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I2NSF Remote Attestation Interface YANG Data Model
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Abstract

This document describes the architecture and interfaces of remote attestation in I2NSF. The architectures defines remote attestation components which must comply with the original architectures of I2NSF and RATs. The interfaces includes remote attestation interface of I2NSF and reference value interface of I2NSF.

Status of This Memo

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[1.](#) Introduction

NSF system is always used in remote scenarios, in which it is hard to guarantee if the deployment environment is secure and the NSF is properly deployed. If the deploy environment or the NSF is compromised, the behavior and the feedback of NSF cannot be trusted.

Remote attestation procedure [[I-D.ietf-rats-architecture](#)] provides an efficient mechanism that a relying party like NSF security controller could appraise if the NSF and the basic platform are trusted. The general remote attestation procedure has been defined by RATs group, however specific interfaces and implementation still need to be determined in I2NSF. This draft aims to create a unified remote attestation architecture of I2NSF to enable remote attestation and promote the security of NSF.

This document will follow the definition of I2NSF [[RFC8329](#)] and will also keep align with RATs architecture.

[2.](#) Terminology

[2.1.](#) Terms

RATs: Remote Attestation Procedure

RoT: Root of Trust

TPM: Trusted platform module

TEE: Trust Execution Environment

RVP: Reference Value Provider

IRAI: I2NSF Remote Attestation Interface

IRARVI: I2NSF Remote Attestation Reference Value Interface

[2.2.](#) Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC 2119](#) [[RFC2119](#)].

[3.](#) Scope and Motivation

[3.1.](#) Scope

The scope of this document mainly focuses on the architecture and expanded interfaces of remote attestation in I2NSF. The details of how to implement measurement or how to make remote attestation evidence is out of scope.

[3.2.](#) Motivation

The architecture of I2NSF aims to provide network security functions to network users. Usually the NSFs are in remote environment and the platform to deploy these NSFs may not be trusted. As a consequence this will bring several potential threats to the NSF, some examples are shown in the follow . The first threat is malfunction of NSF. The inappropriate deployment of NSF or the defective platform in where runs NSF will affect the behaviour of NSF directly. The second threat is the leak of digital asset like policy rules and security intelligence, which is provided by the security controller. If the remote environment is malicious, it will be hard to prevent the leakage. Consider a security company provides NSF in where contains lots of policy rules such as DDoS prevention, traffic filter, AI module, etc. If the platform who carries the NSF is malicious, it could steal this digital asset and provide to other rivals or attackers. The third threat is the potential spoofing attack to the NSF architecture. Adversary could use the compromised NSF to feedback spoofing information or other attacking information to attack or penetrate the NSF architecture. The attackers in platform could also disturb the action of NSF, and feedback the fake notification or event to security controller.

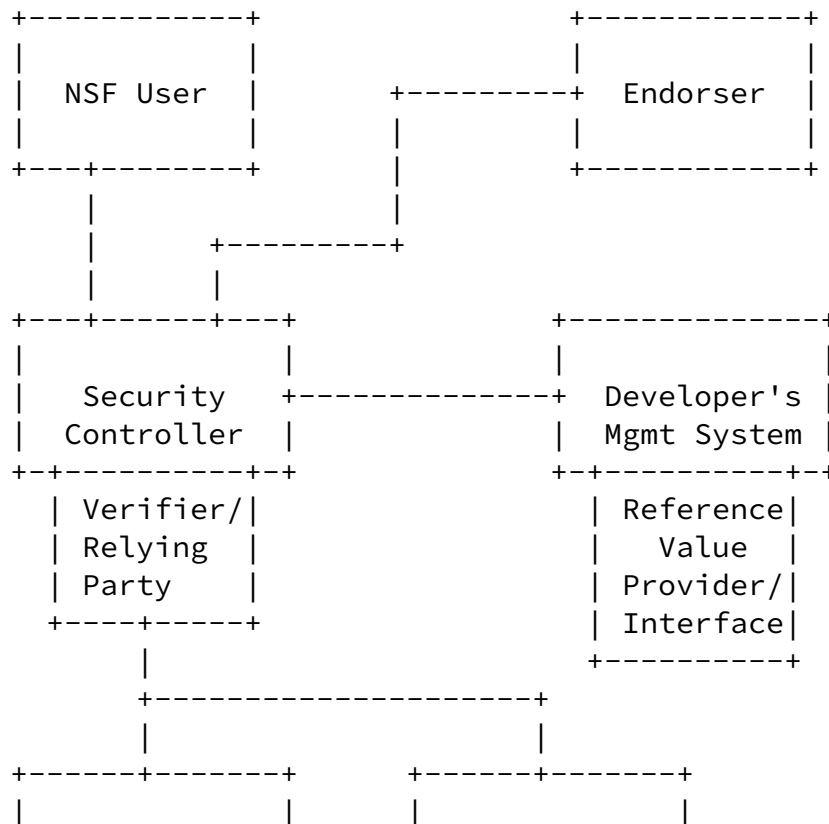
The solution of these threats is also straight, which is using remote attestation to make sure the remote platform is trusted and the NSF is well deployed. While it is true that any environment is vulnerable to malicious activity with full physical access (and this is obviously beyond the scope of this document), the application of attestation mechanisms raises the degree of physical control

necessary to perform an untraceable malicious modification of the environment.

