RATS Architecture & Terminology

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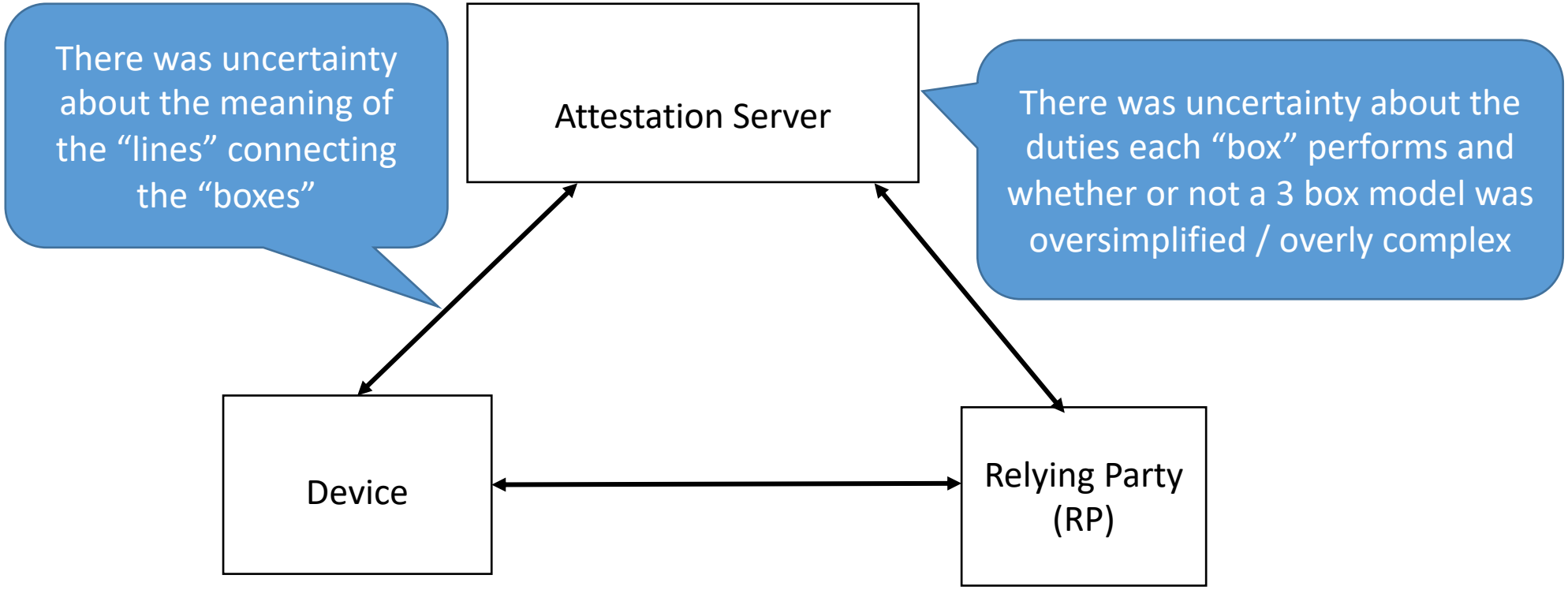
IETF 104, Prague, March 28th, RATS WG

