Network Working Group
Internet Draft
Intended Status: Informational
Expires: October 25, 2012

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April 23, 2012

Additional Methods for Generating Key Identifiers
draft-turner-additional-methods-4kis-03.txt

Abstract

This document specifies additional methods for generating key identifiers from a public key. This document also specifies an extension to identify the algorithms used to generate the key identifiers.

Status of this Memo

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1. Introduction

[RFC5280] defines the AKI (Authority Key Identifier) and SKI (Subject Key Identifier) certificate extensions. These extensions allow one certificate to refer to another certificate via the matching of these corresponding values. These identifiers enable a relying party to disambiguate between two CA (Certification Authority) certificates with the same Subject name, located in the same directory entry. These identifiers are used during certification path construction in support of heuristics to reduce relying party workload. These identifiers are not used during certificate path validation. These key identifiers are used by PKI-enabled security protocols, such as CMP (Certificate Management Protocol) [RFC4210] and CMS (Cryptographic Message Syntax) [RFC5652], to identify the certificate used to protect a message, a session, etc.

[RFC5280] describes two example mechanisms for generating AKI/SKI values: a 160-bit SHA-1 (Secure Hash Algorithm) hash of the public key and a four-bit type field with the value 0100 followed by the least significant 60 bits of the SHA-1 hash. Both of these mechanisms were designed to be non-security critical. That is, the use of a hash algorithm was intended to provide a high probability (but not a guarantee) of uniqueness. [RFC5280] allows for additional mechanisms. (This is consistent with the fact that the SKI and AKI extensions are always marked non-critical.)

This document defines four additional mechanisms for generating key identifier values, using SHA-224, SHA-256, SHA-384, and SHA-512 [SHS]. Sample code for SHA-224, SHA-256, SHA-384, and SHA-512 can be found in [RFC6234]. The motivation for defining these additional means of generating AKI/SKI values is to accommodate use of additional, standard one-way hash functions that are becoming more widely used in PKI contexts.

The additional key identifier generation mechanisms described in this document maintain the 160-bit value size, to avoid adversely affecting relying party code. With these additional mechanisms, CAs can omit code for algorithms that are otherwise unwanted or unused. For example, a CA that issues certificates hashed with SHA-256 and signed with ECDSA on the P-256 curve [RFC5480] might no longer need to implement SHA-1 as part of their CA application.

This document also specifies an extension to identify the algorithms used to generate the key identifiers. The extension also identifies the hash algorithm input used to generate to the key identifier.

1.1. Requirements Terminology

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 [RFC2119].

1.2. ASN.1

The extension is defined using ASN.1 [X.680], [X.681], [X.682], and [X.683].

2. Additional Methods for Generating Key Identifiers

As specified in [RFC5280], both authority and subject key identifiers SHOULD be derived from the public key. Four additional mechanisms CAs can use to identify public keys are as follows:

1) The keyIdentifier is composed of the least significant 160-bits of the SHA-224 hash of the value of the BIT STRING subjectPublicKey (excluding the tag, length, and number of unused bits).

2) The keyIdentifier is composed of the least significant 160-bits of the SHA-256 hash of the value of the BIT STRING subjectPublicKey (excluding the tag, length, and number of unused bits).

3) The keyIdentifier is composed of the least significant 160-bits of the SHA-384 hash of the value of the BIT STRING subjectPublicKey (excluding the tag, length, and number of unused bits).

4) The keyIdentifier is composed of the least significant 160-bits of the SHA-512 hash of the value of the BIT STRING subjectPublicKey (excluding the tag, length, and number of unused bits).

3. Key Identifier Algorithm and Length Extension

The key identifier algorithm and length extension indicates the hash algorithm used to compute the key identifier and the length of the resulting key identifier. This extension MAY, at the option of the certificate issuer, be either critical or non-critical. This extension is identified by id-pe-skiAlgAndLen.

```
ext-kiAlgAndLen EXTENSION ::= {
  SYNTAX KIAlgAndLens
  IDENTIFIED BY id-pe-kiAlgAndLen }

id-pe-kiAlgAndLen OBJECT IDENTIFIER ::= { id-pe TBD }

KIAlgAndLens ::= SEQUNENCE {
  aki  [0] KIAlgAndLen OPTIONAL,
  ski  [1] KIAlgAndLen OPTIONAL }

KIAlgAndLen ::= SEQUNENCE {
  kiAlgorithm   AlgorithmIdentifier
                   { DIGEST-ALGORITHM, {DigestAlgorithmSet} },
  kiHashInput   OBJECT IDENTIFIER (HashInputs, ...) OPTIONAL,
  kiLength      INTEGER OPTIONAL }

HashInputs OBJECT IDENTIFIER ::= {
  id-subjectPublicKey, ... }

id-subjectPublicKey OBJECT IDENTIFIER ::= { id-tbd }
```

If this extension is included in a certificate, then either the aki, ski, or both MUST be included. KIAlgAndLen has two fields:

- o kiAlgorithm indicates the algorithm used to generate the key identifier. For example, if the CA wanted to indicate that one of the algorithms listed in Section 2 was used, then it would include OIDs (Object Identifiers) from [RFC5758].

- o kiHashInput indicates the semantics for the input to the hash algorithm. If this field is absent then only the public key is hashed. This document defines the OID id-subjectPublicKeyInfo to be used when the input to the hash algorithm is the certificate's SubjectPublicKeyInfo field [RFC5280].