When designing remote attestation in I2NSF, three aspects need to be considered. First, determine the remote attestation architecture of I2NSF. Second, refer to the appropriate specifications defined in RATs to create I2NSF remote attestation interfaces. Third, cover the heterogeneity architecture of specific trust architecture like TPM and TEE.

4. Information Model

4.1. Architecture of I2NSF Remote Attestation



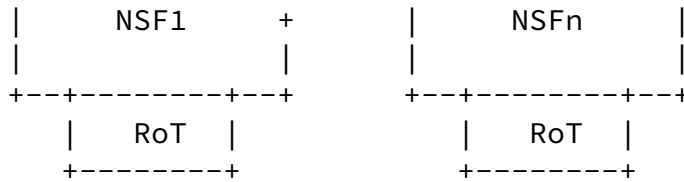
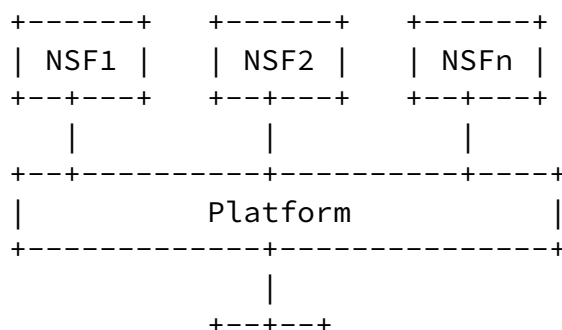


Figure 1: Architecture of Remote Attestation of I2NSF

As shown in figure one is the remote attestation architecture in I2NSF. In this architecture, several new components are introduced to NSF. The first component is RoT which is deployed in the basic platform of NSF as a hardware. The second component is Verifier/Relying Party, which is deployed as part of Security Controller. This component is in charge of verifying if the attestation evidence is complied with the reference value. The third component is the Reference Value Provider/Interface, which will bring the reference value of NSF image and deployment environment to Security Controller. In some conditions, the RVP could be some other vendors like a blockchain, a third party security provider. So the RVP component may be an interface that receive RVP form the third party. Right now this interface haven't beed defined by RATs or other group. The fourth component is Endorser, which will provie the endorsement of RoT. And the verifier could use Endorser to verify the endorsement information of RoT.

Figure 2 is the granularity of remote attestation in I2NSF. One platform could deploy multiple NSFs. In physical environment, NSFs could exist as applications. In virtualization environment, NSFs could exist as VMs. The remote attestation procedure in I2NSF could challenge RoT, Platform and NSFs separately.



| RoT |
+-----+

Figure 2: granularity of remote attestation in I2NSF

[4.2.](#) Root of Trust

Root of Trust is a hardware-based component that could provide endorsement information and relevant functions that cannot be stolen, tampered, or repudiated. RoT MUST be deployed in the basic hardware platform of NSF. Technologies like [[TCGRoT](#)] and [[TEE](#)] could act as RoT.

The architecture of specific RoT is out of scope of this document. But in order to elaborate RoT more clearly, the following segment uses TPM [[tpm12](#)][[tpm20](#)] as an example to explain how RoT works. TPM keeps an EK(Endorsement Key) to identify its identity. EK is an asymmetric root key pair, which will never expose its secret key to public. TPM also derives certain AIKs(Attestation Identity Key) from EK to avoid the exposure of TPM's real identity(EK) during remote attestation. In the booting period, the TPM will record the Hash of measurement of bootloader, OS kernel and applications to a series of PCRs (Platform Configuration Registers), which cannot be tampered. If a remote attestation procedure is initiated, the PCR value will be signed by AIK and send to the verifier for appraising. The specific procedures are based on[I-D.ietf-rats-tpm-based-network-device-attest], which illustrates how integrity verification works inside a network device.

[4.3.](#) Verifier/Relying Party

The Verifier/Relying Party is deployed in Security Controller. In the original architecture of RATs, Verifier and Relying Party could be different components. Verifier is in charge of verifying the remote attestation evidence from attester. The Relying Party is in charge of appraising the attestation result from Verifier. This indicates that the Relying Party does not have to know the detail of

remote attestation evidence and could only focus on the final attestation result and make policies. While in NSF, both the role of Verifier and Relying Party will be included in Security Controller to reduce the redundancy of system.

[4.4.](#) Reference Value Provider

The Developer's Mgmt System is in charge of providing reference value of NSF and the deployment platform. The reference value will be conveyed to Security Controller as the benchmark when verifying remote attestation evidence from attester. When the reference value needs to be collected by third party, the Reference Value Interface or other out-of-band methods in Developer's Mgmt System will be used.

[4.5.](#) Endorser

The Endorser is in charge of providing endorsement to RoT. For example, both EK and AIK in TPM are endorsed by Endorser. The communication between RoT and Endorser is based on specific RoT hardware, and usually has been setup during manufacturing. The Security Controller also needs to communicate with Endorser to get the endorsement of RoT before appraising attestation evidence.

