RATS YANG Module for Challenge-Response-based Remote Attestation Procedures using TPMs

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IETF 111, notinsanfrancisco, July 26th 2021, RATS WG

Document Status

- I-D depends on the RATS Architecture and RIV to clear
    - Made the reference to the RATS Interaction Models informative
- xml2rfc outdenting issue
    - Editorial issue that is probably not a blocker, tried working around that via kramdown-rfc2629 hotfixes in v1.5.5 with mixed success
- YANG Doctors comments seem to be all addressed, waiting for further feedback
- Next steps?

RATS Reference Interaction Models for

Challenge-Response/Time-Based/Streamed Remote Attestation

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Document Status

- Effective final issue was:
  - https://github.com/ietf-rats-wg/draft-ietf-rats-reference-interaction-models/issues/12
    (Authentication Secret)
- The proposal in the remaining PR #43 was vetted and is now considered to be out-of-scope. Some parts of it might move to a new document and some parts of it could move to existing I-Ds.
- Proposal for next step: request for WGLC

RATS Direct Anonymous Attestation

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Document Status

- Around IETF 110, this I-D has been split out of:
    - https://datatracker.ietf.org/doc/draft-ietf-rats-reference-interaction-models/
- -00 received a good amount of pre-adoption reviews and comments:
    - Thanks to Hannes, Thomas, Wei, Laurence, Ned, and Guy!
- Recent feedback is primarily reflected in new Privacy & Security Considerations content:
    - https://www.ietf.org/rfcdiff?url2=draft-birkholz-rats-daa-01.txt
- Dave Thaler joins the authors team. Welcome!
- Proposal for next step: Request for WG adoption call (WGAC)

Describing Attesters to Verifiers:
Concise Reference Integrity Manifests

https://datatracker.ietf.org/doc/draft-birkholz-rats-corim/

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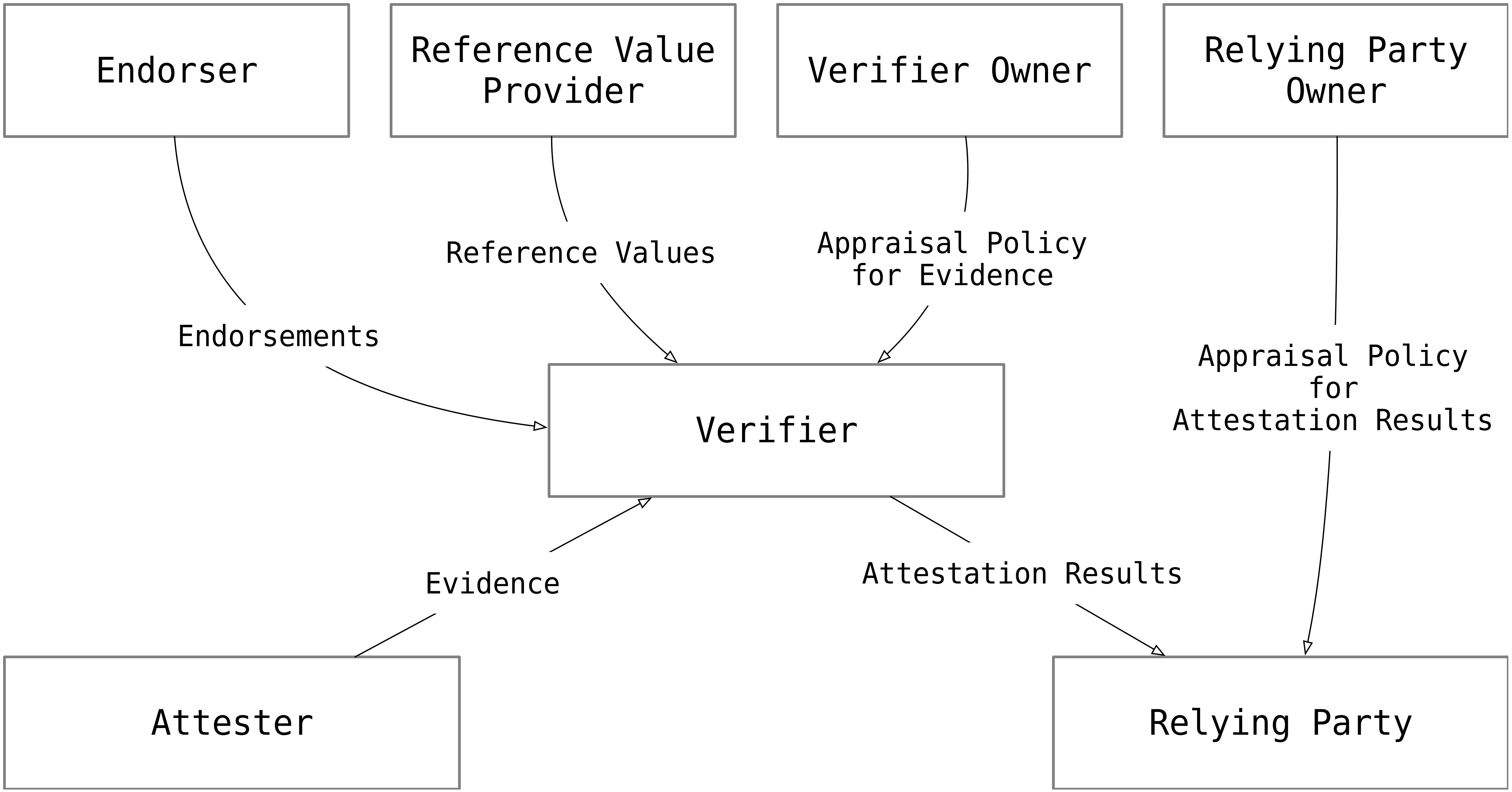


RATS Architecture, Conceptual Data Flow in https://www.ietf.org/archive/id/draft-ietf-rats-architecture-12.html#figure-1

Problem Statement

One or more authorized supply chain actors (OEM, ISVs, SiPs, etc.) need to come together and "describe" an Attester to a Verifier. So, when Evidence from that Attester is passed on to the Verifier, it can use the attributes that apply to the Attester to appraise Evidence against the Appraisal Policy.

Without a standard Information Model / Data Model there is no standard tooling to reduce fragmentation or lower barriers to entry for the supply chain actors.

