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**A YANG Data Model for Challenge-Response-based Remote Attestation  
Procedures using TPMs  
draft-ietf-rats-yang-tpm-charra-00**

Abstract

This document defines a YANG RPC and a minimal datastore tree required to retrieve attestation evidence about integrity measurements from a composite device with one or more roots of trust for reporting. Complementary measurement logs are also provided by the YANG RPC originating from one or more roots of trust of measurement. The module defined requires at least one TPM 1.2 or TPM 2.0 and corresponding Trusted Software Stack included in the device components of the composite device the YANG server is running on.

Status of This Memo

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**1. Introduction**

This document is based on the terminology defined in the [\[I-D.ietf-rats-architecture\]](#) and uses the interaction model and information elements defined in the [\[I-D.birkholz-rats-reference-interaction-model\]](#) document. The currently supported hardware security modules (HSM) - sometimes also referred to as an embedded secure element (eSE) - is the Trusted Platform Module (TPM) version 1.2 and 2.0 specified by the Trusted Computing Group (TCG). One or more TPMs embedded in the components of a composite device - sometimes also referred to as an aggregate device - are required in order to use the YANG module defined in this document. A TPM is used as a root of trust for reporting (RTR) in order to retrieve attestation evidence from a composite device (quote primitive operation). Additionally, it is used as a root of trust for storage (RTS) in order to retain shielded secrets and store



system measurements using a folding hash function (extent primitive operation).

### 1.1. Requirements notation

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [BCP 14 \[RFC2119\] \[RFC8174\]](#) when, and only when, they appear in all capitals, as shown here.

## 2. The YANG Module for Basic Remote Attestation Procedures

One or more TPM 2.0 MUST be embedded in the composite device that is providing attestation evidence via the YANG module defined in this document. The `ietf-basic-remote-attestation` YANG module enables a composite device to take on the role of Claimant and Attester in accordance with the Remote Attestation Procedures (RATS) architecture [[I-D.ietf-rats-architecture](#)] and the corresponding challenge-response interaction model defined in the [[I-D.birkholz-rats-reference-interaction-model](#)] document. A fresh nonce with an appropriate amount of entropy MUST be supplied by the YANG client in order to enable a proof-of-freshness with respect to the attestation evidence provided by the attester running the YANG datastore. The functions of this YANG module are restricted to 0-1 TPM 2.0 per hardware component.

### 2.1. Tree Diagram

```

module: ietf-tpm-remote-attestation
  +--ro rats-support-structures
    +--ro supported-algos*   uint16
    +--ro tpms* [tpm_name]
      | +--ro tpm_name          string
      | +--ro tpm-physical-index? int32 {ietfhw:entity-mib}?
      | +--ro certificates* []
      |   +--ro certificate
      |     +--ro certificate-name?   string
      |     +--ro certificate-type?   enumeration
      |     +--ro certificate-value?  ietfct:end-entity-cert-cms
    +--ro compute-nodes* [node-name]
      +--ro node-name          string
      +--ro node-physical-index? int32 {ietfhw:entity-mib}?

rpcs:
  +---x tpm12-challenge-response-attestation
    | +---w input
    | | +---w tpm1-attestation-challenge
  
```



```

| | +---w pcr-indices*          uint8
| | +---w nonce-value          binary
| | +---w TPM_SIG_SCHEME-value uint8
| | +---w (key-identifier)?
| | | +--:(public-key)
| | | | +---w pub-key-id?      binary
| | | +--:(TSS_UUID)
| | | | +---w TSS_UUID-value
| | | | | +---w ulTimeLow?      uint32
| | | | | +---w usTimeMid?      uint16
| | | | | +---w usTimeHigh?     uint16
| | | | | +---w bClockSeqHigh?  uint8
| | | | | +---w bClockSeqLow?  uint8
| | | | | +---w rgbNode*        uint8
| | +---w add-version?         boolean
| | +---w tpm_name?            string
| | +---w tpm-physical-index?  int32 {ietfhw:entity-mib}?
+--ro output
|   +--ro tpm12-attestation-response* [tpm_name]
|   +--ro tpm_name              string
|   +--ro tpm-physical-index?    int32 {ietfhw:entity-mib}?
|   +--ro up-time?              uint32
|   +--ro node-name?            string
|   +--ro node-physical-index?   int32 {ietfhw:entity-mib}?
|   +--ro fixed?                binary
|   +--ro external-data?        binary
|   +--ro signature-size?       uint32
|   +--ro signature?            binary
|   +--ro (tpm12-quote)
|   | +--:(tpm12-quote1)
|   | | +--ro version* []
|   | | | +--ro major?          uint8
|   | | | +--ro minor?          uint8
|   | | | +--ro revMajor?       uint8
|   | | | +--ro revMinor?       uint8
|   | | +--ro digest-value?     binary
|   | | +--ro TPM_PCR_COMPOSITE* []
|   | | | +--ro pcr-indices*    uint8
|   | | | +--ro value-size?     uint32
|   | | | +--ro tpm12-pcr-value* binary
|   | +--:(tpm12-quote2)
|   | | +--ro tag?              uint8
|   | | +--ro pcr-indices*      uint8
|   | | +--ro locality-at-release? uint8
|   | | +--ro digest-at-release? binary
+---x tpm20-challenge-response-attestation
| +---w input
| | +---w tpm20-attestation-challenge

