PKIX Key Attestation
draft-ietf-rats-pkix-key-attestation

Mike Ounsworth, Jean-Pierre Fiset , Hannes Tschofenig, Henk Birkholz, Monty Wiseman, Ned Smith

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Agenda

1. Terminology
    1. What is “PKIX”?
    2. What is “Key Attestation”?
2. Our draft’s data model

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Terminology

PKIX Key Attestation

Intended for Hardware and software that operates within PKI applications.

Assertions about the **current** protection properties of a given application key.

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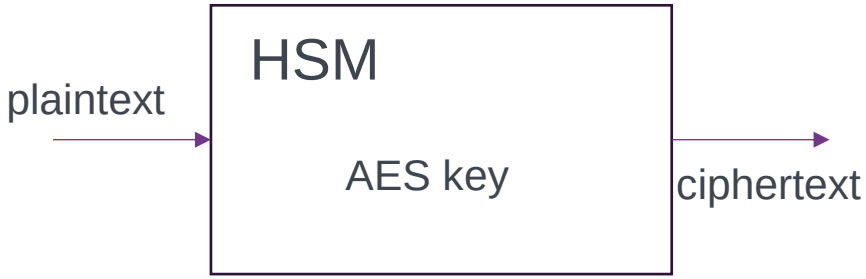
What is “PKIX” ?

- “Public Key Infrastructure Extensions”
- The term generally means X.509, CSR, and supporting protocols:
  - enrollment protocols: CMP, SCEP, EST, CMC
  - revocation protocols: CRL, OCSP
- Sometimes CMS, S/MIME, and applications built on top of them, e.g., PDF signing, Windows code signing, etc. are considered part of PKIX.
- Sometimes people will include the entire set of PKCS standards as part of PKIX. In particular, PKCS#11 is the most common interface between PKI software applications and the hardware designed to support them.

- **We are using the term “PKIX” to mean Hardware and software that operates within PKI applications.**

Hardware Security Modules (HSMs)



- A device whose primary purpose is to hold cryptographic secret keys (symmetric or asymmetric) and offer interfaces to perform operations using those keys without exposing them.

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Two types of HSMs

- HSMs generally split into two categories:
  - **Those intended for PKI applications**. (a.k.a. General-Purpose HSMs)
    HSMs that are generally designed to support applications that use X.509 certificates. They generally expose a PKCS#11 or similar interface and likely handle ASN.1 data structures such as X.509 certificates, SubjectPublicKeyInfo structures, etc.
  - **Those intended for Financial EMV applications.** (a.k.a. Payment HSMs)
    HSMs that generally expose interfaces and data key / ciphertext data structures compliant with the EMVco set of standards.

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  - ~~**Those intended for Financial EMV applications.** (a.k.a. Payment HSMs)~~
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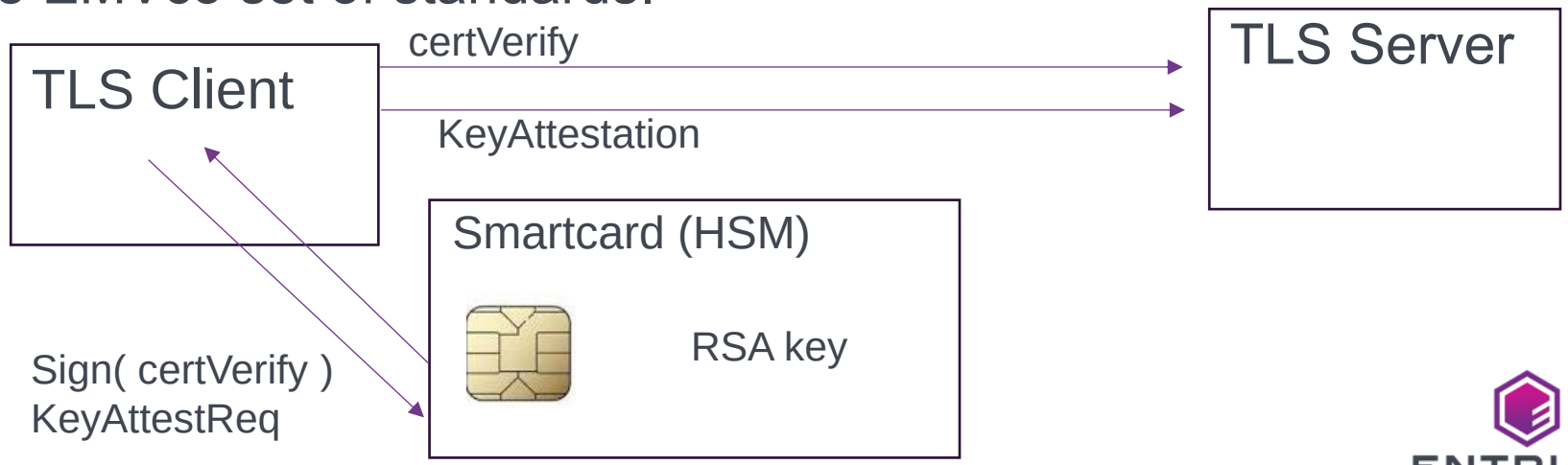
Our target usecase

