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Additional XML Security Uniform Resource Identifiers (URIs)

<[draft-eastlake-rfc6931bis-xmlsec-uris-15.txt](#)>

Abstract

This document updates and corrects the IANA registry for the list of URIs intended for use with XML digital signatures, encryption, canonicalization, and key management. These URIs identify algorithms and types of information. This document corrects three errata against and obsoletes [RFC 6931](#).

The intent is to keep this draft alive while it accumulates updates until it seems reasonable to publish the next version.

Status of This Memo

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1. Introduction

XML digital signatures, canonicalization, and encryption were standardized by the W3C and by the joint IETF/W3C XMLDSIG working group [[W3C](#)] [[XMLSEC](#)]. These are now W3C Recommendations and some are also RFCs. They are available as follows:

RFC Status -----	W3C REC -----	Topic -----
[RFC3275] Draft Standard	[XMLDSIG10]	XML Digital Signatures
[RFC3076] Informational	[CANON10]	Canonical XML
- - - - -	[XMLENC10]	XML Encryption 1.0
[RFC3741] Informational	[XCANON]	Exclusive XML Canonicalization 1.0

These documents and recommendations use URIs [[RFC3986](#)] to identify algorithms and keying information types. The W3C has subsequently produced updated XML Signature 1.1 [[XMLDSIG11](#)], Canonical XML 1.1 [[CANON11](#)], and XML Encryption 1.1 [[XMLENC11](#)] versions, as well as a new XML Signature Properties specification [[XMLDSIG-PROP](#)].

In addition, the XML Encryption recommendation has been augmented by [[GENERIC](#)] which defines algorithms, XML types and elements necessary to use generic hybrid ciphers in XML Security applications. [[GENERIC](#)] also provides a key encapsulation algorithm and a data encapsulation algorithm (see [Section 2.6.4](#)).

All camel-case element names herein, such as DigestValue, are from these documents.

This document is an updated convenient reference list of URIs and corresponding algorithms in which there is expressed interest. This document fixes Errata [[Err3597](#)], [[Err3965](#)], [[Err4004](#)] against and obsoletes [[RFC6931](#)].

All of the URIs appear in the indexes in [Section 4](#). The URIs that were added by [[RFC4051](#)], [[RFC6931](#)], or this document and a few others have a subsection in [Section 2](#) or 3. But most URIs defined elsewhere, for example, use of SHA-256 as defined in [[XMLENC11](#)], have no subsection on that algorithm here, but their URI may be included in the indexes in [Section 4](#).

Specification in this document of the URI representing an algorithm

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does not imply endorsement of the algorithm for any particular purpose. A protocol specification, which this is not, generally gives algorithm and implementation requirements for the protocol. Security considerations for algorithms are constantly evolving, as documented elsewhere. This specification simply provides some URIs and relevant formatting when those URIs are used.

This document is not intended to change the algorithm implementation requirements of any IETF or W3C document. Use of [\[RFC2119\]](#) terminology is intended to be only such as is already stated or implied by other authoritative documents.

Progressing XML Digital Signature [\[RFC3275\]](#) along the Standards Track required removal of any algorithms from the original version [\[RFC3075\]](#) for which there was not demonstrated interoperability. This required removal of the Minimal Canonicalization algorithm, in which there appears to be continued interest. The URI for Minimal Canonicalization was included in [\[RFC4051\]](#) and [\[RFC6931\]](#) and is included here.

[1.1](#) Terminology

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.

"camel-case" refers to terms that are mostly lower case but have internal capital letters.

[1.2](#) Acronyms

The following acronyms are used in this document:

HMAC - Keyed-Hashing MAC [\[RFC2104\]](#)

IETF - Internet Engineering Task Force <www.ietf.org>

MAC - Message Authentication Code

MD - Message Digest

NIST - United States National Institute of Standards and Technology <www.nist.gov>

RC - Rivest Cipher

RSA - Rivest, Shamir, and Adleman

SHA - Secure Hash Algorithm

URI - Uniform Resource Identifier [[RFC3986](#)]

W3C - World Wide Web Consortium <www.w3.org>

XML - eXtensible Markup Language

2. Algorithms

The URI [RFC3986] that was dropped from the XML Digital Signature standard due to the transition from Proposed Standard to Draft Standard [RFC3275] is included in [Section 2.4](#) below with its original

<http://www.w3.org/2000/09/xmlsig#>

prefix so as to avoid changing the XMLSIG standard's namespace.

Additional algorithms in [RFC4051] were given URIs that start with

<http://www.w3.org/2001/04/xmlsig-more#>

further algorithms added in [RFC6931] were given URIs that start with

<http://www.w3.org/2007/05/xmlsig-more#>

and algorithms added in this document are given URIs that start with

<http://www.w3.org/2021/04/xmlsig-more#>

In addition, for ease of reference, this document includes in the indexes in [Section 4](#) many cryptographic algorithm URIs from XML security documents using the namespaces with which they are defined in those documents. For example, 2000/09/xmlsig# for some URIs specified in [RFC3275] and 2001/04/xmlenc# for some URIs specified in [XMLENC10].

See also [XMLSECXREF].

2.1 DigestMethod (Hash) Algorithms

These algorithms are usable wherever a DigestMethod element occurs.

2.1.1 MD5

Identifier:

<http://www.w3.org/2001/04/xmlsig-more#md5>

The MD5 algorithm [RFC1321] takes no explicit parameters. An example of an MD5 DigestAlgorithm element is:

```
<DigestAlgorithm
  Algorithm="http://www.w3.org/2001/04/xmlsig-more#md5"/>
```


An MD5 digest is a 128-bit string. The content of the DigestValue element SHALL be the base64 [RFC2045] encoding of this bit string viewed as a 16-octet stream. See [RFC6151] for MD5 security considerations.

2.1.2 SHA-224

Identifier:

<http://www.w3.org/2001/04/xmldsig-more#sha224>

The SHA-224 algorithm [FIPS180-4] [RFC6234] takes no explicit parameters. An example of a SHA-224 DigestAlgorithm element is:

```
<DigestAlgorithm
  Algorithm="http://www.w3.org/2001/04/xmldsig-more#sha224" />
```

A SHA-224 digest is a 224-bit string. The content of the DigestValue element SHALL be the base64 [RFC2045] encoding of this string viewed as a 28-octet stream.

2.1.3 SHA-384

Identifier:

<http://www.w3.org/2001/04/xmldsig-more#sha384>

The SHA-384 algorithm [FIPS180-4] takes no explicit parameters. An example of a SHA-384 DigestAlgorithm element is:

```
<DigestAlgorithm
  Algorithm="http://www.w3.org/2001/04/xmldsig-more#sha384" />
```

A SHA-384 digest is a 384-bit string. The content of the DigestValue element SHALL be the base64 [RFC2045] encoding of this string viewed as a 48-octet stream.

2.1.4 Whirlpool

Identifier:

<http://www.w3.org/2007/05/xmldsig-more#whirlpool>

The Whirlpool algorithm [10118-3] takes no explicit parameters. A Whirlpool digest is a 512-bit string. The content of the DigestValue element SHALL be the base64 [RFC2045] encoding of this string viewed as a 64-octet stream.

2.1.5 SHA3 Algorithms

Identifiers:

<http://www.w3.org/2007/05/xmldsig-more#sha3-224>

<http://www.w3.org/2007/05/xmldsig-more#sha3-256>

<http://www.w3.org/2007/05/xmldsig-more#sha3-384>

<http://www.w3.org/2007/05/xmldsig-more#sha3-512>

NIST conducted a hash function competition for an alternative to the SHA family. The Keccak-f[1600] algorithm was selected [[Keccak](#)] [[SHA-3](#)]. This hash function is commonly referred to as "SHA-3".

A SHA-3 224, 256, 384, and 512 digest is a 224-, 256-, 384-, and 512-bit string, respectively. The content of the DigestValue element SHALL be the base64 [[RFC2045](#)] encoding of this string viewed as a 28-, 32-, 48-, and 64-octet stream, respectively. An example of a SHA3-224 DigestAlgorithm element is:

```
<DigestAlgorithm
  Algorithm="http://www.w3.org/2007/05/xmldsig-more#sha3-224" />
```

2.2 SignatureMethod MAC Algorithms

This section covers SignatureMethod MAC (Message Authentication Code) Algorithms.

Note: Some text in this section is duplicated from [[RFC3275](#)] for the convenience of the reader. [RFC 3275](#) is normative in case of conflict.