```



```

| | | +---w pcr-list* []
| | | | +---w pcr
| | | |   +---w pcr-indices*          uint8
| | | |   +---w (algo-registry-type)
| | | |     +--:(tcg)
| | | |       | +---w tcg-hash-algo-id?  uint16
| | | |       +--:(ietf)
| | | |         +---w ietf-ni-hash-algo-id?  uint8
| | | +---w nonce-value                binary
| | | +---w (signature-identifier-type)
| | | | +--:(TPM_ALG_ID)
| | | | | +---w TPM_ALG_ID-value?        uint16
| | | | +--:(COSE_Algorithm)
| | | |   +---w COSE_Algorithm-value?   int32
| | | +---w (key-identifier)?
| | |   +--:(public-key)
| | |   | +---w pub-key-id?              binary
| | |   +--:(uuid)
| | |     +---w uuid-value?              binary
| | +---w tpms* [tpm_name]
| |   +---w tpm_name                    string
| |   +---w tpm-physical-index?         int32 {ietfhw:entity-mib}?
+--ro output
+--ro tpm20-attestation-response* [tpm_name]
+--ro tpm_name                          string
+--ro tpm-physical-index?                int32 {ietfhw:entity-mib}?
+--ro up-time?                          uint32
+--ro node-name?                        string
+--ro node-physical-index?              int32 {ietfhw:entity-mib}?
+--ro tpms-attest
+--ro | +--ro pcrdigest?                  binary
+--ro | +--ro tpms-attest-result?         binary
+--ro | +--ro tpms-attest-result-length?  uint32
+--ro +--ro tpmt-signature?              binary
+---x basic-trust-establishment
+---w input
+---w | +---w nonce-value                  binary
+---w | +---w (signature-identifier-type)
+---w | | +--:(TPM_ALG_ID)
+---w | | | +---w TPM_ALG_ID-value?        uint16
+---w | | +--:(COSE_Algorithm)
+---w | |   +---w COSE_Algorithm-value?   int32
+---w | +---w tpm_name?                    string
+---w | +---w tpm-physical-index?          int32 {ietfhw:entity-mib}?
+---w | +---w certificate-name?           string
+--ro output
+--ro | +---w attestation-certificates* [tpm_name]
+--ro | +---w tpm_name                      string

```





```

|      +--ro tpm-physical-index?      int32 {ietfhw:entity-mib}?
|      +--ro up-time?                 uint32
|      +--ro node-name?               string
|      +--ro node-physical-index?     int32 {ietfhw:entity-mib}?
|      +--ro certificate-name?        string
|      +--ro attestation-certificate? ietfct:end-entity-cert-cms
|      +--ro (key-identifier)?
|          +--:(public-key)
|              | +--ro pub-key-id?    binary
|              +--:(uuid)
|                  +--ro uuid-value?  binary
+---x log-retrieval
    +---w input
        | +---w log-selector* [node-name]
        | | +---w node-name          string
        | | +---w node-physical-index? int32 {ietfhw:entity-mib}?
        | | +---w (index-type)?
        | |     +--:(last-entry)
        | |         | +---w last-entry-value? binary
        | |         +--:(index)
        | |             | +---w index-number?  uint64
        | |             +--:(timestamp)
        | |                 +---w timestamp?   yang:date-and-time
        | +---w log-type              identityref
        | +---w pcr-list* []
        | | +---w pcr
        | |     +---w pcr-indices*      uint8
        | |     +---w (algo-registry-type)
        | |         +--:(tcg)
        | |             | +---w tcg-hash-algo-id?  uint16
        | |             +--:(ietf)
        | |                 +---w ietf-ni-hash-algo-id?  uint8
        | +---w log-entry-quantity?  uint16
    +--ro output
        +--ro system-event-logs
            +--ro node-data* [node-name tpm_name]
                +--ro node-name          string
                +--ro node-physical-index? int32 {ietfhw:entity-mib}?
                +--ro up-time?           uint32
                +--ro tpm_name           string
                +--ro tpm-physical-index? int32 {ietfhw:entity-mib}?
                +--ro log-result
                    +--ro (log-type)
                        +--:(bios)
                            | +--ro bios-event-logs
                            |     +--ro bios-event-entry* [event-number]
                            |         +--ro event-number    uint32
                            |         +--ro event-type?     uint32

