TEEP BOF
Architecture

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Ecosystem

TEE Providers

Device Manufactures

Trusted App Managers (TAMs)

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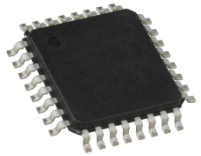
Service Providers (SPs)

Hardware Manufacturers



Device Manufacturer CAs

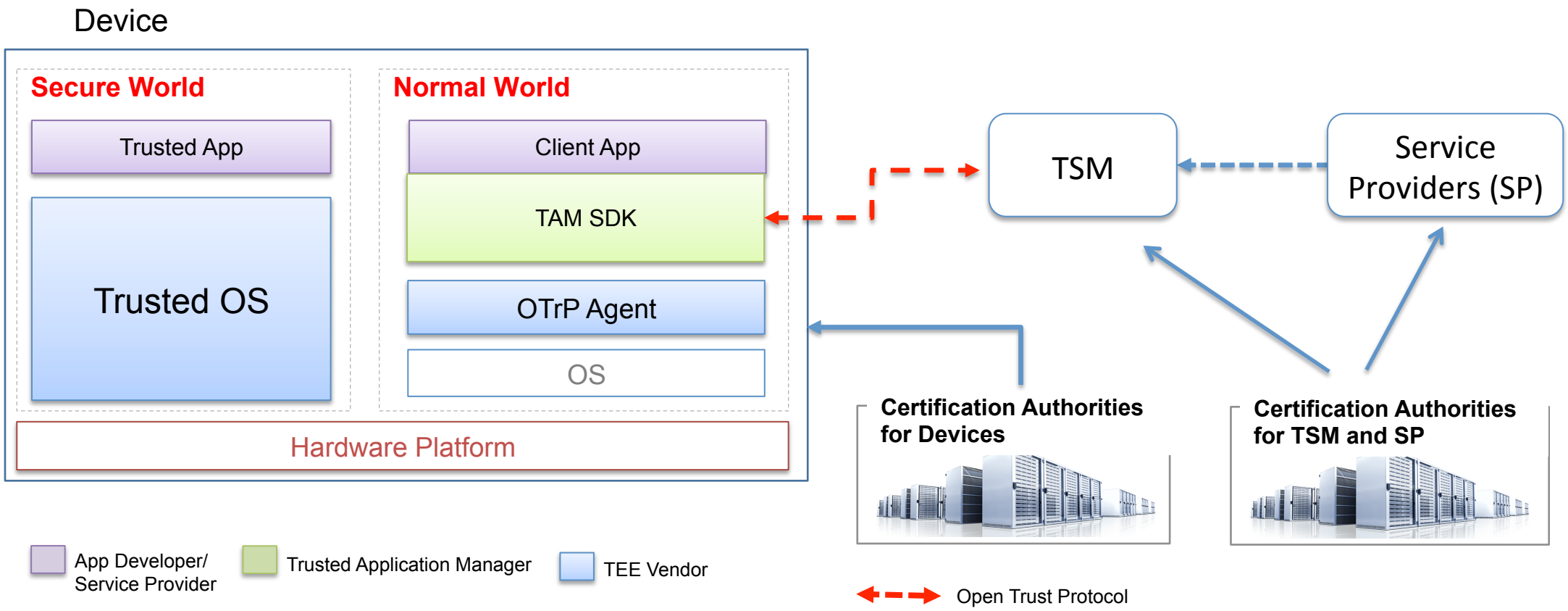
Certification Authorities (CAs)

OTrP Design Choices

- **Uses asymmetric keys and PKI**
  - Manufacturer-provided keys and trust anchors
  - Enables attestation between TAM and TEE-device
- **JSON-based messaging between TAM and TEE**
  - Messages for attestation
  - Messages for security domain management and TA management
  - Use JOSE (JSON signing and encryption specifications) – CBOR alternative spec available.
- **OTrP Agent in REE relays message exchanges between a TAM and TEE**
- **Device has a single TEE only**