[5.](#) Data Model of I2NSF Remote Attestation

The object of I2NSF remote attestation could be NSF, Platform and RoT. In order to decouple the remote attestation result to granularities, the following table shows the mapping between different components. In the TPM based remote attestation, the PCRs are arranged by specific purpose. PCR 0-10 are responsible for the platform related remote attestation. PCR 11-32 are responsible for the NSF remote attestation. If the platform is a virtual machine architecture, PCR 11-32 will be responsible for each virtual machines. And if the platform is a physical machines architecture, PCR 11-32 will be responsible for each NSF functions. The EAT-based row uses Token to realize remote attestation. EAT SYS Token and EAT NSF TOKEN are responsible for platform and NSF respectively.

	TPM-based	EAT-based
RoT	Device Name TPM Name	Device ID
Platform	Boot event log IMA-List System File PCR 1-10	EAT SYS Token
NSF	IMA-list NSF File PCR 11-32	EAT NSF Token

Figure 3: the mapping between different RoTs

Based on the remote attestation architecture, the relevant interfaces are IRAI (I2NSF Remote Attestation Interface) and IRARVI (I2NSF Remote Attestation Registration Interface). The following document will depict the Yang tree diagram and Yang data model of these two interfaces.

5.1. I2NSF Remote Attestation Interface

IRAI focuses on the remote attestation information between NSF and security controller. This interface will fully comply with existing NSF Monitoring Interface [[I-D.ietf-i2nsf-nsf-monitoring-data-model](#)]. IRAI interface defined notification and RPC for RoT, platform and NSFs. Security Controller could attest the NSF in different granularities.

At present, the RoT type now have two categories, one is TPM-based and the other is TEE-based like TrustZone. And the TPM-based RoT is split into TPM12 and TPM20 versions. It can be expected that trusted computing architectures like Intel SGX [[SGX](#)] or other architectures may also be involved in the near future. When design this interface with TPM-based RoT, this document refers to the existing document[I-D.ietf-rats-yang-tpm-charra] as much as possible to avoid unnecessary alignment work. And about the TEE-based RoT, this document refers to the EAT document[I-D.ietf-rats-eat] and uses binary format to express JWT[RFC7519]or CWT [[RFC8392](#)].

[5.1.1.](#) Yang Tree Diagram of I2NSF Remote Attestation Interface

The Yang tree of i2nsf remote attestation interface is shown below.

```

module: ietf-i2nsf-remote-attestation
  +--rw nsf-pcr-set {tpm:tpms}?
  |   +--rw nsf-name?      nsf-name
  |   +--rw pcr-index?    tpm:pcr
  +--rw eat-set {TEE}?
  |   +--rw algorithm?      enumeration
  |   +--rw cwt-uw-choose?  int32

rpcs:
  +---x nsf-challenge-response
  |   +---w input
  |   |   +---w nsf-name?    nsf-name
  |   |   +---w token?      binary
  |   |   +---w nonce?      uint32
  |   +---ro output
  |   |   +---ro (RoT-type)?
  |   |   |   +---:(TPM12) {TPM12}?
  |   |   |   |   +---ro tpm12-ra
  |   |   |   |   |   +---ro event-number?      uint64
  |   |   |   |   |   +---ro ima-template?      string
  |   |   |   |   |   +---ro filename-hint?     string
  |   |   |   |   |   +---ro filedata-hash?     binary
  |   |   |   |   |   +---ro filedata-hash-algorithm? string
  |   |   |   |   |   +---ro template-hash-algorithm? string
  |   |   |   |   |   +---ro template-hash?     binary
  |   |   |   |   |   +---ro pcr-index?         pcr
  |   |   |   |   |   +---ro signature?         binary
  |   |   |   |   |   +---ro up-time?          uint32
  |   |   |   |   |   +---ro TPM_QUOTE2?       binary
  |   |   |   +---:(TPM20) {TPM20}?
  |   |   |   |   +---ro tpm20-ra
  |   |   |   |   |   +---ro event-number?      uint64
  |   |   |   |   |   +---ro ima-template?      string
  |   |   |   |   |   +---ro filename-hint?     string
  |   |   |   |   |   +---ro filedata-hash?     binary
  |   |   |   |   |   +---ro filedata-hash-algorithm? string
  |   |   |   |   |   +---ro template-hash-algorithm? string
  |   |   |   |   |   +---ro template-hash?     binary
  |   |   |   |   |   +---ro pcr-index?         pcr
  |   |   |   |   |   +---ro signature?         binary
  |   |   |   |   |   +---ro TPMS_QUOTE_INFO   binary
  |   |   |   |   |   +---ro quote-signature?   binary

```

```

|         |         +---ro up-time?                uint32
|         |         +---ro unsigned-pcr-values* []

