Intel® Data Center Attestation Primitives (DCAP): Appraisal Engine Developer Guide for Linux* OS

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1. Introduction

Intel® Data Center Attestation Primitives (DCAP) Appraisal Engine is used to appraise the remote attestation result, based on appraisal policies. In the following, we will used "Appraisal Engine" as a shorthand for Intel DCAP Appraisal Engine.

This document guides you on how to use the Intel® DCAP Appraisal Engine for Software Guard Extensions (SGX) and Trust Domain Extensions (TDX) remote attestation. The target users are Linux developers and cloud DevOps.

This document assumes the reader is familiar with DCAP quote generation and quote verification process. The reader can refer to the DCAP documents at (download.01.org/intel-sgx/latest/dcap-latest/linux/docs/) for more information.

Features:

- Appraise SGX-based Quote.
- Appraise TDX-based Quote.
- Appraise SGX Enclave Identity.
- Appraise TD Identity.

Notes:

If you want to run the Appraisal Engine inside an SGX enclave called the Quote Appraisal Enclave(QAE), please contact your SGX support representative. The use of QAE is optional but when used it, this release only supports local attestation mode. Local attestation mode requires the Quote Verification Enclave (QvE), Quote Appraisal Enclave (QAE) and application enclave to be executed on the same physical machine.

1.1 Terminology

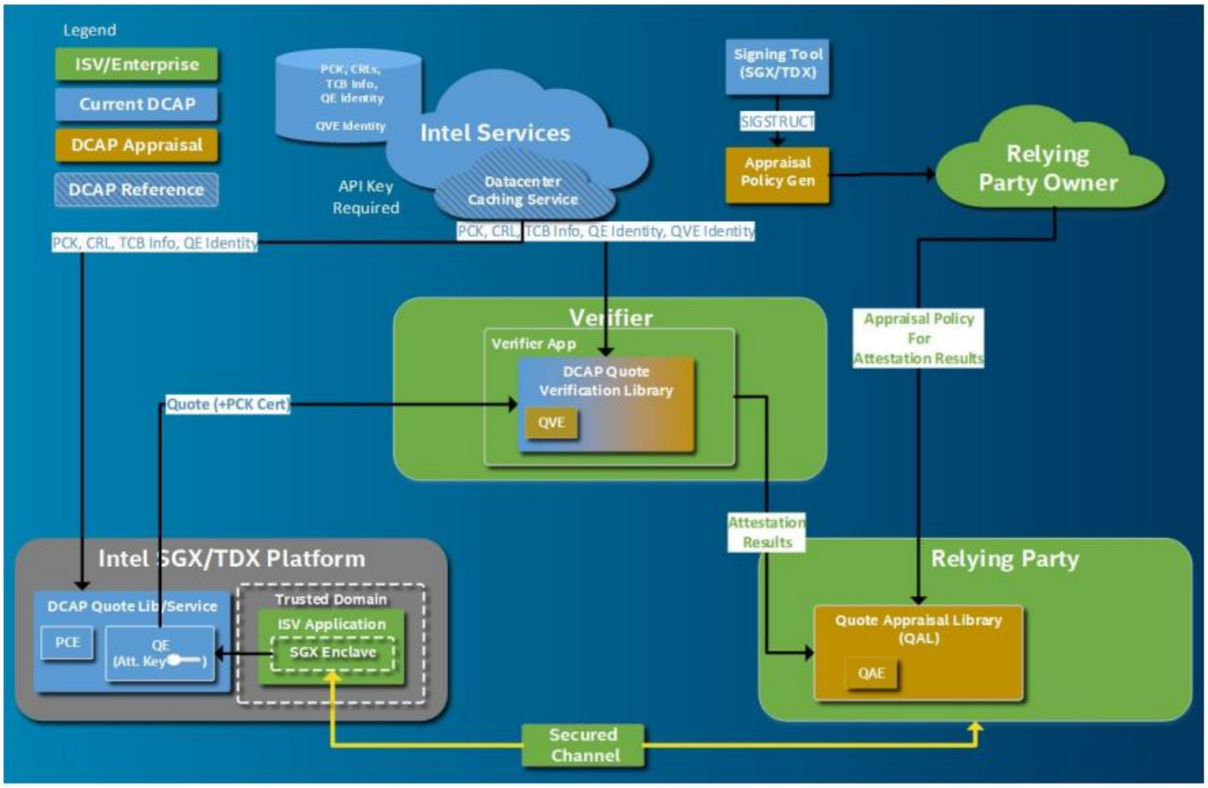
Attestation Key (AK)	**Asymmetric key generated by the Quoting Enclave (QE) or the TD Quoting Enclave (TDQE). The QE/TDQE uses the private key–part to sign SGX/TD** Report**. The QE/TDQE also generates an SGX Report containing the hash of the public key–part. This SGX Report and the public key–part is provided to the Provisioning Certification Enclave**

	(PCE), which verifies the SGX Report, the hash of the AK public key-part, and then signs the SGX Report with the private key-part of the Provisioning Certification Key (PCK).
Intel Data Center Attestation Primitives (DCAP)	Attestation primitives (software and services) to support remote attestation for Intel processors supporting Intel SGX and Intel TDX.
Intel Provisioning Certification Service (Intel PCS)	Service hosted by Intel on the Internet that offers APIs for retrieving the Provisioning Certification Key (PCK) certificates and other Intel endorsements for generating and verifying SGX/TD Quotes
Intel Software Guard Extensions (Intel SGX)	An Intel CPU mode and ISA extensions that support operation and management of SGX enclaves.
Intel Trust Domain Extensions (Intel TDX)	An Intel CPU mode and ISA extension that supports operation and management of Trust Domains (TDs).
SGX Quote	Data structure used to provide proof to an off-platform entity that an Intel SGX enclave is running with Intel SGX protections on a trusted Intel SGX-enabled platform.
Trust Domain (TD)	Trust Domains (TDs) are hardware-isolated virtual machines (VMs) protected by Intel Trust Domain Extensions (Intel TDX).
Trusted Computing Base (TCB)	The Trusted Computing Base (TCB) of Intel SGX/TDX encompasses all components in the platform that are required to implement the Intel SGX/TDX security objectives.
Trusted Computing Base (TCB) level	The Trusted Computing Base (TCB) level is defined as the combination of all patch versions of all the components that are part of the Trusted Computing Base (TCB).
Trusted Computing Base - Recovery (TCB-R)	Applying patches to update the TCB level is called a Trusted Computing Base -Recovery.
TD Quote	Data structure used to provide proof to an off-platform entity that a Trust Domain (TD) is running with Intel TDX protections on a trusted Intel TDX-enabled platform.
TD Quoting Enclave (TDQE)	An Intel SGX enclave, which generates TD Quotes. By default, the TDQE is signed by Intel. In this case, the trust of the TD Quotes is rooted in Intel. Optionally, the TDQE can be provided and signed by any authority trusted by the attestation infrastructure owner. In this case, the trust of the TD Quotes is not rooted in Intel.
Provisioning Certificate Caching Service (PCCS)	A reference caching server to allow a CSP or a datacenter to cache PCK Certificates and other endorsements from the Intel® SGX Provisioning Certification in their local network
Provisioning Certification Enclave (PCE)	Intel® SGX architectural enclave that uses a Provisioning Certification Key (PCK) to sign an SGX Report structures for Provisioning or Quoting

	Enclaves. The signed SGX Reports provide the attestation root of trust for Trust Domains (TD) and Enclaves.
Provisioning Certification Key (PCK)	An asymmetric key unique to the processor package (or platform), the HW TCB, the signer of the PCE, and the Security Version Number (SVN) of the PCE. The PCK can be requested using Intel SGX's EGETKEY instruction
Provisioning Certification Key Certificate **(PCK Cert)**	X.509 certificate chain signed and distributed by Intel for each Intel SGX–enabled or Intel TDX–enabled platform. The leaf certificate contains the public key–part of the Provisioning Certification Key (PCK) generated by the Provisioning Certification Enclave (PCE). A PCK Cert is used by the Quote Verification Library to verify that SGX/TD Quotes were generated by a valid QE/TDQE on a trusted Intel SGX/TDX platform at a particular TCB level.
Quote Appraisal Enclave (QaE)	An Intel SGX enclave that can be used to appraise SGX Quotes or TD Quotes. By default, the QaE is signed by Intel. In this case, the trust of the SGX/TD Quote appraisal is rooted in Intel. Optionally, the QaE can be provided and signed by any authority trusted by the attestation infrastructure owner. In this case, the trust is not rooted in Intel.
Quote Appraisal Library (QAL)	Library used to appraise SGX Quotes or TD Quotes. The library optionally uses the Quote Appraisal Enclave (QaE)
Quoting Enclave (QE)	An Intel SGX enclave, which generates SGX Quotes. By default, the QE is signed by Intel. In this case, the trust of the SGX Quotes is rooted in Intel. Optionally, the QE can be provided and signed by any authority trusted by the attestation infrastructure owner. In this case, the trust of the SGX Quotes is not rooted in Intel.
Quote Verification Enclave (QvE)	An Intel SGX enclave that can be used to verify SGX Quotes or TD Quotes. By default, the QvE is signed by Intel. In this case, the trust of the SGX/TD Quote verification is rooted in Intel. Optionally, the QvE can be provided and signed by any authority trusted by the attestation infrastructure owner. In this case, the trust is not rooted in Intel.
Quote Verification Library (QVL)	Library used to verify SGX Quotes or TD Quotes. The library optionally uses the Quote Verification Enclave (QvE).

2. Quick Start Steps

The following picture shows the set of DCAP components used in the attestation of a Trust Domain Virtual Machine (TD) or a Software Guard Extensions (SGX) enclave to a remote Relying Party.



Quote Appraisal Library is to appraise the result of the quote verification to Relying Party who provides the Appraisal Policies. These include a policy to access the platform and software generating the quote as well as a policy to access the Individual Software Vendor (ISV) enclave or TD.

For use of the Appraisal Engine in bare metal environment, follow these steps:

1. Install the relative packages, including “Quote generation packages”, “Quoting verification library package”, “tee appraisal tool package”, "cache server (PCCS) package”, “multi-package agent package or PCKIDRetrieval tool package”, “PccsAdmintool in DCAP source code”
    a. Install all the packages needed for end-to-end remote attestation(please refer to the DCAP documents at download.01.org/intel-sgx/latest/dcap-latest/linux/docs/ for more information).
    b. Install the “tee appraisal tool package”.

2. Prepare the appraisal policies: including platform policy, user SGX enclave policy or user TD policy.
    a. Intel has provided a tool (tee_appraisal_tool) to help the user generate the policies. The tool just generates the reference policy based on the TD or SGX enclave. The user should

modify the policy if his/her enclave or TD requires a different policy from the generated reference policy.

   b. Then, upload the platform appraisal policies to your environment's caching server with the PccsAdmintool. Note: the uploading operation is optional. You can provide the policies directly when calling the appraisal APIs.

3. Call the new appraisal APIs to perform the appraisal functionality on the attestation results.
   a. Refer to the Sample code: QuoteAppraisalSample

4. After performing the appraisal of the attestation result described in step 3, you may audit the appraisal process.
   a. In this release, from security perspective, audit the appraisal policy is a security requirement. You can refer to the Sample code: QuoteAppraisalSample

To use the Appraisal Engine in the cloud environment, please refer to the Cloud Service Provider's documentation. But typically, these would be the steps:

1. Install the relative packages, including "Quote generation packages", "Quoting verification library package", "tee appraisal tool package".
   a. Install all the packages needed for end-to-end remote attestation(please refer to the DCAP documents at download.01.org/intel-sgx/latest/dcap-latest/linux/docs/ for more information).
   b. Install the "tee appraisal tool package".