Problem Context & Scope

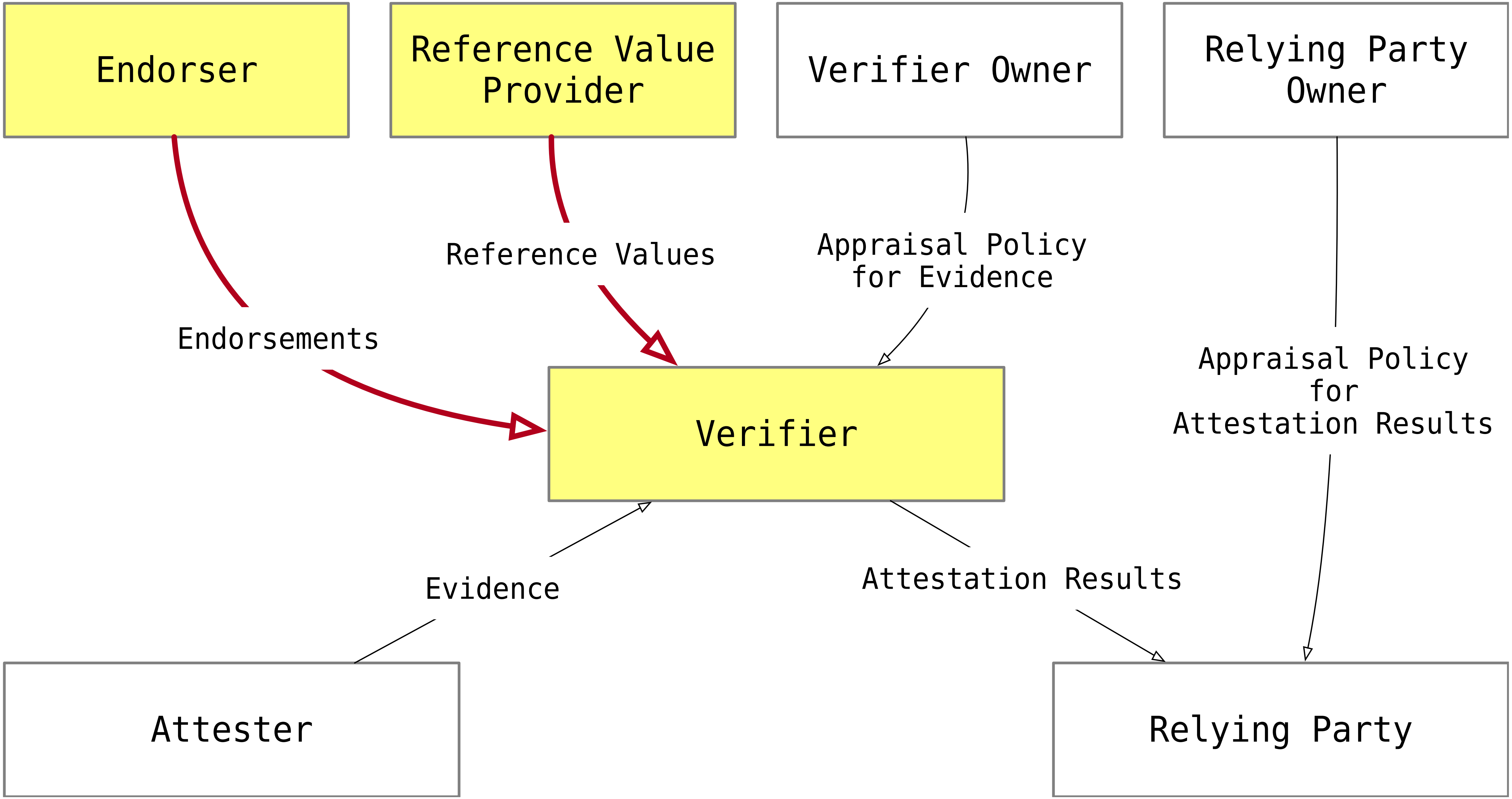
The descriptive material that flows from the supply chain to the Verifier can be, for example:

- Measurements, for example, FW – "Reference Values"
- Verification key material, certification status – "Endorsements"

It is also necessary to describe the composition of an Attester from its relevant parts (i.e., its Attesting and Target Environments):

- This is not necessary for very simple attesters (AE:TE=1:1) but can come in handy for more complex topologies where the device structure is reflected in the Evidence structure (e.g., via submodules in EAT).
- Also, it can be useful for factoring out common parts that are reused across different Attesters.

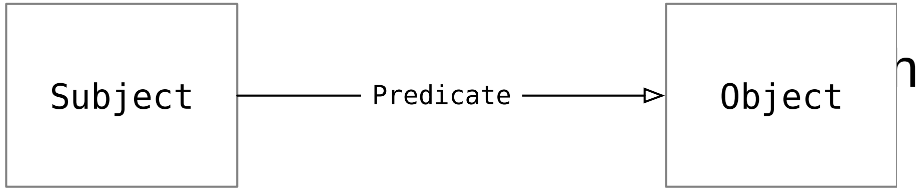
Out of scope – at least for the moment – is the delivery of Verification Policies to the Verifier by the Verifier Owner.



RATS Architecture, Conceptual Data Flow in https://www.ietf.org/archive/id/draft-ietf-rats-architecture-12.html#figure-1

High-Level Design

- Graph Data models (RDF-like) with its own specialized vocabulary and data types
- The "triple" he core pattern



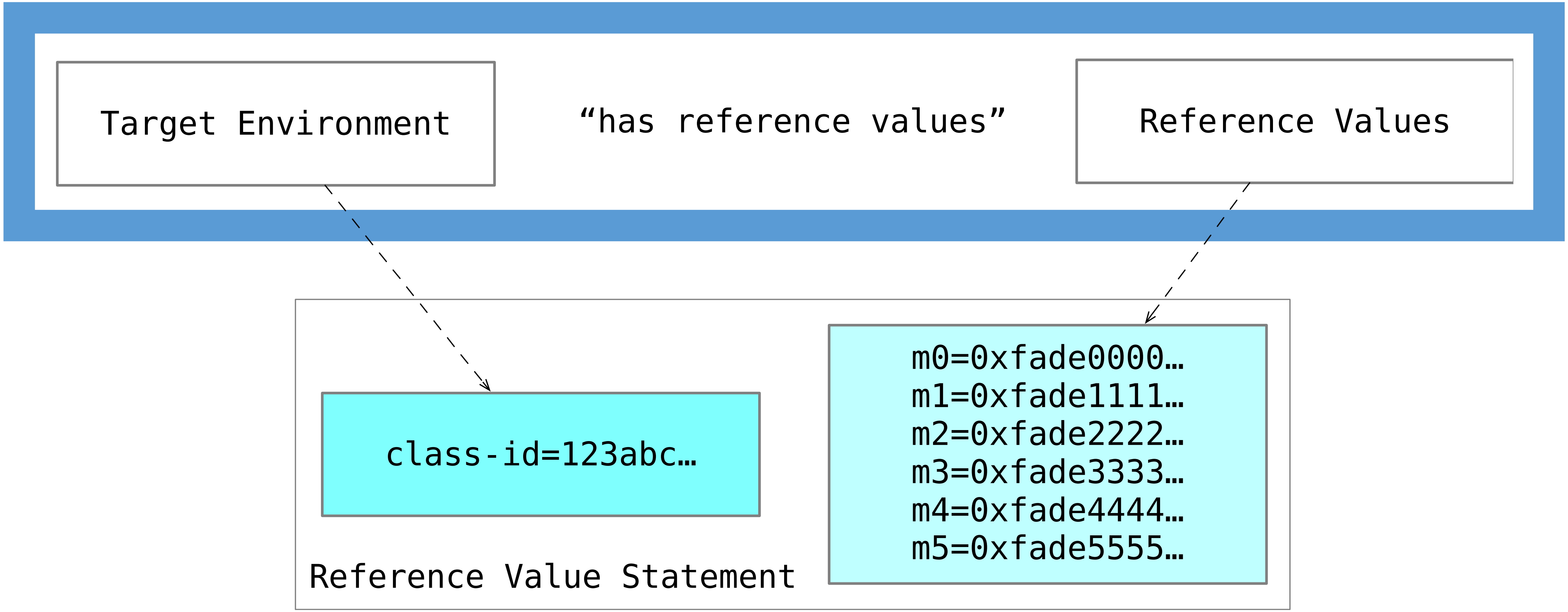
- Used to define an Attester "ontology" (actually a simple directed property graph)
- Tracking triples provenance via explicit cryptographic methods
- **Co**ncise representations (**Co**MID, **Co**RIM)
  - Concise Module Identifier are the "hardware component" complement (including firmware) to CoSWID https://datatracker.ietf.org/doc/draft-ietf-sacm-coswid/, which are already used to represent software components.
  - Concise Reference Integrity Manifests are the trustworthy bundles of CoMID and CoSWID