```

```

|         |         +---ro tpm20-hash-algo?  identityref
|         |         +---ro pcr-values* [pcr-index]
|         |         +---ro pcr-index    pcr
|         |         +---ro pcr-value?   binary
|     +---:(TEE)
|         +---ro header-NSF?           binary
|         +---ro payload-NSF?          binary
|         +---ro signature-NSF?        binary
+---x platform-challenge-response
|   +---w input
|     | +---w token?                    binary
|     | +---w nsf-name?                 nsf-name
|     | +---w nonce?                    int32
|     +---ro output
|       +---ro (RoT-type)?
|         +---:(TPM12) {TPM12}?
|           +---ro tpm12-pra
|             +---ro event-number?      uint64
|             +---ro ima-template?      string
|             +---ro filename-hint?     string
|             +---ro filedata-hash?     binary
|             +---ro filedata-hash-algorithm? string
|             +---ro template-hash-algorithm? string
|             +---ro template-hash?     binary
|             +---ro pcr-index?         pcr
|             +---ro signature?         binary
|             +---ro bios-event-entry* [event-number]
|               | +---ro event-number   uint32
|               | +---ro event-type?    uint32
|               | +---ro pcr-index?     pcr
|               | +---ro digest-list* [hash-alog]
|               | | +---ro hash-algo?   identityref
|               | | +---ro digest*     binary
|               | +---ro event-size?    uint32
|               | +---ro event-data*   uint8
|             +---ro up-time?           uint32
|             +---ro TPM_QUOTE2?        binary
|         +---:(TPM20) {TPM20}?
|           +---ro tpm2-pra

```

```

|         |
|         |         +---ro event-number?          uint64
|         |         +---ro ima-template?        string
|         |         +---ro filename-hint?      string
|         |         +---ro filedata-hash?      binary
|         |         +---ro filedata-hash-algorithm? string
|         |         +---ro template-hash-algorithm? string
|         |         +---ro template-hash?      binary
|         |         +---ro pcr-index?          pcr
|         |         +---ro signature?          binary
|         |

```

```

|         |         +---ro bios-event-entry* [event-number]
|         |         |         +---ro event-number      uint32
|         |         |         +---ro event-type?       uint32
|         |         |         +---ro pcr-index?        pcr
|         |         |         +---ro digest-list* [hash-alog]
|         |         |         |         +---ro hash-algo?  identityref
|         |         |         |         +---ro digest*    binary
|         |         |         +---ro event-size?       uint32
|         |         |         +---ro event-data*       uint8
|         |         +---ro TPMS_QUOTE_INFO             binary
|         |         +---ro quote-signature?           binary
|         |         +---ro up-time?                   uint32
|         |         +---ro unsigned-pcr-values* []
|         |         |         +---ro tpm20-hash-algo?  identityref
|         |         |         +---ro pcr-values* [pcr-index]
|         |         |         |         +---ro pcr-index    pcr
|         |         |         |         +---ro pcr-value?  binary
|         |         +---:(TEE) {TEE}?
|         |         |         +---ro header-platform?   binary
|         |         |         +---ro payload-platform?  binary
|         |         |         +---ro signature-platform? binary
+---x RoT-challenge-response
  +---w input
  | +---w token?      binary
  | +---w nsf-name?   nsf-name
  | +---w nonce?     int32
  +---ro output
  +---ro (RoT-type)?
  +---:(TPM12)
  | +---ro rot-tpm12 {TPM12}?
  |   +---ro rot-name?      ->
  |
  /tpm:rats-support-structures/tpms/tpm/

```

```

    certificates/certificate/name
    |   +--ro certificate-name      certificate-name-ref
    |   +--ro tpm12-hash-algo?     identityref
+--:(TPM20) {TPM20}?
    |   +--ro rot-tpm20
    |   +--ro rot-name?           ->
    |   /tpm:rats-support-structures/tpms/tpm/
    |   certificates/certificate/name
    |   +--ro certificate-name      certificate-name-ref
    |   +--ro tpm20-hash-algo?     identityref
+--:(TEE-general) {TEE}?
    +--ro TEE-UEID?              binary

```

notifications:

```

+---n NSF-remote-attestation-event
|   +--ro event-description?      string

```

```

|   +--ro acquisition-method?     identityref
|   +--ro emission-type?         identityref
|   +--ro dampening-type?        identityref
|   +--ro user                    string
|   +--ro group*                 string
|   +--ro ip-address              inet:ip-address
|   +--ro authentication?        identityref
|   +--ro message?               string
|   +--ro vendor-name?           string
|   +--ro nsf-name?              union
|   +--ro severity?              severity
|   +--ro (RoT-type)?
|       +--:(TPM12) {TPM12}?
|           +--ro tpm12-ra
|               +--ro event-number?      uint64
|               +--ro ima-template?      string
|               +--ro filename-hint?     string
|               +--ro filedata-hash?     binary
|               +--ro filedata-hash-algorithm? string
|               +--ro template-hash-algorithm? string
|               +--ro template-hash?     binary
|               +--ro pcr-index?         pcr
|               +--ro signature?         binary
|               +--ro up-time?           uint32
|               +--ro TPM_QUOTE2?       binary

```

```

+---:(TPM20) {TPM20}?
|   +---ro tpm20-ra
|       +---ro event-number?          uint64
|       +---ro ima-template?          string
|       +---ro filename-hint?         string
|       +---ro filedata-hash?         binary
|       +---ro filedata-hash-algorithm? string
|       +---ro template-hash-algorithm? string
|       +---ro template-hash?         binary
|       +---ro pcr-index?             pcr
|       +---ro signature?             binary
|       +---ro TPMS_QUOTE_INFO         binary
|       +---ro quote-signature?       binary
|       +---ro up-time?                uint32
|       +---ro unsigned-pcr-values* []
|           +---ro tpm20-hash-algo?    identityref
|           +---ro pcr-values* [pcr-index]
|               +---ro pcr-index      pcr
|               +---ro pcr-value?     binary
+---:(TEE)
|   +---ro header-NSF?                binary
|   +---ro payload-NSF?               binary
|   +---ro signature-NSF?             binary