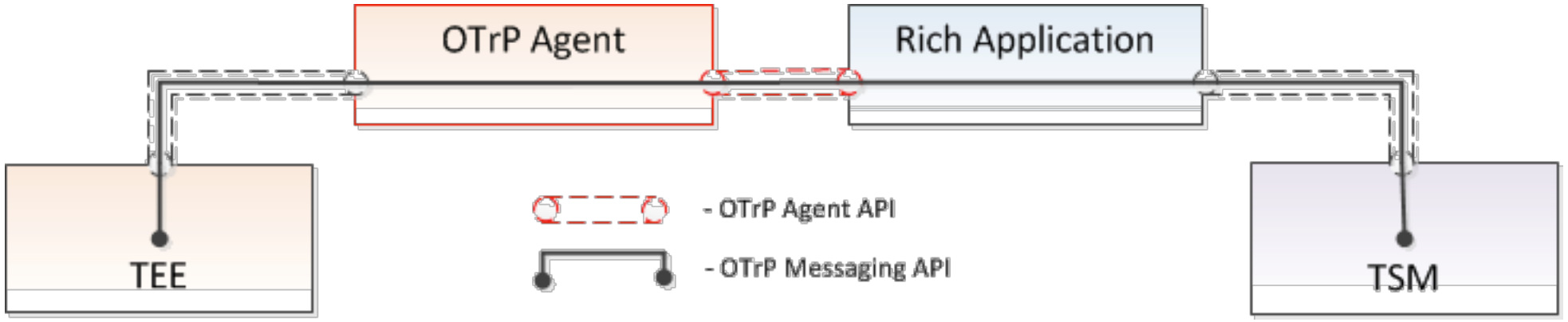
Open Trust Protocol (OTrP) Overview

- CAs issue certificates to OTrP actors (TEE, TAM, SP)
- TAM and TEE exchange messages
- An OTrP Agent relays the OTrP message between TAM and TEE.
  - The communication between Rich App to TAM is up to SP and TAM.



OTrP Agent

- Responsible for routing OTrP Messages to the appropriate TEE
- Most commonly developed and distributed by TEE vendor
- Implements an interface as a service, SDK, etc.