2.2.1 HMAC-MD5

Identifier:

<http://www.w3.org/2001/04/xmldsig-more#hmac-md5>

The HMAC algorithm [[RFC2104](#)] takes the truncation length in bits as a parameter; if the parameter is not specified, then all the bits of the hash are output. An example of an HMAC-MD5 SignatureMethod element is as follows:

```
<SignatureMethod
  Algorithm="http://www.w3.org/2001/04/xmldsig-more#hmac-md5">
  <HMACOutputLength>112</HMACOutputLength>
</SignatureMethod>
```

The output of the HMAC algorithm is ultimately the output (possibly

truncated) of the chosen digest algorithm. This value SHALL be base64 [RFC2045] encoded in the same straightforward fashion as the output of the digest algorithms. Example: the SignatureValue element for the HMAC-MD5 digest

9294727A 3638BB1C 13F48EF8 158BFC9D

from the test vectors in [RFC2104] would be

kpRyejY4uxwT9I74FYv8nQ==

Schema Definition:

```
<simpleType name="HMACOutputLength">
  <restriction base="integer"/>
</simpleType>
```

DTD:

```
<!ELEMENT HMACOutputLength (#PCDATA) >
```

The Schema Definition and DTD immediately above are copied from [RFC3275].

See [RFC6151] for HMAC-MD5 security considerations.

2.2.2 HMAC SHA Variations

Identifiers:

<http://www.w3.org/2001/04/xmldsig-more#hmac-sha224>
<http://www.w3.org/2001/04/xmldsig-more#hmac-sha256>
<http://www.w3.org/2001/04/xmldsig-more#hmac-sha384>
<http://www.w3.org/2001/04/xmldsig-more#hmac-sha512>

SHA-224, SHA-256, SHA-384, and SHA-512 [FIPS180-4] [RFC6234] can also be used in HMAC as described in [Section 2.2.1](#) above for HMAC-MD5.

2.2.3 HMAC-RIPEMD160

Identifier:

<http://www.w3.org/2001/04/xmldsig-more#hmac-ripemd160>

RIPEMD-160 [10118-3] can also be used in HMAC as described in [Section 2.2.1](#) above for HMAC-MD5.

2.2.4 Poly1305

Identifier:

<http://www.w3.org/2021/04/xmldsig-more#poly1305>

Poly1305 [RFC7539] [Poly1305] is a high-speed message authentication code algorithm.

2.2.5 SipHash-2-4

Identifier:

<http://www.w3.org/2021/04/xmldsg-more#siphash-2-4>

SipHash [SipHash1] [SipHash2] computes a 64-bit MAC from a 128-bit secret key and a variable length message.

2.2.6 XMSS and XMSSMT

Identifiers:

<http://www.w3.org/2021/04/xmldsig-more#xmss-sha2-192>

<http://www.w3.org/2021/04/xmldsig-more#xmss-sha2-256>

<http://www.w3.org/2021/04/xmldsig-more#xmss-shake256-192>

<http://www.w3.org/2021/04/xmldsig-more#xmss-shake256-256>

<http://www.w3.org/2021/04/xmldsig-more#xmssmt-sha2-192>

<http://www.w3.org/2021/04/xmldsig-more#xmssmt-sha2-256>

<http://www.w3.org/2021/04/xmldsig-more#xmssmt-shake256-192>

<http://www.w3.org/2021/04/xmldsig-more#xmssmt-shake256-256>

XMSS and XMSSMT are stateful hash-based signature schemes [NIST800-208].

2.3 SignatureMethod Public Key Signature Algorithms

These algorithms are distinguished from those in [Section 2.2](#) above in that they use public key methods. That is to say, the verification key is different from and not feasibly derivable from the signing key.

2.3.1 RSA-MD5

Identifier:

<http://www.w3.org/2001/04/xmldsig-more#rsa-md5>

This implies the PKCS#1 v1.5 padding algorithm described in [RFC8017]. An example of use is

```
<SignatureMethod
  Algorithm="http://www.w3.org/2001/04/xmldsig-more#rsa-md5" />
```

The SignatureValue content for an RSA-MD5 signature is the base64 [RFC2045] encoding of the octet string computed as per [RFC8017], Section 8.2.1, signature generation for the RSASSA-PKCS1-v1_5 signature scheme. As specified in the EMSA-PKCS1-V1_5-ENCODE function in [RFC8017], Section 9.2, the value input to the signature function MUST contain a pre-pended algorithm object identifier for the hash function, but the availability of an ASN.1 parser and recognition of OIDs is not required of a signature verifier. The PKCS#1 v1.5 representation appears as:

CRYPT (PAD (ASN.1 (OID, DIGEST (data))))

The padded ASN.1 will be of the following form:

01 | FF* | 00 | prefix | hash

Vertical bar ("|") represents concatenation. "01", "FF", and "00" are fixed octets of the corresponding hexadecimal value, and the asterisk ("*") after "FF" indicates repetition. "hash" is the MD5 digest of the data. "prefix" is the ASN.1 BER MD5 algorithm designator prefix required in PKCS #1 [RFC8017], that is,

hex 30 20 30 0c 06 08 2a 86 48 86 f7 0d 02 05 05 00 04 10

This prefix is included to make it easier to use standard cryptographic libraries. The FF octet MUST be repeated enough times that the value of the quantity being CRYPTed is exactly one octet shorter than the RSA modulus.

See [RFC6151] for MD5 security considerations.

2.3.2 RSA-SHA256

Identifier:

<http://www.w3.org/2001/04/xmldsig-more#rsa-sha256>

This implies the PKCS#1 v1.5 padding algorithm [[RFC8017](#)] as described

in [Section 2.3.1](#), but with the ASN.1 BER SHA-256 algorithm designator prefix. An example of use is

```
<SignatureMethod
  Algorithm="http://www.w3.org/2001/04/xmldsig-more#rsa-sha256" />
```

[2.3.3](#) RSA-SHA384

Identifier:

<http://www.w3.org/2001/04/xmldsig-more#rsa-sha384>

This implies the PKCS#1 v1.5 padding algorithm [[RFC8017](#)] as described in [Section 2.3.1](#), but with the ASN.1 BER SHA-384 algorithm designator prefix. An example of use is

```
<SignatureMethod
  Algorithm="http://www.w3.org/2001/04/xmldsig-more#rsa-sha384" />
```

Because it takes about the same effort to calculate a SHA-384 message digest as it does a SHA-512 message digest, it is suggested that RSA-SHA512 be used in preference to RSA-SHA384 where possible.

[2.3.4](#) RSA-SHA512

Identifier:

<http://www.w3.org/2001/04/xmldsig-more#rsa-sha512>

This implies the PKCS#1 v1.5 padding algorithm [[RFC8017](#)] as described in [Section 2.3.1](#), but with the ASN.1 BER SHA-512 algorithm designator prefix. An example of use is

```
<SignatureMethod
  Algorithm="http://www.w3.org/2001/04/xmldsig-more#rsa-sha512" />
```

[2.3.5](#) RSA-RIPEMD160

Identifier:

<http://www.w3.org/2001/04/xmldsig-more#rsa-ripemd160>

This implies the PKCS#1 v1.5 padding algorithm [[RFC8017](#)] as described in [Section 2.3.1](#), but with the ASN.1 BER RIPEMD160 algorithm designator prefix. An example of use is


```
<SignatureMethod
  Algorithm="http://www.w3.org/2001/04/xmldsig-more#rsa-ripemd160"
/>
```

2.3.6 ECDSA-SHA*, ECDSA-RIPEMD160, ECDSA-Whirlpool

Identifiers:

<http://www.w3.org/2001/04/xmldsig-more#ecdsa-sha1>
<http://www.w3.org/2001/04/xmldsig-more#ecdsa-sha224>
<http://www.w3.org/2001/04/xmldsig-more#ecdsa-sha256>
<http://www.w3.org/2001/04/xmldsig-more#ecdsa-sha384>
<http://www.w3.org/2001/04/xmldsig-more#ecdsa-sha512>
<http://www.w3.org/2021/04/xmldsig-more#ecdsa-sha3-224>
<http://www.w3.org/2021/04/xmldsig-more#ecdsa-sha3-256>
<http://www.w3.org/2021/04/xmldsig-more#ecdsa-sha3-384>
<http://www.w3.org/2021/04/xmldsig-more#ecdsa-sha3-512>
<http://www.w3.org/2007/05/xmldsig-more#ecdsa-ripemd160>
<http://www.w3.org/2007/05/xmldsig-more#ecdsa-whirlpool>

The Elliptic Curve Digital Signature Algorithm (ECDSA) [FIPS186-4] is the elliptic curve analogue of the Digital Signature Algorithm (DSA) signature method, i.e., the Digital Signature Standard (DSS). It takes no explicit parameters. For some detailed specifications of how to use it with SHA hash functions and XML Digital Signature, please see [X9.62] and [RFC4050]. The #sha3-*, #ecdsa-ripemd160, and #ecdsa-whirlpool fragments identify a signature method processed in the same way as specified by the #ecdsa-sha1 fragment, with the exception that SHA3 (see Section 2.1.5), RIPEMD160 or Whirlpool (see Section 2.1.4) is used instead of SHA-1.