Ex.:



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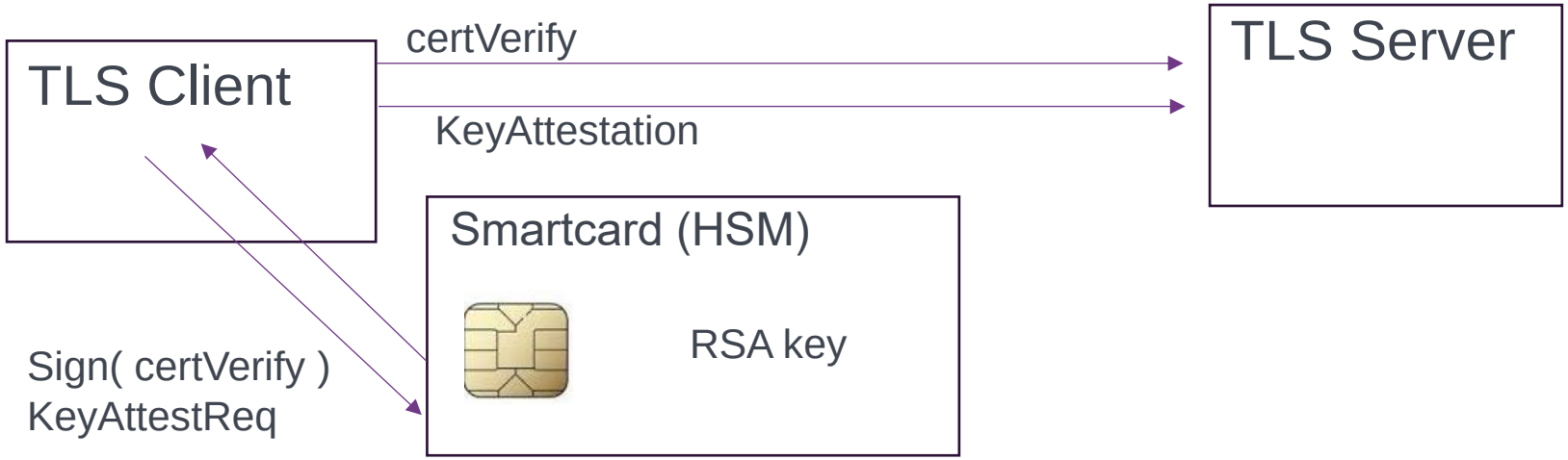
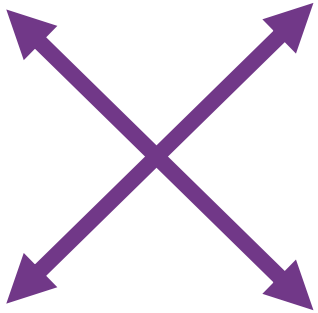
HSMs intended for PKI applications



PKI Applications

- Certification Authority
  - Issuing certs,
  - Issuing CRLs, OCSP
- TLS server / client
- S/MIME email
- PDF signing
- Windows code signing
- 802.11 WiFi supplicant
- Physical building access ID badge cards
- Etc, etc, etc



PKIX HSM form-factor

- Rack-mount network HSM
- PCIe card HSM
- TPM
- Confidential Computing
- USB token
- Smartcard

Any HSM form factor can support any PKI application.

Conceptually they all look the same as the Outlook + smartcard diagram.

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What is “key attestation” ?

- Evidence containing properties of the environment(s) in which the private keys are generated and stored. For example, a Relying Party may want to know whether a private key is stored in a hardware security module and cannot be exported in cleartext.