IETF 103: An Evolution of Boxes

- At the beginning there were boxes



- And there was a bit confusion

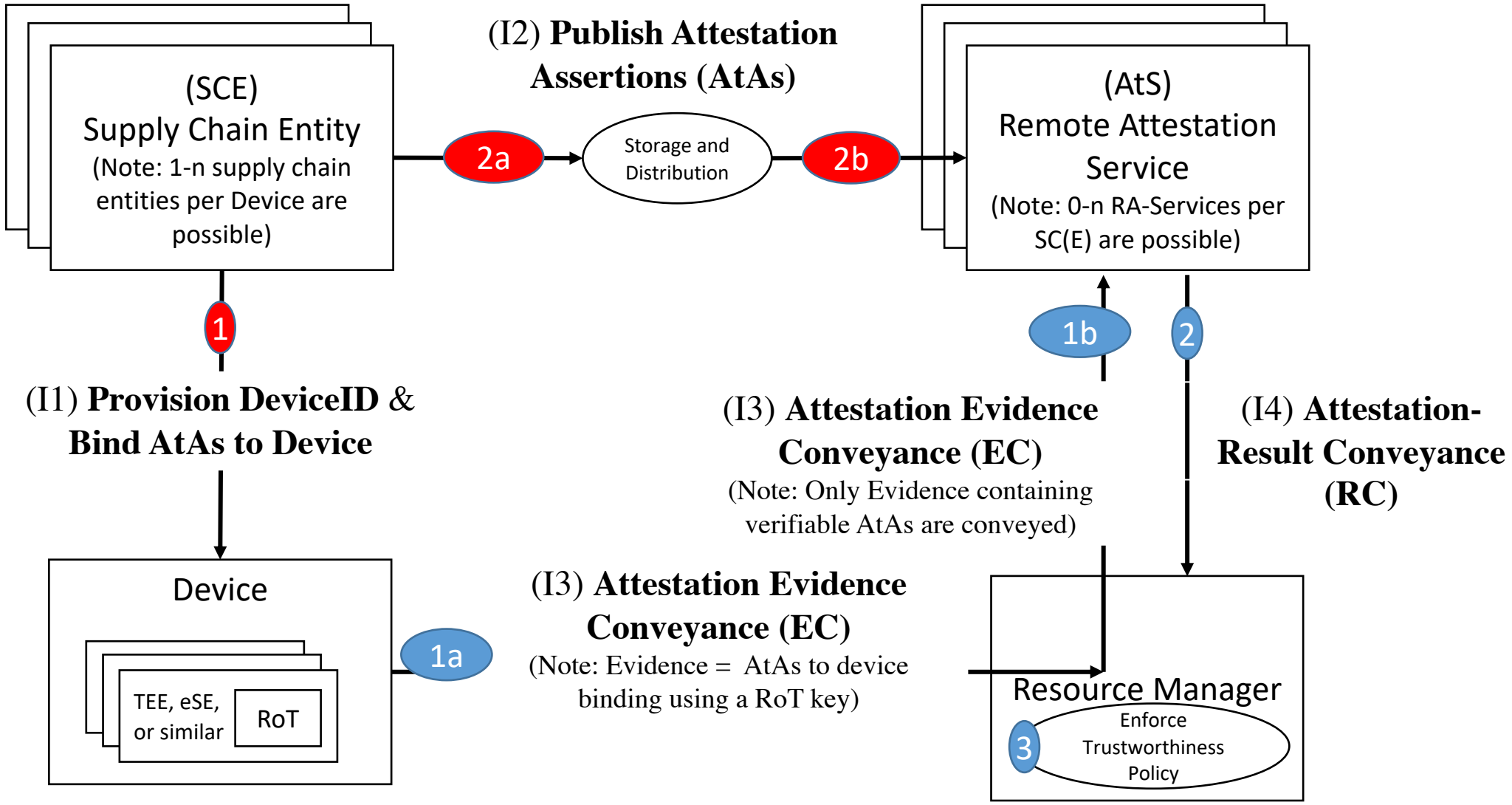
Post IETF 103: Recap (from the rats list) & Evolution

- **RATS Actors:** an architectural container that captures different deployment options
  - Examples:
    - **Device**, TEE, peripheral, co-processor, etc.
    - **Resource manager**, device, directory service, server, sensor, router, gateway, etc.
    - **Supply chain entity**, ODM, OEM, OSV, IHV, etc.
    - **Attestation service**, broker, orchestrator, device, etc.
- **RATS Roles:** provide a more consistent architectural structure:
  - **Attester**, **Relying Party**, **Asserter** & **Verifier**
- **RATS Interactions**: an architectural description of data in motion specifying the content required to be conveyed
- All three concepts combined enable flexible “Composability” to address different use-cases.

