Privacy-Enhancing Proxy Signatures from Non-Interactive Anonymous Credentials

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Outline

- Privacy-enhancing proxy signatures
  - Blank Digital Signatures [HSa]
  - Warrant-Hiding Proxy Signatures [HSb]
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- Our BDS/WHPS constructions
- Conclusion

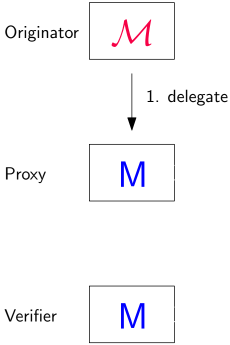
Privacy-Enhancing Proxy Signatures

Originator $\mathcal{M}$

Proxy M

Verifier M

Privacy-Enhancing Proxy Signatures



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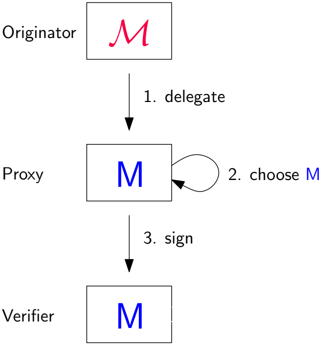

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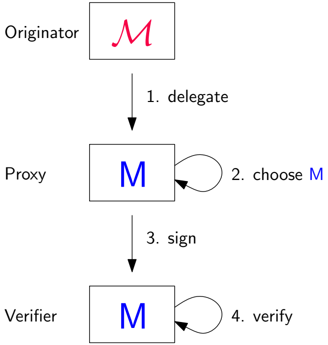

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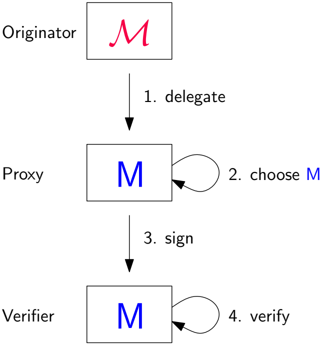

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- New: **Privacy property**
  - Hides $\mathcal{M} \setminus \mathsf{M}$

Blank Digital Signatures

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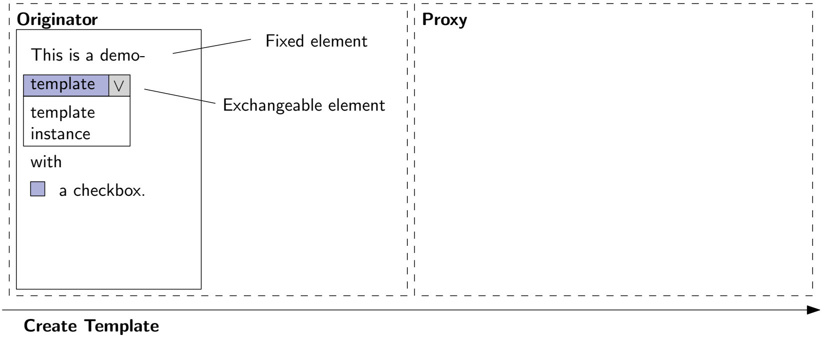

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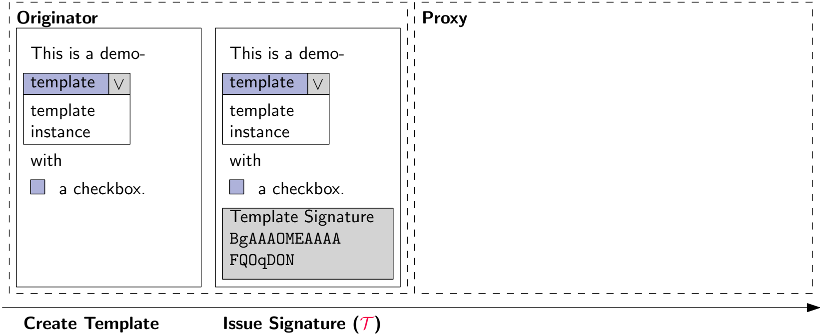