2. Prepare the appraisal policies: user SGX enclave policy or user TD policy.
   a. Intel has provided a tool (tee_appraisal_tool) to help the user generate the policies. The tool just generates the reference policy based on the TD or SGX enclave. The user should modify the policy if his/her enclave or TD requires a different policy from the generated reference policy.
   b. In general, a platform owner (like a Cloud Service Provider) should own the platform policy's generation. As an end user, you don't need to generate the platform policy.

3. Call the new appraisal APIs to perform the appraisal functionality on the attestation results .
   a. Refer to the Sample code: QuoteAppraisalSample.

4. After finishing the appraisal of the attestation result, you can also audit the appraisal process.
   a. From security perspective, if the attestation appraisal process is NOT executed in trusted execution environment (like SGX or TDX environment), auditing the appraisal policy is a security requirement. You can refer to the Sample code: QuoteAppraisalSample.

3. Detailed Steps to Use the Appraisal Engine

The Attestation Appraisal Engine is provided as part of DCAP release packages except for the tool for generating appraisal policies for SGX Enclaves and TD's (tee_appraisal_tool). This tool must be installed separately.

3.1 Install the Necessary Packages

First, install the necessary DCAP software stack into your platform including(you can refer to the doc: Intel_SGX_SW_Installation_Guide_for_Linux):

1. Quote generation libraries.
2. Quote Verification libraries.
3. QCNL/QPL libraries
4. Cache server (PCCS)
5. Multi-package Agent or PCKIDRetrieval Tool
6. PccsAdminTool
7. If you are working on TDX remote attestation, you need to install TDX related packages:
   a. Quote Generation Service
      For rpm packages, you can install it as:
      sudo yum install -y --setopt=install_weak_deps=False --nogpgcheck tdx-qgs
      For Debian packages, you can install it as:
      sudo apt install -y --no-install-recommends tdx-qgs
   b. Ring 3 Attestation Abstraction Library
      For rpm packages, you can install it as:
      sudo yum install -y --setopt=install_weak_deps=False --nogpgcheck libtdx-attest
      sudo yum install -y --setopt=install_weak_deps=False --nogpgcheck libtdx-attest-devel
      For Debian packages, you can install it as:
      sudo apt install -y --no-install-recommends libtdx-attest
      sudo apt install -y --no-install-recommends libtdx-attest-dev

Notes:
If you use the Appraisal Engine in the cloud, please refer to Cloud Service Provider's documentation. Typically, Cloud Service Provider will take care of item 4,5 and 6.

For help in generating appraisal policies, you should install :

1. tee_appraisal_tool

   For rpm packages, you can install it as:
   sudo yum install -y --setopt=install_weak_deps=False --nogpgcheck tee-appraisal-tool
   For Debian packages, you can install it as:
   sudo apt install -y --no-install-recommends tee-appraisal-tool

Notes:

Repositories are supported to distribute packages for the following OS's(instructions for setting up the repo or local repo, refer to the documentation:Intel_SGX_SW_Installation_Guide_for_Linux. Refer to section "Installation Instructions-QuickStart") :

- Ubuntu and Debian: DCAP packages are provided in a Debian* repository at https://download.01.org/intel-sgx/sgx_repo/ and via a tar file located at https://download.01.org/intel-sgx/latest/linux-latest/distro/
- Red Hat, CentOS, Anolis, and SUSE: DCAP packages are provided as RPM Packages via a tar file located in the corresponding folder in https://download.01.org/intel-sgx/latest/linux-latest/distro/

a. Find the RPM packages for SGX libraries and services, which are currently provided in a single TAR archive at https://download.01.org/intel-sgx/latest/linux-latest/distro/

b. Download the file sgx_rpm_local_repo.tgz to a selected folder, for example /opt/intel

```
cd  /opt/intel
sudo  wget https://download.01.org/intel-sgx/latest/linux-
latest/distro/<distro>/sgx_rpm_local_repo.tgz
```

c. Verify the downloaded repo file with the SHA value in this file: https://download.01.org/intel-sgx/latest/dcap-latest/linux/SHA256SUM_dcap_<version>.cfg

d. Expand the archive:

```
sudo tar xvf sgx_rpm_local_repo.tgz
```

Add the RPM local repository to your local repository list:

```
sudo yum-config-manager --add-repo file://PATH_TO_ LOCAL_REPO
```

3.2 Generating Appraisal Polices

The Quote Verification Result Token is a JSON Web Token (JWT). Its payload is a JSON array of following reports:

- **Platform TCB Report** defines the identity of the platform which has been verified. This includes claims on the platform which must be appraised. And it also includes information on the Quoting Enclave which generated the quote in the platform.
- **Enclave or TD Identity Report** defines the identity of the enclave/TD which is being attested. This includes information in the original REPORT from the enclave/TD which is encased in the generated Quote.
- **Additional Reports**: the Verification Result may contain additional reports related to TEEs which are in the TCB of the Application Enclave itself or the attestation flow. Examples may include:
  - **Quote Verification Enclave (QVE) Report:** if this enclave is used in the attestation flow, then its identity (as an Enclave Identity Report) can be inserted into the Verification Result JWT.

A Relying Party needs appraisal policies to process the results of the quote verification. These include a policy to assess the platform and the trusted platform software generating the quote, called the platform policy as well as a policy to appraise an SGX Enclave or TD, called the identity policy .

Identity Policy

DCAP now provides a tool to help user generate the appraisal policy: tee_appraisal_tool.
After installing this tool, its usage is described below :

```
  tee_appraisal_tool <Command> <options> <files>
  Command:
    gen_payload:   Generate the policy payload file with JSON format from an SGX Enclave Report or a TDX Report.
    sign_policy:   Sign the input policy payload with the input EC key and generate the final policy file with JWT format.
    verify_policy:   Verify the JWT policy file.
  Options:
        -in            Specify the input file name
        -key           Specify the key file. The key file must be a EC private key with 384 bytes
                       It is a required option for "sign_policy"
        -out           Specify the output file name
         -v            Enable showing the extra dump message for each command
    Example:
        tee_appraisal_tool gen_payload -in {enclave/TDReport} -out payload.json [-v]
        tee_appraisal_tool sign_policy -in payload.json -key ec_private.pem -out policy.jwt [-v]
        tee_appraisal_tool verify_policy -in policy.jwt [-v]
```

Notes:

1. “gen_payload” subcommand can only generate an SGX enclave or a TD payload as SGX enclave or TD policy.
2. Subcommand “verify_policy” cab be used to verify the policy generated by “sign_policy” subcommand.

Platform Policy

There is not tool for generating a platform policy similar to the tool provided for identity policy generation. Platform policies need to be manually generated but there is a tool for aid in signing the policy. Refer to the following information for generating platform policies based on your workload requirements:

- SGX Platform policy
- TDX platform policy
- Sample policies in Sample code(QuoteAppraisalSample)

Once created, you can use the following command to sign it:

```
tee_appraisal_tool sign_policy -in platform_policy.json -key ec_private.pem -out platform_policy.jwt [-v]
```

After generating and signing the platform policy, you can use the PccsAdmintool to upload the policy to your cache server:

```
pccsamdin put -u https://localhost:8081/sgx/certification/v4/appraisalpolicy [-d] -f fmspc -i policy_file
```

[-d] means default flag for the platform policy, each FMSPC should only has one default policy

Notes:

1. In general, a platform owner (like a CSP) will own the platform policy generation and signing. If you don't own the platform, you don't need to generate the platform policy. However, you must understand and accept the platform owner's platform policy. Typically, the platform owner will publish their platform policy and the platform user can audit the platform policy.

SGX Platform Policy

To appraise the platform's TCB, the Relying Party must provide a platform policy with expected or accepted platform TCB claims. The platform policy is in the JSON Web Token (JWT) payload.

Definition

The Platform Policy is a JSON object, containing a "environment" JSON object and a "reference" JSON object composed of fields detailed in the following table:

Environment fields and values:

- "class_id": "3123ec35-8d38-4ea5-87a5-d6c48b567570

Notes:

In the following table, "R" means this field is required field; "O" means this field is optional field.

Field name	Type	R/O	Field Description
accepted_tcb_status	Array of Strings	R	List of TCB Status that are accepted. The Policy fails if the Platform TCB Report includes any values that are not provided in accepted_tcb_status. Note: a policy should never include "Revoked" in this list. This would be overriding the revoking of the TCB. In addition, a policy should include "UpToDate" which indicates that the platform TCB is current. When the policy accepts "OutOfDate", indicating that the policy is allowing a platform with an out-of-date TCB level,

			then it should qualify or limit how the platform may be out-of date. There are three methods to do this: 1. Provide a platform_grace_period to indicates the amount of time that platform is allowed to be out-of-date. 2. Provide a min_tcb_date which asserts that TCB updates after the min_tcb_date are not required. 3. Provide a list of allowed_advisory_ids which indicates that a platform with only the allowed_advisory_ids is accepted. The following is a mapping between quote_verification_result(please refer to section “B.1” in Intel TDX DCAP Quoting Library API) and tcb_status array: • SGX_QL_QV_RESULT_OK: “UpToDate” • SGX_QL_QV_RESULT_SW_HARDENING_NEEDED: “UpToDate”, “SWHardeningNeeded” • SGX_QL_QV_RESULT_CONFIG_NEEDED: “UpToDate”, “ConfigurationNeeded” • SGX_QL_QV_RESULT_CONFIG_AND_SW_HARDENING_NEEDED: “UpToDate”, “SWHardeningNeeded”, “ConfigurationNeeded” • SGX_QL_QV_RESULT_OUT_OF_DATE: “OutOfDate” • SGX_QL_QV_RESULT_OUT_OF_DATE_CONFIG_NEEDED: “OutOfDate”, “ConfigurationNeeded” • SGX_QL_QV_RESULT_INVALID_SIGNATURE: No Platform TCB Report Generated • SGX_QL_QV_RESULT_REVOKED: “Revoked” • SGX_QL_QV_RESULT_UNSPECIFIED: No Platform TCB Report Generated
collateral_grace_period	Number	R*	Policy provides a collateral grace period which is a measurement in seconds that the collateral is allowed to be expired. The policy must provide this field. A value of zero will indicate that the policy requires collateral which is up-to-date. If the Platform TCB Report.earliest_expiration_date + Policy.collateral_grace_period < current time, then appraisal fails. Either min_eval_num or collateral_grace_period is required as both of these parameters define whether the policy allows collateral used in quote verification to be expired:

			1. collateral_grace_period indicates how long the collateral has been expired. This should be 0 when only valid non-expired collateral is permitted. 2. Min_eval_num provides a monotonically increasing number tied to collateral released with each TCB update.
platform_grace_period	Number	O	Policy provides a platform grace period which is a measurement in seconds. The Policy fails if the Platform TCB Report tcb_date + platform_grace_period < current time. Providing a non-zero platform_grace_period implies that the policy is willing to accept a tcb_status which reports "OutOfDate"; thus, "OutOfDate" should be provided in the accepted_tcb_status array.
min_tcb_date	String	O	Policy may provide a time value asserting that TCB updates after this date/time are not required. The time value is UTC with the encoding compliant to ISO 8601 standard (YYYY-MM-DDThh:mm:ssZ). The Policy fails if the Platform TCB Report tcb_date value is before the Policy min_tcb_date, even if TCB status value "OutOfDate" is accepted. A policy using this field will accept any patching level enforced by Intel on or after this date.
min_pck_crl_num	Number	O	Policy fails if this field is present, and the Platform TCB Report.pck_crl_num has a value lower than the policy value.
min_root_ca_crl_num	Number	O	Policy fails if this field is present, and the Platform TCB Report.root_ca_crl_num has a value lower than the policy value
min_eval_num	Number	R*	Policy may provide a min_eval_num indicating that Platform TCB Reports with higher tcb_eval_num are not required. The Policy fails if the Platform TCB Report includes an tcb_eval_num which is lower than the Policy min_eval_num. Either min_eval_num or collateral_grace_period is required. See note in collateral_grace_period.

