Assertions and Tokens
+
Path tracing

SPIFFE/SPIRE

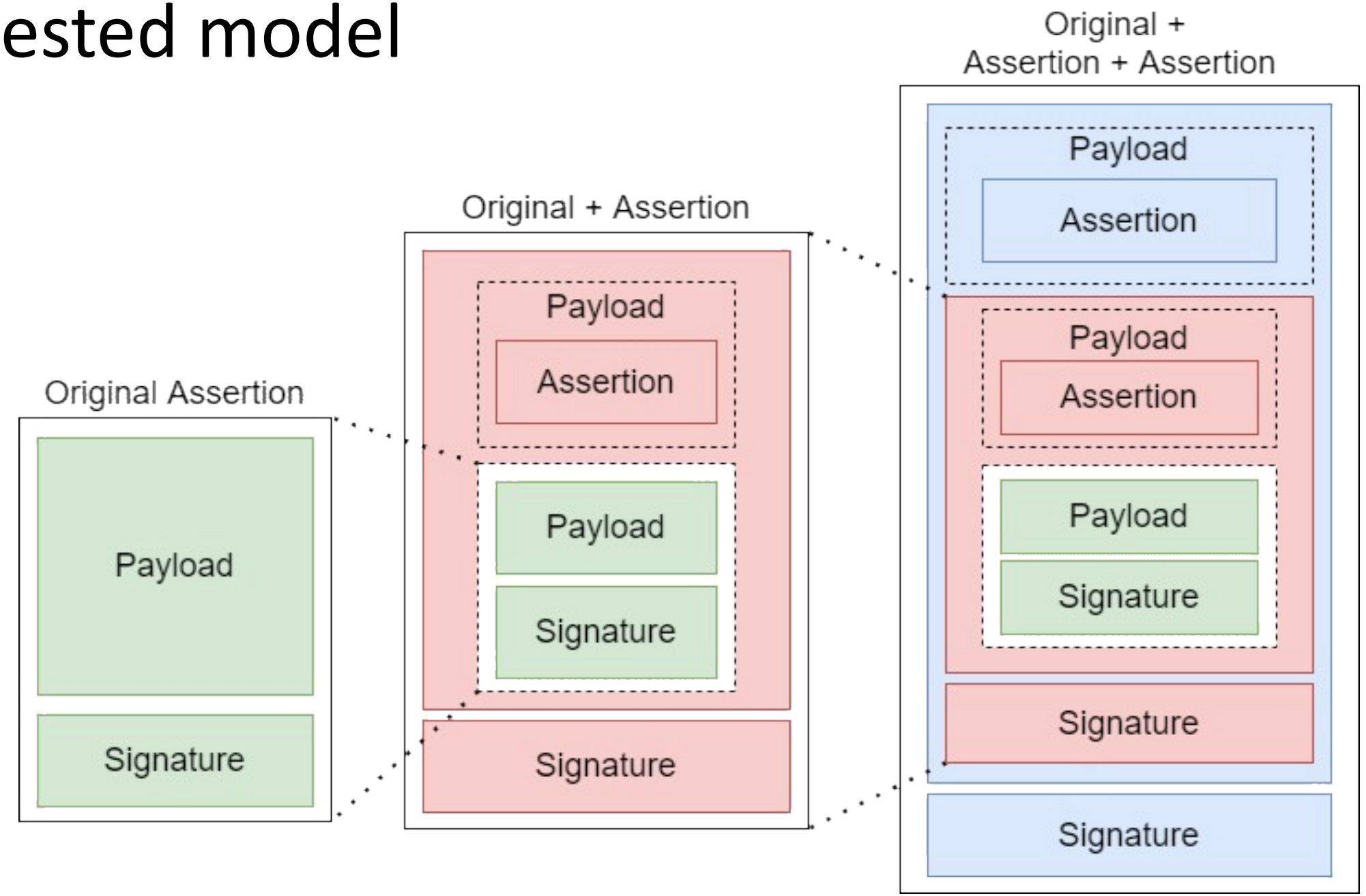
Out/2022

Recap

- **Nested model:** Allows appending new assertions to existing tokens

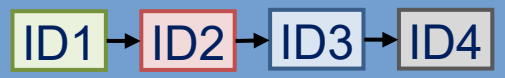
- **Token path tracing**: token path identification and validation
  - **Anonymous mode**: No ID associated to keys. Just path validation
  - **ID mode**: Each signature must be followed by necessary certificates to perform identification and validation