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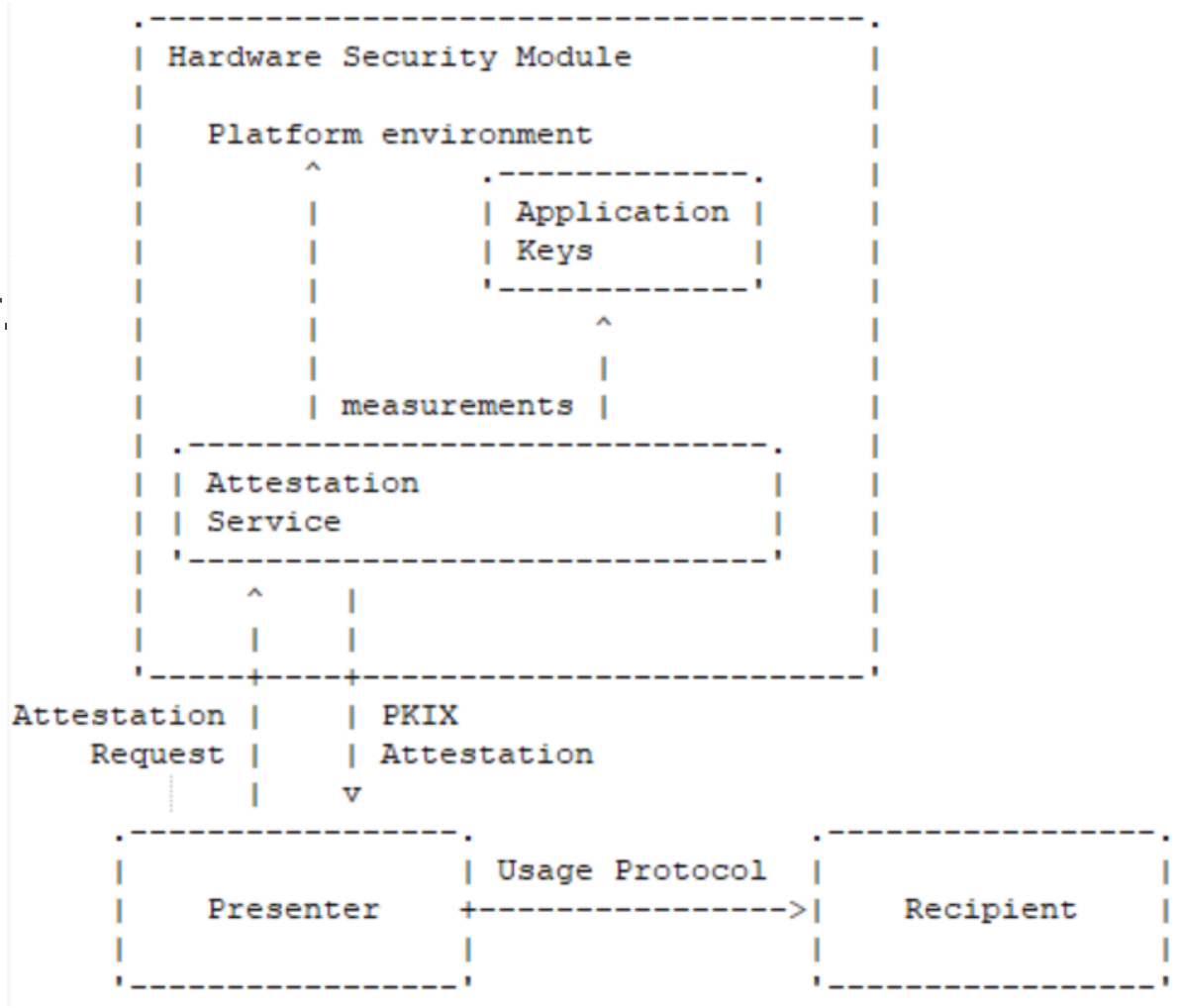
What is “PKIX Key Attestation” ?

- A PKI Application wants to provide proof to its peer of the current properties of a given key.
- The HSM is the RATS Attester.
- The PKI Application is “the Presenter” (this role does not exist in the RATS Architecture).
- The PKI Application’s peer is “the Receiver” and is the RATS Verifier / RP.



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Design Goals

- Define a trusted assertion format for describing common vendor-neutral attributes of PKIX HSMs.
- MUST be ASN.1, as must as possible re-use structures and information models from PKCS#11 and LAMPS PKIX ASN.1 modules.
- The Attestation Key (AK) MUST be in an X.509 Certificate – no other (non-PKIX) certificate formats are supported.
- The PKI Application (Presenter) requests a fresh attestation from the HSM containing a set of attributes appropriate for the PKI Application, and then presents it to their peer over whatever protocol is appropriate (CSR-attest, attested-TLS, etc).

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Out-of-scope

- We ARE NOT defining a way to carry evidence, attestation results, endorsements, or anything else within an X.509v3 certificate.
  - CMW already has a small section with OIDs for this.
  - There are privacy and freshness implications here that may require defining Certificate Signing Policy profiles for when it is and is not appropriate for a CA to copy trusted assertion data into an issued X.509 certificate.