```



```

|         +--ro pcr-index?          uint16
|         +--ro digest-list* []
|         |   +--ro (algo-registry-type)
|         |   |   +--:(tcg)
|         |   |   |   +--ro tcg-hash-algo-id?          uint16
|         |   |   |   +--:(ietf)
|         |   |   |       +--ro ietf-ni-hash-algo-id?  uint8
|         |   |   |       +--ro digest*                binary
|         |   +--ro event-size?          uint32
|         +--ro event-data*          uint8
+--:(ima)
  +--ro ima-event-logs
    +--ro ima-event-entry* [event-number]
      +--ro event-number          uint64
      +--ro ima-template?         string
      +--ro filename-hint?       string
      +--ro filedata-hash?       binary
      +--ro template-hash-algorithm? string
      +--ro template-hash?       binary
      +--ro pcr-index?           uint16
      +--ro signature?           binary

```

## 2.2. YANG Module

This YANG module imports modules from [RFC6991], [RFC8348], and [I-D.ietf-netconf-crypto-types].

```

<CODE BEGINS> file ietf-tpm-remote-attestation@2019-01-07.yang
module ietf-tpm-remote-attestation {
  namespace "urn:ietf:params:xml:ns:yang:ietf-tpm-remote-attestation";
  prefix "yang-brat";

  import ietf-yang-types {
    prefix yang;
  }
  import ietf-hardware {
    prefix ietfhw;
  }
  import ietf-crypto-types {
    prefix ietfct;
  }

  organization
    "IETF RATS (Remote ATtestation procedures) Working Group";

  contact
    "WG Web : <http://datatracker.ietf.org/wg/rats/>
    WG List : <mailto:rats@ietf.org>

```



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#### description

"A YANG module to enable a TPM 2.0 based remote attestation procedure using a challenge-response interaction model and the TPM 2.0 Quote primitive operation.

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This version of this YANG module is part of RFC XXXX (<https://www.rfc-editor.org/info/rfcXXXX>); see the RFC itself for full legal notices.

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```
revision "2020-01-08" {  
  description  
    "Initial version";  
  reference  
    "draft-ietf-rats-tpm2-remote-attestation";  
}
```

```
/* Groupings */  
/*****/
```

```
grouping hash-algo {  
  description
```



```
    "A selector for the hashing algorithm";
choice algo-registry-type {
  mandatory true;
  description
    "Unfortunately, both IETF and TCG have registries here.
    Choose your weapon wisely.";
  case tcg {
    description
      "you chose the east door, the tcg space opens up to
      you.";
    leaf tcg-hash-algo-id {
      type uint16;
      description
        "This is an index referencing the TCG Algorithm
        Registry based on TPM_ALG_ID.";
    }
  }
  case ietf {
    description
      "you chose the west door, the ietf space opens up to
      you.";
    leaf ietf-ni-hash-algo-id {
      type uint8;
      description
        "This is an index referencing the Named Information
        Hash Algorithm Registry.";
    }
  }
}
}

grouping hash {
  description
    "The hash value including hash-algo identifier";
  list hash-digests {
    description
      "The list of hashes.";
    container hash-digest {
      description
        "A hash value based on a hash algorithm registered by an
        SDO.";
      uses hash-algo;
      leaf hash-value {
        type binary;
        description
          "The binary representation of the hash value.";
      }
    }
  }
}
```





```
    }
  }

  grouping nonce {
    description
      "A nonce to show freshness and counter replays.";
    leaf nonce-value {
      type binary;
      mandatory true;
      description
        "This nonce SHOULD be generated via a registered
        cryptographic-strength algorithm. In consequence, the length
        of the nonce depends on the hash algorithm used. The algorithm
        used in this case is independent from the hash algorithm used to
        create the hash-value in the response of the attester.";
    }
  }

  grouping tpm12-pcr-selection {
    description
      "A Verifier can request one or more PCR values using its
      individually created Attestation Key Certificate (AC).
      The corresponding selection filter is represented in this grouping.
      Requesting a PCR value that is not in scope of the AC used, detailed
      exposure via error msg should be avoided.";
    leaf-list pcr-indices {
      type uint8;
      description
        "The numbers/indexes of the PCRs. At the moment this is limited
        to 32.";
    }
  }

  grouping tpm20-pcr-selection {
    description
      "A Verifier can request one or more PCR values uses its
      individually created AC. The corresponding selection filter is
      represented in this grouping. Requesting a PCR value that is not
      in scope of the AC used, detailed exposure via error msg should
      be avoided.";
    list pcr-list {
      description
        "For each PCR in this list an individual list of banks
        (hash-algo) can be requested. It depends on the datastore, if
        every bank in this grouping is included per PCR (crude), or if
        each requested bank set is returned for each PCR individually
        (elegant).";
      container pcr {
```