What Kind of Triples Do We Need?

- Reference Values associated with a Target Environment
- Endorsements associated with an Attesting or a Target Environment
- Cryptographic identities associated with Attesting Environments
- Decomposition of a device in its constituent Attesting and Target Environments and their relational features
- Others that we haven’t yet anticipated (built-in extensibility)

- Examples (coming up in the next slides)

Reference Value Statements


Target Environment

“has reference values”

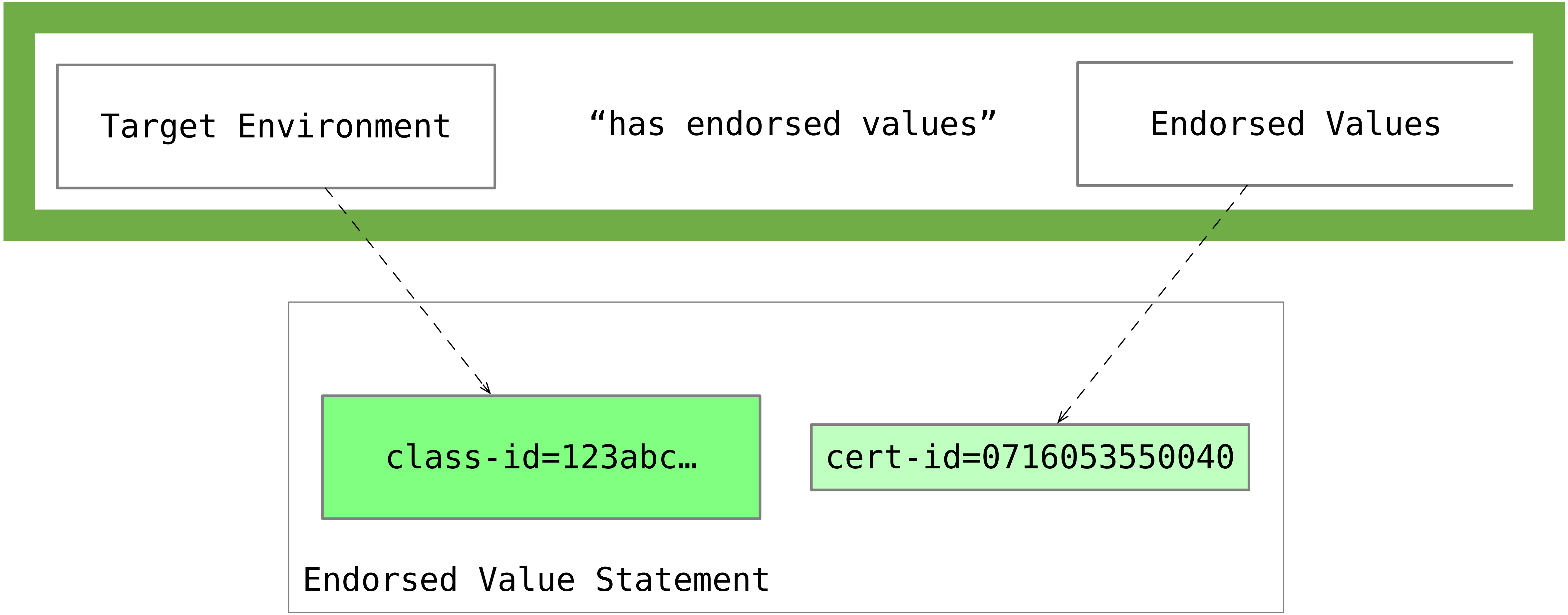
Reference Values

class-id=123abc…

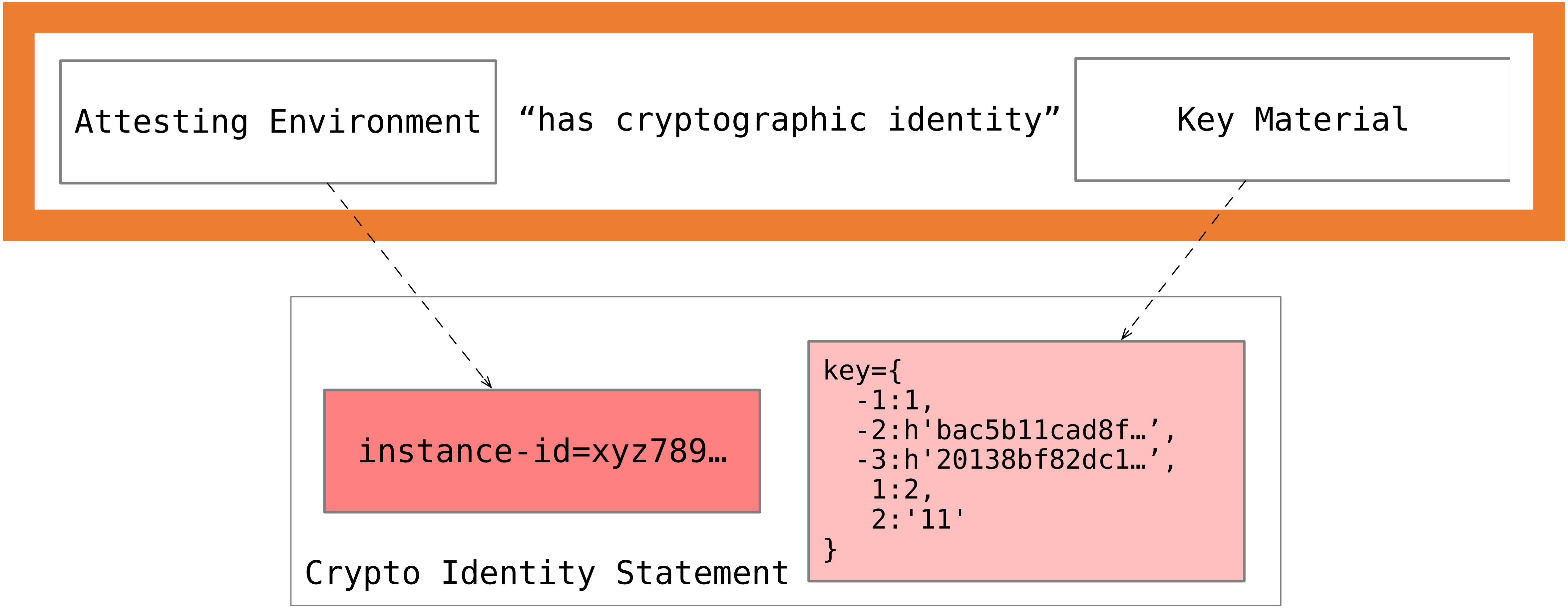
m0=0xfade0000…
m1=0xfade1111…
m2=0xfade2222…
m3=0xfade3333…
m4=0xfade4444…
m5=0xfade5555…

