ABC4TRUST

ABC4Trust on Smart Cards

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Embedding Privacy-ABCs on Smart Cards

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Smart card reference implementation

ABC4Trust Card Lite

- supports device-bound U-Prove and Idemix
- and virtually any discrete-log based pABC system :)
- is free and open source on GitHub

Version 1.2 is based on MultOS ML3 dual-interface cards with $\simeq$64 kB of non-volatile memory, $\simeq$ 1kB of RAM and SLE78 Infineon processor

Why use Smart Cards?

Without smart cards

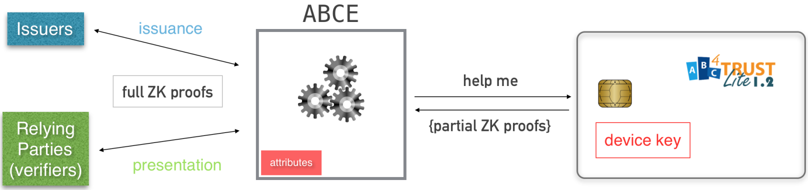
- credentials, attributes, secrets: all in one place
- untrusted computing environment (trojans, viruses, etc)
- identity theft

With smart cards

- stores/uses the user's private key securely
- trusted computing environment
  - logical security can be demonstrated
  - tamper-resistance achievable (side-channels, faults)
  - security certification (common criteria, EMVCo)

What does it do?

- contains the user's private key x
- operates crypto operations on x delegated by the ABC Engine
- + stores blobs for the ABCE, + backup-able, + PIN-protected



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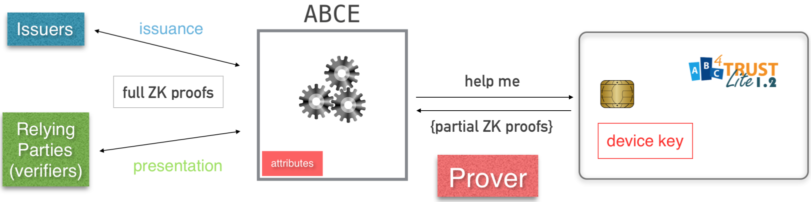

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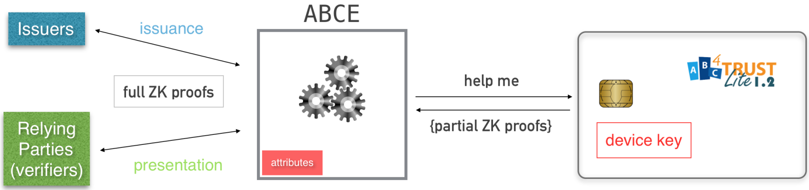

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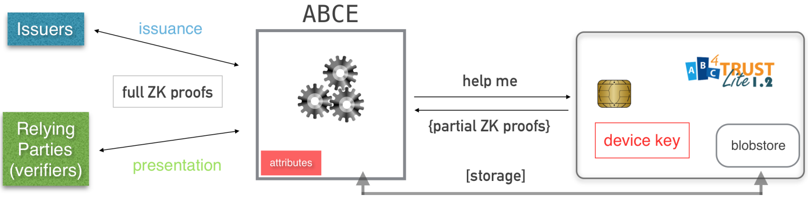
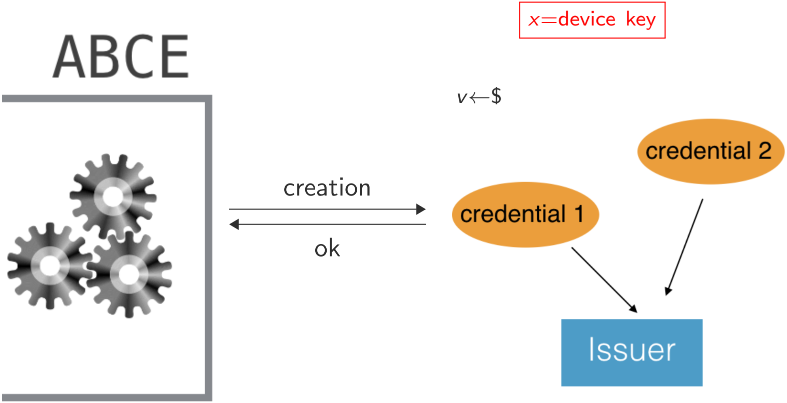