			For eval_num, you can find more background information in tcbEvaluationDataNumber
accepted_platform_provider_ids	String	O	Policy may provide an Array of accepted platform_provider_ids. The Policy fails if the Policy provides a list of platformProvIDs and the Platform TCB Report platformProvID does not match one of the Policy acceptedPlatformProvIDs
accepted_sgx_types	Array of Numbers	O	Policy may provide a listed of accepted SGX type values as defined in sgx_ql_qv_supplemental_t.sgx_type. If this field is present, the policy fails if the report.sgx_type value is not one of the values listed in this field.
allow_dynamic_platform	bool	O	Indicates whether a platform can be extended with additional packages. This value is provided in Platform TCB Report.dynamic_platform. The policy fails if is_dynamic_plaform is true and the policy allow_dynamic_plaform is false. Note: this field is only evaluated if sgx_type is set to either 1 for "scalable" or 2 for "Scalable with Integrity". This field should not be provided in the policy if accepted_sgx_types does not contain either a 1 or a 2.
allow_cached_keys	bool	O	Indicates whether platform root keys are cached by Registration Backend. This value is provided in Platform TCB Report.cached_keys. The policy fails if is_cached_keys is true and the policy.allow_cached_keys is false. Note: this field is only evaluated if sgx_type is set to either 1 for "scalable" or 2 for "Scalable with Integrity". This field should not be provided in the policy if accepted_sgx_types does not contain either a 1 or a 2.
allow_smt_enabled	bool	O	Indicates whether a platform has SMT (simultaneous multithreading) enabled. This value is provided in Platform TCB Report.smt_enabled. The policy fails if is_smt_enabled is true and the policy allow_smt_enabled is false. Note: this field is only evaluated if sgx_type is set to either 1 for "scalable" or 2 for "Scalable with Integrity". This field should not be provided in the policy if accepted_sgx_types does not contain either a 1 or a 2.

rejected_advisory_ids	Array of Strings	O	List of advisory ids that are not allowed to appear in the Platform TCB Report. If the Platform TCB Policy provides a list of rejected_advisory_ids and any of the rejected_advisory_ids match an advisory_id provided in the Platform TCB Report, then the appraisal fails
allowed_root_key_ids	Array of Strings	O	Policy may provide an array of allowed root_key_ids. The Policy fails if the Policy provides a list of allowed root_key_ids and the Platform TCB Report root_key_id does not match one of the Policy entries.

Table 1: Platform TCB Policy Fields

Example Policies

Different relying parties could require different level of platform TCB policies. Below are some of the levels that are commonly used:

- **Strict**
  Platform must have the latest patches according to Intel and all verification collaterals must NOT be expired.
  a) accepted_tcb_status includes only UpToDate
  b) collateral_grace_period = 0

- **Platform grace period**:
  Intel has published new TCB, and all verification collaterals are NOT expired, but the user still needs a grace period to update platform
  a) accepted_tcb_status must include UpToDate and OutOfDate
  b) collateral_grace_period = 0
  c) platform_grace_period indicates the time in seconds that the platform may be out-of-date based on
     - report.tcb_date + platform_grace_period >= current_time
     - tcb_date = min(TCBInfo.TCBLevel.tcbDate, QEIdentity.TCBLevel.tcbDate)

- **Collateral grace period**:
  Intel has published new TCB, but platform owner intentionally uses expired verification collateral prior to the newly published TCB.
  a) accepted_tcb_status must include UpToDate.

  b) collateral_grace_period = time in seconds that the collateral is allowed beyond the expiration time where
    - report.earliest_expiration_date + collateral_grace_period >= current_time

  c) platform_grace_period must not present in current policy.

- **Platform with required patching to a specific TCB level**:
  Platform has patching applied according to a particular TCB Recovery Event
  a) accepted_tcb_status includes UpToDate and OutOfDate
  b) tcb_eval_num >= min_eval_num
    - It will allow expired collateral if this is true.

  c) platform_grace_period must not present in current policy.
  d) collateral_grace_period must not present in current policy.
- **Platform without rejected security advisories**.
  User just cares about the specific security issues. Allow 'out-of-date' if the TCB level's Advisory-ID List does not contain any SA(s) listed in the policy AND no collateral is expired.
  a) accepted_tcb_status includes UpToDate and OutOfDate
  b) all verification collaterals are NOT expired
  c) TCB level's Advisory-ID list doesn't not contain any SA(s) listed in the policy.

For "**platform grace period**", "**collateral grace period**" and "**platform with required patching to a specific TCB level(min_eval_num)**", You can refer to the following table to write your policy.

platform_grace_period	**collateral_grace_period**	**min_eval_num**
accepted_tcb_status must include UpToDate and OutOfDate	accepted_tcb_status must include UpToDate	accepted_tcb_status must include UpToDate
collateral_grace_period==0	platform_grace_period must not be present	platform_grace_period must not be present
min_eval_num must not be present	min_eval_num must not be present	collateral_grace_period must not be present

Example "Strict" SGX Platform policy:

```
{
    "policy_array":[
        {
            "environment": {
                "class_id": "3123ec35-8d38-4ea5-87a5-d6c48b567570",
                "description": "Strict SGX Platform Policy"
            },
            "reference": {
                "#NOTE": "Replace the following configurations based on your own 
requirements",
                "allow_dynamic_plaform": true,
                "accepted_tcb_status": [
                    "UpToDate"
        ],
                "collateral_grace_period": 0
            }
        }
    ]
}
```

Example “platform grace period” policy, with grace period of 120 days (10,368,000 seconds). This policy will also appraise on a platform which requires enclaves to be SW Hardened (i.e., the platform is allowed to report a tcb_status of “SWHardeningNeeded”).
platform_grace_period indicates the time in seconds that the platform may be out-of-date based on

- tcb_date = min(TCBInfo.TCBLevel.tcbDate, QEIdentity.TCBLevel.tcbDate)
- tcb_date + platform_grace_period >= current_time

```
{
    "policy_array":[
        {
            "environment": {
                "class_id": "3123ec35-8d38-4ea5-87a5-d6c48b567570",
                "description": "Grace Period Policy for SGX Platform"
            },
            "reference": {
                "#NOTE": "Replace the following configurations based on your own 
requirements",
                "allow_dynamic_plaform": true,
                "#NOTE": "'accepted_tcb_status' must include 'UpToDate' and 
'OutOfDate' if 'platform_grace_period' is defined",
                "accepted_tcb_status": [
                    "UpToDate",
                    "SWHardeningNeeded",
                    "ConfigurationNeeded",
                    "OutOfDate"
                ],
                "#NOTE": "'platform_grace_period' allows you to pass appraisal 
verification even if the platform has expired within 120 days (10368000 
seconds).",
                "platform_grace_period": 10368000,
                "#NOTE": "'collateral_grace_period' must be defined as 0  if 
'platform_grace_period' is defined",
                "collateral_grace_period": 0
            }
        }
    ]
}
```

Example “collateral grace period” policy, with grace period of 90 days (7,776,000 seconds). collateral_grace_period = time in seconds that the collateral is allowed beyond the expiration time where “report.earliest_expiration_date + collateral_grace_period >= current_time”

```
{
    "policy_array":[
        {
            "environment": {
                "class_id": "3123ec35-8d38-4ea5-87a5-d6c48b567570",
                "description": "Collateral Grace Period Policy for SGX Platform"
            },
            "reference": {
                "#NOTE": "Replace the following configurations based on your own 
requirements",
                "allow_dynamic_platform": true,
                "#NOTE": "'accepted_tcb_status' must include 'UpToDate' if 
'collateral_grace_period' is defined.",
                "accepted_tcb_status": [
                    "UpToDate",
                    "SWHardeningNeeded",
                    "ConfigurationNeeded",
                    "OutOfDate"
                ],
                "#NOTE": "'collateral_grace_period' allows you to pass appraisal 
verification even if the collateral has expired within 90 days (7776000 
seconds).",
                "#NOTE": "If 'collateral_grace_period' is greater than 0, 
'platform_grace_period' must not be defined",
                "collateral_grace_period": 7776000
            }
        }
    ]
}
```

Example “platform with required patching” policy, requiring minimum eval number to be 5: It will allow expired collateral if “tcb_eval_num >= min_eval_num” is true.

```
{
    "policy_array":[
        {
            "environment": {
                "class_id": "3123ec35-8d38-4ea5-87a5-d6c48b567570",
                "description": "Mininum Evaluation Num Policy for SGX Platform"
            },
            "reference": {
                "#NOTE": "Replace the following configurations based on your own
requirements",
                "allow_dynamic_platform": true,
                "#NOTE": "'accepted_tcb_status' must include 'UpToDate' if
'min_eval_num' is defined.",
                "accepted_tcb_status": [
                    "UpToDate",
                    "SWHardeningNeeded",
                    "ConfigurationNeeded",
                    "OutOfDate"
                ],
                "#NOTE": "'min_eval_num' indicates that Platform TCB Reports with
higher tcb_eval_num are not required.",
                "#NOTE": "The Policy fails if the Platform TCB Report includes an
tcb_eval_num which is lower than the value defined in 'min_eval_num'.",
                "#NOTE": "If 'min_eval_num' is defined, 'platform_grace_period'
and 'collateral_grace_period' must not be defined",
                "min_eval_num": 5
            }
        }
    ]
}
```

Example “platform without rejected security advisories” policy, with “INTEL-SA-00078” as a rejected security advisory. This policy allows a grace period for the platform to be out-of-date unless the platform reports a specific security advisory:

```
{
    "policy_array":[
        {
            "environment": {
                "class_id": "3123ec35-8d38-4ea5-87a5-d6c48b567570",
                "description": "SGX Platform Policy with rejected security
advisories"
            },
            "reference": {
                "#NOTE": "Replace the following configurations based on your own requirements",
                "allow_dynamic_platform": true,
                "accepted_tcb_status": [
                    "UpToDate",
                    "OutOfDate"
                ],
                "platform_grace_period": 0,
                "collateral_grace_period": 0,
                "rejected_advisory_ids": [
                    "INTEL-SA-00617"
                ]
            }
        }
    ]
}
```

To generate platform policy, you can refer to the above sample policy to write your own policy based on your workload requirements. Then you can use this tool's signing command to sign it.

Notes:

1. Requirement for signing key: EC key, the key length is 384 bits and the key format is PEM .
2. In a production environment, you need to use your production signing key with the proper protections of its confidentiality. In a development or validation environment, you can generate your own ECDSA signing key pair for test. Run the below command to utilize OpenSSL along with the tool, https://github.com/danedmunds/pem-to-jwk:
   $ openssl ecparam -name secp384r1 -genkey --noout > ec_priv.pem

TDX Platform Policy

To appraise the platform's TCB, the Relying Party must provide a platform policy with expected or accepted platform TCB claims. The platform policy is in the JSON Web Token (JWT) payload.

Definition

The TDX platform TCB policy is like the SGX platform TCB policy, containing a "environment" JSON object and a "reference" JSON object composed of fields detailed in Table 1: Platform TCB Policy Fields. But the class_id has been changed in the "environment" section:

- "class_id"
    a) For TDX version 1.0: "9eec018b-7481-4b1c-8e1a-9f7c0c8c777f"
    b) For TDX version 1.5: "f708b97f-0fb2-4e6b-8b03-8a5bcd1221d3"

Notes:
In the following table, "R" means this field is required field; "O" means this field is optional field.