Reference Value Statement

Endorsed Value Statements



Cryptographic Identity Statement



Attesting Environment

“has cryptographic identity”

Key Material

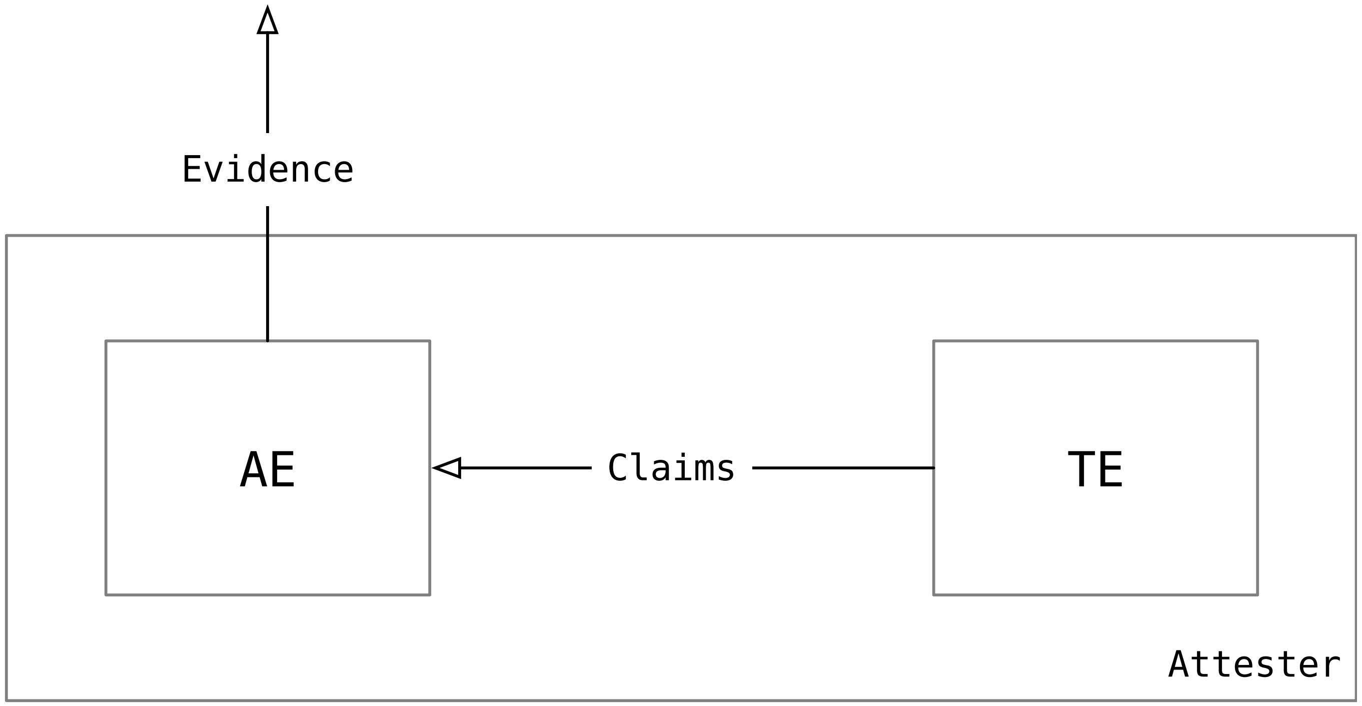
instance-id=xyz789…

```
key={
  -1:1,
  -2:h'bac5b11cad8f…’,
  -3:h'20138bf82dc1…’,
   1:2,
   2:'11'
}
```

Crypto Identity Statement

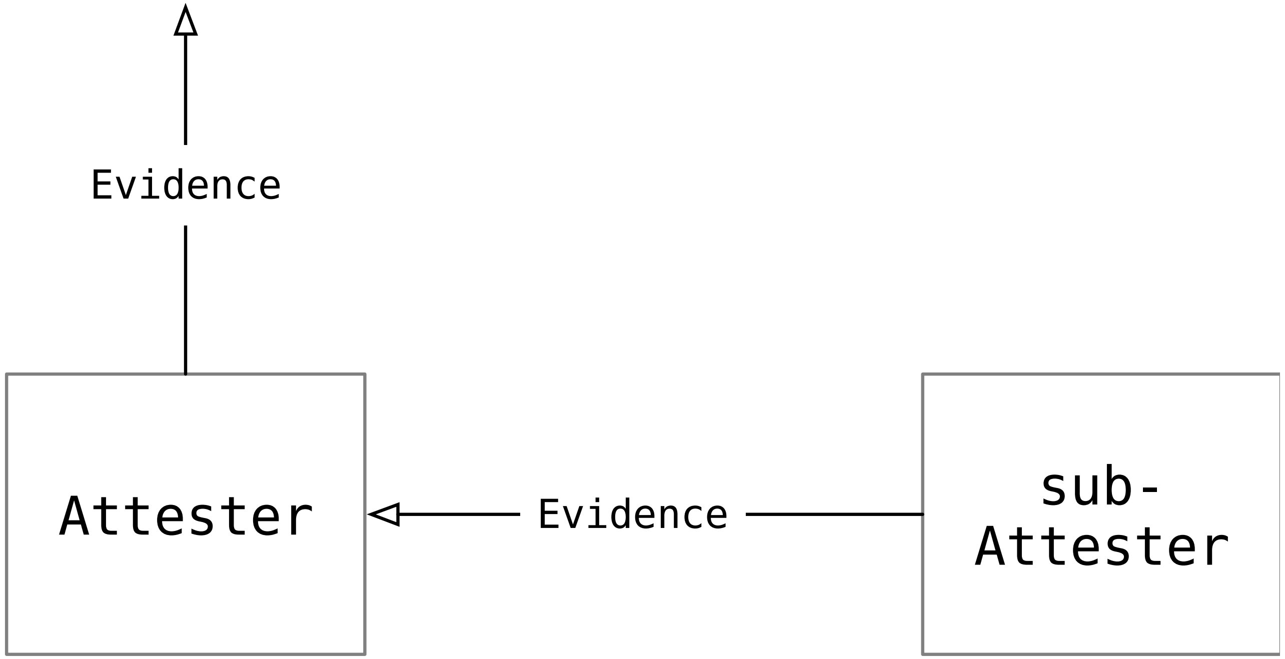
Next Step: Composition Patterns

- Attester (de)composition
  - i.e., relationships between Attesting and Target Environments within an Attester



Next Step: Composition Patterns (cont.)