How does it work? (basic operations)

The card uses an internal representation of pABC objects and roles



x=device key

ABCE

$v \leftarrow \$$

creation

ok

credential 1

credential 2

Issuer

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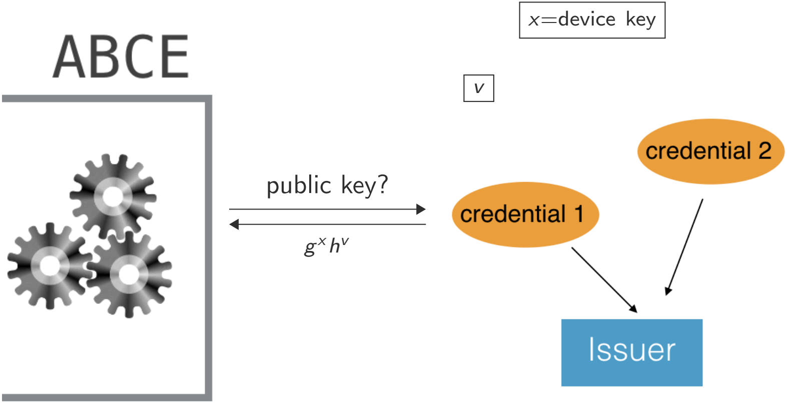

x=device key

v

ABCE

public key?

$g^x h^v$

credential 1

credential 2

Issuer

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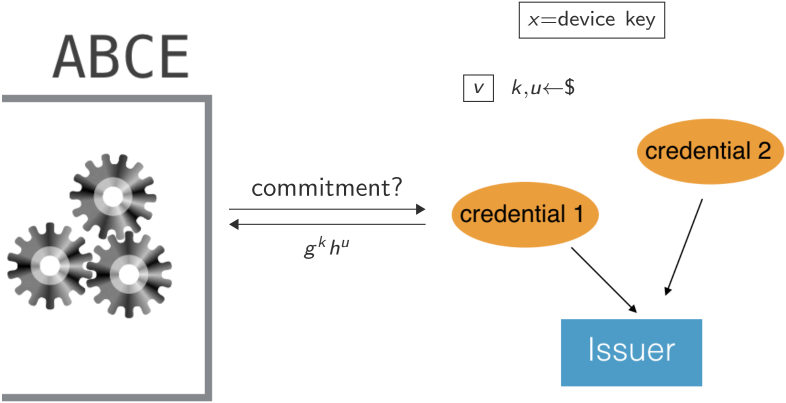

$\boxed{x\text{=device key}}$

ABCE

$\boxed{v}$ $k,u \leftarrow \$$

commitment?

$g^k h^u$

credential 2

credential 1

Issuer

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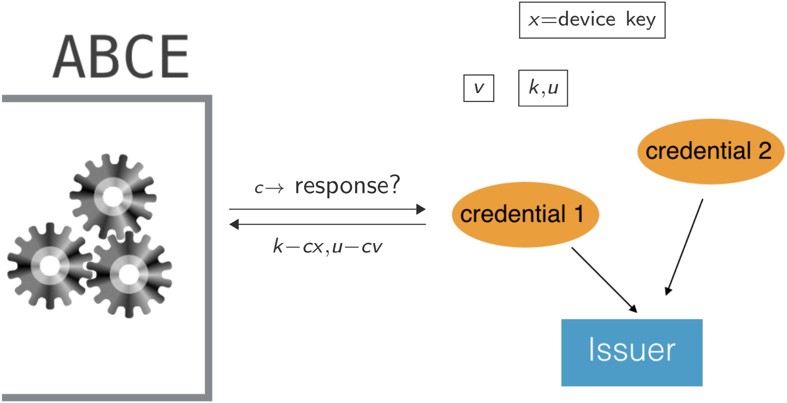


ABCE

x=device key

v

k,u

credential 2

$c \rightarrow$ response?