Field name	Type	R/O	Field Description
accepted_tcb_status	Array of Strings	R	List of TCB Status that are accepted. The Policy fails if the Platform TCB Report includes any values that are not provided in accepted_tcb_status. Note: a policy should never include "Revoked" in this list. This would be overriding the revoking of the TCB. In addition, a policy should include "UpToDate" which indicates that the platform TCB is current. When the policy accepts "OutOfDate", indicating that the policy is allowing a platform with an out-of-date TCB level, then it should qualify or limit how the platform may be out-of date. There are three methods to do this: 4. Provide a platform_grace_period to indicates the amount of time that platform is allowed to be out-of-date. 5. Provide a min_tcb_date which asserts that TCB updates after the min_tcb_date are not required. 6. Provide a list of allowed_advisory_ids which indicates that a platform with only the allowed_advisory_ids is accepted. The following is a mapping between quote_verification_result(please refer to section "B.1" in Intel_TDX_DCAP_Quoting_Library_API) and tcb_status array: • SGX_QL_QV_RESULT_OK: "UpToDate" • SGX_QL_QV_RESULT_SW_HARDENING_NEEDED: "UpToDate", "SWHardeningNeeded" • SGX_QL_QV_RESULT_CONFIG_NEEDED: "UpToDate", "ConfigurationNeeded" • SGX_QL_QV_RESULT_CONFIG_AND_SW_HARDENING_NEEDED: "UpToDate", "SWHardeningNeeded", "ConfigurationNeeded" • SGX_QL_QV_RESULT_OUT_OF_DATE: "OutOfDate" • SGX_QL_QV_RESULT_OUT_OF_DATE_CONFIG_NEEDED: "OutOfDate", "ConfigurationNeeded" • SGX_QL_QV_RESULT_INVALID_SIGNATURE: No Platform TCB Report Generated • SGX_QL_QV_RESULT_REVOKED: "Revoked" • SGX_QL_QV_RESULT_TD_RELAUNCH_ADVISED: "TDRelaunchAdvised"

			• SGX_QL_QV_RESULT_TD_RELAUNCH_ADVISED_CONFIG_NEEDED: "TDRelaunchAdvised", "ConfigurationNeeded" • SGX_QL_QV_RESULT_UNSPECIFIED: No Platform TCB Report Generated
collateral_grace_period	Number	R*	Policy provides a collateral grace period which is a measurement in seconds that the collateral is allowed to be expired. The policy must provide this field. A value of zero will indicate that the policy requires collateral which is up-to-date. If the Platform TCB Report.earliest_expiration_date + Policy.collateral_grace_period < current time, then appraisal fails. Either min_eval_num or collateral_grace_period is required as both of these parameters define whether the policy allows collateral used in quote verification to be expired: 3. collateral_grace_period indicates how long the collateral has been expired. This should be 0 when only valid non-expired collateral is permitted. 4. Min_eval_num provides a monotonically increasing number tied to collateral released with each TCB update.
platform_grace_period	Number	O	Policy provides a platform grace period which is a measurement in seconds. The Policy fails if the Platform TCB Report tcb_date + platform_grace_period < current time. Providing a non-zero platform_grace_period implies that the policy is willing to accept a tcb_status which reports "OutOfDate"; thus, "OutOfDate" should be provided in the accepted_tcb_status array.
min_tcb_date	String	O	Policy may provide a time value asserting that TCB updates after this date/time are not required. The time value is UTC with the encoding compliant to ISO 8601 standard (YYYY-MM-DDThh:mm:ssZ). The Policy fails if the Platform TCB Report tcb_date value is before the Policy min_tcb_date, even if TCB status value "OutOfDate" is accepted.

			A policy using this field will accept any patching level enforced by Intel on or after this date.
min_pck_crl_num	Number	O	Policy fails if this field is present, and the Platform TCB Report.pck_crl_num has a value lower than the policy value.
min_root_ca_crl_num	Number	O	Policy fails if this field is present, and the Platform TCB Report.root_ca_crl_num has a value lower than the policy value
min_eval_num	Number	R*	Policy may provide a min_eval_num indicating that Platform TCB Reports with higher tcb_eval_num are not required. The Policy fails if the Platform TCB Report includes an tcb_eval_num which is lower than the Policy min_eval_num. Either min_eval_num or collateral_grace_period is required. See note in collateral_grace_period. For eval_num, you can find more background information in tcbEvaluationDataNumber
accepted_platform_provider_ids	String	O	Policy may provide an Array of accepted platform_provider_ids. The Policy fails if the Policy provides a list of platformProvIDs and the Platform TCB Report platformProvID does not match one of the Policy acceptedPlatformProvIDs
accepted_sgx_types	Array of Numbers	O	Policy may provide a listed of accepted SGX type values as defined in sgx_ql_qv_supplemental_t.sgx_type. If this field is present, the policy fails if the report.sgx_type value is not one of the values listed in this field.
allow_dynamic_platform	bool	O	Indicates whether a platform can be extended with additional packages. This value is provided in Platform TCB Report.dynamic_platform. The policy fails if is_dynamic_plaform is true and the policy allow_dynamic_plaform is false. Note: this field is only evaluated if sgx_type is set to either 1 for “scalable” or 2 for “Scalable with Integrity”. This field should not be provided in the policy if accepted_sgx_types does not contain either a 1 or a 2.

allow_cached_keys	bool	O	Indicates whether platform root keys are cached by Registration Backend. This value is provided in Platform TCB Report.cached_keys. The policy fails if is_cached_keys is true and the policy.allow_cached_keys is false. Note: this field is only evaluated if sgx_type is set to either 1 for “scalable” or 2 for “Scalable with Integrity”. This field should not be provided in the policy if accepted_sgx_types does not contain either a 1 or a 2.
allow_smt_enabled	bool	O	Indicates whether a platform has SMT (simultaneous multithreading) enabled. This value is provided in Platform TCB Report.smt_enabled. The policy fails if is_smt_enabled is true and the policy allow_smt_enabled is false. Note: this field is only evaluated if sgx_type is set to either 1 for “scalable” or 2 for “Scalable with Integrity”. This field should not be provided in the policy if accepted_sgx_types does not contain either a 1 or a 2.
rejected_advisory_ids	Array of Strings	O	List of advisory ids that are not allowed to appear in the Platform TCB Report. If the Platform TCB Policy provides a list of rejected_advisory_ids and any of the rejected_advisory_ids match an advisory_id provided in the Platform TCB Report, then the appraisal fails
allowed_root_key_ids	Array of Strings	O	Policy may provide an array of allowed root_key_ids. The Policy fails if the Policy provides a list of allowed root_key_ids and the Platform TCB Report root_key_id does not match one of the Policy entries.

We have merged the TD QE policy into the platform policy. A verified TD QE policy is a JSON object containing an “environment” section and a “reference” section with the fields identified in the table below.

Environment fields:

- “class_id”: “3769258c-75e6-4bc7-8d72-d2b0e224cad2”

Field name	Type	R/O	Field Description

accepted_tcb_status	Array of Strings	R	List of TCB Status that are accepted. See Table 1: Platform TCB Policy Fields accepted_tcb_status for a definition of acceptable values The Policy fails if the report “tcb_status” field includes any values that are not provided in this field. The following is additional specific mapping between quote_verification_result and tcb_status array for TDX: • TEE_QV_RESULT_TD_RELAUNCH_ADVISED: “TDRelaunchAdvised” • TEE_QV_RESULT_TD_RELAUNCH_ADVISED_CONFIG_NEEDED: “TDRelaunchAdvised”, “ConfigurationNeeded”
collateral_grace_period	Number	O	Policy provides a collateral grace period which is a measurement in seconds If the report.expiration_date + policy.collateral_grace_period < current time, then appraisal fails.
platform_grace_period	Number	O	Policy provides a platform grace period which is a measurement in seconds The Policy fails if the report.tcb_date + policy.platform_grace_period < current time.
min_tcb_date	String	O	Policy may provide a time value asserting that TCB updates after this date/time are not required. The time value is UTC with the encoding compliant to ISO 8601 standard (YYYY-MM-DDThh:mm:ssZ). The Policy fails if the report.tcb_date value is before the policy.min_tcb_date, even if TCB status value “OutOfDate” is accepted. Note: a policy using this field will accept any patching level on or after this date. This differs from the platform_grace_period in that the grace period is an allowance for a relative time related to the patching update which will expire., where min_tcb_date is an absolute time related to the patch update which does not expire.
min_eval_num	Number	O	Policy may provide a min_eval_num indicating that TDX platform reports with higher tcb_eval_num are not required. The Policy fails if the report.tcb_eval_num is lower than policy.min_eval_num.
allowed_root_key_ids	Array of Strings	O	Policy may provide an array of allowed root_key_ids. The Policy fails if the Policy provides a list of allowed root_key_ids and the Verified QE Identity Report root_key_id does not match one of the Policy entries.

Example Policies

Example “Strict” TDX Platform policy:

```
{
    "policy_array": [
        {
            "environment": {
                "class_id": "f708b97f-0fb2-4e6b-8b03-8a5bcd1221d3",
                "description": "Strict TDX platform policy"
            },
            "reference": {
                "#NOTE": "Replace the following configurations based on your own requirements",
                "allow_dynamic_plaform": true,
                "accepted_tcb_status": [
                    "UpToDate"
                ],
                "collateral_grace_period": 0
            }
        },
        {
            "environment": {
                "class_id": "3769258c-75e6-4bc7-8d72-d2b0e224cad2",
                "description": "Strict Verified TDQE Identity policy"
            },
            "reference": {
                "accepted_tcb_status": [
                    "UpToDate"
                ],
                "collateral_grace_period": 0
            }
        }
    ]
}
```

Example “platform grace period” policy, with grace period of 120 days (10,368,000 seconds). platform_grace_period indicates the time in seconds that the platform may be out-of-date based on

- tcb_date = min(TCBInfo.TCBLevel.tcbDate, QEIdentity.TCBLevel.tcbDate)
- tcb_date + platform_grace_period >= current_time

```
{
    "policy_array": [
        {
            "environment": {
                "class_id": "f708b97f-0fb2-4e6b-8b03-8a5bcd1221d3",
                "description": "Grace Period Policy for TDX Platform"
            },
            "reference": {
                "#NOTE": "Replace the following configurations based on your own 
requirements",
                "allow_dynamic_plaform": true,
                "#NOTE": "'accepted_tcb_status' must include 'UpToDate' and 
'OutOfDate' if 'platform_grace_period' is defined",
                "accepted_tcb_status": [
                    "UpToDate",
                    "TDRelaunchAdvised",
                    "SWHardeningNeeded",
                    "ConfigurationNeeded",
                    "OutOfDate"
                ],
                "#NOTE": "'platform_grace_period' allows you to pass appraisal 
verification even if the platform has expired within 120 days (10368000 
seconds).",
                "platform_grace_period": 10368000,
                "#NOTE": "'collateral_grace_period' must be defined as 0  if 
'platform_grace_period' is defined",
                "collateral_grace_period": 0
            }
        },
        {
            "environment": {
                "class_id": "3769258c-75e6-4bc7-8d72-d2b0e224cad2",
                "description": "Grace Period Policy for Verified TDQE"
            },
            "reference": {
                "#NOTE": "'accepted_tcb_status' must include 'UpToDate' and 
'OutOfDate' if 'platform_grace_period' is defined",
                "accepted_tcb_status": [
                    "UpToDate",
                    "OutOfDate"
                ],
                "#NOTE": "'platform_grace_period' allows you to pass appraisal 
verification even if the platform has expired within 60 days (5184000 seconds).",
                "platform_grace_period": 5184000,
                "#NOTE": "'collateral_grace_period' must be defined as 0  if 
'platform_grace_period' is defined",
                "collateral_grace_period": 0
            }
        }
    ]
}
```

