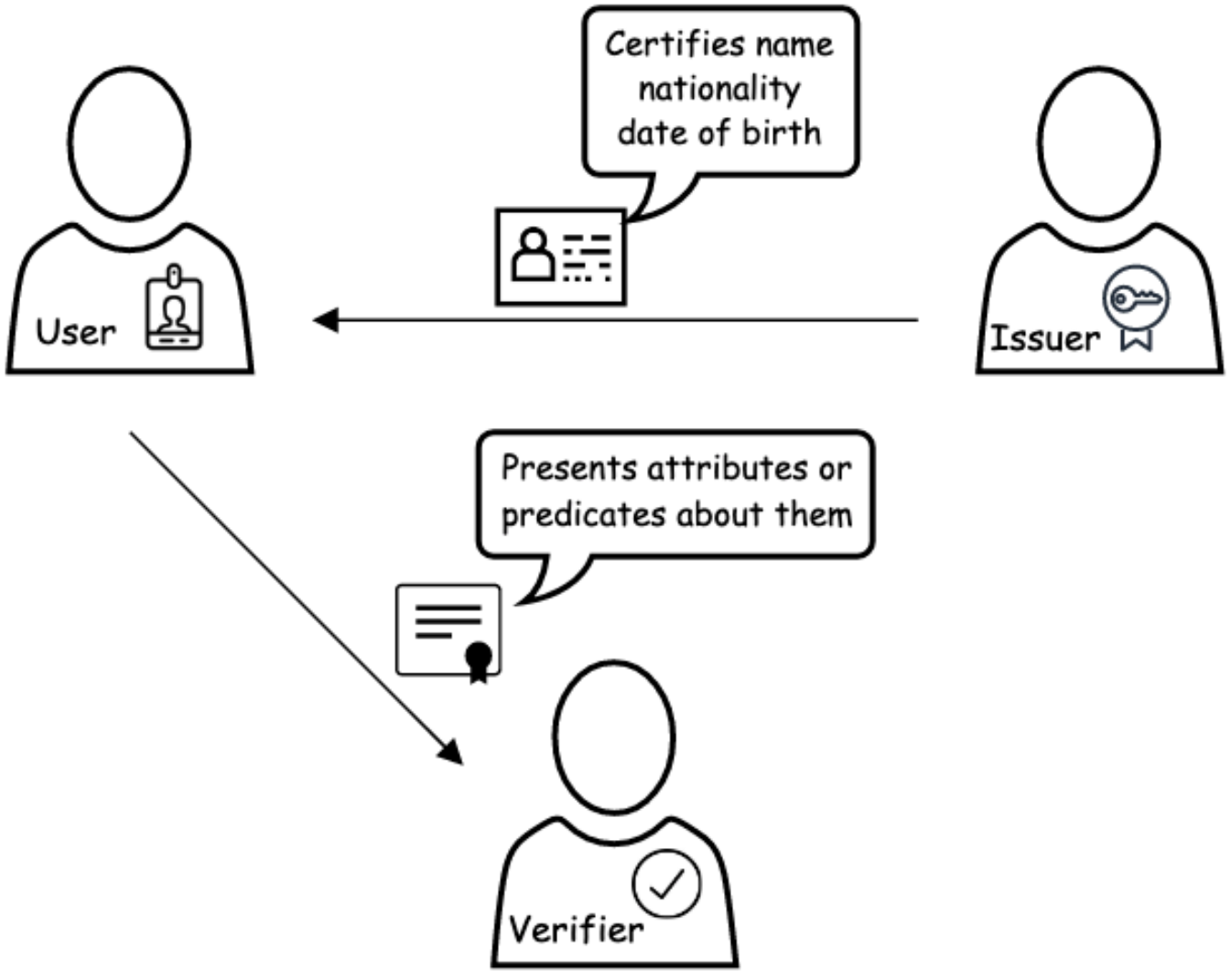
[1]Work done while the author was at Wordline Global.