```

```

+---n Platform-remote-attestation-event
|   +---ro event-description?          string
|   +---ro acquisition-method?         identityref
|   +---ro emission-type?             identityref
|   +---ro dampening-type?            identityref
|   +---ro user                        string
|   +---ro group*                      string
|   +---ro ip-address                  inet:ip-address
|   +---ro authentication?            identityref
|   +---ro message?                   string
|   +---ro vendor-name?               string
|   +---ro nsf-name?                  union
|   +---ro severity?                  severity
|   +---ro (RoT-type)?
|       +---:(TPM12) {TPM12}?
|           +---ro tpm12-pra
|               +---ro event-number?    uint64
|               +---ro ima-template?    string

```

```

+---ro filename-hint?           string
+---ro filedata-hash?          binary
+---ro filedata-hash-algorithm? string
+---ro template-hash-algorithm? string
+---ro template-hash?          binary
+---ro pcr-index?               pcr
+---ro signature?               binary
+---ro bios-event-entry* [event-number]
  | +---ro event-number          uint32
  | +---ro event-type?           uint32
  | +---ro pcr-index?            pcr
  | +---ro digest-list* [hash-alog]
  | | +---ro hash-algo?          identityref
  | | +---ro digest*             binary
  | +---ro event-size?           uint32
  | +---ro event-data*           uint8
+---ro up-time?                  uint32
+---ro TPM_QUOTE2?               binary
+---:(TPM20) {TPM20}?
  +---ro tpm2-pra
    +---ro event-number?         uint64
    +---ro ima-template?         string
    +---ro filename-hint?        string
    +---ro filedata-hash?        binary
    +---ro filedata-hash-algorithm? string
    +---ro template-hash-algorithm? string
    +---ro template-hash?        binary
    +---ro pcr-index?            pcr
    +---ro signature?            binary
    +---ro bios-event-entry* [event-number]

```

```

  | +---ro event-number          uint32
  | +---ro event-type?           uint32
  | +---ro pcr-index?            pcr
  | +---ro digest-list* [hash-alog]
  | | +---ro hash-algo?          identityref
  | | +---ro digest*             binary
  | +---ro event-size?           uint32
  | +---ro event-data*           uint8
+---ro TPMS_QUOTE_INFO           binary
+---ro quote-signature?         binary
+---ro up-time?                  uint32

```

```

|         |         +---ro unsigned-pcr-values* []
|         |         +---ro tpm20-hash-algo?  identityref
|         |         +---ro pcr-values* [pcr-index]
|         |             +---ro pcr-index    pcr
|         |             +---ro pcr-value?  binary
|         +---:(TEE) {TEE}?
|         +---ro header-platform?        binary
|         +---ro payload-platform?       binary
|         +---ro signature-platform?     binary
+----n RoT-remote-attestation-event
    +---ro event-description?            string
    +---ro acquisition-method?          identityref
    +---ro emission-type?               identityref
    +---ro dampening-type?              identityref
    +---ro user                          string
    +---ro group*                        string
    +---ro ip-address                    inet:ip-address
    +---ro authentication?               identityref
    +---ro message?                      string
    +---ro vendor-name?                  string
    +---ro nsf-name?                     union
    +---ro severity?                     severity
    +---ro (RoT-type)?
        +---:(TPM12)
        | +---ro rot-tpm12 {TPM12}?
        |     +---ro rot-name?           ->
        |     /tpm:rats-support-structures/tpms/tpm/
        |     certificates/certificate/name
        |     +---ro certificate-name    certificate-name-ref
        |     +---ro tpm12-hash-algo?   identityref
        +---:(TPM20) {TPM20}?
        | +---ro rot-tpm20
        |     +---ro rot-name?           ->
        |     /tpm:rats-support-structures/tpms/tpm/
        |     certificates/certificate/name
        |     +---ro certificate-name    certificate-name-ref
        |     +---ro tpm20-hash-algo?   identityref