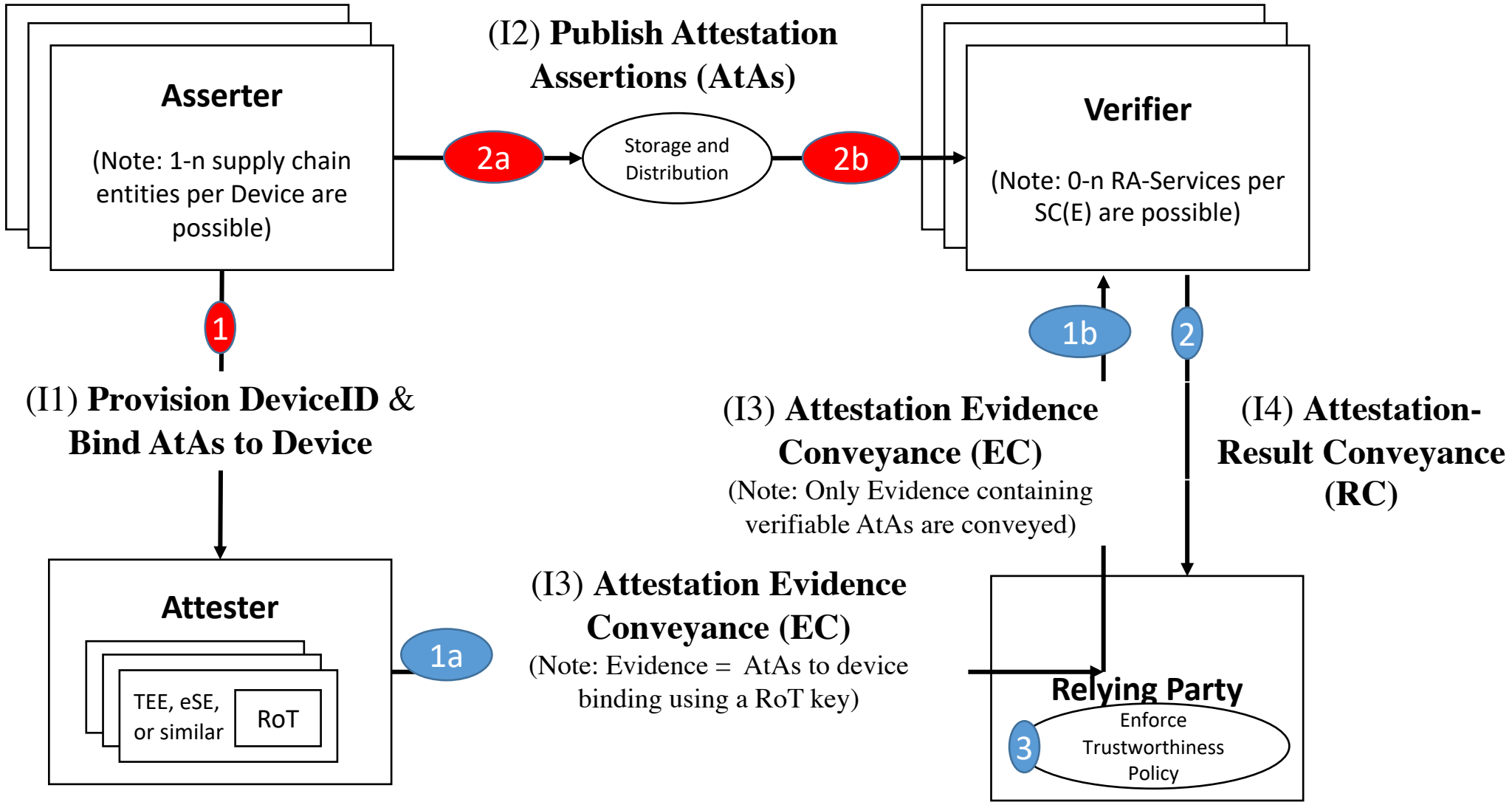
RATS Architecture Principles

- Information Model
  - Abstract representation of evidence, interactions and endpoints
- Data Model
  - Interoperable representation of evidence and interactions
  - Endpoint identity and definition is out-of-scope (but relevant)
- Deployment Flexibility