```
    description
      "The composite of a PCR number and corresponding bank
      numbers.";
    leaf-list pcr-indices {
      type uint8;
      description
        "The number of the PCR. At the moment this is limited
        32";
    }
    uses hash-algo;
  }
}

grouping pcr-selector {
  description
    "A Verifier can request the generation of an attestation
    certificate (a signed public attestation key
    (non-migratable, tpm-resident) wrt one or more PCR values.
    The corresponding creation input is represented in this grouping.
    Requesting a PCR value that is not supported results in an error,
    detailed exposure via error msg should be avoided.";
  list pcr-list {
    description
      "For each PCR in this list an individual hash-algo can be
      requested.";
    container pcr {
      description
        "The composite of a PCR number and corresponding bank
        numbers.";
      leaf-list pcr-index {
        type uint8;
        description
          "The numbers of the PCRs that are associated with
          the created key. At the moment the highest number is 32";
      }
      uses hash-algo;
    }
  }
}

grouping tpm12-signature-scheme {
  description
    "The signature scheme used to sign the evidence via a TPM 1.2.";
  leaf TPM_SIG_SCHEME-value {
    type uint8;
    mandatory true;
    description
```



```
        "Selects the signature scheme that is used to sign the TPM quote
        information response. Allowed values can be found in the table at
        the bottom of page 32 in the TPM 1.2 Structures specification
        (Level 2 Revision 116, 1 March 2011).";
    }
}

grouping tpm20-signature-scheme {
    description
        "The signature scheme used to sign the evidence.";
    choice signature-identifier-type {
        mandatory true;
        description
            "There are multiple ways to reference a signature type.
            This used to select the signature algo to sign the quote
            information response.";
        case TPM_ALG_ID {
            description
                "This references the indices of table 9 in the TPM 2.0
                structure specification.";
            leaf TPM_ALG_ID-value {
                type uint16;
                description
                    "The TPM Algo ID.";
            }
        }
        case COSE_Algorithm {
            description
                "This references the IANA COSE Algorithms Registry indices.
                Every index of this registry to be used must be mapable to a
                TPM_ALG_ID value.";
            leaf COSE_Algorithm-value {
                type int32;
                description
                    "The TPM Algo ID.";
            }
        }
    }
}

grouping tpm12-attestation-key-identifier {
    description
        "A selector for a suitable key identifier for a TPM 1.2.";
    choice key-identifier {
        description
            "Identifier for the attestation key to use for signing
            attestation evidence.";
        case public-key {
```



```
leaf pub-key-id {
  type binary;
  description
    "The value of the identifier for the public key.";
}
}
case TSS_UUID {
  description
    "Use a YANG agent generated (and maintained) attestation
    key UUID that complies with the TSS_UUID datatype of the TCG
    Software Stack (TSS) Specification, Version 1.10 Golden,
    August 20, 2003.";
  container TSS_UUID-value {
    description
      "A detailed structure that is used to create the
      TPM 1.2 native TSS_UUID as defined in the TCG Software
      Stack (TSS) Specification, Version 1.10 Golden,
      August 20, 2003.";
    leaf ulTimeLow {
      type uint32;
      description
        "The low field of the timestamp.";
    }
    leaf usTimeMid {
      type uint16;
      description
        "The middle field of the timestamp.";
    }
    leaf usTimeHigh {
      type uint16;
      description
        "The high field of the timestamp multiplexed with the
        version number.";
    }
    leaf bClockSeqHigh {
      type uint8;
      description
        "The high field of the clock sequence multiplexed with
        the variant.";
    }
    leaf bClockSeqLow {
      type uint8;
      description
        "The low field of the clock sequence.";
    }
    leaf-list rgbNode {
      type uint8;
      description
```