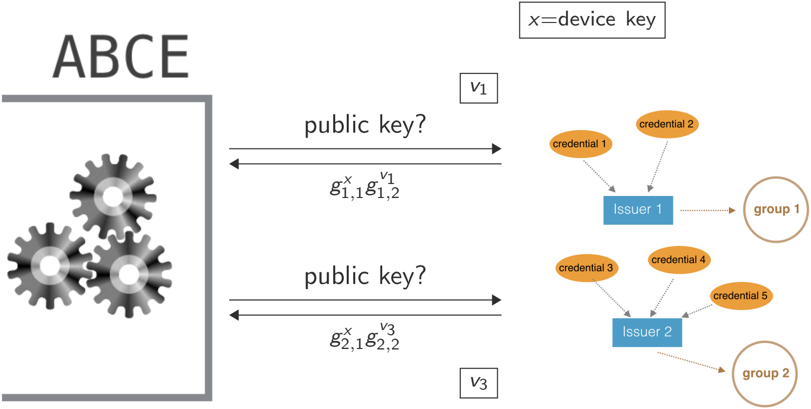
credential 1

$k-cx, u-cv$

Issuer

How does it work? (integrated sessions)

Issuers rely on their own algebraic setting of groups and generators.



x=device key

ABCE

v_1

public key?

$g_{1,1}^{x} g_{1,2}^{v_1}$

public key?

$g_{2,1}^{x} g_{2,2}^{v_3}$

v_3

credential 1

credential 2

Issuer 1

group 1

credential 3

credential 4

credential 5

Issuer 2

group 2

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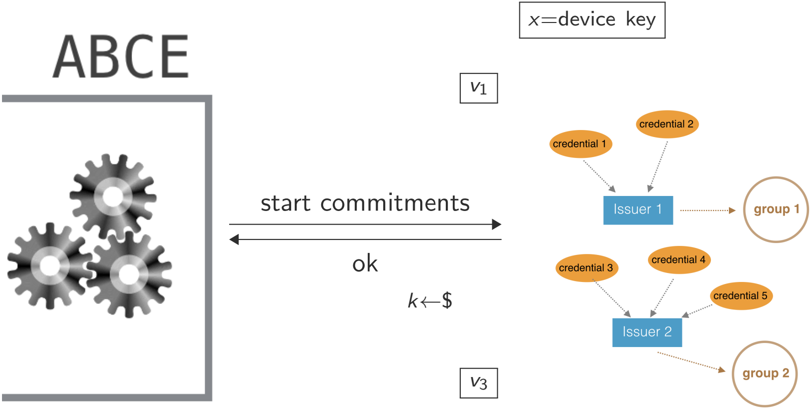

x=device key

v_1

start commitments

ok

$k \leftarrow \$$

v_3

How does it work? (integrated sessions)

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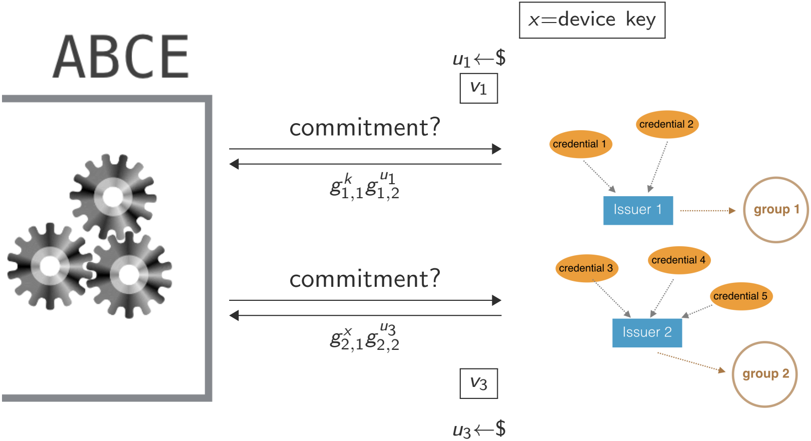

ABCE

$\boxed{x\text{=device key}}$

$u_1 \leftarrow \$$

$\boxed{v_1}$

commitment?