The output of the ECDSA algorithm consists of a pair of integers usually referred by the pair (r, s). The signature value consists of the base64 encoding of the concatenation of two octet streams that respectively result from the octet encoding of the values r and s in that order. Conversion from integer to octet-stream must be done according to the I2OSP operation defined in the [RFC8017] specification with the l parameter equal to the size of the base point order of the curve in bytes (e.g., 32 for the P-256 curve and 66 for the P-521 curve [FIPS186-4]).

For an introduction to elliptic curve cryptographic algorithms, see [RFC6090] and note the errata (Errata ID 2773-2777).

2.3.7 ESIGN-SHA*

Identifiers:

<http://www.w3.org/2001/04/xmldsig-more#esign-sha1>
<http://www.w3.org/2001/04/xmldsig-more#esign-sha224>
<http://www.w3.org/2001/04/xmldsig-more#esign-sha256>
<http://www.w3.org/2001/04/xmldsig-more#esign-sha384>
<http://www.w3.org/2001/04/xmldsig-more#esign-sha512>

The ESIGN algorithm specified in [IEEEP1363a] is a signature scheme based on the integer factorization problem. It is much faster than previous digital signature schemes, so ESIGN can be implemented on smart cards without special co-processors.

An example of use is

```
<SignatureMethod
  Algorithm="http://www.w3.org/2001/04/xmldsig-more#esign-sha1"
/>
```

2.3.8 RSA-Whirlpool

Identifier:

<http://www.w3.org/2007/05/xmldsig-more#rsa-whirlpool>

As in the definition of the RSA-SHA1 algorithm in [XMLDSIG11], the designator "RSA" means the RSASSA-PKCS1-v1_5 algorithm as defined in [RFC8017]. When identified through the #rsa-whirlpool fragment identifier, Whirlpool is used as the hash algorithm instead. Use of the ASN.1 BER Whirlpool algorithm designator is implied. That designator is

hex 30 4e 30 0a 06 06 28 cf 06 03 00 37 05 00 04 40
as an explicit octet sequence. This corresponds to OID
1.0.10118.3.0.55 defined in [10118-3].

An example of use is

```
<SignatureMethod
  Algorithm="http://www.w3.org/2007/05/xmldsig-more#rsa-whirlpool"
/>
```

2.3.9 RSASSA-PSS with Parameters

Identifiers:

<http://www.w3.org/2007/05/xmldsig-more#rsa-pss>

<http://www.w3.org/2007/05/xmldsig-more#MGF1>

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These identifiers use the PKCS#1 EMSA-PSS encoding algorithm [RFC8017]. The RSASSA-PSS algorithm takes the digest method (hash function), a mask generation function, the salt length in bytes (SaltLength), and the trailer field as explicit parameters.

Algorithm identifiers for hash functions specified in XML encryption [XMLENC11] [XMLDSIG11] and in Section 2.1 are considered to be valid algorithm identifiers for hash functions. According to [RFC8017], the default value for the digest function is SHA-1, but due to the discovered weakness of SHA-1 [RFC6194], it is recommended that SHA-256 or a stronger hash function be used. Notwithstanding [RFC8017], SHA-256 is the default to be used with these SignatureMethod identifiers if no hash function has been specified.

The default salt length for these SignatureMethod identifiers, if the SaltLength is not specified, SHALL be the number of octets in the hash value of the digest method, as recommended in [RFC4055]. In a parameterized RSASSA-PSS signature the ds:DigestMethod and the SaltLength parameters usually appear. If they do not, the defaults make this equivalent to <http://www.w3.org/2007/05/xmlldsig-more#sha256-rsa-MGF1> (see Section 2.3.10). The TrailerField defaults to 1 (0xBC) when omitted.

Schema Definition (target namespace <http://www.w3.org/2007/05/xmlldsig-more#>):

```
<xs:element name="RSAPSSParams" type="pss:RSAPSSParamsType">
  <xs:annotation>
    <xs:documentation>
      Top level element that can be used in xs:any namespace="#other"
      wildcard of ds:SignatureMethod content.
    </xs:documentation>
  </xs:annotation>
</xs:element>
<xs:complexType name="RSAPSSParamsType">
  <xs:sequence>
    <xs:element ref="ds:DigestMethod" minOccurs="0"/>
    <xs:element name="MaskGenerationFunction"
      type="pss:MaskGenerationFunctionType" minOccurs="0"/>
    <xs:element name="SaltLength" type="xs:int"
      minOccurs="0"/>
    <xs:element name="TrailerField" type="xs:int"
      minOccurs="0"/>
  </xs:sequence>
</xs:complexType>
<xs:complexType name="MaskGenerationFunctionType">
  <xs:sequence>
    <xs:element ref="ds:DigestMethod" minOccurs="0"/>
```

```
</xs:sequence>  
<xs:attribute name="Algorithm" type="xs:anyURI"
```

```
        default="http://www.w3.org/2007/05/xmldsig-more#MGF1"/>
</xs:complexType>
```

2.3.10 RSASSA-PSS without Parameters

[RFC8017] currently specifies only one mask generation function MGF1 based on a hash function. Although [RFC8017] allows for parameterization, the default is to use the same hash function as the digest method function. Only this default approach is supported by this section; therefore, the definition of a mask generation function type is not needed yet. The same applies to the trailer field. There is only one value (0xBC) specified in [RFC8017]. Hence, this default parameter must be used for signature generation. The default salt length is the length of the hash function.

Identifiers:

<http://www.w3.org/2007/05/xmldsig-more#sha3-224-rsa-MGF1>
<http://www.w3.org/2007/05/xmldsig-more#sha3-256-rsa-MGF1>
<http://www.w3.org/2007/05/xmldsig-more#sha3-384-rsa-MGF1>
<http://www.w3.org/2007/05/xmldsig-more#sha3-512-rsa-MGF1>

<http://www.w3.org/2007/05/xmldsig-more#md2-rsa-MGF1>
<http://www.w3.org/2007/05/xmldsig-more#md5-rsa-MGF1>
<http://www.w3.org/2007/05/xmldsig-more#sha1-rsa-MGF1>
<http://www.w3.org/2007/05/xmldsig-more#sha224-rsa-MGF1>
<http://www.w3.org/2007/05/xmldsig-more#sha256-rsa-MGF1>
<http://www.w3.org/2007/05/xmldsig-more#sha384-rsa-MGF1>
<http://www.w3.org/2007/05/xmldsig-more#sha512-rsa-MGF1>
<http://www.w3.org/2007/05/xmldsig-more#ripemd128-rsa-MGF1>
<http://www.w3.org/2007/05/xmldsig-more#ripemd160-rsa-MGF1>
<http://www.w3.org/2007/05/xmldsig-more#whirlpool-rsa-MGF1>

An example of use is

```
<SignatureMethod
  Algorithm=
    "http://www.w3.org/2007/05/xmldsig-more#SHA3-256-rsa-MGF1"
/>
```

2.3.11 RSA-SHA224

Identifier:

<http://www.w3.org/2001/04/xmldsig-more#rsa-sha224>

This implies the PKCS#1 v1.5 padding algorithm [RFC8017] as described

in [Section 2.3.1](#) but with the ASN.1 BER SHA-224 algorithm designator

prefix. An example of use is

```
<SignatureMethod
  Algorithm="http://www.w3.org/2001/04/xmldsig-more#rsa-sha224" />
```

Because it takes about the same effort to calculate a SHA-224 message digest as it does a SHA-256 message digest, it is suggested that RSA-SHA256 be used in preference to RSA-SHA224 where possible.

See also [Appendix B](#) concerning an erroneous version of this URI that appeared in [[RFC6931](#)].

[2.3.12](#) Edwards-Curve

The Edwards-curve Digital Signature Algorithm (EdDSA) is a variant of Schnorr's signature system with Edwards curves. A specification is provided and some advantages listed in [[RFC8032](#)]. The general EdDSA takes 11 parameters that must be carefully chosen for secure and efficient operation. Identifiers for two variants, Ed25519 and Ed448, are given below.

Ed25519 uses 32 byte public keys and produces 64 byte signatures. It provides about 128 bits of security and uses SHA-512 (see [Section 2.2.2](#)) as its hash algorithm.

Ed448 uses 57 byte public keys and produces 114 byte signatures. It provides about 224 bits of security and uses "SHAKE256" [[FIPS202](#)] as its hash algorithm. (SHAKE256 is specified by NIST as an "Extensible Output Function" and not specified or approved by NIST as a secure hash function.)

For further information on the variants of EdDSA identified below, see [[RFC8032](#)].