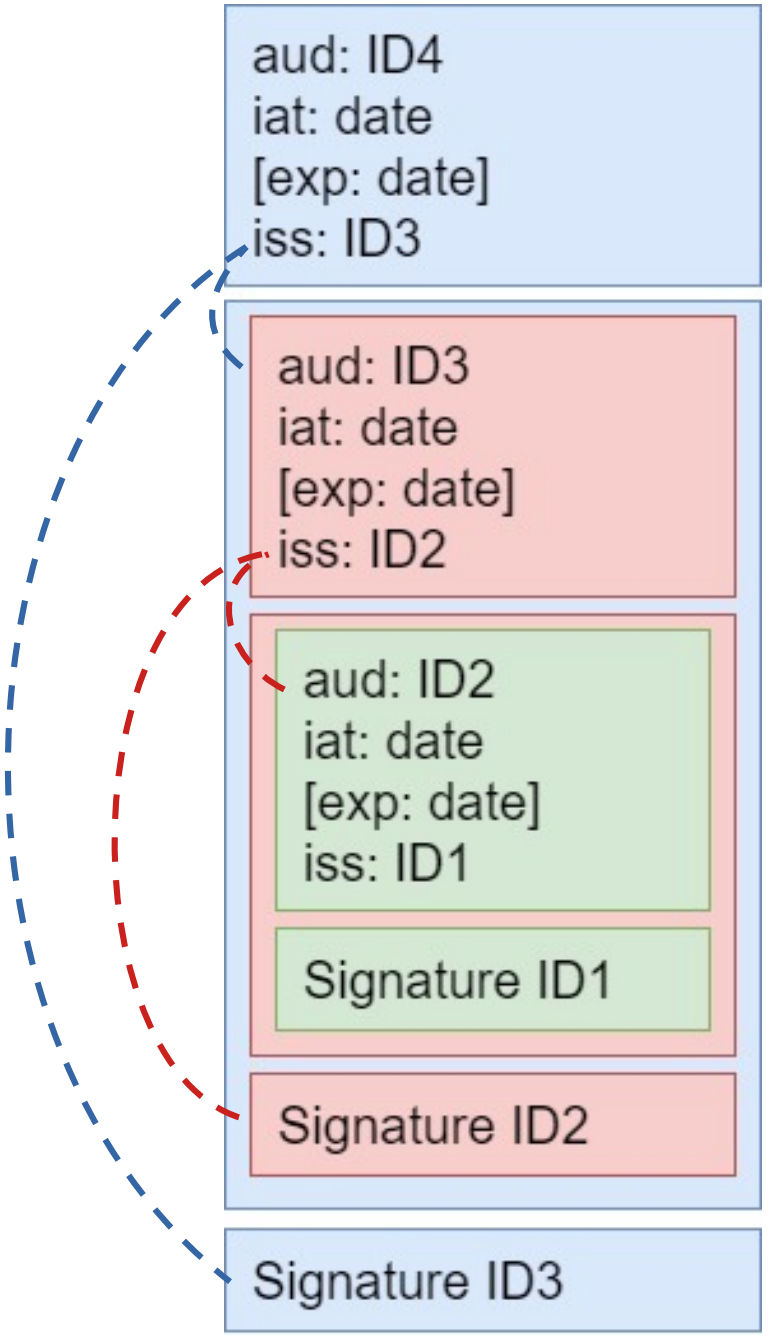
Nested model



Token tracing

Link between issuer and audience





Work so far...

Prototypes developed:

- **ECDSA-SVID:** uses SVID to sign/validate. Can use SPIFFE-ID or SVID as ID, adding to token or using IdP (available)
- **EdDSA-Schnorr**: uses Schnorr EdDSA standard signatures/validation
- **Schnorr Tracing model**: Schnorr EdDSA with issuer/audience validation This prototype uses a secret key as private key generator
- **Concatenated Schnorr**: uses part of previous signature as next private key, and Galindo-Garcia validation model

ECDSA – SVID (ID/Anonymous mode)

Developed solution: **Sign with SVID key, add SPIFFE-ID, SVID or public key to token**

- **Pros**
  - Off-line validation: token contain necessary certs
  - ID and Anonymous mode available
- **Cons**
  - ID mode requires more bandwidth
- **Possibilities**
  - Remove SVID from token and send it apart (ID artifact)
  - Use lightweight SVID
  - Also support anonymous mode (sending token without ID artifact)

EdDSA – Schnorr (anonymous mode)