  - RATS solutions follow / integrate with RATS attestation use cases
  - RATS solutions integrate with IETF and other conveyance protocols
  - RATS solutions integrate with existing and emerging public key infrastructures

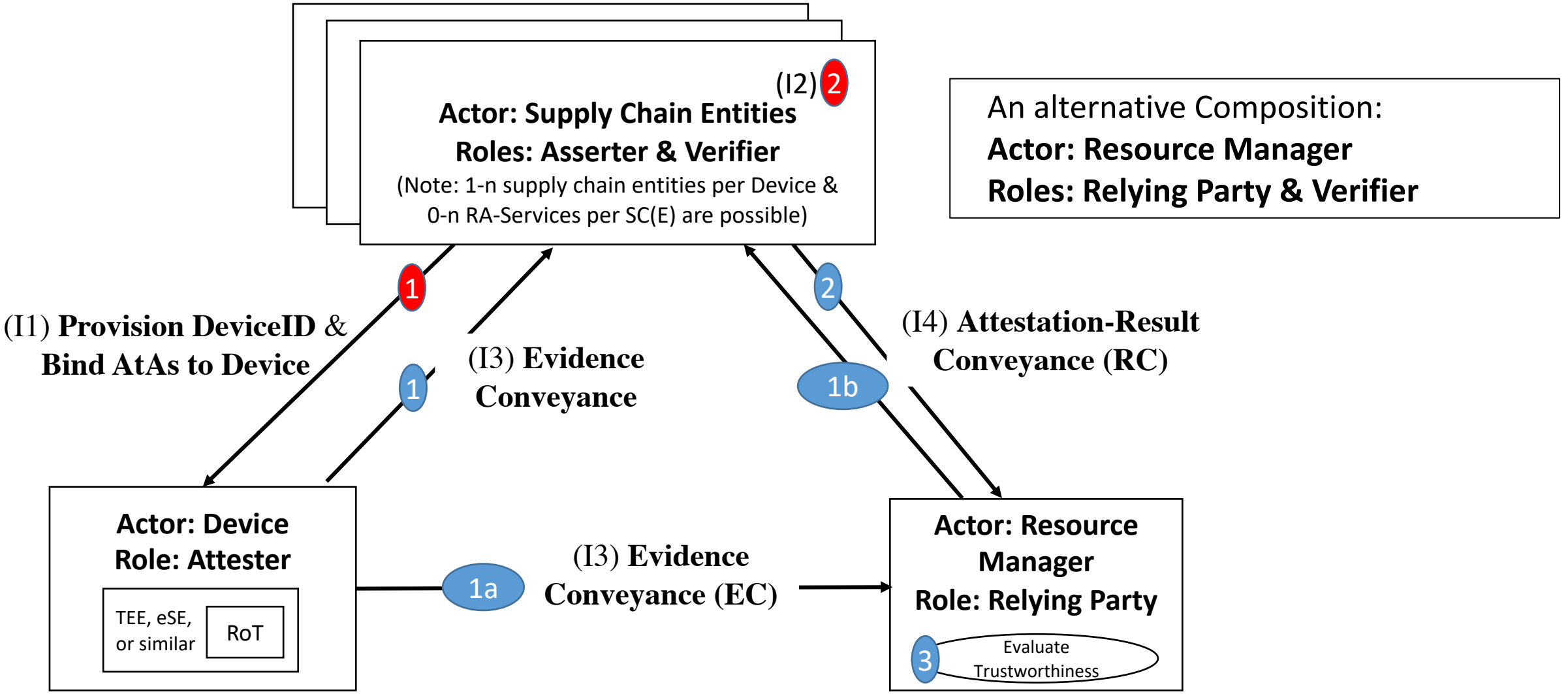
Evolution of RATS Architecture: **Actors**