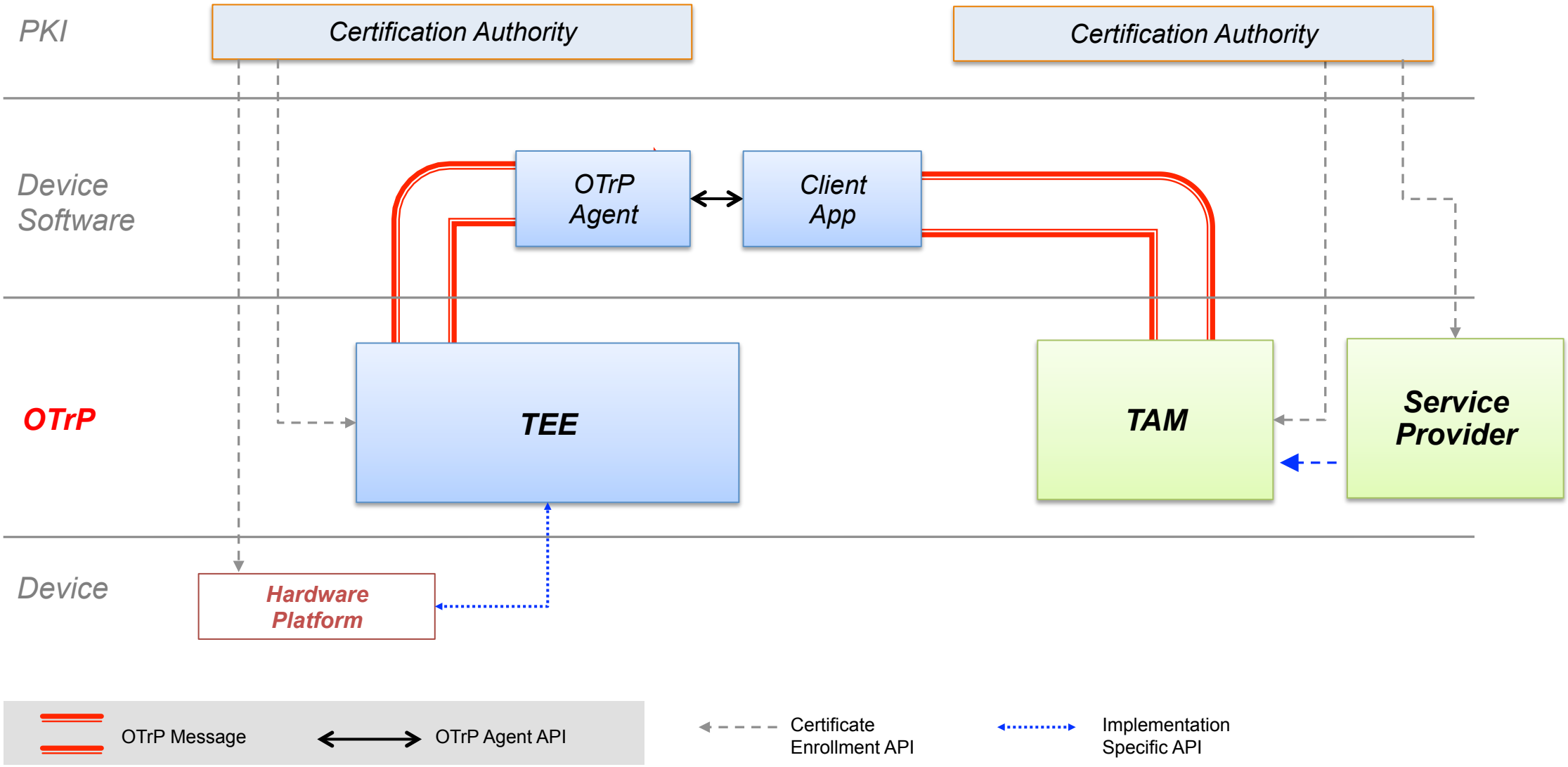


Keys

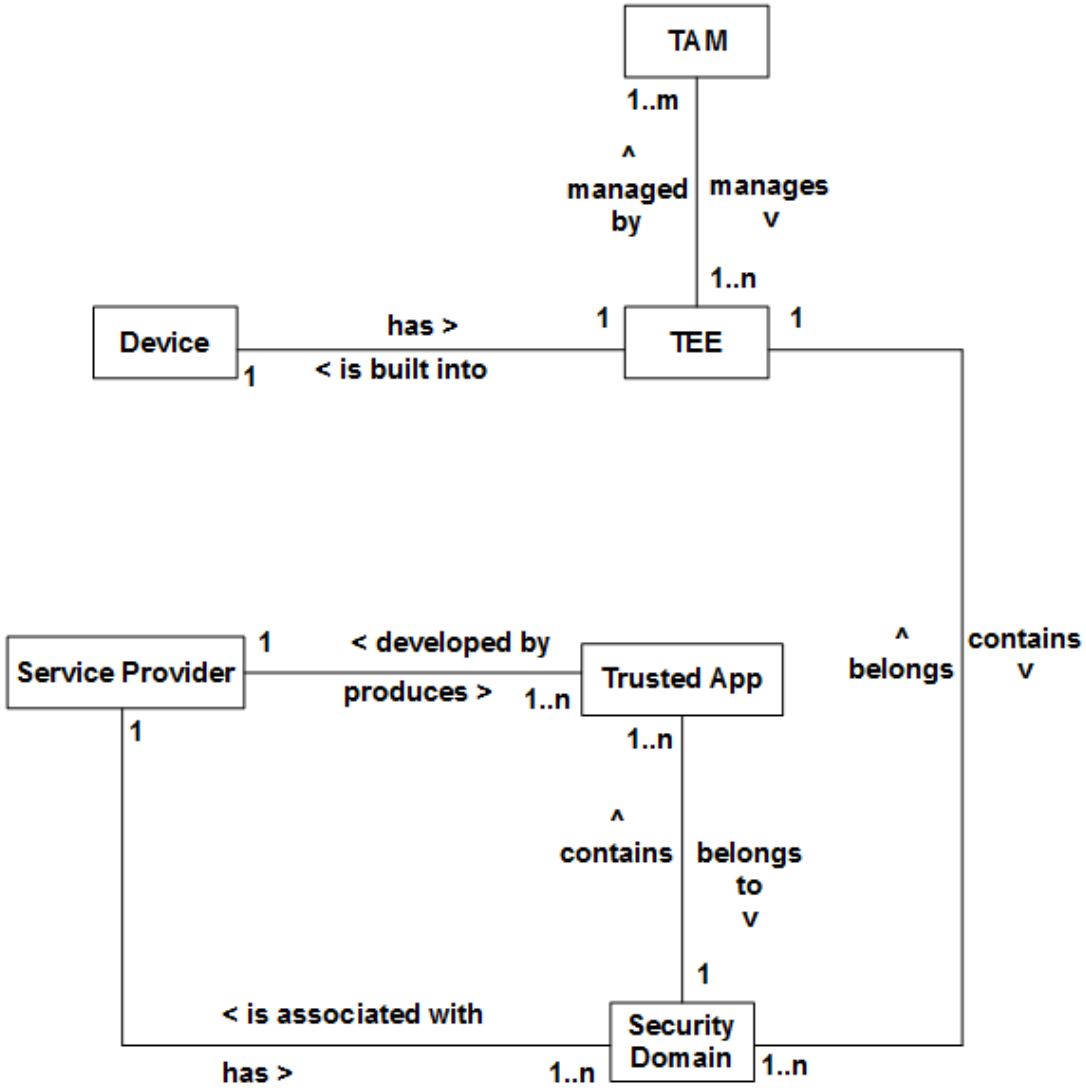
	Certificate Authority	*Service Provider*	*TAM*	*Device TEE*	
Keys	 **CA Certificate**	 SP Key pair and Certificate	 TAM Key pair and Certificate	 **TEE Key pair and Certificate**	 **TFW Key pair and Certificate** (optional)
Trust Anchors			 **Trust Anchors:** trusted Root CA list of TEE certificates	 **Trust Anchors:** trusted Root CA list of TAM & TFW	
Usage	* ***Key pair and Certificate:*** *used to issue certificate*	* ***Key pair and Certificate:*** *used to sign a TA*	* ***Key pair and Certificate:*** *sign OTrP requests to be verified by TEE*	* ***Key pair and Certificate:*** *device attestation to remote TAM and SP.* * ***SP AIK in runtime*** *for use by SP (encrypt TA data / verify)*	* ***Key pair and Certificate:*** *evidence of secure boot and trustworthy firmware*