Identifiers:

```
http://www.w3.org/2021/04/xmldsig-more#eddsa-ed25519ph
http://www.w3.org/2021/04/xmldsig-more#eddsa-ed25519ctx
http://www.w3.org/2021/04/xmldsig-more#eddsa-ed25519

http://www.w3.org/2021/04/xmldsig-more#eddsa-ed448
http://www.w3.org/2021/04/xmldsig-more#eddsa-ed448ph
```

An example of use is

```
<SignatureMethod Algorithm=
  "http://www.w3.org/2021/04/xmldsig-more#eddsa-ed448" />
```


2.4 Minimal Canonicalization

Thus far, two independent interoperable implementations of Minimal Canonicalization have not been announced. Therefore, when XML Digital Signature was advanced along the Standards Track from [RFC3075] to [RFC3275], Minimal Canonicalization was dropped. However, there is still interest. For its definition, see [Section 6.5.1 of \[RFC3075\]](#).

For reference, its identifier remains:

<http://www.w3.org/2000/09/xmlsig#minimal>

2.5 Transform Algorithms

All CanonicalizationMethod algorithms can also be used as Transform algorithms.

2.5.1 XPointer

Identifier:

<http://www.w3.org/2001/04/xmlsig-more#xptr>

This transform algorithm takes an [XPointer] as an explicit parameter. An example of use is:

```
<Transform
  Algorithm="http://www.w3.org/2001/04/xmlsig-more/xptr">
  <XPointer
    xmlns="http://www.w3.org/2001/04/xmlsig-more/xptr">
    xpointer(id("foo")) xmlns(bar=http://foobar.example)
    xpointer(//bar:Zab[@Id="foo"])
  </XPointer>
</Transform>
```

Schema Definition:

```
<element name="XPointer" type="string"/>
```

DTD:

```
<!ELEMENT XPointer (#PCDATA) >
```

Input to this transform is an octet stream (which is then parsed into XML).

Output from this transform is a node set; the results of the XPointer are processed as defined in the XMLDSIG specification [[RFC3275](#)] for a same-document XPointer.

2.6 EncryptionMethod Algorithms

This subsection gives identifiers and information for several EncryptionMethod Algorithms.

2.6.1 ARCFOUR Encryption Algorithm

Identifier:

<http://www.w3.org/2001/04/xmlldsig-more#arcfour>

ARCFOUR is a fast, simple stream encryption algorithm that is compatible with RSA Security's RC4 algorithm [[RC4](#)]. An example EncryptionMethod element using ARCFOUR is

```
<EncryptionMethod
  Algorithm="http://www.w3.org/2001/04/xmlldsig-more#arcfour">
  <KeySize>40</KeySize>
</EncryptionMethod>
```

Arcfour makes use of the generic KeySize parameter specified and defined in [[XMLENC11](#)].

2.6.2 Camellia Block Encryption

Identifiers:

<http://www.w3.org/2001/04/xmlldsig-more#camellia128-cbc>

<http://www.w3.org/2001/04/xmlldsig-more#camellia192-cbc>

<http://www.w3.org/2001/04/xmlldsig-more#camellia256-cbc>

Camellia is a block cipher with the same interface as the AES [[Camellia](#)] [[RFC3713](#)]; it has a 128-bit block size and 128-, 192-, and 256-bit key sizes. In XML Encryption Camellia is used in the same way as the AES: It is used in the Cipher Block Chaining (CBC) mode with a 128-bit initialization vector (IV). The resulting cipher text is prefixed by the IV. If included in XML output, it is then base64 encoded. An example Camellia EncryptionMethod is as follows:


```
<EncryptionMethod
  Algorithm=
  "http://www.w3.org/2001/04/xmldsig-more#camellia128-cbc"
/>
```

2.6.3 Camellia Key Wrap

Identifiers:

<http://www.w3.org/2001/04/xmldsig-more#kw-camellia128>
<http://www.w3.org/2001/04/xmldsig-more#kw-camellia192>
<http://www.w3.org/2001/04/xmldsig-more#kw-camellia256>

Camellia [[Camellia](#)] [[RFC3713](#)] key wrap is identical to the AES key wrap algorithm [[RFC3394](#)] specified in the XML Encryption standard with "AES" replaced by "Camellia". As with AES key wrap, the check value is 0xA6A6A6A6A6A6A6A6.

The algorithm is the same whatever the size of the Camellia key used in wrapping, called the "key encrypting key" or "KEK". If Camellia is supported, it is particularly suggested that wrapping 128-bit keys with a 128-bit KEK and wrapping 256-bit keys with a 256-bit KEK be supported.

An example of use is:

```
<EncryptionMethod
  Algorithm=
  "http://www.w3.org/2001/04/xmldsig-more#kw-camellia128"
/>
```

2.6.4 PSEC-KEM, RSAES-KEM, and ECIES-KEM

Identifiers:

<http://www.w3.org/2001/04/xmldsig-more#psec-kem>
<http://www.w3.org/2010/xmlsec-ghc#rsaes-kem>
<http://www.w3.org/2010/xmlsec-ghc#ecies-kem>

These algorithms, specified in [[18033-2](#)], are key encapsulation mechanisms using elliptic curve encryption. RSAEA-KEM and ECIES-KEM are also specified in [[GENERIC](#)].

An example of use of PAEC-KEM is:


```
<EncryptionMethod
  Algorithm="http://www.w3.org/2001/04/xmlenc#psec-kem">
  <ECParameters>
    <Version>version</Version>
    <FieldID>id</FieldID>
    <Curve>curve</Curve>
    <Base>base</Base>
    <Order>order</Order>
    <Cofactor>cofactor</Cofactor>
  </ECParameters>
</EncryptionMethod>
```

See [18033-2] for information on the parameters above.

2.6.5 SEED Block Encryption

Identifier:

<http://www.w3.org/2007/05/xmldsig-more#seed128-cbc>

SEED [RFC4269] is a 128-bit block size with 128-bit key sizes. In XML Encryption, SEED can be used in the Cipher Block Chaining (CBC) mode with a 128-bit initialization vector (IV). The resulting cipher text is prefixed by the IV. If included in XML output, it is then base64 encoded.

An example SEED EncryptionMethod is as follows:

```
<EncryptionMethod
  Algorithm="http://www.w3.org/2007/05/xmldsig-more#seed128-cbc" />
```

2.6.6 SEED Key Wrap

Identifier:

<http://www.w3.org/2007/05/xmldsig-more#kw-seed128>

Key wrapping with SEED is identical to [Section 2.2.1 of \[RFC3394\]](#) with "AES" replaced by "SEED". The algorithm is specified in [RFC4010]. The implementation of SEED is optional. The default initial value is 0xA6A6A6A6A6A6A6A6.

An example of use is:

```
<EncryptionMethod
  Algorithm=
    "http://www.w3.org/2007/05/xmldsig-more#kw-seed128"
```

/>

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2.6.7 ChaCha20

Identifier:

<http://www.w3.org/2021/04/xmldsig-more#chacha20>

ChaCha20 [RFC7539], a stream cipher, is a variant of Salsa20 [ChaCha]. It is considerably faster than AES in software-only implementations.

An example of use is:

```
<EncryptionMethod
  Algorithm=
  "http://www.w3.org/2021/04/xmldsig-more#chacha20"
/>
```

2.7 AgreementMethod Algorithms

This subsection gives identifiers and information for an additional AgreementMethod Algorithms [XMLENC11].

2.7.1 X25519 Key Agreement

Identifier:

<http://www.w3.org/2021/04/xmldsig-more#x25519>

The X25519 key agreement algorithm is specified in [RFC7748].

3. KeyInfo

In [Section 3.1](#) below a new KeyInfo element child is specified, while in [Section 3.2](#) additional KeyInfo Type values for use in RetrievalMethod are specified.

3.1 PKCS #7 Bag of Certificates and CRLs

A PKCS #7 [[RFC2315](#)] "signedData" can also be used as a bag of certificates and/or certificate revocation lists (CRLs). The PKCS7signedData element is defined to accommodate such structures within KeyInfo. The binary PKCS #7 structure is base64 [[RFC2045](#)] encoded. Any signer information present is ignored. The following is an example [[RFC3092](#)], eliding the base64 data:

```
<foo:PKCS7signedData
  xmlns:foo="http://www.w3.org/2001/04/xmldsig-more">
  ...
</foo:PKCS7signedData>
```

3.2 Additional RetrievalMethod Type Values

The Type attribute of RetrievalMethod is an optional identifier for the type of data to be retrieved. The result of dereferencing a RetrievalMethod reference for all KeyInfo types with an XML structure is an XML element or document with that element as the root. The various "raw" key information types return a binary value. Thus, they require a Type attribute because they are not unambiguously parsable.