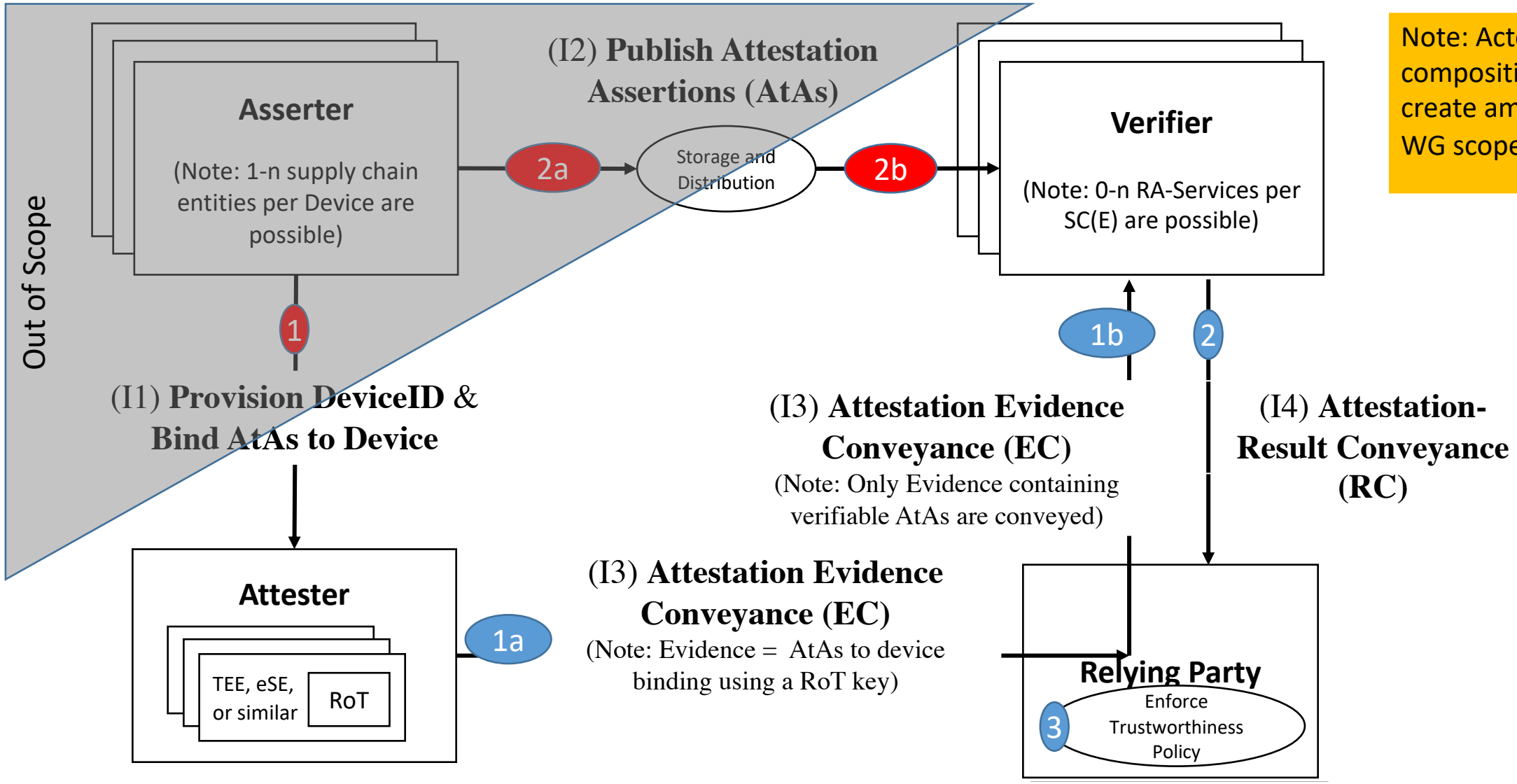
Evolution of RATS Architecture: **Roles**