- Device layering
  - i.e., how different Attesters come together in a composite device



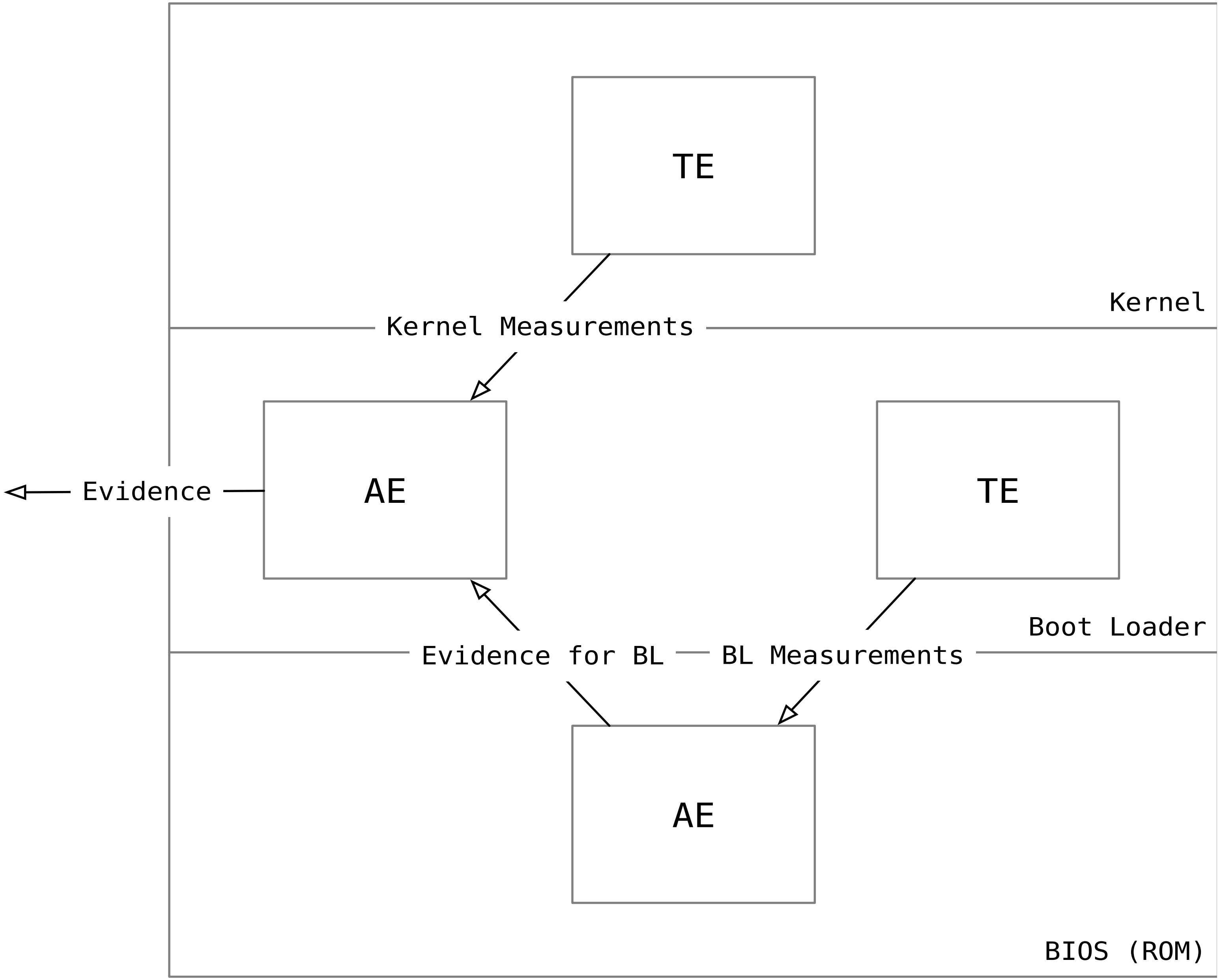
Next Step: Composition Patterns (cont.)

It turns out that both can be expressed with the same statement:

> *Attesting Environment {class-id} retrieves {"claims"|"evidence"} by {"active"|"passive" } collection over {"trusted"|"untrusted"} path from Environment {class-id}*

where the "object" Environment could be either a Target Environment or another Attesting Environment in a sub-Attester.