$g_{1,1}^{k} g_{1,2}^{u_1}$

commitment?

$g_{2,1}^{x} g_{2,2}^{u_3}$

$\boxed{v_3}$

$u_3 \leftarrow \$$

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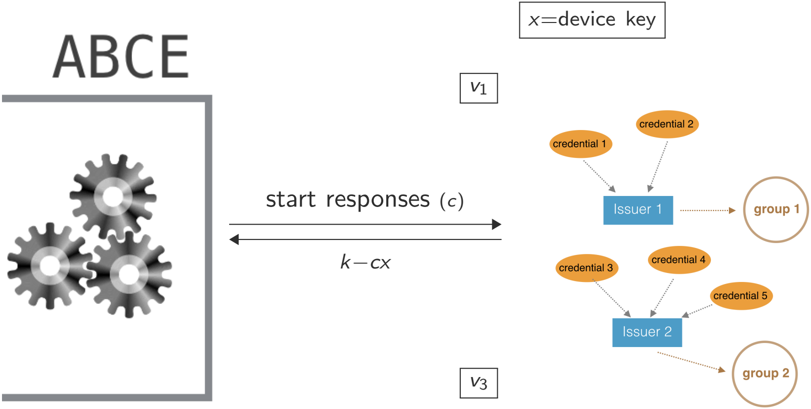

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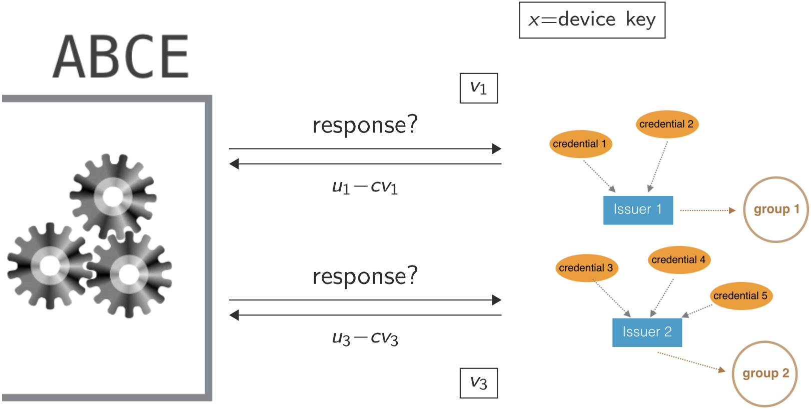
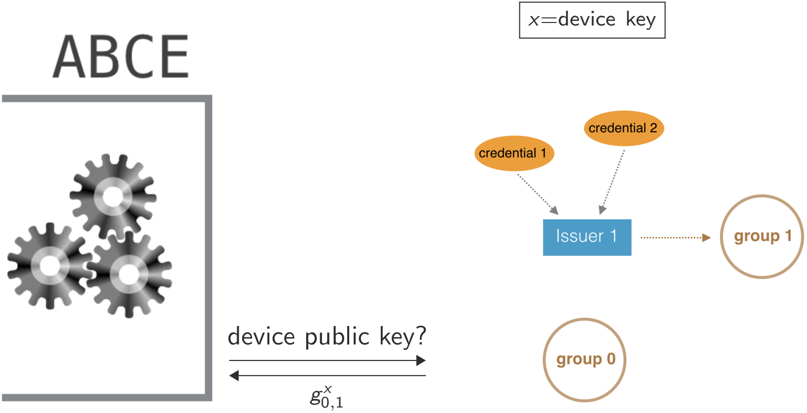


How does it work? (pseudonyms)

There is a group 0 specifically for pseudonyms.



x=device key

ABCE

credential 1

credential 2

Issuer 1

group 1

group 0

device public key?