Our draft’s data model

Data Model – cryptographic envelope

The envelop structure is:

```
~~~asn.1
PkixAttestation ::= SEQUENCE {
    tbs TbsPkixAttestation,
    signatures SEQUENCE SIZE (0..MAX) of SignatureBlock
}

TbsPkixAttestation ::= SEQUENCE {
    version INTEGER,
    reportedEntities SEQUENCE SIZE (1..MAX) OF ReportedEntity
}

SignatureBlock ::= SEQUENCE {
   certChain SEQUENCE of Certificate,
   signatureAlgorithm AlgorithmIdentifier,
   signatureValue OCTET STRING
}
~~~
```

```
~~~asn.1
ReportedEntity ::= SEQUENCE {
    entityType          OBJECT IDENTIFIER,
    reportedAttributes SEQUENCE SIZE (1..MAX) OF ReportedAttribute
}
~~~
```

Is loosely CMS-like.

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Transaction Entities

- Only one Transaction Entity per PKIXAttestation.

Attribute	AttributeValue	Reference	Multiple Allowed	Request Contains a Value	Description
nonce	bytes	RFCthis	No	**MUST**	Repeats a "nonce" provided during the atttestation request.
timestamp	time	[I-D.ietf-rats-eat]	No	**MUST NOT**	The time at which this attestation was generated. Corresponds to EAT IAT claim.

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Platform Entities

- Only one Platform Entity per PKIXAttestation.

Attribute	AttributeValue	Reference	Multiple Allowed	Request Contains a Value	Description
vendor	utf8String	RFCthis	No	**MUST NOT**	A human-readable string by which the vendor identifies themself.
oemid	bytes	[I-D.ietf-rats-eat]	No	**MUST NOT**	The EAT OEM ID as defined in [I-D.ietf-rats-eat].
hwmodel	utf8String	[I-D.ietf-rats-eat]	No	**MUST NOT**	Model or product line of the hardware module.
hwserial	utf8String	RFCthis	No	**MUST NOT**	Serial number of the hardware module, often matches the number engraved or stickered on the case.

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Platform Entities

- Only one Platform Entity per PKIXAttestation.

fipsboot	bool	[FIPS.140-3]	No	**MUST NOT**	Indicates whether the devices is currently running in FIPS mode.
fipsver	utf8String	[FIPS.140-3]	No	**MUST NOT**	Indicates the version of the FIPS CMVP standard that is being enforced. At time of writing this is typically "FIPS 140-2" or "FIPS 140-3".
fipslevel	int	[FIPS.140-3]	No	**MUST NOT**	Indicates the FIPS Level to which the device is currently operating in compliance with.
envid	utf8String	RFCthis	Yes	**MAY**	An environment ID, which will typically be a URI, UUID, or similar.
envdesc	utf8String	RFCthis	Yes	**MUST NOT**	Further description of the environment.

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Key Entities

- Any number of Key Entities per PKIXAttestation.
  - Ex.: you could ask the HSM to attest a single key, a set of keys, or all the keys that it contains.

Attribute	AttributeValue	Reference	Multiple Allowed	Request Contains a Value	Description
identifier	utf8String	RFCthis	Yes	**MAY**	Identifies the subject key, with a vendor-specific format which could be numeric, UUID, or other textual identifier.
spki	bytes	RFCthis	No	**MAY**	A complete DER-encoded SubjectPublicKeyInfo representing the public key associated with the asymetric key pair being attested.
purpose	bytes	[PKCS11]	No	**MAY**	Defines the intended usage for the key.
extractable	bool	[PKCS11]	No	**MAY**	Indicates if the key is able to be exported from the module. Corresponds directly to PKCS#11 CKA_EXTRACTABLE.

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sensitive	bool	[PKCS11]	No	**MAY**	Indicates that the key cannot leave the module in plaintext. Corresponds directly to PKCS#11 CKA_SENSITIVE.
never-extractable	bool	[PKCS11]	No	**MAY**	Indicates if the key was able to be exported from the module. Corresponds directly to PKCS#11 CKA_NEVER_EXTRACTABLE.
local	bool	RFCthis	No	**MAY**	Indicates whether the key was generated locally or imported.
expiry	time	RFCthis	No	**MAY**	Defines the expiry date or "not after" time for the key.
protection	bytes	RFCthis	No	**MAY**	Indicates any additional key protection properties.

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Attestation Request format

- The same as the general PKIXAttestation, except:
  - Could carry a SignatureBlock acting as a client signature on the request, or could be an un-signed TbsPkixAttestation.
  - MUST contain a single entity: a Request Entity.
  - Some request attributes carry a value (ex.: a KeyID or Public Key if you want to request attestation of that key)
  - Some request attributes are un-valued (indicates that the HSM should collect a measurement for that attribute).

Next steps

- Continue iterating ASN.1 data model.
- Continue iterating terminology.
- Continue explanatory text.
- Continue hackathon on reference implementation [1]

- … basically, this is an -00 and needs more iteration.

https://github.com/ietf-rats-wg/key-attestation/tree/main/sampledata/idea3

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