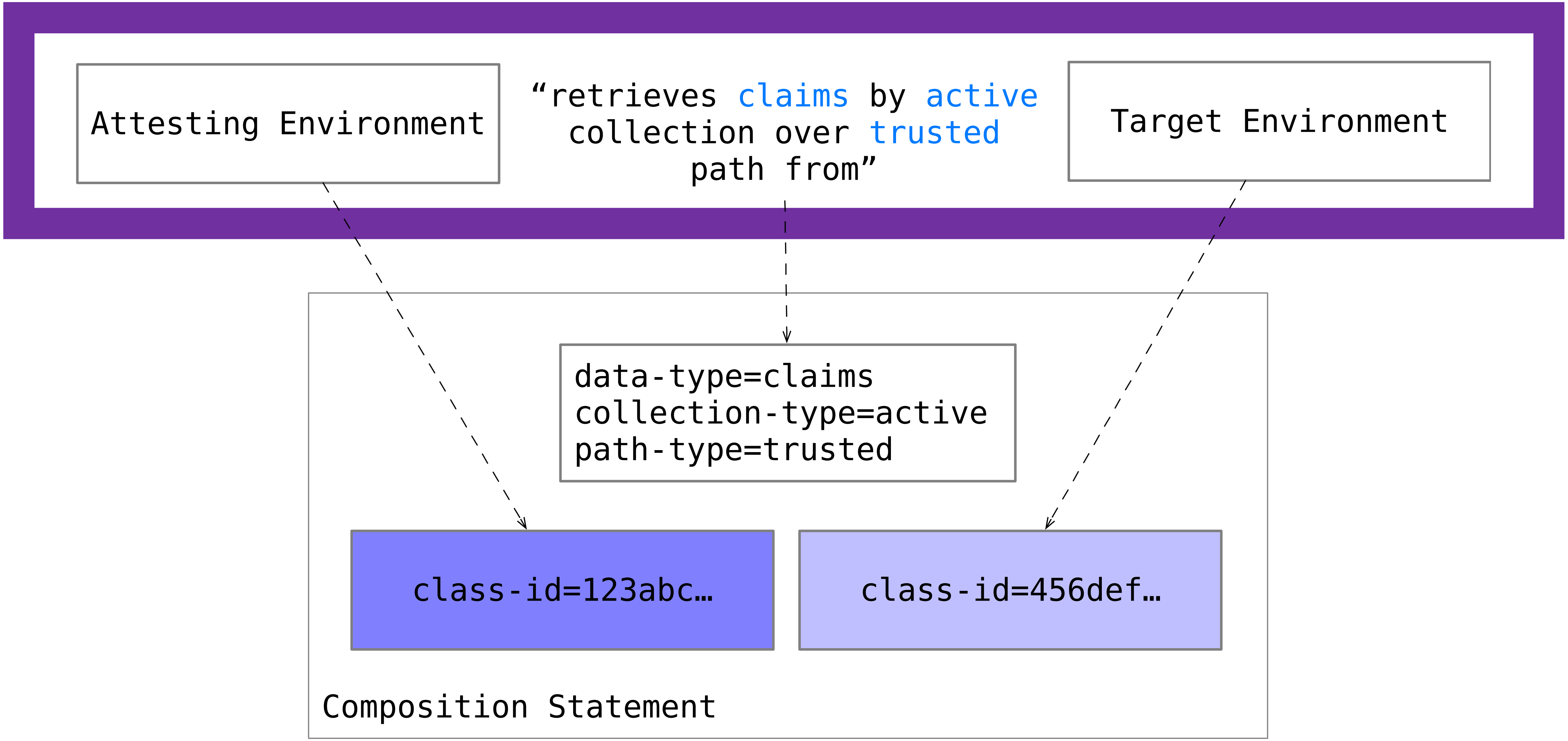
Note: There is also a separate statement to describe the environments that compose a certain Attester. (This is effectively just a grouping overlay on top of a device decomposition that can be fully described by the statement above.)



- BIOS retrieves claims by active collection over trusted path from Boot Loader
- Boot Loader retrieves evidence by active collection over trusted path from BIOS
- Boot Loader retrieves claims by active collection over trusted path from Kernel

Based on RATS Architecture, Layered Attester https://www.ietf.org/archive/id/draft-ietf-rats-architecture-12.html#figure-3

Next Step Example: Composition Statement



Attesting Environment

“retrieves claims by active collection over trusted path from”

Target Environment

data-type=claims
collection-type=active
path-type=trusted

class-id=123abc…

class-id=456def…

Composition Statement

CoMID &CoSWID Usage: Grouping Statements

- Similar to CoSWID, CoMID tags are the wrapper around a bunch of statements, but pertain to hardware and firmware
- Like CoSWID tags, CoMID tags allow grouping, identification, typed linking (e.g., *supersedes*, *updates*) with other tags, plus some further encoding optimization in CoMID (e.g., if the statements subject is always the same it can be factored out)
- Grouping criteria are use-case specific. We can *suggest* a few (e.g., for handling FW updates), but we expect best practices to emerge with time and use

CoRIM Usage:
Grouping Groups of Statements

- CoMIDs and CoSWIDs are grouped into CoRIMs
- CoRIMs are signed by the relevant supply chain actor
- Used as the end-to-end conveyance payload (we don’t define the transport)
- The outer signature augments the triples in the CoMID statements with provenance:
  - “Supply chain actor X says ${CoMID-statement} and/or ${CoSWID-statement}”

Pulling All Together

Navigating the sea of triples allows a Verifier to construct a comprehensive device/attester description that it can use as the backdrop against which its Appraisal Policy for Evidence is evaluated.

TL;DR

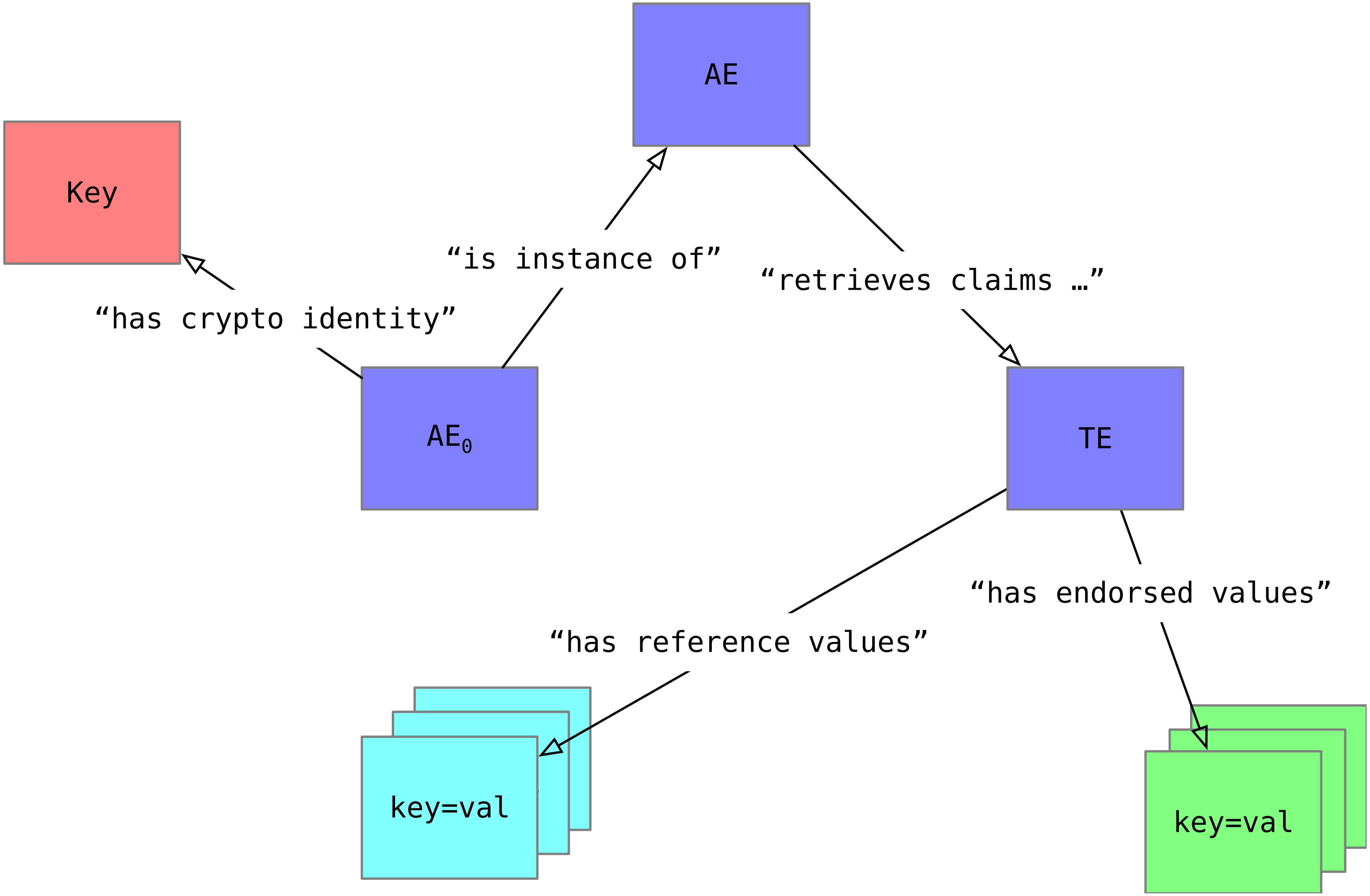
- Information Model Design Authority: TCG DICE WG
- work-in-progress
- Keep an eye on
  - https://github.com/ietf-rats/ietf-corim-cddl
  - https://github.com/ietf-rats/draft-birkholz-rats-corim
  - https://github.com/thomas-fossati/draft-psa-endorsements