Agenda

Attribute-based credentials



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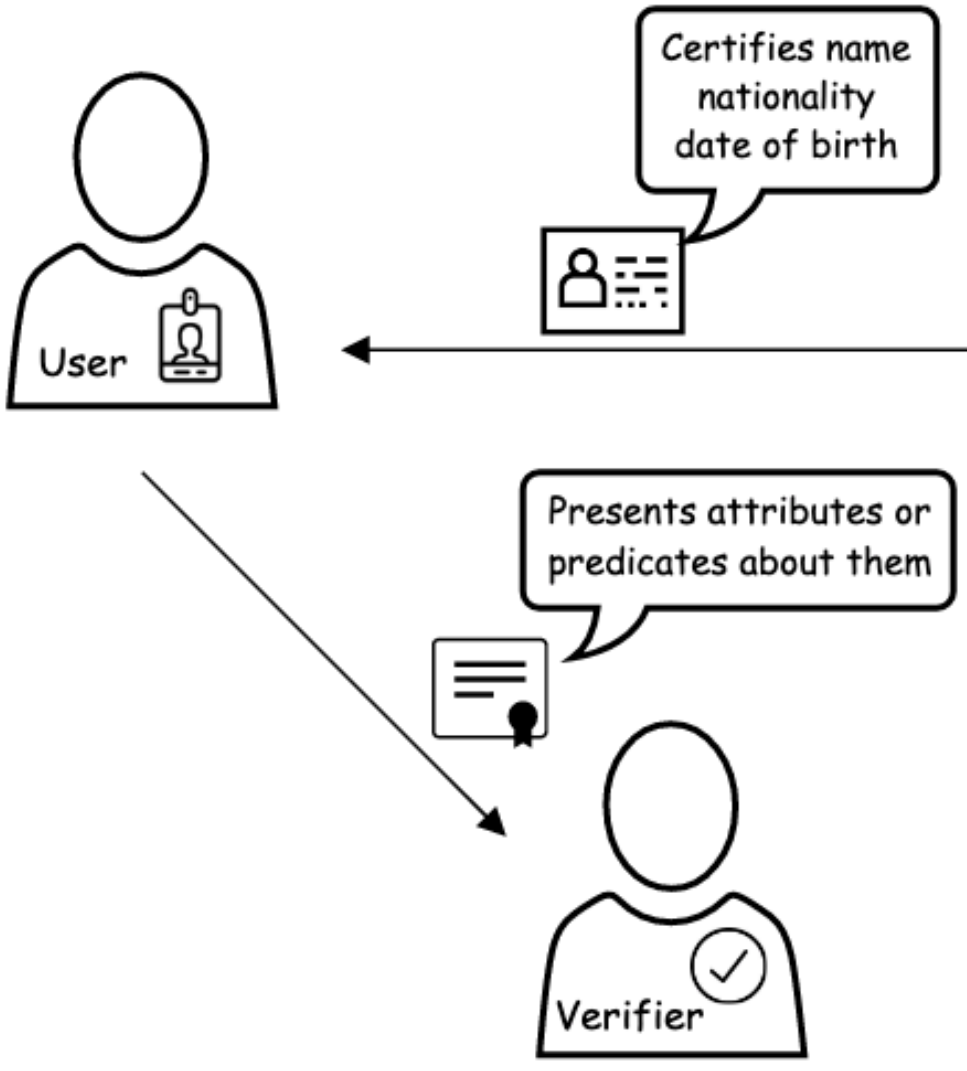