```

```

+---:(TEE-general) {TEE}?
    +---ro TEE-UEID?      binary

```


The Yang Model of I2NSF Remote Attestation Interface is shown below.

```
module ietf-i2nsf-remote-attestation {
  yang-version 1.1;
  namespace
    "urn:ietf:params:xml:ns:yang:ietf-i2nsf-remote-attestation";
  prefix
    nsfra;
  import ietf-i2nsf-nsf-monitoring{
    prefix nsfmi;
  }
  reference
    "Section 9 of draft-ietf-i2nsf-nsf-facing-interface";
  import ietf-tpm-remote-attestation{
    prefix tpm;
  }
  import ietf-inet-types{
    prefix inet;
  }
  reference
    "section 4 of RFC 6991";
  organization
    "IETF I2NSF (Interface to Network Security Functions)
    Working Group";
  contact
    "WG Web: <http://tools.ietf.org/wg/i2nsf>
    WG List: <mailto:i2nsf@ietf.org>

    Editor: Penglin Yang
    <mailto:yangpenglin@chinamobile.com>";

  description
    "This module is a YANG module for I2NSF Remote
    Attestation Interface.";
  feature TPM12{
    description
      "This device is for TPM12 remote attestation";
  }
  feature TPM20{
    description
      "This device is for TPM20 remote attestation";
  }
  feature TEE{
```

```
    description
      "This device is for general TEE remote attestation";
  }
  typedef nsf-name{
    type union{
      type string;
      type inet:ip-address-no-zone;
    }
    description
      "nsf-name for remote attestation";
  }
  identity RoT-type{
    description
      "RoT have different types, like TPM, TEE, etc.";
  }
  identity TPM12{
    base RoT-type;
    description
      "RoT type is TPM1.2";
  }
  identity TPM20{
    base RoT-type;
    description
      "RoT type is TPM2.0";
  }
  identity TEE{
    base RoT-type;
    description
      "RoT type is TEE";
  }
  identity cwt{
    description
      "cbor web token for remote attestation";
  }
  identity jwt{
    description
      "json web token for remote attestation";
  }
  identity nsf-name{
    description
      "nsf name";
  }
}

grouping nsf-remote-attestation{
  description
    "This grouping is for certain nsf's remote attestation result.";
  choice RoT-type{
```

```
case TPM12{
```

```
    if-feature "TPM12";
    description
        "The filename hint of IMA log item is NSF name. The range
        of PCR index is defined as 11~32.";
    container tpm12-ra{
        uses tpm:ima-event;
        uses tpm:tpm12-attestation;
    }
}
case TPM20{
    if-feature "TPM20";
    container tpm20-ra{
        uses tpm:ima-event;
        uses tpm:tpm20-attestation;
    }
}
case TEE{
    description
        "EAT for NSF remote attestation";
    leaf header-NSF{
        type binary;
    }
    leaf payload-NSF{
        type binary;
    }
    leaf signature-NSF{
        type binary;
    }
}
}
}
grouping platform-remote-attestation{
    description
        "this item is for platform remote attestation";
    choice RoT-type{
        case TPM12{
            if-feature "TPM12";
            container tpm12-pra{
                uses tpm:ima-event;
                uses tpm:bios-event-log;
```

```

        uses tpm:tpm12-attestation;
    }
}
case TPM20{
    if-feature "TPM20";
    container tpm20-pra{
        uses tpm:ima-event;
        uses tpm:bios-event-log;
    }
}

```

```

        uses tpm:tpm20-attestation;
    }
}
case TEE{
    if-feature "TEE";
    description
        "EAT for Platform Remote Attestation";
    leaf header-platform{
        type binary;
    }
    leaf payload-platform{
        type binary;
    }
    leaf signature-platform{
        type binary;
    }
}
}
}
grouping RoT-remote-attestation{
    description
        "this item is for the identity of platform and RoT";
    choice RoT-type{
        case TPM12{
            container rot-tpm12{
                if-feature "TPM12";
                description
                    "the identity of TPM could be represented by
                    TPM-name and certificate";
                leaf rot-name{
                    type leafref {
                        path "/tpm:rats-support-structures/tpm:tpms/tpm:tpm"
                        + "/tpm:certificates/tpm:certificate/tpm:name";
                    }
                }
            }
        }
    }
}

```

```

        }
    }
    uses tpm:certificate-name-ref;
    uses tpm:tpm12-hash-algo;
}
}
case TPM20{
    if-feature "TPM20";
    description
        "the identity of TPM could be represented
        by TPM-name and certificate";
    container rot-tpm20{
        leaf rot-name{
            type leafref {
                path "/tpm:rats-support-structures/tpm:tpms/tpm:tpm"

```

```

        + "/tpm:certificates/tpm:certificate/tpm:name";
    }
}
uses tpm:certificate-name-ref;
uses tpm:tpm20-hash-algo;
}
}
case TEE-general{
    if-feature "TEE";
    leaf TEE-UEID{
        type binary;
    }
}
}
}
notification NSF-remote-attestation-event{
    description
        "Event that triggered the NSF remote attestation
        will use this notification";
    leaf event-description{
        description
            "describe the reason why notification was triggered";
        type string;
    }
}
uses nsfmi:characteristics;
uses nsfmi:i2nsf-system-event-type-content;

```

```

    uses nsfmi:common-monitoring-data;
    uses nsf-remote-attestation;
}
notification Platform-remote-attestation-event{
  description
    "Event that triggered the platform remote attestation
    will use this notification ";
  leaf event-description{
    description
      "describe why this notification was triggered";
    type string;
  }
  uses nsfmi:characteristics;
  uses nsfmi:i2nsf-system-event-type-content;
  uses nsfmi:common-monitoring-data;
  uses platform-remote-attestation;
}
notification RoT-remote-attestation-event{
  description
    "Event that triggered the rot remote attestation
    will use this notification";
  leaf event-description{

```

```

    description
      "describe why this notification was triggered";
    type string;
  }
  uses nsfmi:characteristics;
  uses nsfmi:i2nsf-system-event-type-content;
  uses nsfmi:common-monitoring-data;
  uses RoT-remote-attestation;
}

//token in RPC is for specify the identity of RPC caller. //
grouping token{
  description
    "this token is for identify rpc caller. How to define
    this token, oauth, JWT, or other? Or not necessary, TBD";
  leaf token{
    type binary;
  }
}
}