Example “collateral grace period” policy, with grace period of 90 days (7,776,000 seconds)
collateral_grace_period = time in seconds that the collateral is allowed beyond the expiration time
where “report.earliest_expiration_date + collateral_grace_period >= current_time”

```
{
    "policy_array": [
        {
            "environment": {
                "class_id": "f708b97f-0fb2-4e6b-8b03-8a5bcd1221d3",
                "description": "Collateral Grace Period Policy for TDX Platform"
            },
            "reference": {
                "#NOTE": "Replace the following configurations based on your own
requirements",
                "allow_dynamic_plaform": true,
                "#NOTE": "'accepted_tcb_status' must include 'UpToDate' if
'collateral_grace_period' is defined.",
                "accepted_tcb_status": [
                    "UpToDate",
                    "TDRelaunchAdvised",
                    "SWHardeningNeeded",
                    "ConfigurationNeeded",
                    "OutOfDate"
                ],
                "#NOTE": "'collateral_grace_period' allows you to pass appraisal
verification even if the collateral has expired within 90 days (7776000
seconds).",
                "#NOTE": "If 'collateral_grace_period' is greater than 0,
'platform_grace_period' must not be defined",
                "collateral_grace_period": 7776000
            }
        },
        {
            "environment": {
                "class_id": "3769258c-75e6-4bc7-8d72-d2b0e224cad2",
                "description": "Collateral Grace Period Policy for Verified TDQE"
            },
            "reference": {
                "#NOTE": "'accepted_tcb_status' must include 'UpToDate' if
'collateral_grace_period' is defined.",
                "accepted_tcb_status": [
                    "UpToDate",
                    "OutOfDate"
                ],
                "#NOTE": "'collateral_grace_period' allows you to pass appraisal
verification even if the collateral has expired within 60 days (5184000
seconds).",
                "#NOTE": "If 'collateral_grace_period' is greater than 0,
'platform_grace_period' must not be defined",
                "collateral_grace_period": 5184000
            }
        }
    ]
}
```

Example “platform without rejected security advisories” policy, with “INTEL-SA-00617” as a rejected security advisory. This policy allows a grace period for the platform to be out-of-date unless the platform reports a specific security advisory:

```
{
    "policy_array": [
        {
            "environment": {
                "class_id": "f708b97f-0fb2-4e6b-8b03-8a5bcd1221d3",
                "description": "TDX Platform Policy with rejected security
advisories"
            },
            "reference": {
                "#NOTE": "Replace the following configurations based on your own
requirements",
                "allow_dynamic_plaform": true,
                "accepted_tcb_status": [
                    "UpToDate",
                    "OutOfDate"
                ],
                "rejected_advisory_ids": [
                    "INTEL-SA-00617"
                ]
            }
        },
        {
            "environment": {
                "class_id": "3769258c-75e6-4bc7-8d72-d2b0e224cad2",
                "description": "Verified TDQE Identity policy with rejected
security advisories"
            },
            "allow_dynamic_plaform": true,
            "reference": {
                "accepted_tcb_status": [
                    "UpToDate",
                    "OutOfDate"
                ],
                "rejected_advisory_ids": [
                    "INTEL-SA-00617"
                ]
            }
        }
    ]
}
```

Example “platform with required patching” policy, requiring minimum eval number to be 5: It will allow expired collateral if “tcb_eval_num >= min_eval_num” is true.

```
{
    "policy_array": [
        {
            "environment": {
                "class_id": "f708b97f-0fb2-4e6b-8b03-8a5bcd1221d3",
                "description": "Mininum Evaluation Num Policy for TDX Platform"
            },
            "reference": {
                "#NOTE": "Replace the following configurations based on your own
requirements",
                "allow_dynamic_plaform": true,
                "#NOTE": "'accepted_tcb_status' must include 'UpToDate' if
'min_eval_num' is defined.",
                "accepted_tcb_status": [
                    "UpToDate",
                    "TDRelaunchAdvised",
                    "SWHardeningNeeded",
                    "ConfigurationNeeded",
                    "OutOfDate"
                ],
                "#NOTE": "'min_eval_num' indicates that Platform TCB Reports with
higher tcb_eval_num are not required.",
                "#NOTE": "The Policy fails if the Platform TCB Report includes an
tcb_eval_num which is lower than the value defined in 'min_eval_num'.",
                "#NOTE": "If 'min_eval_num' is defined, 'platform_grace_period'
and 'collateral_grace_period' must not be defined",
                "min_eval_num": 5
            }
        },
        {
            "environment": {
                "class_id": "3769258c-75e6-4bc7-8d72-d2b0e224cad2",
                "description": "Mininum Evaluation Num Policy for Verified TDQE"
            },
            "reference": {
                "#NOTE": "'accepted_tcb_status' must include 'UpToDate' if
'min_eval_num' is defined.",
                "accepted_tcb_status": [
                    "UpToDate",
                    "OutOfDate"
                ],
                "#NOTE": "'min_eval_num' indicates that Platform TCB Reports with
higher tcb_eval_num are not required.",
                "#NOTE": "The Policy fails if the Platform TCB Report includes an
tcb_eval_num which is lower than the value defined in 'min_eval_num'.",
                "#NOTE": "If 'min_eval_num' is defined, 'platform_grace_period'
and 'collateral_grace_period' must not be defined",
                "min_eval_num": 5
            }
        }
    ]
}
```

SGX Enclave Identity Policy

To appraise the enclave, the Relying Party or enclave owner must generate and sign a JSON Web Token appraisal policy to compare against the enclave's Report: to evaluate expected or accepted values.

To generate an enclave identity policy, you can use this tool's following command to generate the policy template:

tee_appraisal_tool gen_payload -in {enclave } -out payload.json [-v]

then you can edit the generated policy template based on your requirements, then you can sign the policy:

tee_appraisal_tool sign_policy -in payload.json -key ec_private.pem -out policy.jwt [-v]

This section details the Enclave Identity Policy and provides a few example policies.

Definition

The Enclave Identity Policy is a JSON object containing an "environment" JSON object and "reference" JSON object composed of fields detailed in Table 2: Enclave Identity Policy Fields. For each field, the definition includes how the measurements in the Enclave Identity report are evaluated by the field. Environment fields and values:

- "class_id": "bef7cb8c-31aa-42c1-854c-10db005d5c41"
- "description": optional field that can be set with a descriptive text.

Field name	Type	R/O	Field value and Appraisal Policy
sgx_miscselect	String	O	Hex-encoded byte array (4 bytes) representing sgx_miscselect expected value (upon applying sgx_miscselect_mask).
sgx_miscselect_mask	String	O	Hex-encoded byte array (4 bytes) representing mask to be applied to miscselect value retrieved from the platform. • REPORT.sgx_miscselect & POLICY.sgx_miscselect_mask == POLICY.sgx_miscselect
sgx_attributes	String	R	Hex-encoded byte array (16 bytes) representing attributes expected value (upon applying mask). This is required to confirm ATTRIBUTES.DEBUG Setting Note: the KSS bit in sgx_attributes and sgx_attributes_mask field must be set for the fields sgx_configid / sgx_configsvn / sgx_isvextprodid / sgx_isvfamilyid to be valid.
sgx_attributes_mask	String	R	Hex-encoded byte array (16 bytes) representing mask to be applied to attributes value retrieved from the platform. This is evaluated in the following way: • REPORT.sgx_attributes & POLICY.sgx_attributes_mask == POLICY.sgx_attributes (Note: POLICY.sgx_attributes & POLICY.sgx_attributes_mask == POLICY.sgx_attributes)
sgx_mrsigner	String	R*	Hex-encoded byte array (32 bytes) representing sgx_mrsigner hash.
sgx_mrenclave	String	R*	Hex-encoded byte array (32 bytes) representing a hash of the enclave build process (ENCLAVEHASH value from SIGSTRUCT).
sgx_isvprodid	Number	R*	ISV Product ID.
sgx_isvsvn_min	Number	R*	Minimum ISV SVN. A valid policy should provide. The policy creator tool should only allow the following: • **sgx_mrsigner, sgx_isvprodId, sgx_isvsvn_min** : Identifies a specific enclave and a minimum SVN, but not a specific build of the enclave • **sgx_mrenclave, sgx_mrsigner** : identifies a specific build of a specific enclave, and the signer (this impacts sealing to mrsigner) • ***sgx_mrenclave** : we can allow this, but must warn that this impacts sealing to mrsigner and configuration of other features (miscselect, attributes, etc.)

sgx_configid	String	O	If provided, then REPORT.sgx_attributes.KSS must be 1 and then REPORT.sgx_configid == POLICY.sgx_configid (note: the appraisal service should select the Appraisal POLICY based on REPORT.sgx_configid)
sgx_configsvn_min	Number	O	If provided, then REPORT.sgx_attributes.KSS must be 1 and then REPORT.sgx_configsvn >= POLICY.sgx_configsvn_min (may need this if sgx_configid is used)
sgx_isvextprodid	String	O	If provided, then REPORT. attributes.KSS must be 1 and then REPORT.sgx_isvextprodid == POLICY.sgx_isvextprodid
sgx_isvfamilyid	String	O	If provided, then REPORT.sgx_attributes.KSS must be 1 and then REPORT.sgx_isvfamilyid == POLICY.sgx_isvfamilyid

Table 2: Enclave Identity Policy Fields

Note: you can refer to the sgx attributes and sgx miscselect in here.

Example Policies

Below is an example JSON object holding an example application enclave policy. Typically, in production environment this policy requires that the SGX_attributes debug bit, is not set. The information can be obtained from the SGX Sign Tool when an enclave is signed.

```
{
    "policy_array":[
        {
            "environment": {
                "class_id": "bef7cb8c-31aa-42c1-854c-10db005d5c41",
                "description":"Application SGX Enclave Policy"
            },
            "reference": {
                "#NOTE": "Replace the following configurations based on your own 
enclave",
                "sgx_miscselect":"00000000",
                "sgx_miscselect_mask":"FFFFFFFF",
                "sgx_attributes":"00000000000000030000000000000005",
                "sgx_attributes_mask":"FFFFFFFFFFFFFF1BFF00FFFFFFFFFFFD",
                "sgx_isvprodid":0,
                "sgx_isvsvn_min":0,
                "sgx_isvfamilyid":"00000000000000000000000000000000",
                "sgx_isvextprodid":"00000000000000000000000000000000",
                "#NOTE": "To make the following configurations take effect, 
modify the value in the following lines, and uncomment the lines by removing '#' 
from the key",
                "#sgx_mrenclave":"8845C3F4D658FF5C12DD2868F4D01DFE73471642C7141EF
5D80EFF551FFD299B",
                "#sgx_mrsigner":"258C20C86869C8AE080CD78D3543DD1E6A419DAB1E4A8332
5D4EEFC018FFE6E1"
            }
        }
    ]
}
```

An enclave can either be identified by its mrenclave, or a mrsigner/isvprodid/ISVSVN tuple. It's not necessary to use all fields. In a production environment, an enclave shall always run in release mode (e.g. not in debug mode).

Below is an example of a policy which identifies an enclave by its signer, ISV Product ID and a minimum SVN. This policy also requires that the attributes debug bit, bit 1, is not set. This information can be obtained from the SGX Sign Tool when an enclave is signed.

```
{
    "policy_array":[
        {
            "environment": {
                "class_id": "bef7cb8c-31aa-42c1-854c-10db005d5c41",
                "description":"Application SGX Enclave Policy"
            },
            "reference": {
                "#NOTE": "Replace the following configurations based on your own
enclave",
                "sgx_mrsigner":"8845C3F4D658FF5C12DD2868F4D01DFE73471642C7141EF5D
80EFF551FFD299B",
                "sgx_isvprodid":123,
                "sgx_isvsvn_min":5,
                "sgx_attributes":"00000000000000030000000000000005",
                "sgx_attributes_mask":"FFFFFFFFFFFFFFF1BFF00FFFFFFFFFFD"

            }
        }
    ]
}
```

Below is an example of a policy which just identifies an enclave by its mrenclave. Typically, in production environment this policy requires that the SGX_attributes debug bit, is not set. This information can be obtained from the SGX Sign Tool when an enclave is signed.

```
{
    "policy_array":[
        {
            "environment": {
                "class_id": "bef7cb8c-31aa-42c1-854c-10db005d5c41",
                "description":"Application SGX Enclave Policy"
            },
            "reference": {
                "#NOTE": "Replace the following configurations based on your own 
enclave",
                "sgx_mrenclave":"8845C3F4D658FF5C12DD2868F4D01DFE73471642C7141EF5
D80EFF551FFD299B",
                "sgx_attributes":"00000000000000030000000000000005",
                "sgx_attributes_mask":"FFFFFFFFFFFFFF1BFF00FFFFFFFFFFFD"
            }
        }
    ]
}
```

TD Identity Policy

To appraise the TD, the Relying Party or TD owner must generate and sign a JSON Web Token appraisal policy to compare against the TD's Report: to evaluate expected or accepted values.