```
        "The spatially unique node identifier.";
    }
}
}
}
}

grouping tpm20-attestation-key-identifier {
  description
    "A selector for a suitable key identifier.";
  choice key-identifier {
    description
      "Identifier for the attestation key to use for signing
      attestation evidence.";
    case public-key {
      leaf pub-key-id {
        type binary;
        description
          "The value of the identifier for the public key.";
      }
    }
    case uuid {
      description
        "Use a YANG agent generated (and maintained) attestation
        key UUID.";
      leaf uuid-value {
        type binary;
        description
          "The UUID identifying the corresponding public key.";
      }
    }
  }
}

grouping tpm-name {
  description
    "In a system with multiple-TPMs get the data from a specific TPM
    identified by the name and physical-index.";
  leaf tpm_name {
    type string;
    description
      "Name of the TPM or All";
  }
  leaf tpm-physical-index {
    if-feature ietfhw:entity-mib;
    type int32 {
      range "1..2147483647";
    }
  }
}
```



```
    config false;
    description
      "The entPhysicalIndex for the TPM.";
    reference
      "RFC 6933: Entity MIB (Version 4) - entPhysicalIndex";
  }
}
grouping compute-node {
  description
    "In a distributed system with multiple compute nodes
    this is the node identified by name and physical-index.";
  leaf node-name {
    type string;
    description
      "Name of the compute node or All";
  }
  leaf node-physical-index {
    if-feature ietfhw:entity-mib;
    type int32 {
      range "1..2147483647";
    }
    config false;
    description
      "The entPhysicalIndex for the compute node.";
    reference
      "RFC 6933: Entity MIB (Version 4) - entPhysicalIndex";
  }
}
grouping tpm12-pcr-info-short {
  description
    "This structure is for defining a digest at release when the only
    information that is necessary is the release configuration.";
  uses tpm12-pcr-selection;
  leaf locality-at-release {
    type uint8;
    description
      ".This SHALL be the locality modifier required to release the
      information (TPM 1.2 type TPM_LOCALITY_SELECTION)";
  }
  leaf digest-at-release {
    type binary;
    description
      "This SHALL be the digest of the PCR indices and PCR values
      to verify when revealing auth data (TPM 1.2 type
      TPM_COMPOSITE_HASH).";
  }
}
}
```



```
grouping tpm12-version {
  description
    "This structure provides information relative the version of
    the TPM.";
  list version {
    description
      "This indicates the version of the structure
      (TPM 1.2 type TPM_STRUCT_VER). This MUST be 1.1.0.0.";
    leaf major {
      type uint8;
      description
        "Indicates the major version of the structure.
        MUST be 0x01.";
    }
    leaf minor {
      type uint8;
      description
        "Indicates the minor version of the structure.
        MUST be 0x01.";
    }
    leaf revMajor {
      type uint8;
      description
        "Indicates the rev major version of the structure.
        MUST be 0x00.";
    }
    leaf revMinor {
      type uint8;
      description
        "Indicates the rev minor version of the structure.
        MUST be 0x00.";
    }
  }
}

grouping tpm12-quote-info-common {
  description
    "These statements are used in bot quote variants of the TPM 1.2";
  leaf fixed {
    type binary;
    description
      "This SHALL always be the string 'QUOT' or 'QUO2'
      (length is 4 bytes).";
  }
  leaf external-data {
    type binary;
    description
      "160 bits of externally supplied data, typically a nonce.";
  }
}
```



```
    }
    leaf signature-size {
      type uint32;
      description
        "The size of TPM 1.2 'signature' value.";
    }
    leaf signature {
      type binary;
      description
        "Signature over SHA-1 hash of tpm12-quote-info2'.";
    }
  }
}

grouping tpm12-quote-info {
  description
    "This structure provides the mechanism for the TPM to quote the
    current values of a list of PCRs (as used by the TPM_Quote2
    command).";
  uses tpm12-version;
  leaf digest-value {
    type binary;
    description
      "This SHALL be the result of the composite hash algorithm using
      the current values of the requested PCR indices
      (TPM 1.2 type TPM_COMPOSITE_HASH.)";
  }
}

grouping tpm12-quote-info2 {
  description
    "This structure provides the mechanism for the TPM to quote the
    current values of a list of PCRs
    (as used by the TPM_Quote2 command).";
  leaf tag {
    type uint8;
    description
      "This SHALL be TPM_TAG_QUOTE_INFO2.";
  }
  uses tpm12-pcr-info-short;
}

grouping tpm12-cap-version-info {
  description
    "TPM returns the current version and revision of the TPM 1.2 .";
  list TPM_PCR_COMPOSITE {
    description
      "The TPM 1.2 TPM_PCRVALUES for the pcr-indices.";
    uses tpm12-pcr-selection;
  }
}
```