```

```

rpc nsf-challenge-response{
  description
    "this is the unified rpc for nsf remote attestation";
  input{
    leaf nsf-name{
      type nsf-name;
    }
    uses token;
    leaf nonce{
      type uint32;
    }
  }
  output{
    uses nsf-remote-attestation;
  }
}
rpc platform-challenge-response{
  description
    "this rpc is for platform challenge ";
  input{
    uses token;
    leaf nsf-name{
      type nsf-name;
    }
    leaf nonce{
      type int32;
    }
  }
  output{

```

```

    uses platform-remote-attestation;
  }
}
rpc RoT-challenge-response{
  input{
    uses token;
    leaf nsf-name{
      type nsf-name;
    }
    leaf nonce{
      type int32;
    }
  }

```

```

    }
    output{
        uses RoT-remote-attestation;
    }
}

//*****//
// configuration about PCR and NSF set. //
//*****//
container nsf-pcr-set{
    description
        "this container is used for NSF-name, IMA log and
        PCR index setting. NSF-name needs to be set as the
        IMA item filename-hint, the pcr value need to be
        set as the IMA pcr index.";
    if-feature "tpm:tpms";
    leaf nsf-name{
        type nsf-name;
    }
    leaf pcr-index{
        type tpm:pcr;
    }
}

//*****//
// configuration about EAT set. //
//*****//
container eat-set{
    description
        "this container is for NSF-name set in EAT environment";
    if-feature "TEE";
    leaf algorithm{
        description
            "set the signing algorithm for generating EAT";
        type enumeration{
            enum HS256;//hmac with sha256

```

```

        enum RS256;//rsa with sha256
    }
}
leaf cwt-uwat-choose{
    type int32;

```



```
    description
      "0 is cwt, 1 is uccs, 2 is jwt";
  }
}
```

[5.2.](#) I2NSF Remote Attestation Reference Value Interface

The reference value of a NSF needs to be conveyed by I2NSF Remote Attestation Reference Value Interface. The interface works between Security Controller and Developer's Management System.

[5.2.1.](#) Yang Tree Diagram of I2NSF Remote Attestation Reference Value Interface

```

module: ietf-i2nsf-remote-attestation-reference-value
  +--rw nsf-tpm-reference-value-registration
  |   +--rw nsf-name          nsf-name
  |   +--rw ima-template?    string
  |   +--rw nsf-hash?        binary
  |   +--rw nsf-hash-algorithm? string
  |   +--rw pcr-index?       pcr
  +--rw nsf-tee-reference-value-registration
  |   +--rw nsf-name          nsf-name
  |   +--rw header-NSF?      binary
  |   +--rw payload-NSF?     binary
  |   +--rw signature-NSF?   binary
  +--rw rot-reference-value-registration
  |   +--rw (RoT-type)?
  |   |   +--:(TPM12) {TPM12}?
  |   |   |   +--rw rot-tm12
  |   |   |   |   +--rw rot-tpm12-name?    string
  |   |   |   |   +--rw certificate-name    certificate-name-ref
  |   |   |   |   +--rw tpm12-hash-algo?   identityref
  |   |   |   +--:(TPM20) {TPM20}?
  |   |   |   |   +--rw rot-tpm20
  |   |   |   |   |   +--rw rot-tpm20-name?    string
  |   |   |   |   |   +--rw certificate-name    certificate-name-ref
  |   |   |   |   |   +--rw tpm20-hash-algo?   identityref
  |   |   |   +--:(TEE) {TEE}?
  |   |   |   |   +--rw TEE-UEID?          binary
  +--rw platform-tpm-reference-value-registration
  |   +--rw platform-name      string
  |   +--rw ima-template?      string
  |   +--rw nsf-hash?          binary
  |   +--rw nsf-hash-algorithm? string
  |   +--rw pcr-index?         pcr
  +--rw platform-tee-remote-attestation-reference-value
  |   +--rw platform-name      nsf-name
  |   +--rw header-NSF?        binary
  |   +--rw payload-NSF?       binary
  |   +--rw signature-NSF?     binary

```

[5.2.2.](#) Yang Data Model of I2NSF Remote Attestation Reference Value Interface

The Yang Model of I2NSF Remote Attestation Reference Value Interface is shown below. The registration information will refer to the measurement logs and algorithms of remote attestation. The log information contains all the information needed by Security Controller to appraise attester's evidence.

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```
module ietf-i2nsf-remote-attestation-reference-value {
  yang-version 1.1;
  namespace
    "urn:ietf:params:xml:ns:yang:ietf-i2nsf-remote-
      attestation-reference-value";
  prefix
    nsfrarv;

  import ietf-tpm-remote-attestation{
    prefix tpm;
  }
  import ietf-inet-types{
    prefix inet;
  }
  organization
    "IETF I2NSF (Interface to Network Security Functions)
      Working Group";
  contact
    "WG Web: <http://tools.ietf.org/wg/i2nsf>
      WG List: <mailto:i2nsf@ietf.org>
      Editor: Penglin Yang
      <mailto:yangpenglin@chinamobile.com>";

  description
    "This module is a YANG module for I2NSF NSF remote
      attestation reference value.";

  identity RoT-type{
    description
      "RoT have different types, like TPM, TEE, etc.";
  }

  identity TPM12{
    base RoT-type;
    description
      "RoT type is TPM1.2";
  }
  identity TPM20{
    base RoT-type;
    description
      "RoT type is TPM2.0";
  }
}
```