* AIK: Attestation Identity Key, TFW: Trusted Firmware

Proposed Scope

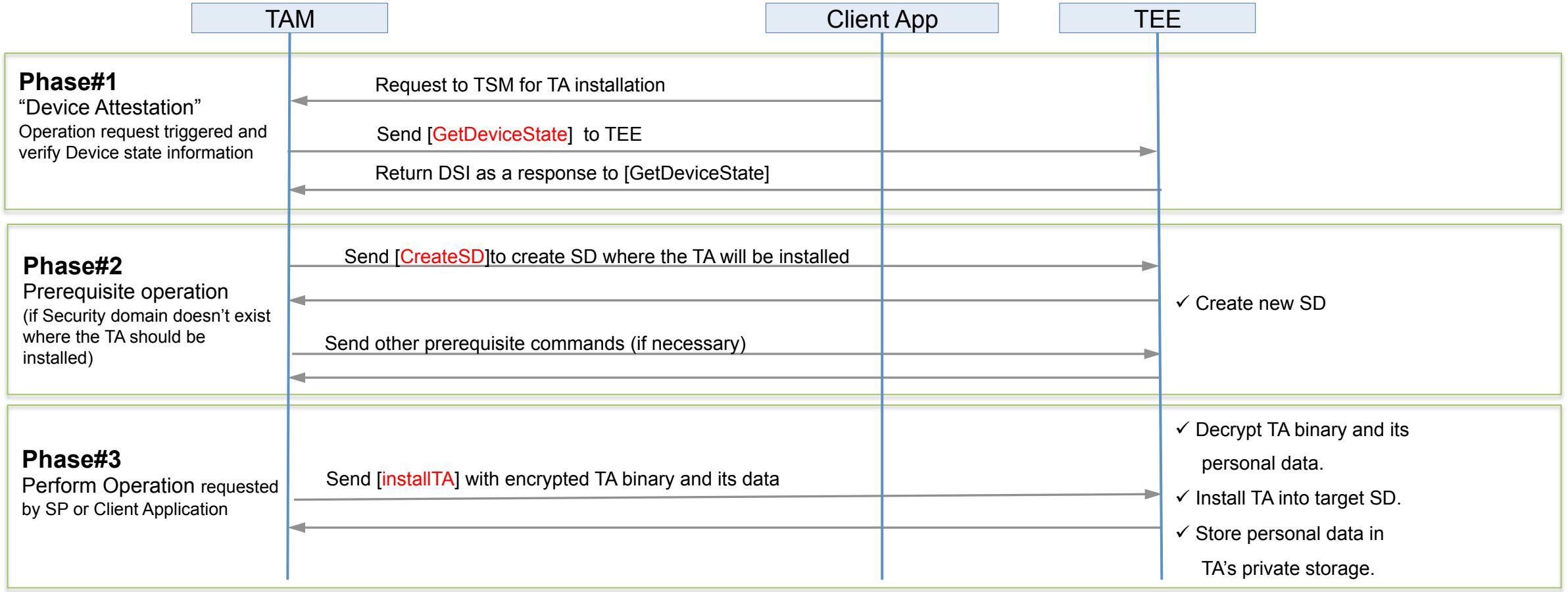


Entity Relationships



Protocol Flow

- Security of the Operation Protocol is enhanced by applying the following three Measures:
  - ✓ Verifies validity of Message Sender's Certificate
  - ✓ Verifies signature of Message Sender to check immutability
  - ✓ Encrypted to guard against exposure of Sensitive data



Discussion

Thank you!