```
leaf value-size {
  type uint32;
  description
    "This SHALL be the size of the 'tpm12-pcr-value' field
    (not the number of PCRs).";
}
leaf-list tpm12-pcr-value {
  type binary;
  description
    "The list of TPM_PCRVALUES from each PCR selected in sequence
    of tpm12-pcr-selection.";
}
list version-info {
  description
    "An optional output parameter from a TPM 1.2 TPM_Quote2.";
  leaf tag {
    type uint16;
    description
      "The TPM 1.2 version and revision
      (TPM 1.2 type TPM_STRUCTURE_TAG).
      This MUST be TPM_CAP_VERSION_INFO (0x0030)";
  }
  uses tpm12-version;
  leaf spec-level {
    type uint16;
    description
      "A number indicating the level of ordinals supported.";
  }
  leaf errata-rev {
    type uint8;
    description
      "A number indicating the errata version of the
      specification.";
  }
  leaf tpm-vendor-id {
    type binary;
    description
      "The vendor ID unique to each TPM manufacturer.";
  }
  leaf vendor-specific-size {
    type uint16;
    description
      "The size of the vendor-specific area.";
  }
  leaf vendor-specific {
    type binary;
    description
      "Vendor specific information.";
```



```
    }  
  }  
}
```

```
grouping tpm12-pcr-composite {  
  description  
    "The actual values of the selected PCRs (a list of TPM_PCRVALUES  
    (binary)and associated metadata for TPM 1.2.";  
  list TPM_PCR_COMPOSITE {  
    description  
      "The TPM 1.2 TPM_PCRVALUES for the pcr-indices.";  
    uses tpm12-pcr-selection;  
    leaf value-size {  
      type uint32;  
      description  
        "This SHALL be the size of the 'tpm12-pcr-value' field  
        (not the number of PCRs).";  
    }  
    leaf-list tpm12-pcr-value {  
      type binary;  
      description  
        "The list of TPM_PCRVALUES from each PCR selected in sequence  
        of tpm12-pcr-selection.";  
    }  
  }  
}
```

```
grouping node-uptime {  
  description  
    "Uptime in seconds of the node.";  
  leaf up-time {  
    type uint32;  
    description  
      "Uptime in seconds of this node reporting its data";  
  }  
}
```

```
identity log-type {  
  description  
    "The type of logs available.";  
}
```

```
identity bios {  
  base log-type;  
  description  
    "Measurement log created by the BIOS/UEFI.";  
}
```



```
identity ima {
  base log-type;
  description
    "Measurement log created by IMA.";
}

grouping log-identifier {
  description
    "Identifier for type of log to be retrieved.";
  leaf log-type {
    type identityref {
      base log-type;
    }
    mandatory true;
    description
      "The corresponding measurement log type identity.";
  }
}

grouping boot-event-log {
  description
    "Defines an event log corresponding to the event that extended the
    PCR";
  leaf event-number {
    type uint32;
    description
      "Unique event number of this event";
  }
  leaf event-type {
    type uint32;
    description
      "log event type";
  }
  leaf pcr-index {
    type uint16;
    description
      "Defines the PCR index that this event extended";
  }
  list digest-list {
    description "Hash of event data";
    uses hash-algo;
    leaf-list digest {
      type binary;
      description
        "The hash of the event data";
    }
  }
  leaf event-size {
```



```
    type uint32;
    description
        "Size of the event data";
}
leaf-list event-data {
    type uint8;
    description
        "the event data size determined by event-size";
}
}

grouping ima-event {
    description
        "Defines an hash log extend event for IMA measurements";
    leaf event-number {
        type uint64;
        description
            "Unique number for this event for sequencing";
    }
    leaf ima-template {
        type string;
        description
            "Name of the template used for event logs
            for e.g. ima, ima-ng";
    }
    leaf filename-hint {
        type string;
        description
            "File that was measured";
    }
    leaf filedata-hash {
        type binary;
        description
            "Hash of filedata";
    }
    leaf template-hash-algorithm {
        type string;
        description
            "Algorithm used for template-hash";
    }
    leaf template-hash {
        type binary;
        description
            "hash(filedata-hash, filename-hint)";
    }
    leaf pcr-index {
        type uint16;
        description
```





```
        "Defines the PCR index that this event extended";
    }
    leaf signature {
        type binary;
        description
            "The file signature";
    }
}

grouping bios-event-log {
    description
        "Measurement log created by the BIOS/UEFI.";
    list bios-event-entry {
        key event-number;
        description
            "Ordered list of TCG described event log
            that extended the PCRs in the order they
            were logged";
        uses boot-event-log;
    }
}

grouping ima-event-log {
    list ima-event-entry {
        key event-number;
        description
            "Ordered list of ima event logs by event-number";
        uses ima-event;
    }
    description
        "Measurement log created by IMA.";
}

grouping event-logs {
    description
        "A selector for the log and its type.";
    choice log-type {
        mandatory true;
        description
            "Event log type determines the event logs content.";
        case bios {
            description
                "BIOS/UEFI event logs";
            container bios-event-logs {
                description
                    "This is an index referencing the TCG Algorithm
                    Registry based on TPM_ALG_ID.";
                uses bios-event-log;
            }
        }
    }
}
```