Identifiers:

- <http://www.w3.org/2001/04/xmldsig-more#KeyName>
- <http://www.w3.org/2001/04/xmldsig-more#KeyValue>
- <http://www.w3.org/2001/04/xmldsig-more#PKCS7signedData>
- <http://www.w3.org/2001/04/xmldsig-more#rawPGPKeyPacket>
- <http://www.w3.org/2001/04/xmldsig-more#rawPKCS7signedData>
- <http://www.w3.org/2001/04/xmldsig-more#rawSPKISexp>
- <http://www.w3.org/2001/04/xmldsig-more#rawX509CRL>
- <http://www.w3.org/2001/04/xmldsig-more#RetrievalMethod>

4. Indexes

The following subsections provide an index by URI and by fragment identifier (the portion of the URI after "#") of the algorithm and KeyInfo URIs defined in this document and in the standards (plus the one KeyInfo child element name defined in this document). The "Sec/Doc" column has the section of this document or, if not specified in this document, the standards document where the item is specified. See also [\[XMLSECXREF\]](#).

4.1 Index by Fragment Index

The initial "http://www.w3.org/" part of the URI is not included below. The first six entries have a null fragment identifier or no fragment identifier. "{Bad}" indicates a Bad value that was accidentally included in [\[RFC6931\]](#). Implementations SHOULD only generate the correct URI but SHOULD understand both the correct and erroneous URI. See also [Appendix B](#).

Fragment	URI	Sec/Doc
-----	----	-----
	2002/06/xmldsig-filter2	[XPATH]
	2006/12/xmlc12n11# {Bad}	[CANON11]
	2006/12/xmlc14n11#	[CANON11]
	TR/1999/REC-xslt-19991116	[XSLT]
	TR/1999/REC-xpath-19991116	[XPATH]
	TR/2001/06/xml-exc-c14n#	[XCANON]
	TR/2001/REC-xml-c14n-20010315	[CANON10]
	TR/2001/REC-xmlschema-1-20010502	[Schema]
aes128-cbc	2001/04/xmlenc#aes128-cbc	[XMLENC11]
aes128-gcm	2009/xmlenc11#aes128-gcm	[XMLENC11]
aes192-cbc	2001/04/xmlenc#aes192-cbc	[XMLENC11]
aes192-gcm	2009/xmlenc11#aes192-gcm	[XMLENC11]
aes256-cbc	2001/04/xmlenc#aes256-cbc	[XMLENC11]
aes256-gcm	2009/xmlenc11#aes256-gcm	[XMLENC11]
arcfour	2001/04/xmldsig-more#arcfour	2.6.1
base64	2000/09/xmldsig#base64	[RFC3275]
camellia128-cbc	2001/04/xmldsig-more#camellia128-cbc	2.6.2
camellia192-cbc	2001/04/xmldsig-more#camellia192-cbc	2.6.2
camellia256-cbc	2001/04/xmldsig-more#camellia256-cbc	2.6.2
chacha20	2021/04/xmldsig-more#chacha20	2.6.7
ConcatKDF	2009/xmlenc11#ConcatKDF	[XMLENC11]

decrypt#XML	2002/07/decrypt#XML	[DECRYPT]
decrypt#Binary	2002/07/decrypt#Binary	[DECRYPT]
DEREncodedKeyValue	2009/xmlsig11#DEREncodedKeyValue	[XMLDSIG11]
dh	2001/04/xmlenc#dh	[XMLENC11]
dh-es	2009/xmlenc11#dh-es	[XMLENC11]
dsa-sha1	2000/09/xmlsig#dsa-sha1	[RFC3275]
dsa-sha256	2009/xmlsig11#dsa-sha256	[XMLDSIG11]
DSAKeyValue	2000/09/xmlsig#DSAKeyValue	[XMLDSIG11]
ECDH-ES	2009/xmlenc11#ECDH-ES	[XMLENC11]
ecdsa-ripemd160	2007/05/xmlsig-more#ecdsa-ripemd160	2.3.6
ecdsa-sha1	2001/04/xmlsig-more#ecdsa-sha1	2.3.6
ecdsa-sha224	2001/04/xmlsig-more#ecdsa-sha224	2.3.6
ecdsa-sha256	2001/04/xmlsig-more#ecdsa-sha256	2.3.6
ecdsa-sha384	2001/04/xmlsig-more#ecdsa-sha384	2.3.6
ecdsa-sha512	2001/04/xmlsig-more#ecdsa-sha512	2.3.6
ecdsa-sha3-224	2021/04/xmlsig-more#ecdsa-sha3-224	2.3.6
ecdsa-sha3-256	2021/04/xmlsig-more#ecdsa-sha3-256	2.3.6
ecdsa-sha3-384	2021/04/xmlsig-more#ecdsa-sha3-384	2.3.6
ecdsa-sha3-512	2021/04/xmlsig-more#ecdsa-sha3-512	2.3.6
ecdsa-whirlpool	2007/05/xmlsig-more#ecdsa-whirlpool	2.3.5
ecies-kem	2010/xmlsec-ghc#ecies-kem	[GENERIC]
ECKeyValue	2009/xmlsig11#ECKeyValue	[XMLDSIG11]
eddsa-ed25519	2021/04/xmlsig-more#eddsa-ed25519	2.3.12
eddsa-ed25519ctx	2021/04/xmlsig-more#eddsa-ed25519ctx	2.3.12
eddsa-ed25519ph	2021/04/xmlsig-more#eddsa-ed25519ph	2.3.12
eddsa-ed448	2021/04/xmlsig-more#eddsa-ed448	2.3.12
eddsa-ed448ph	2021/04/xmlsig-more#eddsa-ed448ph	2.3.12
enveloped-signature	2000/09/xmlsig#enveloped-signature	[RFC3275]
esign-sha1	2001/04/xmlsig-more#esign-sha1	2.3.7
esign-sha224	2001/04/xmlsig-more#esign-sha224	2.3.7
esign-sha256	2001/04/xmlsig-more#esign-sha256	2.3.7
esign-sha384	2001/04/xmlsig-more#esign-sha384	2.3.7
esign-sha512	2001/04/xmlsig-more#esign-sha512	2.3.7
generic-hybrid	2010/xmlsec-ghc#generic-hybrid	[GENERIC]
hmac-md5	2001/04/xmlsig-more#hmac-md5	2.2.1
hmac-ripemd160	2001/04/xmlsig-more#hmac-ripemd160	2.2.3
hmac-sha1	2000/09/xmlsig#hmac-sha1	[RFC3275]
hmac-sha224	2001/04/xmlsig-more#hmac-sha224	2.2.2
hmac-sha256	2001/04/xmlsig-more#hmac-sha256	2.2.2
hmac-sha384	2001/04/xmlsig-more#hmac-sha384	2.2.2
hmac-sha512	2001/04/xmlsig-more#hmac-sha512	2.2.2
KeyName	2001/04/xmlsig-more#KeyName	3.2
KeyValue	2001/04/xmlsig-more#KeyValue	3.2
kw-aes128	2001/04/xmlenc#kw-aes128	[XMLENC11]

kw-aes128-pad
kw-aes192

2009/xmlenc11#kw-aes-128-pad
2001/04/xmlenc#kw-aes192

[[XMLENC11](#)]
[[XMLENC11](#)]