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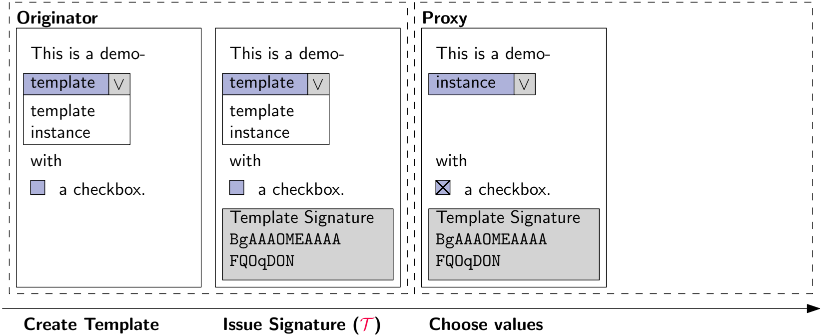

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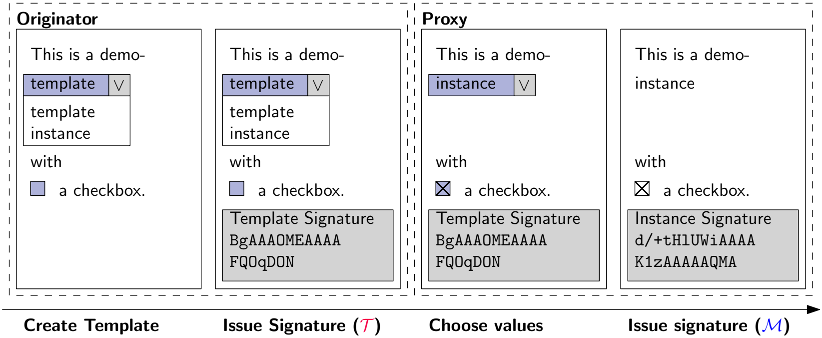

BDS Template/Message Representation

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Verifier does not learn unused choices in the template

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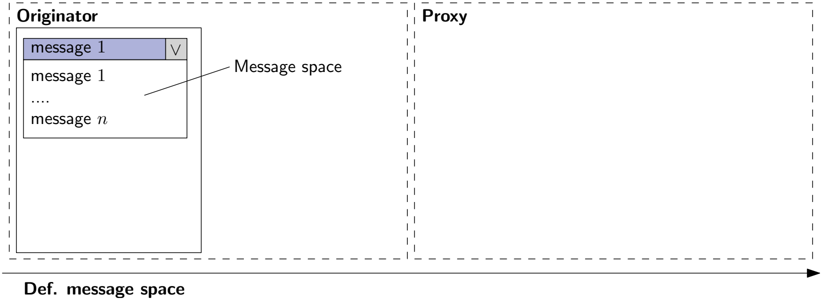

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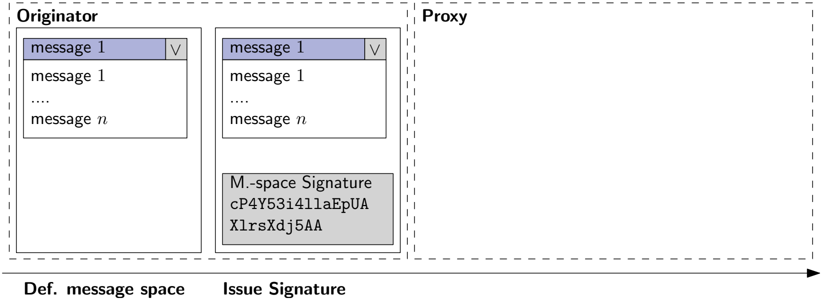

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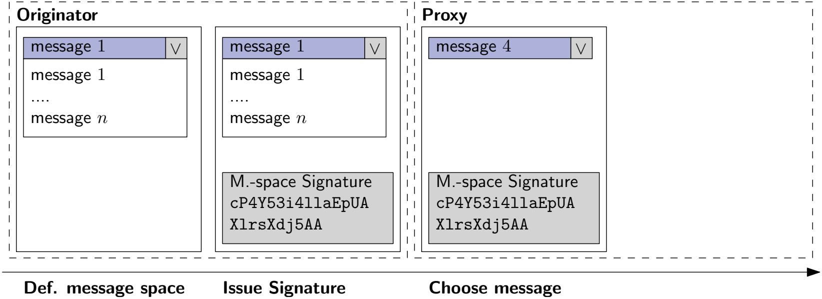