Multi-show ABC's: arbitrary number of unlinkable showings

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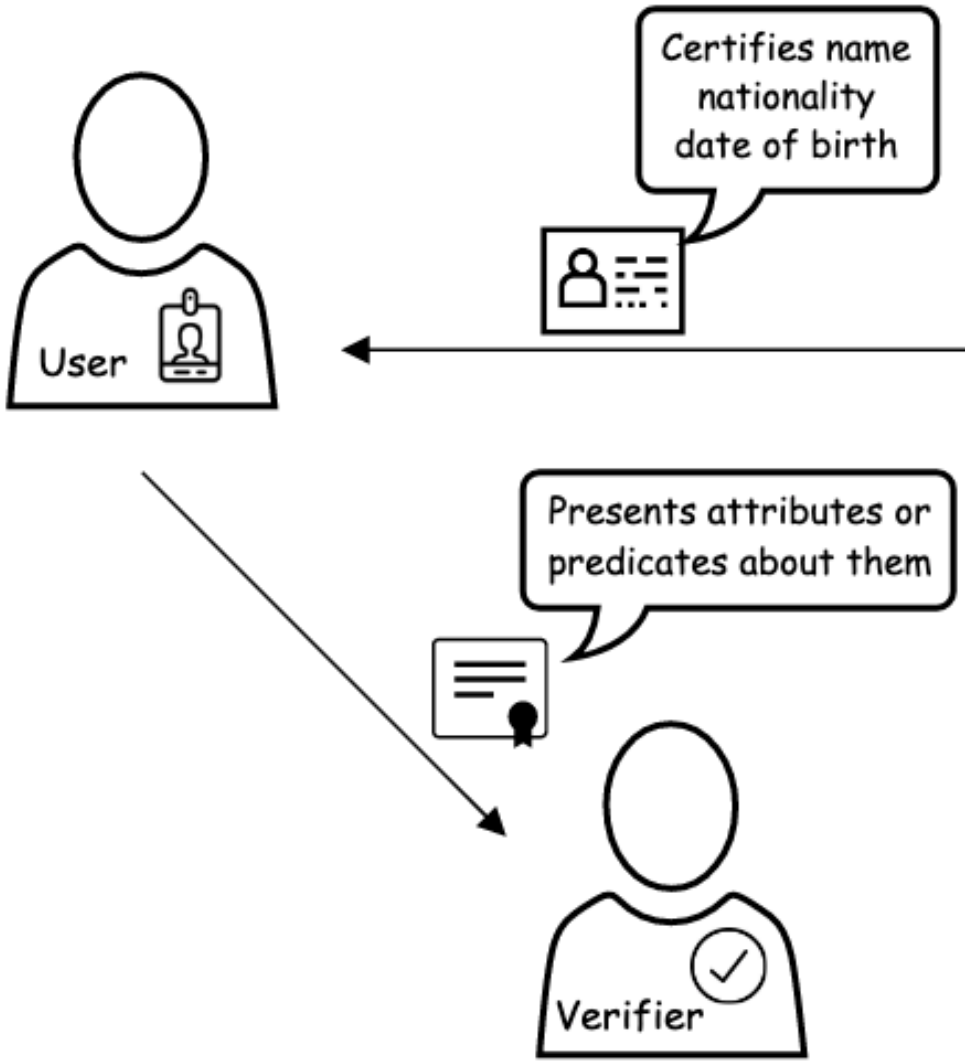

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Multi-authority ABC's: single credential for attributes issued by multiple authorities

Attribute-based credentials: differences

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Expressiveness

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Revocation

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- Structure-Preserving Signatures on Equivalence Classes (SPS-EQ): [HS14], [DHS15] and [FHS19]
- All previous constructions leak the issuer's identity