Composability of **Roles** on **Actors**



RATS WG Scoping



Note: Actor-Role compositions can create ambiguous WG scope scenarios

Relationships to Corresponding Architectures

- **TEEP** Architecture Components
  - Trusted Application Managers (TAM) - Actor taking on the role of **Relying Party** AND/OR **Verifier**
  - Device /w TEE - Actor taking on the role of **Attester**
- Platform Security Architecture (**PSA**) Components
  - Network and App Services - Actor taking on the role of **Relying Party** AND/OR **Verifier**
  - Hardware - Actor taking on the role of **Attester**
- **EAT** Overall System Components
  - Relying Party - Actor maps to **Relying Party** role
  - Entity - Actor taking on the role of the **Attester**
  - Entity Manufacturer - Actor taking on the role of **Asserter** AND/OR **Verifier**

Overlap with other Working Groups

- **TEEP WG**
  - Trusted Execution Environments (TEE) in **Devices**
  - **Manifest Profiles**
  - TEE **Attestation Provenance** procedures
- **SUIT WG**
  - **Manifest** Format & **Information Model** (approach)
- **SACM WG**
  - Identity **Manifest** & **Information Model** (CoSWID)
- **NETCONF WG**
  - Managed **Trust Anchor** Repository (data at rest)
- **TAMP WG**
  - Protocol for configuring **Trust Anchor** policies (data in motion)

Overlapping Terminology

- RFC 4949 defines common security terminology
- Mapping of terms between different WG work efforts
  - SACM: security automation terminology
  - TEEP: attestation & trusted computing terminology
  - SUIT: evidence & measurement terminology
  - NETCONF: trust anchor terminology
- NIST, Global Platform, FIDO, and TCG defines attestation terminology.
- RATS Architecture needs to build consensus on a core vocabulary.

Architecture Commentary

- A suitable level of abstraction combined with thorough guidance that enables one to create interoperable solutions from it
- E.g. the RATS Architecture avoids the term “claim” as that term is “claimed” by CWT and might create a bias towards a specific scope of solutions. The generic term used instead is “assertion”.
  - Assertions are represented as claims in CWT.
  - Assertions might be represented differently in other representation.
- The intent of the current Actor/Role/Duty/Interaction concepts that compose the RATS Architecture is to take into account, align, and consolidate current IETF WG work (& work of different SDO).

Vital Elements of RATS (next steps)

- Vital Elements of the RATS enabled by the architecture document are :
  - Attestation Assertion (AtAs) and
  - Attestation Semantics (AtSe)
- The common denominator is a compact set of (occasionally semantical grouped) assertions about the Computing Context to be attested/conveyed.
- Asserters (mostly called Claimants at this point of time) provide these assertion (data origin), but they are not necessarily the initial point where they are acquired (data source).
- Proposal: a basic set of assertions for RATS is required (e.g. via an Information Model)
  - Please take into account the lessons learned in the SACM WG
- The initial set of information elements is about “Remote Attestation” and not “Attestation Provisioning” (which is out-of-scope for now).

Reference Interaction Model for Challenge-Response-based Remote Attestation Procedures

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Why is this a Useful Normative Document?

- Background
  - Most **protocols** that require a **proof-of-freshness** use a **Challenge/Response**-based based interaction
  - A **Nonce** that is provided by the challenger, processed cryptographically by the receiver and then returned to the challenger in a way that proofs that the response is a freshly composed set of information.
- Usage
  - This procedure is done at many places and in many protocols **already** 👍
  - This procedure is mostly “re-”explained and illustrated **over and over again** 👎
- Contribution
  - By describing and illustrating this essential concept in an elaborate and use-case agnostic fashion will **prevent “cloning” this normative text** over and over again.