```
identity TEE{
  base RoT-type;
  description
    "RoT type is TEE general";
}
feature TPM12{
```

```
  description
    "tpm 1.2 version";
}
feature TPM20{
  description
    "tpm 2.0 version";
}
feature TEE{
  description
    "TEE version";
}
typedef nsf-name{
  type union{
    type string;
    type inet:ip-address-no-zone;
  }
  description
    "nsf-name for regular expression";
}
typedef pcr{
  type uint8{
    range "0..31";
  }
}

container nsf-tpm-reference-value-registration{
  description
    "the reference value is for nsf in tpm20 platform";
  leaf nsf-name{
    type nsf-name;
    mandatory true;
    description
      "The name of nsf";
  }
  leaf ima-template {
```

```

    type string;
    description
        "Name of the template used for event logs
        for e.g. ima, ima-ng, ima-sig";
}
leaf nsf-hash {
    type binary;
    description
        "Hash of nsf file/image";
}
leaf nsf-hash-algorithm {
    type string;
    description

```

```

        "Algorithm used for filedata-hash";
    }
    leaf pcr-index {
        type pcr;
        description
            "Defines the PCR index that stores this nsf";
    }
}
container nsf-tee-reference-value-registration{
    description
        "the reference value is for nsf in TEE platform";
    leaf nsf-name{
        type nsf-name;
        mandatory true;
        description
            "The name of nsf";
    }
    leaf header-NSF{
        type binary;
    }
    leaf payload-NSF{
        type binary;
    }
    leaf signature-NSF{
        type binary;
    }
}
container rot-reference-value-registration{

```

```

description
    "this container is for root of trust reference value";
choice RoT-type{
    case TPM12{
        if-feature "TPM12";
        description
            "the identity of TPM could be represented by
            TPM-name and certificate";
        container rot-tm12{
            leaf rot-tpm12-name{
                type string;
            }
            uses tpm:certificate-name-ref;
            uses tpm:tpm12-hash-algo;
        }
    }
    case TPM20{
        if-feature "TPM20";
        description
            "the identity of TPM could be represented by

```

```

        TPM-name and certificate";
    container rot-tpm20{
        leaf rot-tpm20-name{
            type string;
        }
        uses tpm:certificate-name-ref;
        uses tpm:tpm20-hash-algo;
    }
}
case TEE{
    if-feature "TEE";
    leaf TEE-UEID{
        //provide a UEID to identify TEE
        type binary;
    }
}
}
}
container platform-tpm-reference-value-registration{
    description
        "this container is for platform reference value";

```

```

leaf platform-name{
  type string;
  mandatory true;
  description
    "The name of nsf";
}
leaf ima-template {
  type string;
  description
    "Name of the template used for event logs
    for e.g. ima, ima-ng, ima-sig";
}
leaf nsf-hash {
  type binary;
  description
    "Hash of nsf file/image";
}
leaf nsf-hash-algorithm {
  type string;
  description
    "Algorithm used for filedata-hash";
}
leaf pcr-index {
  type pcr;
  description
    "Defines the PCR index that stores this nsf";
}

```

```

}
container platform-tee-remote-attestation-reference-value{
  description
    "the reference value is for platform in TEE platform";
  leaf platform-name{
    type nsf-name;
    mandatory true;
    description
      "The name of nsf";
  }
  leaf header-NSF{
    type binary;
  }
  leaf payload-NSF{

```

```
    type binary;
  }
  leaf signature-NSF{
    type binary;
  }
}
```

6. IANA Considerations

This document requests IANA to register the following URI in the "IETF XML Registry" [RFC 3688](#) [[RFC3688](#)]:

URI: urn:ietf:params:xml:ns:yang:ietf-i2nsf-remote-attestation
Registrant Contact: The IESG.

XML: N/A; the requested URI is an XML namespace.

URI: urn:ietf:params:xml:ns:yang:ietf-i2nsf-remote-attestation-reference-value
Registrant Contact: The IESG.

XML: N/A; the requested URI is an XML namespace.

This document requests IANA to register the following YANG module in the "YANG Module Names" registry [RFC 7950](#) [[RFC7950](#)] [RFC 8525](#) [[RFC8525](#)]:

Name: ietf-i2nsf-remote-attestation-interface

Namespace: urn:ietf:params:xml:ns:yang:ietf-i2nsf-remote-attestation

Prefix: nsfra

Reference: RFC XXXX

Name: ietf-i2nsf-remote-attestation-reference-value-interface

Namespace: urn:ietf:params:xml:ns:yang:ietf-i2nsf-remote-attestation-reference-value

Prefix: nsfteri

Reference: RFC XXXX

7. Security Considerations

This document introduces the architecture of I2NSF remote attestation and designs related interfaces. Different RoT architectures have different trust ability and different appearance. Security Controller will determine if it will trust these remote attestation results by customized policy rules. The I2NSF remote attestation interfaces need to be protected by secure channel when transmission occurs. Meanwhile, the remote attestation results in interfaces are protected by their own mechanisms like TPM signature or token.

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