To generate TD identity policy, you can use this tool's following command to generate the policy template:

tee_appraisal_tool gen_payload -in {TDReport } -out payload.json [-v]

then you can edit the generated policy template based on your requirement, then you can sign the policy:

tee_appraisal_tool sign_policy -in payload.json -key ec_private.pem -out policy.jwt [-v]

Definition

The TD identity policy is a JSON object containing an "environment" JSON object and "reference" JSON object.

Environment fields and values:

- Required "class_id"
  - An UUID string that identifies the type of the TCB the report is for TD.

  - For TDX version 1.0, UUID is “a1e4ee9c-a12e-48ac-bed0-e3f89297f687”
  - For TDX version 1.5, UUID is “45b734fc-aa4e-4c3d-ad28-e43d08880e68”
- Optional “description”

The “reference” JSON object is composed of fields listed in the table below. For each field, the definition includes how TD identity report fields are appraised against it.s

Field name	Type	Version	R/O	Field value
tdx_attributes_mask	String	1.0 and 1.5	R	This field need work with field tdx_attributes
tdx_attributes	String	1.0 and 1.5	R	(report.tdx_attributes & policy.tdx_attributes_mask) == (policy.tdx_attributes & policy.tdx_attributes_mask)
tdx_xfam_mask	String	1.0 and 1.5	O	This field need work with field tdx_xfam
tdx_xfam	String	1.0 and 1.5	O	If present, the masked report.tdx_xfam must be equal to this policy value
tdx_mrconfigid	String	1.0 and 1.5	O	If present, the report.tdx_mrconfigid must be equal to this policy value
tdx_mrowner	String	1.0 and 1.5	O	If present, the report.tdx_mrowner must be equal to this policy value
tdx_mrownerconfig	String	1.0 and 1.5	O	If present, the report.tdx_mrownerconfig must be equal to this policy value
tdx_mrtd	String	1.0 and 1.5	O	If present, the report.tdx_mrtd must be equal to this policy value
tdx_rtmr0	String	1.0 and 1.5	O	If present, the report.tdx_rtmr0 must be equal to this policy value
tdx_rtmr1	String	1.0 and 1.5	O	If present, the report.tdx_rtmr1 must be equal to this policy value
tdx_rtmr2	String	1.0 and 1.5	O	If present, the report.tdx_rtmr2 must be equal to this policy value
tdx_rtmr3	String	1.0 and 1.5	O	If present, the report.tdx_rtmr3 must be equal to this policy value
tdx _mrservicetd	String	1.5 only	O	If present, report.tdx_mrservicetd must be equal to this policy value

Notes: for tdx attributes and xfam field’s definition, please refer to the “Section 22.2: TD Parameters Types” in tdx module spec.

Example Policy

Below is an example JSON object holding an example TD policy. Typically, td policy needs make sure td is not in debug mode. In the tdx_attributes setting: if bit 0 has been set to 1, it means the TD is under debug status, the td is untrusted.

```
{
    "policy_array":[
        {
            "environment":{
                "class_id":"45b734fc-aa4e-4c3d-ad28-e43d08880e68",
                "description":"Application TD TCB 1.5"
            },
            "reference":{
                "tdx_attributes":"0000000010000000",
                "#NOTE": "To make the following configurations take effect,
modify the value in the following lines, and uncomment the lines by removing '#'
from the key",
                "#tdx_xfam":"0000000000061AE7",
                "#tdx_mrtd":"B3A00908F83729DF749648AD1769EA8F5C1205CEF83A13E23D3F
6C33C6F34769B97D5E7FD8780DC36234C8F5823A08AA",
                "#tdx_mrconfigid":"0000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000",
                "#tdx_mrowner":"0000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000",
                "#tdx_mrownerconfig":"0000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000",
                "#tdx_rtmr0":"253BD8107069789723F4FD400A229A68E1DE4D4B02F2DF7F5E5
A07BE50B8C267170C9133FA371C24FC48AD2A6823EA5A",
                "#tdx_rtmr1":"000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000",
                "#tdx_rtmr2":"03A0D035817AFED078819D64EBD683ADCDD84B8B8C06E37A3A3
963DB4AB9B82E8ACB5A1A6E9D092B77C5FDC315FACDB2",
                "#tdx_rtmr3":"03A0D035817AFED078819D64EBD683ADCDD84B8B8C06E37A3A3
963DB4AB9B82E8ACB5A1A6E9D092B77C5FDC315FACDB2"
        }
    }
    ]
}
```

3.3 Calling the Quote Verification and Appraisal APIs

After the platform generates the quote, you must use the new API(tee_verify_quote_qvt) to verify it and generate the new verification result token. The new verification result is required by the appraisal API.

Then you must call the new API (tee_appraise_verification_token) to appraise the verification result token.

The Quote Appraisal Sample code has been provided to demo how to use these APIs. You can refer to it when generating your code. See QuoteAppraisalSample.

Quote verification APIs:

tee_verify_quote_qvt

tee_free_verify_quote_qvt

Appraisal functional APIs:

tee_appraise_verification_token

tee_free_appraisal_token

3.4 Calling the Appraisal Audit APIs

After the appraisal process, the relying party needs to check

- Whether the appraisal result is generated based on expected policies(tee_authenticate_appraisal_result). This function will ask the relying party to provide a set of policies, then compare if the policies are matched with appraisal output.
- Or whether the appraisal result is generated based on expected policies and the exact quote(tee_authenticate_appraisal_result_ex). This function will ask the relying party to provide a set of policies and quote, then compare if both the policies and quote are matched with appraisal output.
- Or whether the appraisal result is generated based on specific owner's policies(tee_authenticate_policy_owner). This function will ask the relying party to provide a set of policy signing key(s), then compare if the policy signing keys are matched with appraisal output.

Note:

1. the policy of appraisal and auditing should be exact same, or auditing policies are superset of appraisal policies.
2. Or the policy signing key(s) of appraisal and the policy signing key(s) of auditing should be exact same, or policy signing key(s) of auditing policies are superset of policy signing key(s) of appraisal policies.

A tenant or relying party can perform the audit to make sure the final appraisal result is trusted. Three APIs have been provided to help the user to do it, and the QuoteAppraisalSample demos how to use these APIs.

tee_authenticate_appraisal_result

tee_authenticate_appraisal_result_ex

tee_authenticate_policy_owner

3.5 Verify QAE's report and identity in application enclave

When Quoting Appraisal Enclave (QAE) is used for appraisal, A tenant or relying party can call the following APIs to make sure the QAE meet the security requirement. This API is located in trusted verification library (TVL), and this library is released with SGX SDK.

tee_verify_qae_report_and_identity

4. Quote Verification APIs

4.1 tee_verify_quote_qvt()

The tee_verify_quote_qvt() function verifies an SGX/TDX Quote. It takes the same quote and collateral inputs as the existing sgx_qv_verify_quote(), but provides the result as a Verification Result (VR) JSON Web Token (JWT). It also has an optional input of User Data which is presented as serialized JSON string and verified using the REPORTDATA of the SGX/TDX Quote.

Syntax:

```
quote3_error_t tee_verify_quote_qvt(
                        const uint8_t *p_quote,
                        uint32_t quote_size,
                        const sgx_ql_qve_collateral_t *p_quote_collateral,
                        sgx_ql_qe_report_info_t *p_qve_report_info,
                        const uint8_t *p_user_data,
                        uint32_t *p_verification_result_token_buffer_size,
                        uint8_t **p_verification_result_token);
```

Parameters:

p_quote [In]

Pointer to an SGX/TDX Quote. Currently, the Intel® DCAP QVL only supports Quotes with CertType = 5. The Intel signed QVE will only verify Quotes generated by an Intel Signed QE. This type of certification data contains the PCK Certificate Chain in the Quote.

quote_size [In]

Size of the buffer pointed to by p_quote (in bytes).

p_quote_collateral [In]

This parameter is optional. If not NULL, this is a pointer to the Quote Certification Collateral provided by the caller. The quote collateral structure contains a version number. This is the data that is required to fully verify the quote. Such as the TCBInfo, QEIdentity and CRL structures, etc. If it is NULL, the DCAP library will attempt to retrieve the collateral from the platform quote provider library if available. If the platform quote provider library is not available or the collateral cannot be retrieved, this API will return TEE_PLATFORM_LIB_UNAVAILABLE or TEE_UNABLE_TO_GET_COLLATERAL respectively.

p_qve_report_info [In, Out]

This parameter is optional. If not NULL, then this parameter should provide a target_info structure for an enclave which will verify the generated report. If this parameter is provided, then the QVE will be used to perform the verification and it will generate a report using the target_info provided in the sgx_ql_qe_report_info_t structure . The QVE.REPORT.REPORT_DATA is set to SHA256_HASH(VR JWT).

const uint8_t *p_user_data [IN]

If not NULL, this points to a buffer holding a null-terminated string for user data. The hash of this string will be verified to match the SGX/TDX reportData held in the input quote. Upon successful verification, the user data will be converted back into JSON format and included in the output VR JWT.

uint32_t *p_verification_result_token_buffer_size[IN, OUT]

Points to a variable holding the size of the input quote_verification_token buffer.
If the size is not big enough, the function will return an error code with the needed size in this variable.

uint8_t **p_verification_result_token[OUT]

If a sufficiently sized buffer is provided in p_verification_result_token_size / p_ verification_result_token, then a VR(Verification Result) JWT as a null-terminated string is output in this buffer.
The output VR JWT can be unsigned or signed.

Return Values

TEE_SUCCESS:

Successfully evaluated the Quote.

TEE_ERROR_INVALID_PARAMETER:

One of the input parameters is invalid.

TEE_QUOTE_FORMAT_UNSUPPORTED:

The format of the inputted Quote is not supported. Either because the header information is not supported or the Quote is malformed in some way.

TEE_QUOTE_CERTIFICATION_DATA_UNSUPPORTED:

The QVL doesn’t support the certification data in the Quote. Currently, the QVL only support QE Report Certification Data.CertType = 5.

TEE_QE_REPORT_UNSUPPORTED_FORMAT:

The QVL doesn’t support the format of the QE3/TDQE Report in the Quote.

TEE_QE_REPORT_INVALID_SIGNATURE:

The signature over the QE3/TDQE Report is invalid.

TEE_PCK_CERT_UNSUPPORTED_FORMAT: The format of the PCK Cert is unsupported.

TEE_PCK_CERT_CHAIN_ERROR:

There was an error verifying the certificate chain contained in the PCK Cert. This error can also be returned while validating the PCK Cert revocation.

TEE_TCBINFO_UNSUPPORTED_FORMAT:

The format of the TCBInfo structure is unsupported.

TEE_TCBINFO_CHAIN_ERROR:

There was an error verifying the signature chain of the TCBInfo. This error can also be returned while validating the TCBInfo revocation.

TEE_TCBINFO_MISMATCH:

PCK Cert FMSPc does not match the TCBInfo FMSPc.

TEE_QEIDENTITY_UNSUPPORTED_FORMAT:

The format of the QEIdentity structure is unsupported.