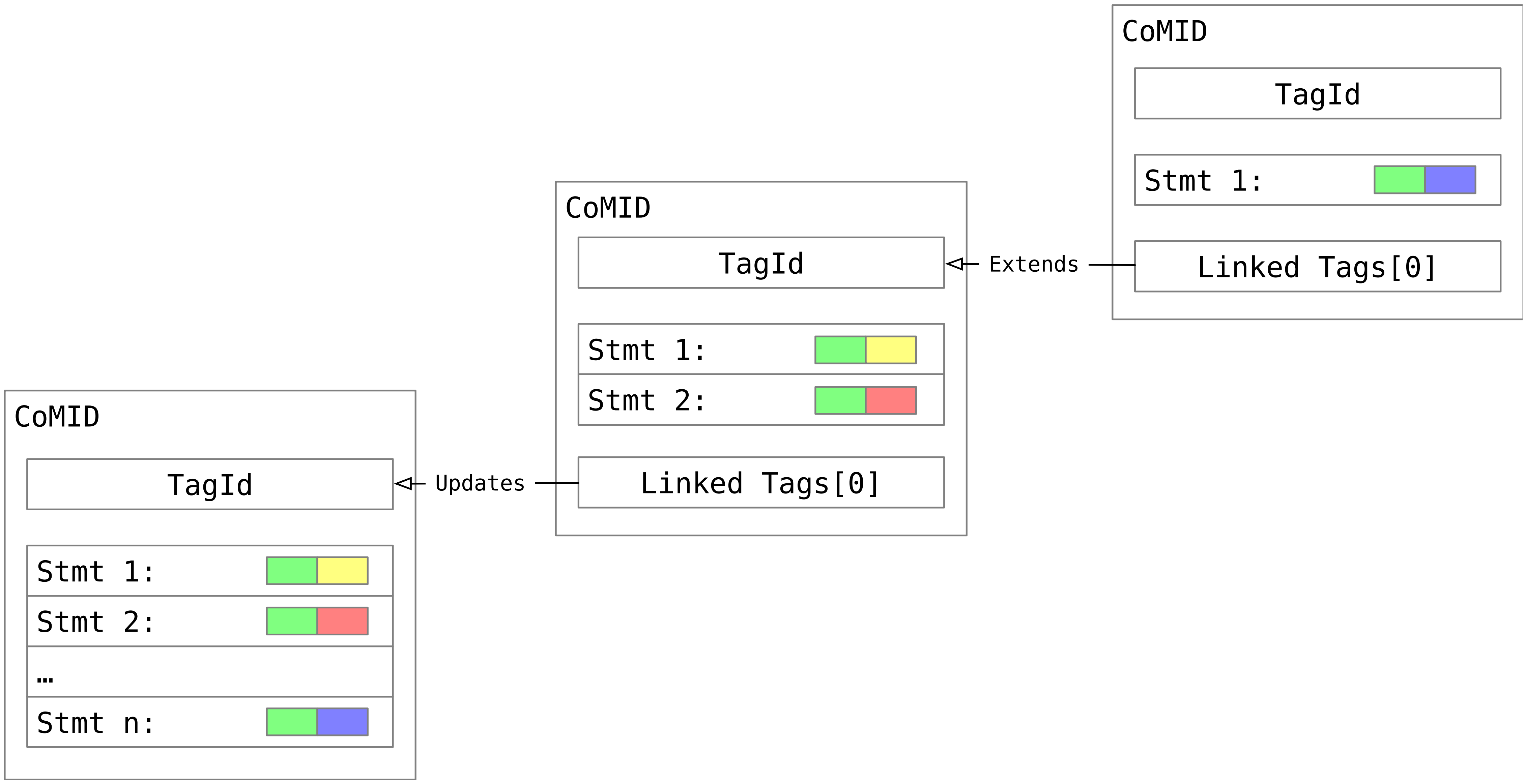
This slide is intentionally left…

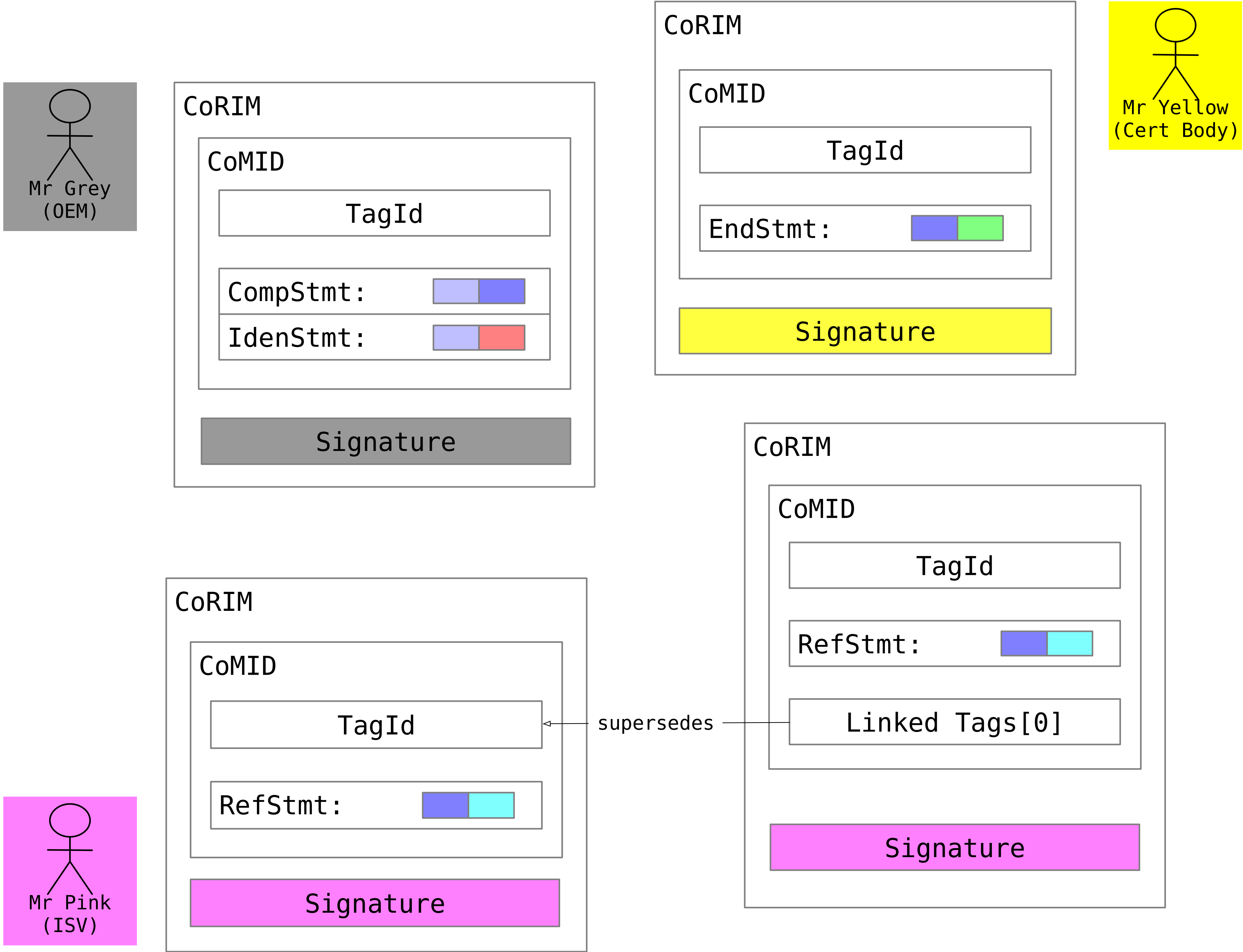
- … almost blank

And a few more…

- Attester’s private key has certification path *x5chain*
- A and B are aliases for Attester
- Attester is a member of Group
- *<insert your statement here, the format is extensible>*


AE
Key
“is instance of”
“retrieves claims …”
“has crypto identity”
AE$_0$
TE
“has endorsed values”
“has reference values”
key=val
key=val


CoMID
TagId