Developed solution: **Use standard Schnorr signature and validation**

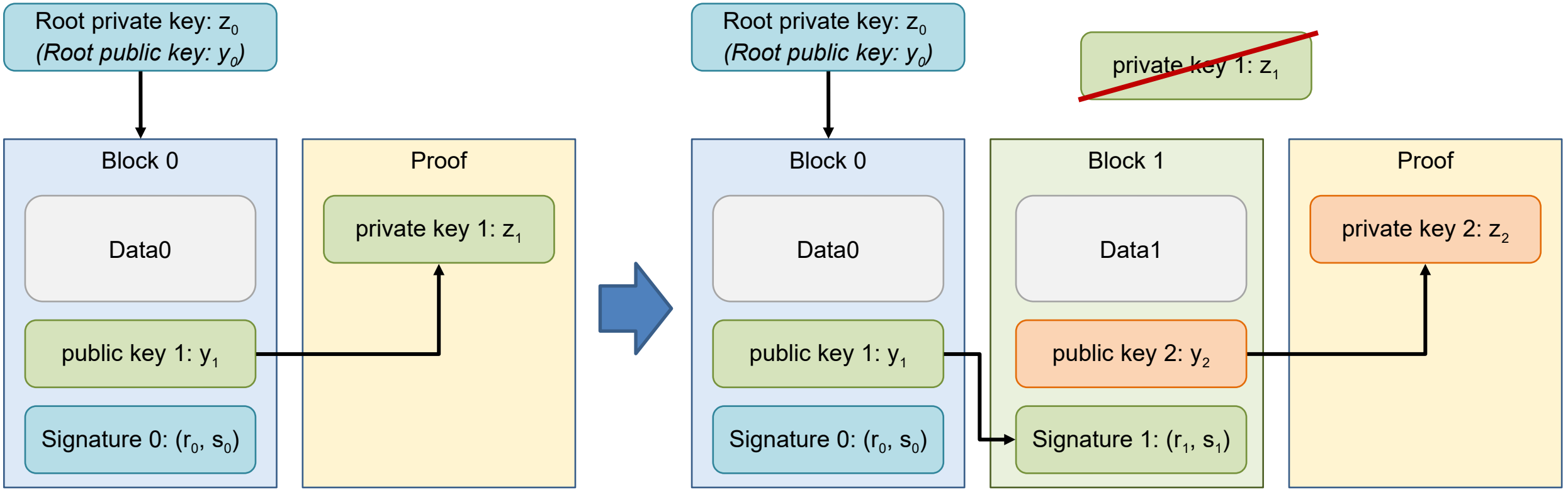
- **Pros**
  - Simpler construction
  - Slightly smaller signatures
- **Cons**
  - No identity model adopted
- **Possibilities**
  - Study of ECDSA – Schnorr possibility, allowing usage of SVID/Schnorr solution

Schnorr – Tracing model (anonymous mode)

Developed solution: **Each hop generates a private key, used by next hop to append assertions**

- **Pros**
  - Implement issuer/audience validation
- **Cons**
  - No identity model adopted
- **Possibilities**
  - Study of ECDSA – Schnorr possibility, allowing usage of SVID/Schnorr solution

Tracing model (biscuits-based model with Schnorr EdDSA)



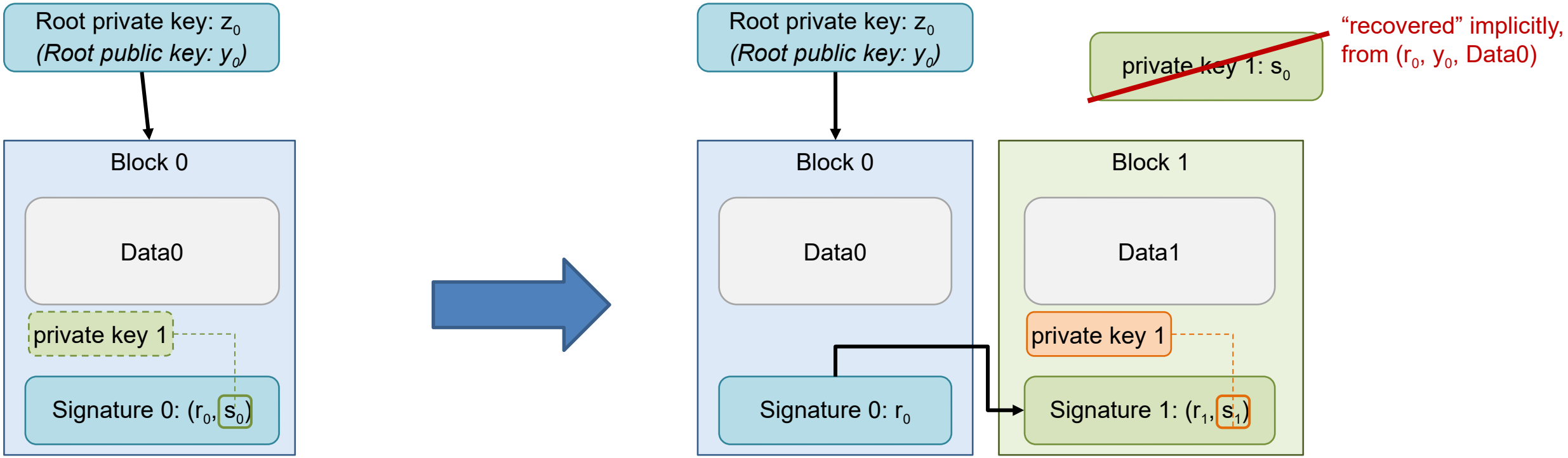
EdDSA – Concatenated Schnorr (anonymous mode)