kw-aes192-pad	2009/xmlenc11#kw-aes-192-pad	[XMLENC11]
kw-aes256	2001/04/xmlenc#kw-aes256	[XMLENC11]
kw-aes256-pad	2009/xmlenc11#kw-aes-256-pad	[XMLENC11]
kw-camellia128	2001/04/xmldsig-more#kw-camellia128	2.6.3
kw-camellia192	2001/04/xmldsig-more#kw-camellia192	2.6.3
kw-camellia256	2001/04/xmldsig-more#kw-camellia256	2.6.3
kw-seed128	2007/05/xmldsig-more#kw-seed128	2.6.6
md2-rsa-MGF1	2007/05/xmldsig-more#md2-rsa-MGF1	2.3.10
md5	2001/04/xmldsig-more#md5	2.1.1
md5-rsa-MGF1	2007/05/xmldsig-more#md5-rsa-MGF1	2.3.10
MGF1	2007/05/xmldsig-more#MGF1	2.3.9
mgf1sha1	2009/xmlenc11#mgf1sha1	[XMLENC11]
mgf1sha224	2009/xmlenc11#mgf1sha224	[XMLENC11]
mgf1sha256	2009/xmlenc11#mgf1sha256	[XMLENC11]
mgf1sha384	2009/xmlenc11#mgf1sha384	[XMLENC11]
mgf1sha512	2009/xmlenc11#mgf1sha512	[XMLENC11]
MgmtData	2000/09/xmldsig#MgmtData	[XMLDSIG11]
minimal	2000/09/xmldsig#minimal	2.4
pbkdf2	2009/xmlenc11#pbkdf2	[XMLENC11]
PGPData	2000/09/xmldsig#PGPData	[XMLDSIG11]
PKCS7signedData	2001/04/xmldsig-more#PKCS7signedData	3.1
PKCS7signedData	2001/04/xmldsig-more#PKCS7signedData	3.2
poly1305	2021/04/xmldsig-more#poly1305	2.2.4
psec-kem	2001/04/xmldsig-more#psec-kem	2.6.4
rawPGPKeyPacket	2001/04/xmldsig-more#rawPGPKeyPacket	3.2
rawPKCS7signedData	2001/04/xmldsig-more#rawPKCS7signedData	3.2
rawSPKISexp	2001/04/xmldsig-more#rawSPKISexp	3.2
rawX509Certificate	2000/09/xmldsig#rawX509Certificate	[RFC3275]
rawX509CRL	2001/04/xmldsig-more#rawX509CRL	3.2
RetrievalMethod	2001/04/xmldsig-more#RetrievalMethod	3.2
ripemd128-rsa-MGF1	2007/05/xmldsig-more#ripemd128-rsa-MGF1	2.3.10
ripemd160	2001/04/xmlenc#ripemd160	[XMLENC11]
ripemd160-rsa-MGF1	2007/05/xmldsig-more#ripemd160-rsa-MGF1	2.3.10
rsa-1_5	2001/04/xmlenc#rsa-1_5	[XMLENC11]
rsa-md5	2001/04/xmldsig-more#rsa-md5	2.3.1
rsa-oaep	2009/xmlenc11#rsa-oaep	[XMLENC11]
rsa-oaep-mgf1p	2001/04/xmlenc#rsa-oaep-mgf1p	[XMLENC11]
rsa-pss	2007/05/xmldsig-more#rsa-pss	2.3.9
rsa-ripemd160	2001/04/xmldsig-more#rsa-ripemd160	2.3.5
rsa-sha1	2000/09/xmldsig#rsa-sha1	[RFC3275]
rsa-sha224	2007/05/xmldsig-more#rsa-sha224 {Bad}	2.3.11
rsa-sha224	2001/04/xmldsig-more#rsa-sha224	2.3.11
rsa-sha256	2001/04/xmldsig-more#rsa-sha256	2.3.2

rsa-sha384	2001/04/xmldsig-more#rsa-sha384	2.3.3
rsa-sha512	2001/04/xmldsig-more#rsa-sha512	2.3.4

rsa-whirlpool	2007/05/xmldsig-more#rsa-whirlpool	2.3.5
rsaes-kem	2010/xmlsec-ghc#rsaes-kem	[GENERIC]
RSAPublicKey	2000/09/xmldsig#RSAPublicKey	[XMLDSIG11]
seed128-cbc	2007/05/xmldsig-more#seed128-cbc	2.6.5
sha1	2000/09/xmldsig#sha1	[RFC3275]
sha1-rsa-MGF1	2007/05/xmldsig-more#sha1-rsa-MGF1	2.3.10
sha224	2001/04/xmldsig-more#sha224	2.1.2
sha224-rsa-MGF1	2007/05/xmldsig-more#sha224-rsa-MGF1	2.3.10
sha256	2001/04/xmlenc#sha256	[XMLENC11]
sha256-rsa-MGF1	2007/05/xmldsig-more#sha256-rsa-MGF1	2.3.10
sha3-224	2007/05/xmldsig-more#sha3-224	2.1.5
sha3-224-rsa-MGF1	2007/05/xmldsig-more#sha3-224-rsa-MGF1	2.3.10
sha3-256	2007/05/xmldsig-more#sha3-256	2.1.5
sha3-256-rsa-MGF1	2007/05/xmldsig-more#sha3-256-rsa-MGF1	2.3.10
sha3-384	2007/05/xmldsig-more#sha3-384	2.1.5
sha3-384-rsa-MGF1	2007/05/xmldsig-more#sha3-384-rsa-MGF1	2.3.10
sha3-512	2007/05/xmldsig-more#sha3-512	2.1.5
sha3-512-rsa-MGF1	2007/05/xmldsig-more#sha3-512-rsa-MGF1	2.3.10
sha384	2001/04/xmldsig-more#sha384	2.1.3
sha384-rsa-MGF1	2007/05/xmldsig-more#sha384-rsa-MGF1	2.3.10
sha512	2001/04/xmlenc#sha512	[XMLENC11]
sha512-rsa-MGF1	2007/05/xmldsig-more#sha512-rsa-MGF1	2.3.10
siphhash-2-4	2021/04/xmldsig-more#siphhash-2-4	2.2.5
SPKIData	2000/09/xmldsig#SPKIData	[XMLDSIG11]
tripleDES-cbc	2001/04/xmlenc#tripleDES-cbc	[XMLENC11]
whirlpool	2007/05/xmldsig-more#whirlpool	2.1.4
whirlpool-rsa-MGF1	2007/05/xmldsig-more#whirlpool-rsa-MGF1	2.3.10
WithComments	2006/12/xml-c14n11#WithComments	[CANON11]
WithComments	TR/2001/06/xml-exc-c14n#WithComments	[XCANON]
WithComments	TR/2001/REC-xml-c14n-20010315#WithComments	[CANON10]
x25519	2021/04/xmldsig-more#x25519	2.7.1
X509Data	2000/09/xmldsig#X509Data	[XMLDSIG11]
xmss-sha2-192	2021/04/xmldsig-more#xmss-sha2-192	2.2.6
xmss-sha2-256	2021/04/xmldsig-more#xmss-sha2-256	2.2.6
xmss-shake256-192	2021/04/xmldsig-more#xmss-shake256-192	2.2.6
xmss-shake256-256	2021/04/xmldsig-more#xmss-shake256-256	2.2.6
xmssmt-sha2-192	2021/04/xmldsig-more#xmssmt-sha2-192	2.2.6
xmssmt-sha2-256	2021/04/xmldsig-more#xmssmt-sha2-256	2.2.6
xmssmt-shake256-192	2021/04/xmldsig-more#xmssmt-shake256-192	2.2.6
xmssmt-shake256-256	2021/04/xmldsig-more#xmssmt-shake256-256	

xptr

2001/04/xmlsig-more#xptr

2.2.6

2.5.1

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The initial "http://www.w3.org/" part of the URI is not included above.

4.2 Index by URI

The initial "http://www.w3.org/" part of the URI is not included below. "{Bad}" indicates a Bad value that was accidentally included in [RFC6931]. Implementations SHOULD only generate the correct URI but SHOULD understand both the correct and erroneous URI. See also [Appendix B](#).

URI	Sec/Doc	Type
----	-----	-----
2000/09/xmldsig#base64	[RFC3275]	Transform
2000/09/xmldsig#DSAKeyValue	[RFC3275]	Retrieval type
2000/09/xmldsig#dsa-sha1	[RFC3275]	SignatureMethod
2000/09/xmldsig#enveloped-signature	[RFC3275]	Transform
2000/09/xmldsig#hmac-sha1	[RFC3275]	SignatureMethod
2000/09/xmldsig#MgmtData	[RFC3275]	Retrieval type
2000/09/xmldsig#minimal	2.4	Canonicalization
2000/09/xmldsig#PGPData	[RFC3275]	Retrieval type
2000/09/xmldsig#rawX509Certificate	[RFC3275]	Retrieval type
2000/09/xmldsig#rsa-sha1	[RFC3275]	SignatureMethod
2000/09/xmldsig#RSAKeyValue	[RFC3275]	Retrieval type
2000/09/xmldsig#sha1	[RFC3275]	DigestAlgorithm
2000/09/xmldsig#SPKIData	[RFC3275]	Retrieval type
2000/09/xmldsig#X509Data	[RFC3275]	Retrieval type
2001/04/xmldsig-more#arcfour	2.6.1	EncryptionMethod
2001/04/xmldsig-more#camellia128-cbc	2.6.2	EncryptionMethod
2001/04/xmldsig-more#camellia192-cbc	2.6.2	EncryptionMethod
2001/04/xmldsig-more#camellia256-cbc	2.6.2	EncryptionMethod
2001/04/xmldsig-more#ecdsa-sha1	2.3.6	SignatureMethod
2001/04/xmldsig-more#ecdsa-sha224	2.3.6	SignatureMethod
2001/04/xmldsig-more#ecdsa-sha256	2.3.6	SignatureMethod
2001/04/xmldsig-more#ecdsa-sha384	2.3.6	SignatureMethod
2001/04/xmldsig-more#ecdsa-sha512	2.3.6	SignatureMethod
2001/04/xmldsig-more#esign-sha1	2.3.7	SignatureMethod
2001/04/xmldsig-more#esign-sha224	2.3.7	SignatureMethod
2001/04/xmldsig-more#esign-sha256	2.3.7	SignatureMethod
2001/04/xmldsig-more#esign-sha384	2.3.7	SignatureMethod
2001/04/xmldsig-more#esign-sha512	2.3.7	SignatureMethod
2001/04/xmldsig-more#hmac-md5	2.2.1	SignatureMethod
2001/04/xmldsig-more#hmac-ripemd160	2.2.3	SignatureMethod
2001/04/xmldsig-more#hmac-sha224	2.2.2	SignatureMethod