The State of the Document

- Invaluable side-effect: visibility & review
  - Everyone, who is interested, can potentially find a small detail that might be missing, or wrong, or could be forked into multiple alternatives on how to do it.
- Current work
  - There are two complete (and rather thorough) sets of reviews that did not make it into the current I-D still. Stay tuned!
  - We hope for even more visibility and feedback after IETF 104.
- Current application
  - The first I-D to off-load this content is:
    I-D. birkholz-yang-basic-remote-attestation
- Early feedback: this seems to work pretty well, already. Please bash, if you think otherwise! Alternatively, please add the details you may find missing.

YANG Module for Basic Challenge-Response-based Remote Attestation Procedures

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The Contribution of this Document

- Background
  - YANG defines a language to define data **repositories for data at rest** and it defines a **set of operations** to **operate on these YANG datastores**.
  - Additionally, there are ways to create **RPCs**, to subscribe to “hardcoded” **notifications**, or to changes (to parts of a) YANG datastore, i.e. creating **continuous telemetry**.
  - Curious? NETCONF (& NETMOD) is the place to go exploring ☺
- Usage
  - **YANG is widely used and deployed**, especially on network equipment and virtual services.
  - Adding Remote Attestation as procedures to **existing and implemented management interfaces** significantly reduces the threshold of adoption (another good example: tokbind)
- Contribution
  - This YANG module provides an **RPC** implementing the **Reference Interaction Model for Challenge/Response based RATS** (i.e. “nonce-based”).
  - The YANG module also supports multiple **Roots-of-Trust for Reporting** in a **composite device** to create remote attestation evidence about integrity and therefore trustfulness of network equipment (or VNF, respectively). I.e. enabling **trustworthy continuous telemetry.**

The State of the Document

- Current Work
  - The current version of the YANG module is already quite mature.
  - It defines an RFC for the Challenge/Response Procedure and a datastore for complementary information elements, such as Identity Documents, Endorsement Documents, or Device Composition – but maybe more is needed?
- The YANG statements in the I-D might require more textual description in another section (the description statement already helps, but is not enough to convey the bigger picture – probably).

Time-Based Uni-Directional Attestation (TUDA)

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The Contribution of this Document

- The Reference Interaction Model presented before utilizes a nonce-based procedure to provide a proof for freshness
  - The hand-shake involved in bi-directional protocols
- TUDA uses an **external** trusted time source:
  - an RFC 3161 Time Stamping Authority (TSA) that is
  - creating trusted Time Stamp Tokens (TST).
- As a result, TUDA allows for **uni-directional** unicast, broadcast, or multicast of attestation evidence – requiring **no response from the Verifier**.
  - TUDA creates secure and **trustworthy Audit Logs** of past operational states.

TUDA Methodology (in a nutshell)

- A local source of time creates a timestamp that is cryptographically bound to a timestamp created by a trusted system global source of time (the TSA).
- The result again is cryptographically bound to a second timestamp of the local source of time.
- The resulting Sync-Proof provides evidence in which period of time the association (cryptographically binding) with the trusted system global source of time (TSA) must have happened.
- Consequently, evidence signed via a Root-of-Trust of Reporting in this period of time must have been fresh [see RFC4949] and must compose provable operational state of the Attester at that given time.
- The output of this procedure are secure audit logs that constitute attestation evidence that can be conveyed and verified at any time in the future without a nonce-based proof of recentness.

The State of the Document

- All technical details, information elements and functions required by the Attester role are completed and mature (including running code).
- Structure and layout need improvement.
- A corresponding SNMP MIB & YANG module are included.
  - The YANG module is “simply” derived from the MIB and needs refactoring.
- A consolidated RATS terminology (and maybe a base set of RATS assertion/information elements) is still required for another update of this I-D.
- If there are appropriate use-cases defined, the use of CWT to convey the TUDA information elements could be taken into consideration.