```

    }
  }
  case ima {
    description
      "IMA event logs";
    container ima-event-logs {
      description
        "This is an index referencing the TCG Algorithm
        Registry based on TPM_ALG_ID.";
      uses ima-event-log;
    }
  }
}

/*****
/*   RPC operations   */
*****/

rpc tpm12-challenge-response-attestation {
  description
    "This RPC accepts the input for TSS TPM 1.2 commands of the
    managed device. ComponentIndex from the hardware manager YANG
    module to refer to dedicated TPM in composite devices,
    e.g. smart NICs, is still a TODO.";
  input {
    container tpm1-attestation-challenge {
      description
        "This container includes every information element defined
        in the reference challenge-response interaction model for
        remote attestation. Corresponding values are based on
        TPM 1.2 structure definitions";
      uses tpm12-pcr-selection;
      uses nonce;
      uses tpm12-signature-scheme;
      uses tpm12-attestation-key-identifier;
      leaf add-version {
        type boolean;
        description
          "Whether or not to include TPM_CAP_VERSION_INFO; if true,
          then TPM_Quote2 must be used to create the response.";
      }
      uses tpm-name;
    }
  }
  output {
    list tpm12-attestation-response {

```



```

    key tpm_name;
    description
      "The binary output of TPM 1.2 TPM_Quote/TPM_Quote2, including
        the PCR selection and other associated attestation evidence
        metadata";
    uses tpm-name;
    uses node-uptime;
    uses compute-node;
    uses tpm12-quote-info-common;
    choice tpm12-quote {
      mandatory true;
      description
        "Either a tpm12-quote-info or tpm12-quote-info2, depending
          on whether TPM_Quote or TPM_Quote2 was used
          (cf. input field add-verson).";
      case tpm12-quote1 {
        description
          "BIOS/UEFI event logs";
        uses tpm12-quote-info;
        uses tpm12-pcr-composite;
      }
      case tpm12-quote2 {
        description
          "BIOS/UEFI event logs";
        uses tpm12-quote-info2;
      }
    }
  }
}

rpc tpm20-challenge-response-attestation {
  description
    "This RPC accepts the input for TSS TPM 2.0 commands of the
      managed device. ComponentIndex from the hardware manager YANG
      module to refer to dedicated TPM in composite devices,
      e.g. smart NICs, is still a TODO.";
  input {
    container tpm20-attestation-challenge {
      description
        "This container includes every information element defined
          in the reference challenge-response interaction model for
          remote attestation. Corresponding values are based on
          TPM 2.0 structure definitions";
      uses tpm20-pcr-selection;
      uses nonce;
      uses tpm20-signature-scheme;
      uses tpm20-attestation-key-identifier;
    }
  }
}

```



```
    }
    list tpms {
      key tpm_name;
      description
        "TPMs to fetch the attestation information.";
      uses tpm-name;
    }
  }
  output {
    list tpm20-attestation-response {
      key tpm_name;
      description
        "The binary output of TPM2b_Quote. An TPMS_ATTEST structure
        including a length, encapsulated in a signature";
      uses tpm-name;
      uses node-uptime;
      uses compute-node;
      container tpms-attest {
        leaf pcrdigest {
          type binary;
          description
            "split out value of TPMS_QUOTE_INFO for convenience";
        }
        leaf tpms-attest-result {
          type binary;
          description
            "The complete TPM generate structure including
            signature.";
        }
        leaf tpms-attest-result-length {
          type uint32;
          description
            "Length of attest result provided by the TPM structure.";
        }
      }
      description
        "A composite of value and length and list of selected
        pcrs (original name: [type]attested)";
    }
    leaf tpmt-signature {
      type binary;
      description
        "Split out value of the signature for convenience.
        TODO: check for length values that complement binary value
        data node leafs.";
    }
  }
}
}
```