2001/04/xmlsig-more#hmac-sha256
2001/04/xmlsig-more#hmac-sha384

2.2.2 SignatureMethod
2.2.2 SignatureMethod

2001/04/xmldsig-more#hmac-sha512	2.2.2	SignatureMethod
2001/04/xmldsig-more#KeyName	3.2	Retrieval type
2001/04/xmldsig-more#KeyValue	3.2	Retrieval type
2001/04/xmldsig-more#kw-camellia128	2.6.3	EncryptionMethod
2001/04/xmldsig-more#kw-camellia192	2.6.3	EncryptionMethod
2001/04/xmldsig-more#kw-camellia256	2.6.3	EncryptionMethod
2001/04/xmldsig-more#md5	2.1.1	DigestAlgorithm
2001/04/xmldsig-more#PKCS7signedData	3.2	Retrieval type
2001/04/xmldsig-more#psec-kem	2.6.4	EncryptionMethod
2001/04/xmldsig-more#rawPGPKeyPacket	3.2	Retrieval type
2001/04/xmldsig-more#rawPKCS7signedData	3.2	Retrieval type
2001/04/xmldsig-more#rawSPKISexp	3.2	Retrieval type
2001/04/xmldsig-more#rawX509CRL	3.2	Retrieval type
2001/04/xmldsig-more#RetrievalMethod	3.2	Retrieval type
2001/04/xmldsig-more#rsa-md5	2.3.1	SignatureMethod
2001/04/xmldsig-more#rsa-sha224	2.3.11	SignatureMethod
2001/04/xmldsig-more#rsa-sha256	2.3.2	SignatureMethod
2001/04/xmldsig-more#rsa-sha384	2.3.3	SignatureMethod
2001/04/xmldsig-more#rsa-sha512	2.3.4	SignatureMethod
2001/04/xmldsig-more#rsa-ripemd160	2.3.5	SignatureMethod
2001/04/xmldsig-more#sha224	2.1.2	DigestAlgorithm
2001/04/xmldsig-more#sha384	2.1.3	DigestAlgorithm
2001/04/xmldsig-more#xptr	2.5.1	Transform
2001/04/xmldsig-more#PKCS7signedData	3.1	KeyInfo child
2001/04/xmlenc#aes128-cbc	[XMLENC11]	EncryptionMethod
2001/04/xmlenc#aes192-cbc	[XMLENC11]	EncryptionMethod
2001/04/xmlenc#aes256-cbc	[XMLENC11]	EncryptionMethod
2001/04/xmlenc#dh	[XMLENC11]	AgreementMethod
2001/04/xmlenc#kw-aes128	[XMLENC11]	EncryptionMethod
2001/04/xmlenc#kw-aes192	[XMLENC11]	EncryptionMethod
2001/04/xmlenc#kw-aes256	[XMLENC11]	EncryptionMethod
2001/04/xmlenc#ripemd160	[XMLENC11]	DigestAlgorithm
2001/04/xmlenc#rsa-1_5	[XMLENC11]	EncryptionMethod
2001/04/xmlenc#rsa-oaep-mgf1p	[XMLENC11]	EncryptionMethod
2001/04/xmlenc#sha256	[XMLENC11]	DigestAlgorithm
2001/04/xmlenc#sha512	[XMLENC11]	DigestAlgorithm
2001/04/xmlenc#tripledes-cbc	[XMLENC11]	EncryptionMethod
2002/06/xmldsig-filter2	[XPATH]	Transform
2002/07/decrypt#XML	[DECRYPT]	Transform
2002/07/decrypt#Binary	[DECRYPT]	Transform
2006/12/xmldc12n11# {Bad}	[CANON11]	Canonicalization
2006/12/xmldc14n11#	[CANON11]	Canonicalization
2006/12/xmldc14n11#WithComments	[CANON11]	Canonicalization

2007/05/xmldsig-more#ecdsa-ripemd160	2.3.6	SignatureMethod
2007/05/xmldsig-more#ecdsa-whirlpool	2.3.5	SignatureMethod
2007/05/xmldsig-more#kw-seed128	2.6.6	EncryptionMethod
2007/05/xmldsig-more#md2-rsa-MGF1	2.3.10	SignatureMethod
2007/05/xmldsig-more#md5-rsa-MGF1	2.3.10	SignatureMethod
2007/05/xmldsig-more#MGF1	2.3.9	SignatureMethod
2007/05/xmldsig-more#ripemd128-rsa-MGF1	2.3.10	SignatureMethod
2007/05/xmldsig-more#ripemd160-rsa-MGF1	2.3.10	SignatureMethod
2007/05/xmldsig-more#rsa-pss	2.3.9	SignatureMethod
2007/05/xmldsig-more#rsa-sha224 {Bad}	2.3.11	SignatureMethod
2007/05/xmldsig-more#rsa-whirlpool	2.3.5	SignatureMethod
2007/05/xmldsig-more#seed128-cbc	2.6.5	EncryptionMethod
2007/05/xmldsig-more#sha1-rsa-MGF1	2.3.10	SignatureMethod
2007/05/xmldsig-more#sha224-rsa-MGF1	2.3.10	SignatureMethod
2007/05/xmldsig-more#sha256-rsa-MGF1	2.3.10	SignatureMethod
2007/05/xmldsig-more#sha3-224	2.1.5	DigestAlgorithm
2007/05/xmldsig-more#sha3-224-rsa-MGF1	2.3.10	SignatureMethod
2007/05/xmldsig-more#sha3-256	2.1.5	DigestAlgorithm
2007/05/xmldsig-more#sha3-256-rsa-MGF1	2.3.10	SignatureMethod
2007/05/xmldsig-more#sha3-384	2.1.5	DigestAlgorithm
2007/05/xmldsig-more#sha3-384-rsa-MGF1	2.3.10	SignatureMethod
2007/05/xmldsig-more#sha3-512	2.1.5	DigestAlgorithm
2007/05/xmldsig-more#sha3-512-rsa-MGF1	2.3.10	SignatureMethod
2007/05/xmldsig-more#sha384-rsa-MGF1	2.3.10	SignatureMethod
2007/05/xmldsig-more#sha512-rsa-MGF1	2.3.10	SignatureMethod
2007/05/xmldsig-more#whirlpool	2.1.4	DigestAlgorithm
2007/05/xmldsig-more#whirlpool-rsa-MGF1	2.3.10	SignatureMethod
2009/xmlenc11#kw-aes-128-pad	[XMLENC11]	EncryptionMethod
2009/xmlenc11#kw-aes-192-pad	[XMLENC11]	EncryptionMethod
2009/xmlenc11#kw-aes-256-pad	[XMLENC11]	EncryptionMethod
2009/xmldsig11#dsa-sha256	[XMLDSIG11]	SignatureMethod
2009/xmldsig11#ECKeyValue	[XMLDSIG11]	Retrieval type
2009/xmldsig11#DEREncodedKeyValue	[XMLDSIG11]	Retrieval type
2009/xmlenc11#aes128-gcm	[XMLENC11]	EncryptionMethod
2009/xmlenc11#aes192-gcm	[XMLENC11]	EncryptionMethod
2009/xmlenc11#aes256-gcm	[XMLENC11]	EncryptionMethod
2009/xmlenc11#ConcatKDF	[XMLENC11]	EncryptionMethod
2009/xmlenc11#mgf1sha1	[XMLENC11]	SignatureMethod
2009/xmlenc11#mgf1sha224	[XMLENC11]	SignatureMethod
2009/xmlenc11#mgf1sha256	[XMLENC11]	SignatureMethod
2009/xmlenc11#mgf1sha384	[XMLENC11]	SignatureMethod
2009/xmlenc11#mgf1sha512	[XMLENC11]	SignatureMethod
2009/xmlenc11#pbkdf2	[XMLENC11]	EncryptionMethod
2009/xmlenc11#rsa-oaep	[XMLENC11]	EncryptionMethod
2009/xmlenc11#ECDH-ES	[XMLENC11]	EncryptionMethod
2009/xmlenc11#dh-es	[XMLENC11]	EncryptionMethod