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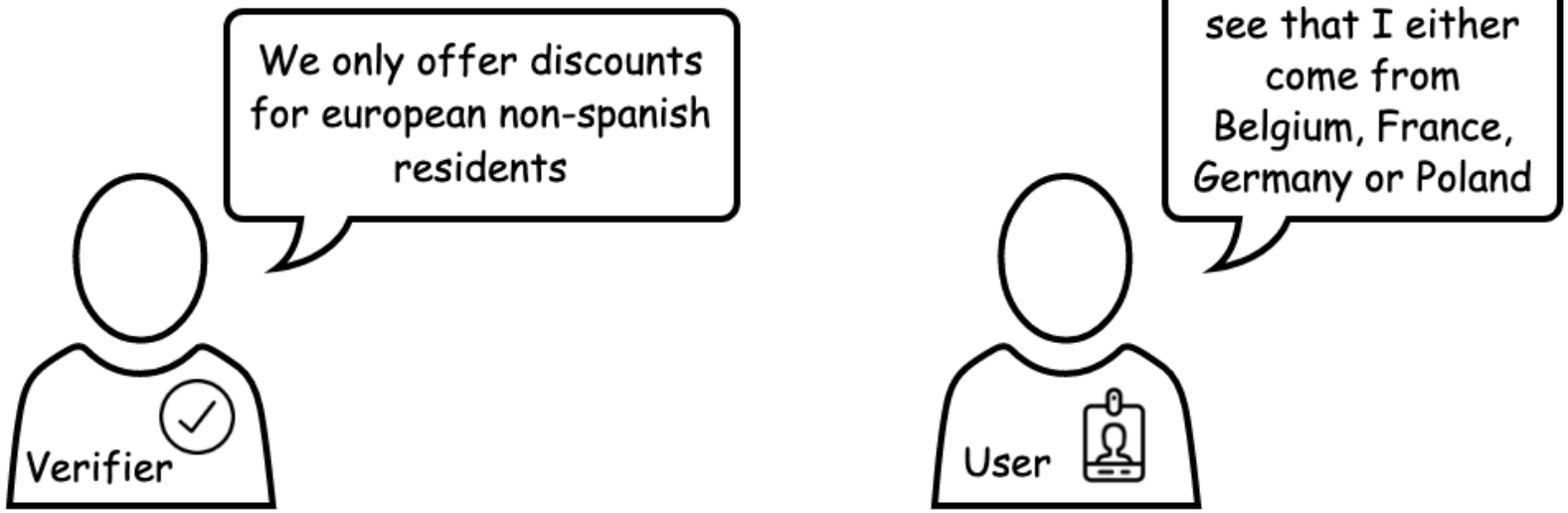

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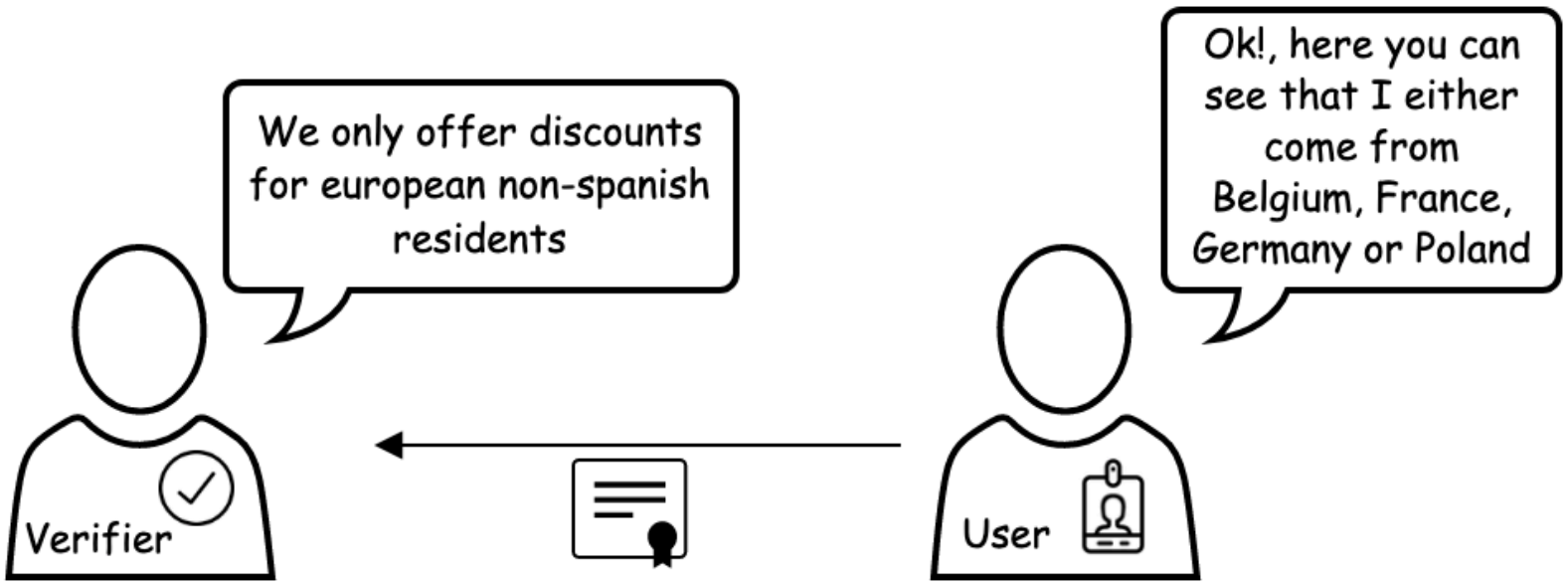

