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The Profile for Algorithms and Key Sizes for use in the Resource Public
Key Infrastructure
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Abstract

This document specifies the algorithms, algorithms' parameters, asymmetric key formats, asymmetric key size, and signature format for the Resource Public Key Infrastructure (RPKI) subscribers that generate digital signatures on certificates, Certificate Revocation Lists (CRLs), Cryptographic Message Syntax (CMS) signed objects and certification requests as well as for the relying parties (RPs) that verify these digital signatures.

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1. Introduction

This document specifies:

- * the digital signature algorithm and parameters;
- * the hash algorithm and parameters;
- * the public and private key formats; and,
- * the signature format

used by Resource Public Key Infrastructure (RPKI) [[RFC6480](#)] subscribers when they apply digital signatures to certificates and Certificate Revocation Lists (CRLs) [[RFC5280](#)], Cryptographic Message Syntax (CMS) signed objects [[RFC5652](#)] (e.g., Route Origin Authorizations (ROAs) [[RFC6482](#)] and manifests [[RFC6486](#)]), and certification requests [[RFC2986](#)][RFC4211]. Relying parties (RPs) also use the algorithms defined in this document to verify RPKI subscribers' digital signatures [[RFC6480](#)].

This document is referenced by other RPKI profiles and specifications, including the RPKI Certificate Policy (CP) [[RFC6484](#)], the RPKI Certificate Profile [[RFC6487](#)], the RPKI Architecture [[RFC6480](#)], and the Signed Object Template for the RPKI [[RFC6488](#)]. Familiarity with these documents is assumed.

1.1. 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](#)].

2. Algorithms

Two cryptographic algorithms are used in the RPKI:

- * The signature algorithm used in certificates, CRLs, CMS signed objects, and certification requests is RSA Public-Key Cryptography Standards (PKCS) #1 Version 1.5 (sometimes referred to as "RSASSA-PKCS1-v1_5") from [Section 8.2 of \[RFC3447\]](#).
- * The hashing algorithm used in certificates, CRLs, CMS signed objects and certification requests is SHA-256 [[SHS](#)] (see note below).

NOTE: The exception is the use of SHA-1 [[SHS](#)] when CAs generate authority and subject key identifiers [[RFC6487](#)].

In certificates, CRLs, and certification requests the hashing and digital signature algorithms are identified together, i.e., "RSA PKCS#1 v1.5 with SHA-256" or more simply "RSA with SHA-256". The Object Identifier (OID) sha256WithRSAEncryption from [[RFC4055](#)] MUST be used in these products.

The OID is in the following locations:

In the certificate, the OID appears in the signature and signatureAlgorithm fields [[RFC4055](#)];

In the CRL, the OID appears in the signatureAlgorithm field [[RFC4055](#)]; and

In a certification request, the OID appears in the PKCS #10 signatureAlgorithm field [[RFC2986](#)], or in the Certificate Request Message Format (CRMF) POPOSigningKey algorithmIdentifier field [[RFC4211](#)].

In CMS SignedData, the hashing (message digest) and digital signature algorithms are identified separately. The object identifier and parameters for SHA-256 (as defined in [[RFC5754](#)]) MUST be used for the SignedData digestAlgorithms field and the SignerInfo digestAlgorithm field. The object identifier and parameters for rsaEncryption [[RFC3370](#)] MUST be used for the SignerInfo signatureAlgorithm field when generating CMS SignedData objects. RPKI implementations MUST accept either rsaEncryption or sha256WithRSAEncryption for the SignerInfo signatureAlgorithm field when verifying CMS SignedData objects (for compatibility with objects produced by implementations conforming to [[RFC6485](#)]).

3. Asymmetric Key Pair Formats

The RSA key pairs used to compute the signatures MUST have a 2048-bit modulus and a public exponent (e) of 65,537.

3.1. Public Key Format

The subject's public key is included in subjectPublicKeyInfo [[RFC5280](#)]. It has two sub-fields: algorithm and subjectPublicKey. The values for the structures and their sub-structures follow:

algorithm (which is an AlgorithmIdentifier type):

The object identifier for RSA PKCS#1 v1.5 with SHA-256 MUST be used in the algorithm field, as specified in [Section 5 of](#) [[RFC4055](#)]. The value for the associated parameters from that clause MUST also be used for the parameters field.

subjectPublicKey:

RSAPublicKey MUST be used to encode the certificate's subjectPublicKey field, as specified in [\[RFC4055\]](#).