```
rpc basic-trust-establishment {
  description
    "This RPC creates a tpm-resident, non-migratable key to be used
    in TPM_Quote commands, an attestation certificate.";
  input {
    uses nonce;
    uses tpm20-signature-scheme;
    uses tpm-name;
    leaf certificate-name {
      type string;
      description
        "An arbitrary name for the identity certificate chain
        requested.";
    }
  }
  output {
    list attestation-certificates {
      key tpm_name;
      description
        "Attestation Certificate data from a TPM identified by the TPM
        name";
      uses tpm-name;
      uses node-uptime;
      uses compute-node;
      leaf certificate-name {
        type string;
        description
          "An arbitrary name for this identity certificate or
          certificate chain.";
      }
      leaf attestation-certificate {
        type ietfct:end-entity-cert-cms;
        description
          "The binary signed certificate chain data for this identity
          certificate.";
      }
      uses tpm20-attestation-key-identifier;
    }
  }
}

rpc log-retrieval {
  description
    "Logs Entries are either identified via indices or via providing
    the last line received. The number of lines returned can be
    limited. The type of log is a choice that can be augmented.";
  input {
    list log-selector {
```



```
key node-name;
description
  "Selection of log entries to be reported.";
uses compute-node;
choice index-type {
  description
    "Last log entry received, log index number, or timestamp.";
  case last-entry {
    description
      "The last entry of the log already retrieved.";
    leaf last-entry-value {
      type binary;
      description
        "Content of an log event which matches 1:1 with a
        unique event record contained within the log. Log
        entries subsequent to this will be passed to the
        requester. Note: if log entry values are not unique,
        this MUST return an error.";
    }
  }
  case index {
    description
      "Numeric index of the last log entry retrieved, or zero.";
    leaf index-number {
      type uint64;
      description
        "The numeric index number of a log entry. Zero means
        to start at the beginning of the log. Entries
        subsequent to this will be passed to the
        requester.";
    }
  }
  case timestamp {
    leaf timestamp {
      type yang:date-and-time;
      description
        "Timestamp from which to start the extraction. The next
        log entry subsequent to this timestamp is to be sent.";
    }
    description
      "Timestamp from which to start the extraction.";
  }
}
}
uses log-identifier;
uses tpm20-pcr-selection;
leaf log-entry-quantity {
  type uint16;
```



```

        description
            "The number of log entries to be returned. If omitted, it
            means all of them.";
    }
}
output {
    container system-event-logs {
        description
            "The requested data of the measurement event logs";
        list node-data {
            key "node-name tpm_name";
            description
                "Event logs of a node in a distributed system
                identified by the node name";
            uses compute-node;
            uses node-uptime;
            uses tpm-name;
            container log-result {
                description
                    "The requested entries of the corresponding log.";
                uses event-logs;
            }
        }
    }
}
}

/*****
/*  Protocol accessible nodes  */
*****/

container rats-support-structures {
    config false;
    description
        "The datastore definition enabling verifiers or relying
        parties to discover the information necessary to use the
        remote attestation RPCs appropriately.";
    leaf-list supported-algos {
        type uint16;
        description
            "Supported TPM_ALG_ID values for the TPM in question.
            Will include ComponentIndex soon.";
    }
    list tpms {
        key tpm_name;
        uses tpm-name;
        description
            "A list of TPMs in this composite

```



```
    device that rats can be conducted with.";
list certificates {
  container certificate {
    leaf certificate-name {
      type string;
      description
        "An arbitrary name for this identity certificate or
        certificate chain.";
    }
    leaf certificate-type {
      type enumeration {
        enum endorsement-cert {
          value 0;
          description
            "An endorsement key certificate.";
        }
        enum attestation-cert {
          value 1;
          description
            "An attestation key certificate.";
        }
      }
    }
    description
      "Type of this certificate";
  }
  leaf certificate-value {
    type ietfct:end-entity-cert-cms;
    description
      "The binary signed public endorsement key (EK),
      attestation key (AK) and corresponding claims (EK or
      AK Certificate). In a TPM 2.0 the EK,AK Certificate
      resides in a well-defined NVRAM location by the TPM
      vendor.";
  }
  description
    "The list of certificates each TPM can be distinguished with.";
}
description
  "The TPM's endorsement-certificate.";
}
}
list compute-nodes {
  key node-name;
  uses compute-node;
  description
    "A list names of hardware components in this composite
    device that rats can be conducted with.";
}
```





```
}  
}  
<CODE ENDS>
```

### **3. IANA considerations**

This document will include requests to IANA:

To be defined yet.

### **4. Security Considerations**

There are always some.

### **5. Acknowledgements**

Not yet.

### **6. Change Log**

Changes from version 00 to version 01:

- o Addressed author's comments
- o Extended complementary details about attestation-certificates
- o Relabeled chunk-size to log-entry-quantity
- o Relabeled location with compute-node or tpm-name where appropriate
- o Added a valid entity-mib physical-index to compute-node and tpm-name to map it back to hardware inventory
- o Relabeled name to tpm\_name
- o Removed event-string in last-entry

### **7. References**

#### **7.1. Normative References**

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