Stmt 1:
Linked Tags[0]
Extends
CoMID
TagId
Stmt 1:
Stmt 2:
Linked Tags[0]
Updates
CoMID
TagId
Stmt 1:
Stmt 2:
…
Stmt n:



Mr Grey
(OEM)

CoRIM

CoMID

TagId

CompStmt:

IdenStmt:

Signature

CoRIM

CoMID

TagId

EndStmt:

Signature

Mr Yellow
(Cert Body)

CoRIM

CoMID

TagId

RefStmt:

Signature

supersedes

CoRIM

CoMID

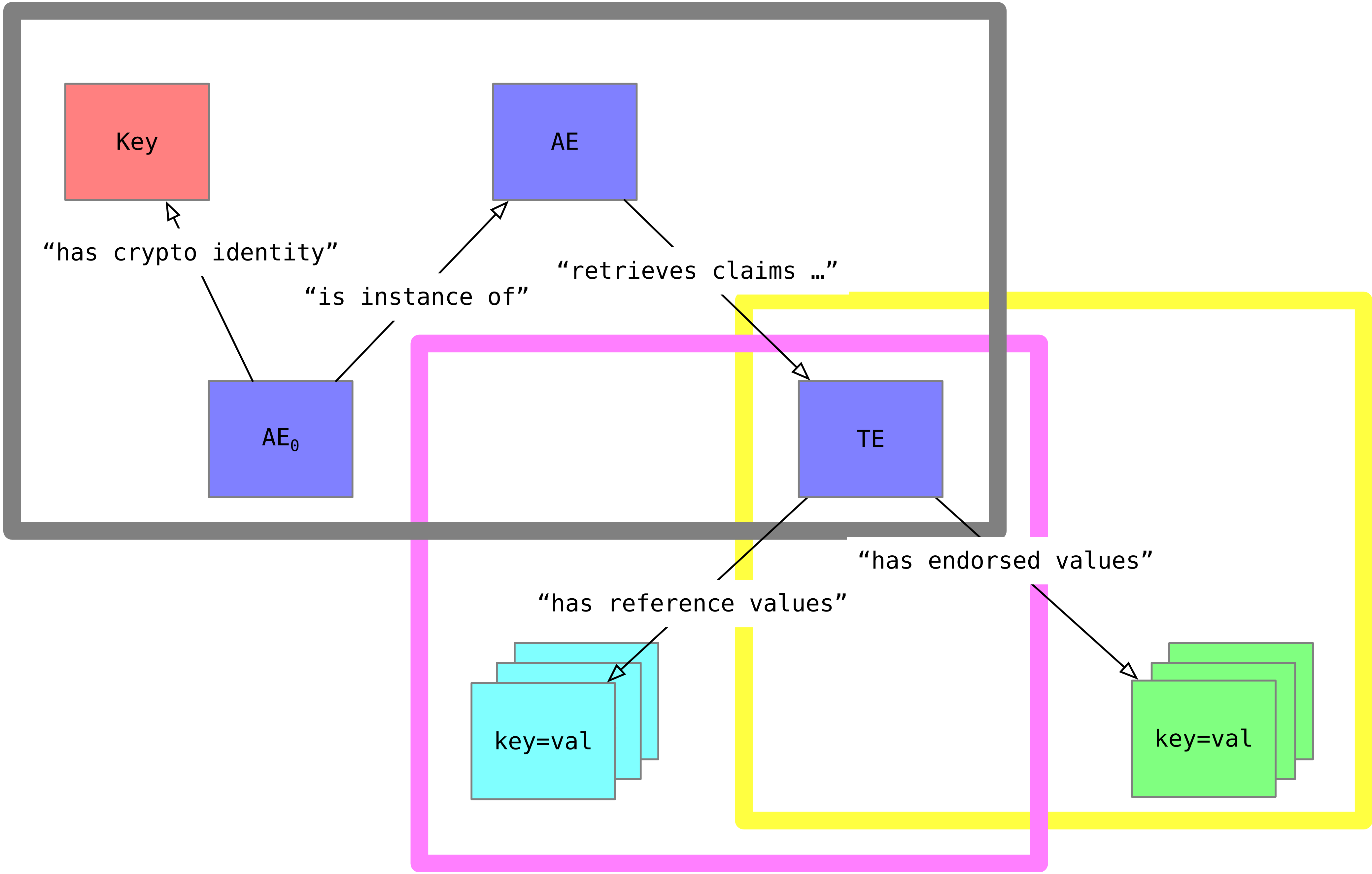
TagId

RefStmt:

Linked Tags[0]

Signature

Mr Pink
(ISV)


Key
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key=val
key=val