TEE_QEIDENTITY_MISMATCH:

The identity of the TDQE contained in the Quote does not match the provided QEIdentity.

TEE_QEIDENTITY_CHAIN_ERROR:

There was an error verifying the signature chain of the QEIdentity. This error can also be returned while validating QEIdentity revocation.

TEE_ERROR_OUT_OF_MEMORY:

Heap memory allocation error in the QVL.

TEE_INVALID_REPORT:

Report MAC check failed on QE3/TDQE Report.

TEE_PLATFORM_LIB_UNAVAILABLE:

The Quote Verification Library could not locate the Platform Quote Provider Library or one of Platform Quote Provider Library's required function.

TEE_NO_QUOTE_COLLATERAL_DATA:

The Platform Quote Provider Library available, but it could not retrieve the data.

TEE_ERROR_UNEXPECTED: An unexpected internal error occurred.

TEE_UNKNOWN_MESSAGE_RESPONSE:

QVL received unexpected message while retrieving verification collateral.

TEE_ERROR_MESSAGE_PARSING_ERROR:

Generic message parsing error from the attestation infrastructure while retrieving the platform data.

TEE_PLATFORM_UNKNOWN:

The Platform Quote Provider Library was not able to collect the TDTCBInfo for this platform.

TEE_TDX_MODULE_MISMATCH:

The security level of the TDX Module installed on the platform cannot be evaluated because it is not represented in the TDTCBInfo. This can happen when an old TDTCBInfo is used in the verification.

TEE_ERROR_REPORT:

Failed in checking user report data.

TEE_ERROR_QVL_QVE_MISMATCH:

Only returned when the quote verification library supports both the untrusted mode of verification and the QvE backed mode of verification. This error indicates that the 2 versions of the verification modes are different. Most caused by using a QvE that does not match the version of the DCAP installed.

4.2 tee_free_verify_quote_qvt()

The tee_free_verify_quote_qvt() function frees “quote verification result token” buffer that is returned by tee_verify_quote_qvt function. So this function need work with tee_verify_quote_qvt function together.

Syntax:

```
quote3_error_t tee_free_verify_quote_qvt(
                            uint8_t * p_verification_result_token,
                            uint32_t *p_verification_result_token_buffer_size);
```

Parameters:

uint8_t *p_verification_result_token[IN]

pointer to the verification result token buffer.

uint32_t *p_verification_result_token_buffer_size[IN]

Points to the verification result token buffer size.

Return Values

TEE_SUCCESS:

Successfully evaluated the Quote.

TEE_ERROR_INVALID_PARAMETER:

One of the input parameters is invalid.

5. Appraisal APIs

5.1 tee_appraise_verification_token()

tee_appraise_verification_token() appraises a Verification Result JWT against one or more Quote Appraisal Policies. If the Verification Result meets a policy, then the policy ID is inserted into the Appraisal Result JWT.

Syntax:

```
quote3_error_t tee_appraise_verification_token(
                        const uint8_t *p_verification_result_token,
                        uint8_t **p_qaps,
                        uint8_t qaps_count,
                        const time_t appraisal_check_date,
                        sgx_ql_qe_report_info_t *p_qae_report_info,
                        uint32_t *p_appraisal_result_token_buffer_size,
                        uint8_t **p_ appraisal_result_token);
```

Parameters:

uint8_t* p_verification_result_token[IN]

A null-terminated string containing the input Verification Result JWT generated by tee_verify_quote(). The VR JWT can be unsigned or signed

uint8_t** p_qaps[IN]

Points to an array of pointers, with each pointer pointing to a buffer holding a quote appraisal policy JWT token. Each token is a null-terminated string holding a JWT. Each token can hold one or more policies.

Each policy token is signed JWT, the signing cert or public key needs to be included in the QAP JWT header.

uint8_t qaps_count[IN]

Holds the number of pointers in the p_qaps array.

time_t appraisal_check_date [IN]

This date used by the appraisal engine to check the expiry of the inputted collateral. Typically, it will be the current time. If any of the input collateral expiration date is before this inputted date, the appraisal_result_token will set the expiration_date_check value to indicate expiry.

sgx_ql_qe_report_info_t* p_qae_report_info[IN,OUT],

This parameter is optional. If not NULL, then this parameter should provide a target_info structure for an enclave which will verify the generated report. If this parameter is provided, then the QAE will be used to perform the appraisal and it will generate a report using the target_info provided in the sgx_ql_qe_report_info_t structure. The QAE.REPORT.REPORT_DATA = SHA256_HASH(AR JWT).

uint32_t* p_appraisal_result_token_buffer_size[IN,OUT]

Points to a variable holding the size of the p_appraisal_result_token buffer

uint8_t** p_appraisal_result_token [OUT]

If a sufficiently sized buffer is provided in p_appraisal_result_token_buffer_size / p_appraisal_result_token, then an Appraisal Result (AR) JWT as a null-terminated string is output in this buffer.

The output AR JWT can be unsigned or signed.

Notes:

For parameters qaps_count and p_qaps, the user must provide a “TD Identity” policy or an “Enclave Identity” policy. For platform policy, user may provide the platform policy when he/she calls this API, but it is not a requirement. If a platform policy is not provided, this API will internally try to retrieve the platform policy from the cache server (like PCCS). If a platform policy could NOT be retrieved from the cache server, this API will use the hard-coded ‘strict’ platform policy. The priority for platform policy selection is as follows:

1. User input platform policy provided to this API.
2. If user does not provide platform policy to this API, it will internally try to get platform policy from the cache server.
3. If the cache server doesn’t contain a platform policy, this API will use the hard-coded ‘strict’ platform policy.

Return Values

TEE_SUCCESS:

Successfully evaluated the Quote.

TEE_ERROR_INVALID_PARAMETER:

One of the input parameters is invalid.

TEE_ERROR_OUT_OF_MEMORY:

Heap memory allocation error in the QVL.

TEE_OUT_OF_EPC:

Not enough EPC memory to load one of the enclaves needed to complete this operation.

TEE_ENCLAVE_LOST:

Enclave is lost after power transition or used in a child process created by linux:fork().

TEE_ERROR_UNEXPECTED: An unexpected internal error occurred.

TEE_UNKNOWN_MESSAGE_RESPONSE:

QVL received unexpected message while retrieving verification collateral.

TEE_ERROR_MESSAGE_PARSING_ERROR:

Generic message parsing error from the attestation infrastructure while retrieving the platform data.

5.2 tee_free_appraisal_token ()

The tee_free_appraisal_token() function frees "appraisal result token" buffer that is returned by the tee_appraise_verification_token function. This function works together with the tee_appraise_verification_token function.

Syntax:

quote3_error_t tee_free_appraisal_token (uint8_t * p_appraisal_result_token);

Parameters:

uint8_t *p_appraisal_result_token[IN]

pointer to the appraisal result token buffer.

Return Values

TEE_SUCCESS:

Successfully evaluated the Quote.

TEE_ERROR_INVALID_PARAMETER:

One of the input parameters is invalid.

5.3 tee_authenticate_appraisal_result ()

The tee_authenticate_appraisal_result() function will check:
Whether the input policies are used in the appraisal process by comparing the policies with the appraisal result. It is mainly used to mitigate the replacement attack.

Syntax:

```
quote3_error_t tee_authenticate_appraisal_result (
                        const uint8_t * p_appraisal_result_token,
                        const tee_policy_bundle_t *p_policies,
                        tee_policy_auth_result_t *result);
```

Parameters:

const uint8_t *p_appraisal_result_token[IN]

pointer to the appraisal result token JWT buffer that is generated by the "tee_appraise_verification_token" function.

const tee_policy_bundle_t *p_policies[IN]

Policies that will be used to authenticate the appraisal result. This ensures that the appraisal performed by functional call "tee_appraise_verification_token used the same policies . For this parameter's structure, you can refer to the tee_policy_bundle_t definition in Appendix's Data Structure part.

tee_policy_auth_result_t* result[OUT]

Output the authentication result. For this parameter's detail information, you can refer to the tee_policy_auth_result_t definition in Appendix's Data Structure part.

Return Values

TEE_SUCCESS:

Successfully evaluated the Quote.

TEE_ERROR_INVALID_PARAMETER:

One of the input parameters is invalid.

TEE_ERROR_OUT_OF_MEMORY:

Heap memory allocation error in the QVL.

TEE_ERROR_UNEXPECTED: An unexpected internal error occurred.

5.4 tee_authenticate_appraisal_result_ex ()

This API is an enhanced version of tee_authenticate_appraisal_result. While their functionalities are similar, there are two key differences:

- Allow user to specify whether the authentication process should be executed within QAE.
- Allow user to provide an optional quote buffer, then the API will verify that appraisal output JWT should be consistent with the quote.

Syntax:

```
quote3_error_t tee_authenticate_appraisal_result_ex (
                const uint8_t *p_quote,
                uint32_t quote_size,
                const uint8_t * p_appraisal_result_token,
                const tee_policy_bundle_t *p_policies,
                const uint8_t *td_identity_blob,
                tee_policy_auth_result_t *result,
                sgx_ql_qe_report_info_t *p_qae_report_info);
```

Parameters:

const uint8_t* p_quote [IN][Optional]

Points to quote buffer, which is an optional input, when user provide the quote, this API will check the quote hash in appraisal output JWT.

uint32_t quote_size

the buffer size of optional p_quote, it should be 0 when p_quote is NULL.

const uint8_t *p_appraisal_result_token[IN]

pointer to the appraisal result token JWT buffer that is generated by the "tee_appraise_verification_token" function.

const tee_policy_bundle_t *p_policies[IN]

Policies that will be used to authenticate the appraisal result. To make sure the appraisal process use the same policies during functional call "tee_appraise_verification_token". For this parameter's structure, you can refer to the tee_policy_bundle_t definition in Appendix's Data Structure part.

Const uint8_t* td_identity_blob[IN][Optional]

Must be NULL now.

tee_policy_auth_result_t* result[OUT]

Output the authentication result. For this parameter's detail information, you can refer to the tee_policy_auth_result_t definition in Appendix's Data Structure part.

sgx_ql_qe_report_info_t* p_qae_report_info[IN/OUT]
This parameter can be used in two ways:

If p_qae_report_info is NOT NULL, the API will use Intel QAE to check the policies and appraisal result, and QAE will generate a report using the target_info in sgx_ql_qe_report_info_t structure. You should verify the report and QAE identity by using API in Intel TVL library.

If p_qae_report_info is NULL, the API will use QVL library to check the polices and appraisal result, note that the results cannot be cryptographically authenticated in this mode.

Return Values

TEE_SUCCESS:

Successfully evaluated the Quote.

TEE_ERROR_INVALID_PARAMETER:

One of the input parameters is invalid.

TEE_ERROR_OUT_OF_MEMORY:

Heap memory allocation error in the QVL.

TEE_ERROR_UNEXPECTED: An unexpected internal error occurred.

5.5 tee_authenticate_policy_owner ()

The tee_authenticate_policy_owner() function will check:
Whether the input policies are signed by the specific owner.