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- Recently extended to consider equivalence classes on the key space (*e.g.*, [BHKS18, CL19, CL21])

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- Main drawback: **expressiveness is limited**

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  - security model (~~GGM~~ Standard model + CRS)

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- Extended the security model from [FHS19]

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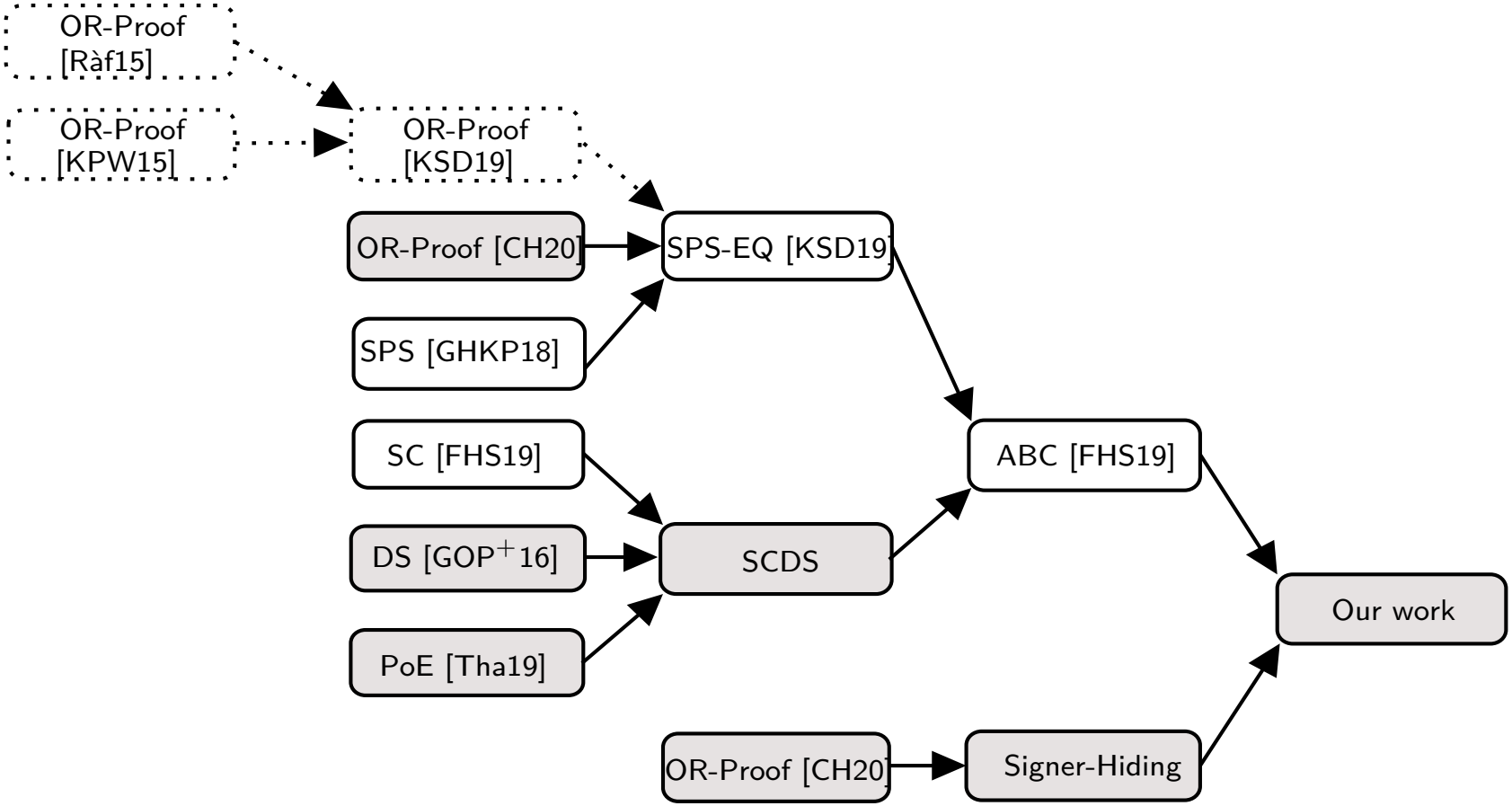