3.2. Private Key Format

Local policy determines the private key format.

4. Signature Format

The structure for the certificate's signature field is as specified in [Section 1.2 of \[RFC4055\]](#). The structure for the CMS SignedData's signature field is as specified in [\[RFC5652\]](#).

5. Additional Requirements

It is anticipated that the RPKI will require the adoption of updated key sizes and a different set of signature and hash algorithms over time, in order to maintain an acceptable level of cryptographic security to protect the integrity of signed products in the RPKI. This profile should be replaced to specify such future requirements, as and when appropriate.

Certification Authorities (CAs) and RPs SHOULD be capable of supporting a transition to allow for the phased introduction of additional encryption algorithms and key specifications, and also accommodate the orderly deprecation of previously specified algorithms and keys. Accordingly, CAs and RPs SHOULD be capable of supporting multiple RPKI algorithm and key profiles simultaneously within the scope of such anticipated transitions. The recommended procedures to implement such a transition of key sizes and algorithms is specified in [\[RFC6916\]](#)

6. Security Considerations

The Security Considerations of [\[RFC4055\]](#), [\[RFC5280\]](#), and [\[RFC6487\]](#) apply to certificate and CRLs. The Security Considerations of [\[RFC2986\]](#), [\[RFC4211\]](#), and [\[RFC6487\]](#) apply to certification /> requests. The Security Considerations of [\[RFC5754\]](#) apply to CMS signed objects. No new security threats are introduced as a result of this specification.

7. IANA Considerations

[Remove before publication. There are no IANA considerations in this document.]

8. Changes Aplied to [RFC6485](#)

This update includes a slight technical change to [\[RFC6485\]](#) that is considered to be outside the limited scope of an erratum. The document update process has included other errata and also corrected a number of nits.

[Section 2 of \[RFC6485\]](#) specified sha256WithRSAEncryption as the OID to use for the SignerInfo signatureAlgorithm field in CMS SignedObjects. However, existing implementations use the rsaEncryption OID for this field. (Support for rsaEncryption in 3rd party cryptographic libraries is better than sha256WithRSAEncryption, perhaps because [\[RFC3370\]](#) says that support for rsaEncryption is required while support for OIDs that specify both RSA and a digest algorithm is optional.)

Rather than force existing implementations to switch to sha256WithRSAEncryption, this document was changed to follow existing practice. This does not represent a cryptographic algorithm change, just an identifier change. (Unlike certificates, CRLs, and certification requests, CMS signed objects have a separate algorithm identifier field for the hash (digest) algorithm, and that field is already required to contain the id-sha256 OID per [Section 2](#).)

To avoid compatibility problems, RPs are still required to accept sha256WithRSAEncryption if encountered.

Other changes include:

- * Minor wording and typo fixes.
- * Some incorrect references were fixed ([\[RFC5652\]](#) instead of [\[RFC3370\]](#), [\[RFC3447\]](#) instead of [\[RFC4055\]](#)).
- * Additional citations were added to the Introduction.
- * [Section 2](#) now references the correct CRMF POPOSigningKey field (algorithmIdentifier instead of signature).
- * Certification requests are now mentioned along with certificates, CRLs, and CMS signed objects.
- * [Section 5](#) now cites [\[RFC6916\]](#) (algorithm agility).
- * "Signed object" is now "CMS signed object" everywhere.

9. Acknowledgments

The authors acknowledge the reuse in this document of material originally contained in working drafts the RPKI Certificate Policy [RFC6484] and resource certificate profile [RFC6487] documents. The co-authors of these two documents, namely Stephen Kent, Derrick Kong, Karen Seo, Ronald Watro, George Michaelson and Robert Loomans, are acknowledged, with thanks. The constraint on key size noted in this profile is the outcome of comments from Stephen Kent and review comments from David Cooper. Sean Turner has provided additional review input to this document.

Andrew Chi and David Mandelberg discovered the issue addressed in this update to [RFC6485], and the changes in this updated specification reflect the outcome of a discussion between Rob Austein and Matt Lepinski on the SIDR Working group mailing list. Richard Hansen edited this update to the document.

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