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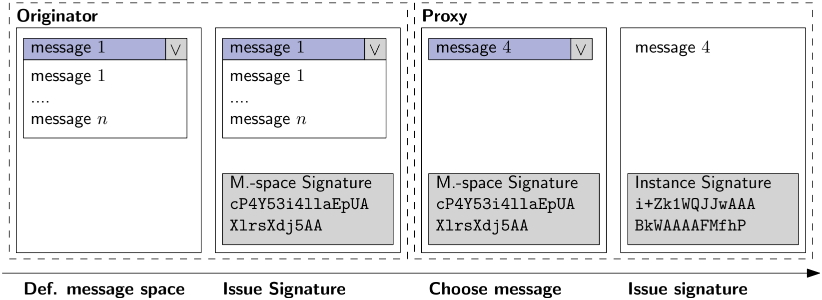

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Verifier does not learn unrevealed messages in the warrant.

Motivation

- Attorney makes business deal
  - ...on behalf of the client
  - Privacy property

$\mathcal{T} =$
$(\{"I, hereby, declare\ to\ pay\ "\},$
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- Warrant-Hiding Proxy Signatures
  - Subset of BDS use cases

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- Organization issues credentials to users
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- Users can then anonymously demonstrate possession
  - and, thereby, selectively disclose a subset of attributes

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Selective Disclosure

- Verifier learns nothing about non-shown attributes
- Informal requirement of all AC systems
- All known AC systems employ proofs of knowledge
  - Nothing beyond the shown attributes revealed by definition

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- Showing
  - Verify blind signature
  - Prove knowledge of DLREP
  - Multiple showings are linkable

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- Showing
  - Verify re-randomized signature
  - Prove knowledge of attributes in C
  - Multiple showings unlinkable
    - Not needed in our context

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  - Apply Fiat-Shamir transform [FS] to proofs
- Non-interactive Proof
  - …together with proving knowledge of a secret key
  - Secure digital signature in the random oracle model [CLb]
  - Interpreted as the proxy's signature

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  - Provide non-interactive showings
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    - Prove knowledge of secret key and remaining attributes

BDS Encoding

- Template uniquely defined by its elements
  - Fixed elements
    - Position i in the template
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- Template element $\mapsto$ AC attribute

$$\mathcal{T} = (\{m_{1_1}\}, \{m_{2_1}, m_{2_2}, m_{2_3}\})$$
$$\downarrow$$
$$\mathcal{T}^{\text{enc}} = (H(m_{1_1}||1), H(m_{2_1}||2), H(m_{2_2}||2), H(m_{2_3}||2))$$

BDS Encoding (2)

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- Ensure that one attribute m_{i_j} is shown for each $1 \leq i \leq l$

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- Instantiation: $\{\blacksquare, \ldots, \blacksquare, \ldots, H(m_i), \ldots, \blacksquare\}$

Modeling the Delegation

- Keys compatible with system parameters of used ACs
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- In addition to encoded attributes
  - Incorporate sk as attribute without disclosing it
  - ... by using pk as public commitment

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  - Incorporate sk as attribute without disclosing it
  - ... by using pk as public commitment
- Possible for Brands' and CL credentials

Modeling the Delegation

- Keys compatible with system parameters of used ACs
  - Secret key $\mathsf{sk} \in \mathbb{Z}_p^*$
  - Public key $\mathsf{pk} = \mathsf{sk} \cdot P$ (P generates used group $\mathbb{G}$)
- In addition to encoded attributes
  - Incorporate sk as attribute without disclosing it
  - ... by using pk as public commitment
- Possible for Brands' and CL credentials
- If not
  - Incorporate public key as attribute
  - Prove knowledge by providing a signature

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- First approach to build special signature schemes from AC
  - Inspiration for other constructions
- Proposed encoding might also be useful for AC

Thank you.

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