Developed solution: **SchCo-biscuits**. Each hop uses part of previous signature as private key.

- **Pros**
  - Smaller token size when compared to std. model
  - Faster validation (using Galindo-Garcia) than sequencial model
  - Cryptographic-linked signatures
- **Cons**
  - No tracing capabilities
- **Possibilities**
  - Study aggregated signatures *state-of-art* to verify its viability

SchCo-Biscuits

(using concatenated Schnorr-based signatures: Galindo-Garcia-style)



Validation runtime and token size comparison

Token with 10 signatures	Std. Schnorr EdDSA	Concatenated Schnorr
1	15.666	8.806
2	16.057	15.548
3	19.031	7.823
4	8.724	12.274
5	18.621	14.156
6	15.904	8.223
7	17.341	11.199
8	13.056	14.249
9	10.706	9.473
10	9.559	8.149
Average runtime	**14.467**	**10.990**

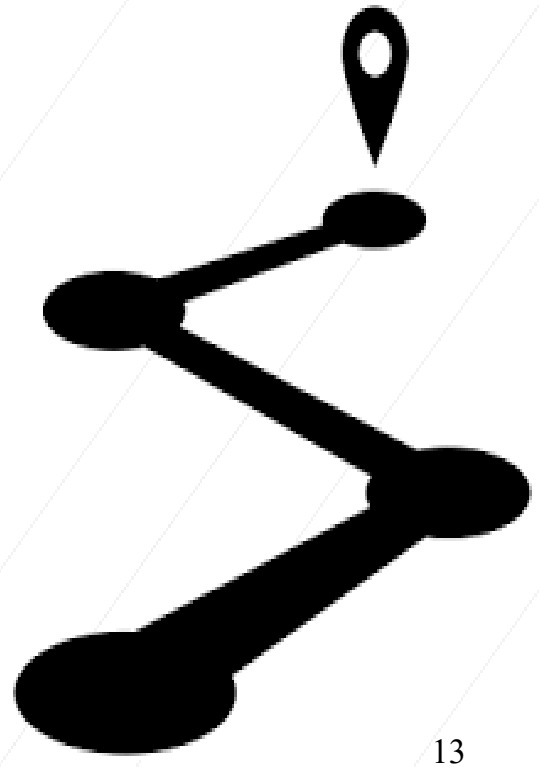
***milliseconds**

	Std. Schnorr EdDSA	Concatenated signatures
x1	196	196
x2	463	351
x3	730	506
x4	997	661
x5	1264	816
x6	1531	971

***bytes**

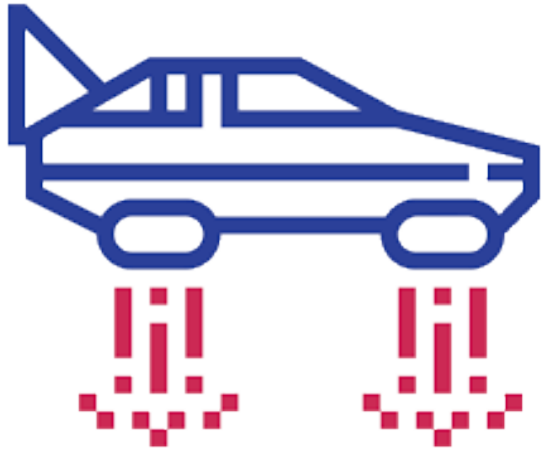
Next Steps

- Add proxy and more middle-tiers to PoC scenario
- Implement anonymous/ID mode in PoC application
- Generate assertions using SPIRE selectors
- General solution benchmarks



Future Work

- Specify and implement lightweight SVID
- Identity-based SVID: lightweight SVID with Galindo-Garcia
- Develop Biscuits prototype, with support to Galindo-Garcia
- Protobuf / JSON analysis

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