Syntax:

```
quote3_error_t tee_authenticate_policy_owner (
                    const uint8_t *p_quote,
                    uint32_t quote_size,
                    const uint8_t * p_appraisal_result_token,
                    const uint **policy_signing_key_list,
                    uint32_t list_size,
                    const uint8_t *td_identity_blob,
                    tee_policy_auth_result_t *result,
                    sgx_ql_qe_report_info_t *p_qae_report_info);
```

Parameters:

const uint8_t* p_quote [IN][Optional]

Points to quote buffer, which is an optional input, when user provide the quote, this API will check the quote hash in appraisal output JWT.

uint32_t quote_size

the buffer size of optional p_quote, it should be 0 when p_quote is NULL.

const uint8_t *p_appraisal_result_token[IN]

pointer to the appraisal result token JWT buffer that is generated by the "tee_appraise_verification_token" function.

const policy_signing_key_list[IN]

Points to an array of pointers, with each pointer pointing to a buffer holding a policy signing key

uint32_t list_size[IN]

Policy signing key number

Const uint8_t* td_identity_blob[IN][Optional]

Must be NULL now.

tee_policy_auth_result_t* result[OUT]

output the authentication result. For this parameter's detail information, you can refer to the tee_policy_auth_result_t definition in Appendix's Data Structure part.

sgx_ql_qe_report_info_t* p_qae_report_info[IN/OUT]

This parameter can be used in two ways:

If p_qae_report_info is NOT NULL, the API will use Intel QAE to check the policies and appraisal result, and QAE will generate a report using the target_info in sgx_ql_qe_report_info_t structure. You should verify the report and QAE identity by using API in Intel TVL library.

If p_qae_report_info is NULL, the API will use QVL library to check the polices and appraisal result, note that the results cannot be cryptographically authenticated in this mode.

Return Values

TEE_SUCCESS:

Successfully evaluated the Quote.

TEE_ERROR_INVALID_PARAMETER:

One of the input parameters is invalid.

TEE_ERROR_OUT_OF_MEMORY:

Heap memory allocation error in the QVL.

TEE_ERROR_UNEXPECTED: An unexpected internal error occurred.

5.6 tee_verify_qae_report_and_identity ()

The tee_verify_qae_report_and_identity() verifies the QAE report and identity based on the provided policies and the specified mode, mode includes QAE appraisal, strict policy authentication, or policy owner authentication.

Syntax:

```
quote3_error_t tee_verify_qae_report_and_identity (
                                qae_verification_input_t *input,
                                sgx_ql_qe_report_info_t qae_report_info,
                                sgx_isv_svn_t qae_isvsvn_threshold);
```

Parameters:

qae_verification_input_t *input [IN]

For this parameter's detail information, you can refer to the qae_verification_input_t definition in Appendix's Data Structure part.

sgx_ql_qe_report_info_t* p_qae_report_info[IN/OUT]

QAE report information structure which contains `nonce` and QAE report.

sgx_isv_svn_t qae_isvsvn_threshold[IN]:

ISV SVN threshold for QAE. The actual QAE ISVSVN must equal or greater than the threshold.

Return Values

TEE_SUCCESS:

Successfully verify QAE's report and identity.

TEE_ERROR_INVALID_PARAMETER:

One of the input parameters is invalid.

TEE_ERROR_OUT_OF_MEMORY:

Heap memory allocation error in the QVL.

TEE_ERROR_UNEXPECTED:

An unexpected internal error occurred.

TEE_ERROR_REPORT:

The QAE report can NOT be verified.

TEE_QAEIDENTITY_MISMATCH:

The QAE identity info from report doesn't match to value in sgx_dcap_tvl.

TEE_QAE_OUT_OF_DATE:
The input QAE ISV_SVN threshold is smaller than actual QAE ISV_SVN.

TEE_RESULT_REPORT_DATA_MISMATCH:
QAE's report data is mismatch.

Notes:

This API provides three operation modes:

APPRAISAL mode	Verify QAE's report and identity, and make sure: **report_data = SHA384(nonce in p_qae_report_info || QVL output JSON || policy array || Tenant TD identity and TCB mapping table || appraisal output JWT || appraisal_check_date) || 00'**
AUTH_POLICY	Verify QAE's report and identity, and make sure: **report_data = SHA384 (nonce in p_qae_report_info|| appraisal output JWT || policy bundle || Tenant TD identity and TCB mapping table || audit result || quote (optional)) || 00'** for the operation parameter "quote", you must use the same "quote" between this API and 'tee_authenticate_appraisal_result_ex'
AUTH_OWNER	Verify QAE's report and identity, and make sure: **report_data = SHA384 (nonce in p_qae_report_info || appraisal output JWT || policy key list array || Tenant TD identity and TCB mapping table || audit result || quote (optional)) || 00')** for the operation parameter "quote", you must use the same "quote" between this API and 'tee_authenticate_policy_owner'

6. Appendix

6.1 Appraisal Result Token

The Appraisal Result Token (ART) is a JSON Web Token (JWT). Every JWT has a JOSE header with the fields in the table below. Some field names are defined in RFC7515 or RFC7519

JOSE header field	Req./ Opt.	Notes
alg	O	Registered JWT claim for Algorithm, defined in RFC 7518 Only required for signed JWT
jwk	O	Registered JWS claim for JSON Web Key, defined in RFC 7517 Only required for signed JWT
iat	R	“Issued At” time. Its value MUST be a number containing a NumericDate value
exp	R	Expiration Time. Its value MUST be a number containing a NumericDate value, which is “Seconds since the Epoch”.
version	O	A string identifying the version for the report data structure format. This string is composed of two decimal numbers separated by a dot in between, e.g., “1.2”. The number on the left is major version, and the number on the right is minor version.

Example JWT JOSE header:

```
{
    “alg”: “ES384”,
    “typ”: “JWT”,
    “jwk” : {
    “kty”: “EC”,
    “crv”: “P-384”,
    “x”: "<x-value>",
    "y": "<y-value>",
    "kid" : "<key-ID-string>"
  }
}
```

For every input report JSON object, an appraisal result JSON object is produced with these fields:

- Field “appraisal_result”, a number representing one of the results.
    - 1 – a policy is identified and appraisal is successful
    - 0 – a policy is identified but appraisal failed
    - -1 – no policy is identified for this report. In this case, the policy field is not present.
- Report information

    - Report environment
    - Report measurement including endorsed values upon successful appraisal
- Policy information, if a policy is identified for the report. Otherwise, this field is not present
    a) The policy environment copied directly from the policy
    b) Policy signing public key and signature
        - Public key in JSON Web Key (RFC7517) format, with algorithms defined in RFC7518.
        - Signature is the signature section in the signed JWT string.
    c) “appraisal_check_date”, which is the reference time that the appraisal engine uses to check expiration dates. This is typically the current time.

The appraisal result includes an overall appraisal result claim, “overall_appraisal_result”, with the possible values:

- 1 – all reports have been successfully appraised
- 0 – at least one report failed appraisal
    - There could be zero or more reports without identified policies
- -1 – There is at least one report without identified policy
    - All other reports (if any) are appraised successfully

The result JWT payload is a JSON object as defined below:

```
{
"overall_appraisal_result" : 1,
    “nonce” : xxxx,
    “appraisal_check_date”: 17023703,
    "appraised_reports": [
        {
            "appraisal_result": 1,
            "report":{
                "environment": {
                // Environment fields
                },
                "measurement": {
                // Measurement values, including endorsed values
                }
            }
            "policy": {
                "environment" : {
                    "class_id": "3123ec35-8d38-4ea5-87a5-d6c48b567570",
                    "description": "SGX Platform Policy for CSP"
                },
                "signing_key" : {
                    // Signing public key in JSON Web Key (RFC7517) format
                },
                "signature" : {
                    // JWT signature, the signature section in the signed JWT
string
                }
            }
        },
        {
            "appraisal_result": 1,
            "report":{
                "environment": {
                // Environment fields
                },
                "measurement": {
                // Measurement values, including endorsed values
                }
            }
            "policy": {
                "environment" : {
                    "class_id": "bef7cb8c-31aa-42c1-854c-10db005d5c41",
                    "description": "SGX Enclave Policy"
                },
                "signing_key" : {
                    // Signing public key in JSON Web Key (RFC7517) format
                },
                "signature" : {
                    // JWT signature, the signature section in the signed JWT
string
                }
            }
        }
    ],
    "certification_data" : [
        {
            “certification_data”: {
                “qe_identity_issue_chain”: “xxx”,
                “root_ca_crl”: “xxx”,
                “pck_crl”: “xxx”,
                “pck_crl_isser_chain”: “xxx”,
                “tcb_info”: “xxx”,
                “qe_identify”: “xxx”,
                “tcb_info_issue_chain”: “xxx”
            }
        }
    ]
}
```

6.2 Data Structures

```
typedef enum _tee_platform_policy_type_t
{
    DEFAULT_STRICT = 0,
    CUSTOMIZED
} tee_platform_policy_type_t;

typedef struct _tee_platform_policy_t
{
    tee_platform_policy_type_t pt;
    const uint8_t* p_policy;
} tee_platform_policy_t;

typedef struct _tee_policy_bundle_t
{
    const uint8_t *p_tenant_identity_policy;
    tee_platform_policy_t platform_policy;

    tee_platform_policy_t tdqe_policy;  /* For tdqe. Only for TDX and only need
to be set when user uses a seperate tdqe_policy
                                         * instead of an integrated
platform_policy including both TDX platform policy and TDQE. */

    tee_platform_policy_t reserved[2];  /* Reserved for future usage */
} tee_policy_bundle_t;

typedef enum _tee_policy_auth_result_t
{
    TEE_AUTH_INCOMPLET = -1,    /* Only part of the policies are provided and
authenticated successfully. For example, you only input
                                 * SGX platform policy for an SGX appraisal
token, and the platform policy is authenticated successfully */
    TEE_AUTH_SUCCESS = 0,       /* All the policies are authenticated
successfully. For SGX, both SGX platform policies are provided and successfully
*/
    TEE_AUTH_FAILURE = 1,       /* At least one of the input policies are
authenticated failed */
} tee_policy_auth_result_t;
```

```
typedef enum _tvl_mode_t
{
    APPRAISAL = 1,    //should be used along with QVL API
`tee_appraise_verification_token`
    AUTH_POLICY,    //should be used along with QVL
API`tee_authenticate_appraisal_result_ex`
    AUTH_OWNER    //should be used along with QVL
API`tee_authenticate_policy_owner`
} tvl_mode_t;

typedef struct _qae_verification_input_t
{
    tvl_mode_t mode;
    union
    {
        struct
        {
            char* p_appraisal_jwt;   //Pointer to the final appraisal JWT
            char* p_qvl_jwt;    //Pointer to the QvE output JWT
            time_t appraisal_check_date;    //The date for appraisal check
            uint8_t** p_policies;    //Pointer to an array of pointers to
individual policies
            uint8_t policy_count;    //Count of individual policies provided
        } appraisal;  // APPRAISAL mode
        struct
        {
            char* p_appraisal_jwt;    //Pointer to the final appraisal JWT
            tee_policy_bundle_t* p_policy_bundle;    //Pointer to the policy
bundle structure
            const uint8_t* p_td_identity;    //This parameter should currently be
set to NULL; functionality to be implemented in a future release
            const uint8_t* p_td_tcb_mapping_table;    //This parameter should
currently be set to NULL; functionality to be implemented in a future release
            tee_policy_auth_result_t* p_result;    //Pointer to the result of
policy authentication
            uint8_t *p_quote;    //Optional. Pointer to the quote data
            uint32_t quote_size;   //quote size, it should be 0 if p_quote is
NULL
        } auth_policy;  // AUTH POLICY mode
        struct
        {
            char* p_appraisal_jwt;   //Pointer to the final appraisal JWT
            uint8_t** p_policy_key_list;    //Points to an array of pointers, with each pointer pointing to a buffer holding a policy signing key
            uint8_t key_list_count;    //Count of individual policy keys provided
            const uint8_t* p_td_identity;    //This parameter should currently be set to NULL; functionality to be implemented in a future release
            const uint8_t* p_td_tcb_mapping_table;    //This parameter should currently be set to NULL; functionality to be implemented in a future release
            tee_policy_auth_result_t* p_result;    //Pointer to the result of policy authentication
            uint8_t * p_quote;    //Optional. Pointer to the quote data
            uint32_t quote_size;    //quote size, it should be 0 if p_quote is NULL
        } auth_owner;  // AUTH OWNER mode
    }input;
} qae_verification_input_t;
```

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