APPENDIX

JSON Message Security and Crypto Algorithms

- Use JSON signing and encryption RFCs
  - RFC 7515, JSON Web Signature (JWS)
  - RFC 7516, JSON Web Encryption (JWE)
  - RFC 7517, JSON Web Key (JWK)
  - RFC 7518, JSON Web Algorithms (JWA)
- Supported encryption algorithms
  - A128CBC-HS256
  - A256CBC-HS512
- Supported signing algorithms
  - RS256 (RSA 2048-bit key)
  - ES256 (ECC P-256)

OTrP Agent API

```
interface IOTrPAgentService {
    String processMessage(String tsmInMsg) throws OTrPAgentException;
    String getTAInformation(String spid, String taid, byte[] nonce);
}

public class OTrPAgentException extends Throwable {
    private int errCode;
}
```

OTrP Operations and Messages

✓ Remote Device Attestation

Command	Descriptions
GetDeviceState	• Retrieve information of TEE device state including SD and TA associated to a TAM

✓ Security Domain Management

Command	Descriptions
CreateSD	• Create SD in the TEE associated to a TAM
UpdateSD	• Update sub-SD within SD or SP related information
DeleteSD	• Delete SD or SD related information in the TEE associated to a TAM

✓ Trusted Application Management

Command	Descriptions
InstallTA	• Install TA in the SD associated to a TAM
UpdateTA	• Update TA in the SD associated to a TAM
DeleteTA	• Delete TA in the SD associated to a TAM

OTrP JSON Message Format and Convention

```
{
   “<name>[Request | Response]”: {
      "payload": "<payload contents of <name>TBS[Request | Response]>",
      "protected":"<integrity-protected header contents>",
      "header":  <non-integrity-protected header contents>,
      "signature":"<signature contents>"
   }
}
```

For example:

- CreateSDRequest
- CreateSDResponse

OTrP JSON Sample Message: GetDeviceState

```
{
  "GetDeviceStateTBSRequest": {
     "ver": "1.0",
      "rid": "<Unique request ID>",
      "tid": "<transaction ID>",
      "ocspdat": "<OCSP stapling data of TSM certificate>",
      "icaocspdat": "<OCSP stapling data for TSM CA certificates>",
      "supportedsigalgs": "<comma separated signing algorithms>"
   }
}
```

```
{
    "GetDeviceStateRequest": {
     "payload":"<BASE64URL encoding of the GetDeviceStateTBSRequest JSON above>",
     "protected": "<BASE64URL encoded signing algorithm>",
     "header": {
        "x5c": "<BASE64 encoded TSM certificate chain up to the root CA certificate>"
     },
     "signature":"<signature contents signed by TSM private key>"
    }
}
```

OTrP Sample Message: CreateSD Request

```
{
   "CreateSDTBSRequest": {
     "ver": "1.0",
     "rid": "<unique request ID>",
     "tid": "<transaction ID>", // this may be from prior message
     "tee": "<TEE routing name from the DSI for the SD's target>",
     "nextdsi": "true | false",
     "dsihash": "<hash of DSI returned in the prior query>",
     "content": ENCRYPTED { // this piece of JSON data will be encrypted
          "spid": "<SP ID value>",
        "sdname": "<SD name for the domain to be created>",
        "spcert": "<BASE64 encoded SP certificate>",
        "tsmid": "<An identifiable attribute of the TSM certificate>",
        "did": "<SHA256 hash of the TEE cert>"
     }
   }
 }
```

OTrP Sample Message: CreateSD Response

```
{
  “CreateSDTBSResponse”: {
     “ver”: “1.0”,
     “status”: “<operation result>”,
     “rid”: “<the request ID received>”,
     “tid”: “<the transaction ID received>”,
     “content”: ENCRYPTED {
        “reason”:”<failure reason detail>”, // optional
        “did”: “<the device id received from the request>”,
        “sdname”: “<SD name for the domain created>”,
        “teespaik”: “<TEE SP AIK public key, BASE64 encoded>”,
        “dsi”: “<Updated TEE state, including all SD owned by this TSM>”
     }
  }
}
```