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- Main idea:
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  - Present them to the verifier alongside a proof of correct randomization of issuer's public-key
- The 1-out-of-n OR-proof is a fully adaptive NIZK argument
- Users can select arbitrary long sets of public keys to compute a proof with linear cost

Signer-hiding: Formalization

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An ABC system supports signer-hiding if for all $\lambda > 0$, all $q > 0$, all $n > 0$, all $t > 0$, all $\mathcal{X}$ with $0 < |\mathcal{X}| \leq t$, all $\emptyset \neq \mathcal{S} \subset \mathcal{X}$ and $\emptyset \neq \mathcal{D} \not\subseteq \mathcal{X}$ with $0 < |\mathcal{D}| \leq t$, and p.p.t adversaries $\mathcal{A}$, the following holds

$$\Pr\left[\begin{array}{l} \mathsf{pp} \xleftarrow{\$} \mathsf{Setup}(1^\lambda, 1^q); \\ \forall\ i \in [n] : (\mathsf{osk}_i, \mathsf{opk}_i) \xleftarrow{\$} \mathsf{OrgKGen}(\mathsf{pp}); \\ (\mathsf{usk}, \mathsf{upk}) \xleftarrow{\$} \mathsf{UsrKGen}(\mathsf{pp}); j \xleftarrow{\$} [n]; \\ (\mathsf{cred}, \top) \xleftarrow{\$} (\mathsf{Obtain}(\mathsf{usk}, \mathsf{opk}_j, \mathcal{X}), \\ \qquad\qquad\qquad \mathsf{Issue}(\mathsf{upk}, \mathsf{osk}_j, \mathcal{X})); \\ j^* \xleftarrow{\$} \mathcal{A}^{\mathcal{O}_{\mathsf{Show}}}(\mathsf{pp}, \mathcal{S}, \mathcal{D}, \mathsf{opk}_i)_{i \in [n]}) \end{array} : \ j^* = j \right] \leq \frac{1}{n}$$

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- We obtained a more flexible framework leveraging different trade-offs
- The proposed signer-hiding notion enables more use cases
- Exploring the use of aggregatable signatures with SPS-EQ in the multi-authority setting could enable even more use cases
- Devising other ways to define equivalence classes could lead to new and more efficient constructions

Thank you for your time!

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