$g_{0,1}^{x}$

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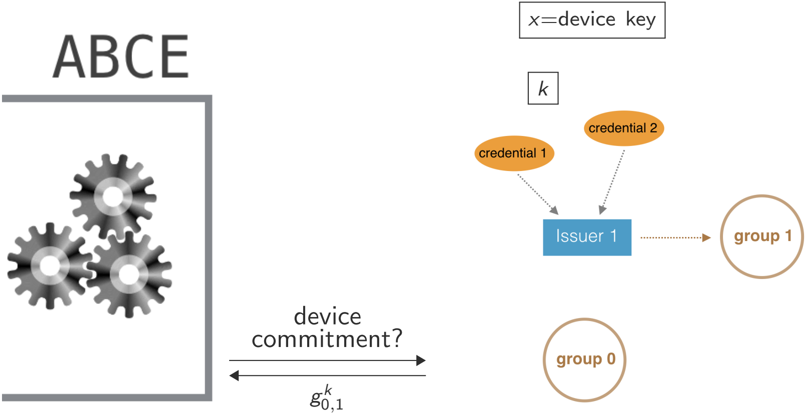
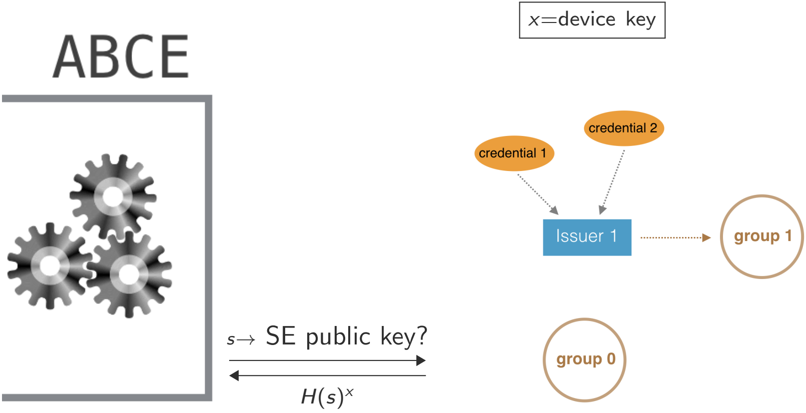


How does it work? (SE pseudonyms)

Group 0 is also used for scope-exclusive pseudonyms.



ABCE

$s \rightarrow$ SE public key?

$H(s)^x$

x=device key

credential 1

credential 2

Issuer 1

group 1

group 0

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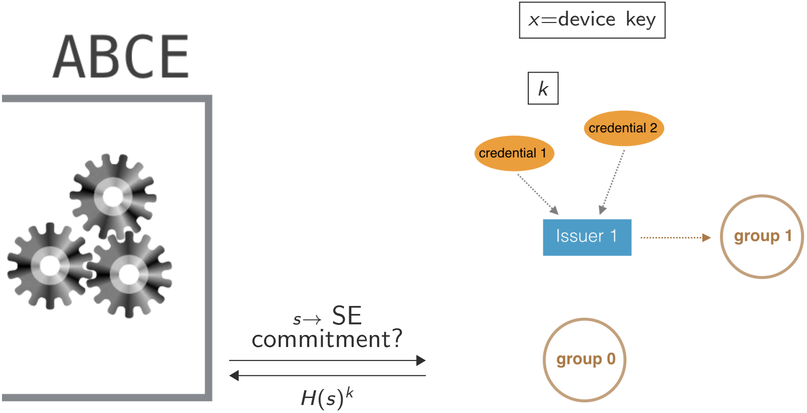


ABCE

x=device key

k

credential 1

credential 2

Issuer 1

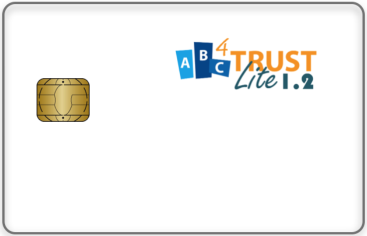
group 1

group 0

$s \rightarrow$ SE commitment?

$H(s)^k$

Conclusion



- Smart card implementation that supports device-bound privacy-ABCs in a maximally flexible way
- Protects user private key from logical and physical attacks
- Open source application based on MultOS, freely available on Github (C code)
- Fully documented and standardization-ready application