- o kiLength indicates the length of the key identifier. It MUST be included if the key identifier is truncated (i.e., the length is shorter than the output of the hash algorithm); otherwise, it is OPTIONAL. For example, the output lengths of the hash algorithms defined in Section 2 are for 224, 256, 384, and 512-bits but all

would indicate 160 to truncated to 160-bits for SHA-224, SHA-256, SHA-384, and SHA-512 bits.

4. Security Considerations

The security considerations of [RFC5280] apply to certificates. The security considerations of [RFC5758] apply to the hash algorithms. The security considerations of [RFC5912] apply to the ASN.1.

While hash algorithms provide collision resistance, this property is not needed for key identifiers.

5. IANA Considerations

None.

NOTE there are some OIDs that need to be registered in the PKIX Arc. This will be completed later in the process.

6. References

6.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC5280] Cooper, D., Santesson, S., Farrell, S., Boeyen, S., Housley, R., and W. Polk, "Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile", RFC 5280, May 2008.

[RFC5758] Dang, Q., Santesson, S., Moriarty, K., Brown, D., and T. Polk, "Internet X.509 Public Key Infrastructure: Additional Algorithms and Identifiers for DSA and ECDSA", RFC 5758, January 2010.

[RFC5912] Hoffman, P. and J. Schaad, "New ASN.1 Modules for the Public Key Infrastructure Using X.509 (PKIX)", RFC 5912, June 2010.

[SHS] National Institute of Standards and Technology (NIST), FIPS Publication 180-3: Secure Hash Standard, October 2008.

[X.680] ITU-T Recommendation X.680 (2002) | ISO/IEC 8824-1:2002, Information technology - Abstract Syntax Notation One (ASN.1): Specification of basic notation.

[X.681] ITU-T Recommendation X.681 (2002) | ISO/IEC 8824-2:2002, Information Technology - Abstract Syntax Notation One: Information Object Specification.

[X.682] ITU-T Recommendation X.682 (2002) | ISO/IEC 8824-3:2002, Information Technology - Abstract Syntax Notation One: Constraint Specification.

[X.683] ITU-T Recommendation X.683 (2002) | ISO/IEC 8824-4:2002, Information Technology - Abstract Syntax Notation One: Parameterization of ASN.1 Specifications.

6.2. Informative References

[RFC4210] Adams, C., Farrell, S., Kause, T., and T. Mononen, "Internet X.509 Public Key Infrastructure Certificate Management Protocol (CMP)", RFC 4210, September 2005.

[RFC5652] Housley, R., "Cryptographic Message Syntax (CMS)", STD 70, RFC 5652, September 2009.

[RFC5480] Turner, S., Brown, D., Yiu, K., Housley, R., and T. Polk, "Elliptic Curve Cryptography Subject Public Key Information", RFC 5480, March 2009.

[RFC6234] Eastlake 3rd, D. and T. Hansen, "US Secure Hash Algorithms (SHA and SHA-based HMAC and HKDF)", RFC 6234, May 2011.

Appendix A ASN.1 Module

```
KIAlgAndLen-2012
   { iso(1) identified-organization(3) dod(6) internet(1)
     security(5) mechanisms(5) pkix(7) id-mod(0)
     id-mod-skiAlgAndLen(TBD) }

  DEFINITIONS EXPLICIT TAGS ::=
  BEGIN
  IMPORTS

  -- Imports are all from [RFC5912]

  id-pe
    FROM PKIX1Explicit-2009
      { iso(1) identified-organization(3) dod(6) internet(1)
        security(5) mechanisms(5) pkix(7) id-mod(0)
        id-mod-pkix1-explicit-02(51) }

  AlgorithmIdentifier{}, DIGEST-ALGORITHM
    FROM AlgorithmInformation-2009
      { iso(1) identified-organization(3) dod(6) internet(1)
        security(5) mechanisms(5) pkix(7) id-mod(0)
        id-mod-algorithmInformation-02(58) }

  mda-sha224, mda-sha256, mda-sha384, mda-sha512
    FROM PKIX1-PSS-OAEP-Algorithms-2009
      { iso(1) identified-organization(3) dod(6) internet(1)
        security(5) mechanisms(5) pkix(7) id-mod(0)
        id-mod-pkix1-rsa-pkalgs-02(54) } ;

  ext-skiAlgAndLen EXTENSION ::= {
    SYNTAX SKIAlgAndLen
    IDENTIFIED BY id-pe-skiAlgAndLen }

  id-pe-skiAlgAndLen OBJECT IDENTIFIER ::= { id-pe TBD }

  KIAlgAndLens ::= SEQUNENCE {
    aki  [0] KIAlgAndLen OPTIONAL,
    ski  [1] KIAlgAndLen OPTIONAL }

  KIAlgAndLen ::= SEQUNENCE {
    kiAlgorithm   AlgorithmIdentifier
                     { DIGEST-ALGORITHM, { KIHashAlgs } },
    kiHashInput   OBJECT IDENTIFIER (HashInputs, ...) OPTIONAL,
    kiLength      INTEGER OPTIONAL }
```

```
KIHashAlgs DIGEST-ALGORITHM ::= {
  mda-224, mda-256, mda-384, mda-512, ... }

HashInputs OBJECT IDENTIFIER ::= {
  id-subjectPublicKey, ... }

id-subjectPublicKey OBJECT IDENTIFIER ::= { id-tbd }


END
```

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