2010/xmlsec-ghc#generic-hybrid	[GENERIC]	Generic Hybrid
2010/xmlsec-ghc#rsaes-kem	[GENERIC]	Generic Hybrid
2010/xmlsec-ghc#ecies-kem	[GENERIC]	Generic Hybrid
2021/04/xmldsig-more#chacha20	2.6.7	EncrytionMethod
2021/04/xmldsig-more#ecdsa-sha3-224	2.3.6	SignatureMethod
2021/04/xmldsig-more#ecdsa-sha3-256	2.3.6	SignatureMethod
2021/04/xmldsig-more#ecdsa-sha3-384	2.3.6	SignatureMethod
2021/04/xmldsig-more#ecdsa-sha3-512	2.3.6	SignatureMethod
2021/04/xmldsig-more#eddsa-ed25519ph	2.3.12	SignatureMethod
2021/04/xmldsig-more#eddsa-ed25519ctx	2.3.12	SignatureMethod
2021/04/xmldsig-more#eddsa-ed25519	2.3.12	SignatureMethod
2021/04/xmldsig-more#eddsa-ed448	2.3.12	SignatureMethod
2021/04/xmldsig-more#eddsa-ed448ph	2.3.12	SignatureMethod
2021/04/xmldsig-more#po1305	2.2.4	SignatureMethod
2021/04/xmldsig-more#siphash-2-4	2.2.5	SignatureMethod
2021/04/xmldsig-more#x25519	2.7.1	AgreementMethod
2021/04/xmldsig-more#xmss-sha2-192	2.2.6	SignatureMethod
2021/04/xmldsig-more#xmss-sha2-256	2.2.6	SignatureMethod
2021/04/xmldsig-more#xmss-shake256-192	2.2.6	SignatureMethod
2021/04/xmldsig-more#xmss-shake256-256	2.2.6	SignatureMethod
2021/04/xmldsig-more#xmssmt-sha2-192	2.2.6	SignatureMethod
2021/04/xmldsig-more#xmssmt-sha2-256	2.2.6	SignatureMethod
2021/04/xmldsig-more#xmssmt-shake256-192	2.2.6	SignatureMethod
2021/04/xmldsig-more#xmssmt-shake256-256	2.2.6	SignatureMethod
TR/1999/REC-xpath-19991116	[XPATH]	Transform
TR/1999/REC-xslt-19991116	[XSLT]	Transform
TR/2001/06/xml-exc-c14n#	[XCANON]	Canonicalization
TR/2001/06/xml-exc-c14n#WithComments	[XCANON]	Canonicalization
TR/2001/REC-xml-c14n-20010315	[CANON10]	Canonicalization
TR/2001/REC-xml-c14n-20010315#WithComments	[CANON10]	Canonicalization
TR/2001/REC-xmlschema-1-20010502	[Schema]	Transform

The initial "http://www.w3.org/" part of the URI is not included above. "{Bad}" indicates a Bad value that was accidentally included in [[RFC6931](#)]. Implementations SHOULD only generate the correct URI but SHOULD understand both the correct and erroneous URI. See also [Appendix B](#).

5. Allocation Considerations

W3C and IANA allocation considerations are given below.

5.1 W3C Allocation Considerations

As it is easy for people to construct their own unique URIs [[RFC3986](#)] and, if appropriate, to obtain a URI from the W3C, it is not intended that any additional "http://www.w3.org/2007/05/xmlsig-more#" URIs be created. (W3C Namespace stability rules prohibit the creation of new URIs under "http://www.w3.org/2000/09/xmlsig#" and URIs under "http://www.w3.org/2001/04/xmlsig-more#" were frozen with the publication of [[RFC4051](#)].)

The W3C has assigned "http://www.w3.org/2021/04/xmlsig-more#" for additional new URIs specified in this document.

An "xmlsig-more" URI does not imply any official W3C or IETF status for these algorithms or identifiers nor does it imply that they are only useful in digital signatures. Currently, dereferencing such URIs may or may not produce a temporary placeholder document. Permission to use these URI prefixes has been given by the W3C.

5.2 IANA Considerations

IANA has established a registry entitled "XML Security URIs". The initial contents correspond to [Section 4.2](#) of this document with each section number in the "Sec/Doc" column augmented with a reference to this RFC (for example, "2.6.4" means "[this document], [Section 2.6.4](#)").

New entries, including new Types, will be added based on Expert Review [[RFC8126](#)]. Criterion for inclusion are (1) documentation sufficient for interoperability of the algorithm or data type and the XML syntax for its representation and use and (2) sufficient importance as normally indicated by inclusion in (2a) an approved W3C Note, Proposed Recommendation, or Recommendation or (2b) an approved IETF Standards Track document. Typically, the registry will reference a W3C or IETF document specifying such XML syntax; that document will either contain a more detailed description of the algorithm or data type or reference another document with a more detailed description.

6. Security Considerations

This RFC is concerned with documenting the URIs that designate algorithms and some data types used in connection with XML security. The security considerations vary widely with the particular algorithms, and the general security considerations for XML security are outside of the scope of this document but appear in [[XMLDSIG11](#)], [[XMLENC11](#)], [[CANON10](#)], [[CANON11](#)], and [[GENERIC](#)].

[RFC6151] should be consulted before considering the use of MD5 as a DigestMethod or RSA-MD5 as a SignatureMethod.

See [[RFC6194](#)] for SHA-1 security considerations and [[RFC6151](#)] for MD5 security considerations.

Additional security considerations are given in connection with the description of some algorithms in the body of this document.

Implementers should be aware that cryptographic algorithms become weaker with time. As new cryptoanalysis techniques are developed and computing performance improves, the work factor to break a particular cryptographic algorithm will decrease. Therefore, cryptographic implementations should be modular, allowing new algorithms to be readily inserted. That is, implementers should be prepared for the set of mandatory-to-implement algorithms for any particular use to change over time. This is sometimes referred to as "algorithm agility".

Acknowledgements

The contributions of the following, listed in alphabetic order, by reporting errata against [[RFC6931](#)] or contributing to this document, are gratefully acknowledged:

Pim van der Eijk, Frederick Hirsch, Gayle Noble, Axel Puhlmann, Annie Yousar

The contributions of the following, listed in alphabetic order, to [[RFC6931](#)], on which this document is based, are gratefully acknowledged:

Benoit Claise, Adrian Farrel, Stephen Farrell, Ernst Giessmann, Frederick Hirsch, Bjoern Hoehrmann, Russ Housley, Satoru Kanno, Charlie Kaufman, Konrad Lanz, HwanJin Lee, Barry Leiba, Peter Lipp, Subramanian Moonesamy, Thomas Roessler, Hanseong Ryu, Peter Saint-Andre, and Sean Turner.

The following contributors to [[RFC4051](#)] are gratefully acknowledged:

Glenn Adams, Merlin Hughes, Gregor Karlinger, Brian LaMachia, Shiho Moriai, Joseph Reagle, Russ Housley, and Joel Halpern.

Appendix A: Changes from [RFC 6931](#)

The following changes have been made in [RFC 6931](#) to produce this document.

1. Delete Appendix on Changes from [RFC 4051](#), since they were already included in [RFC 6931](#), and remove reference to [RFC 4051](#) and to the one Errata against [RFC 4051](#).
2. Fix three errata as follows: [[Err3597](#)], [[Err3965](#)], and [[Err4004](#)]. In cases where [[RFC6931](#)] had an erroneous URI, it is still included in the indices and it is stated that implementations SHOULD only generate the correct URI but SHOULD understand both the correct and erroneous URI.
3. Added the following algorithms:

Section	Algorithm(s)
-----	-----
2.2.4	Poly1305
2.2.5	SipHash-2-4
2.2.6	XMSS amd XMSSMT
2.3.6	ECDSA with SHA3
2.3.12	Edwards-Curve Signatures
2.6.7	ChaCha20
2.7.1	X25519

4. Listed ECIES-KEM and RSAES-KEM in [Section 2.6.4](#) so they are easier to find even though the URI for them is specified in [[GENERIC](#)].
5. Updated references for [[GENERIC](#)] and FIPS 186, added appropriate references.
6. Minor typo fixes and editorial changes.

Appendix B: Bad URIs

[RFC6931] included two bad URIs as shown below. "{Bad}" in the indexes ([Section 4.1](#) and 4.2) indicates such a Bad value. Implementations SHOULD only generate the correct URI but SHOULD understand both the correct and erroneous URI.

2006/12/xmlc12n11#

Appears in the indices ([Section 4.1](#) and 4.2] of [[RFC6931](#)] when it should be "2006/12/xmlc14n11#" (i.e., "12" should have been "14"). This is [[Err3965](#)] and is corrected in this document.

2007/05/xmldsig-more#rsa-sha224

Appears in the indices ([Section 4.1](#) and 4.2] of [[RFC6931](#)] when it should be "2001/04/xmldsig-more#rsa-sha224". This is [[Err4004](#)] and is corrected in this document.

Appendix Z: Change History

RFC Editor Note: Please delete this Appendix before publication.

-00 to -01 to -02 to -03 to -04 to -05 to -06 to -07 to -08

Bump up version and date to keep draft alive as a place where new URIs can be accumulated. At some point in here, author address was updated.

-08 to -09 to -10

Update author affiliation and references.

-10 to -11

Update author address.

-11 to -12

Bump up version and date to keep draft alive.

-12 to -13

Numerous editorial/typo fixes thanks to Gayle Noble who is added to the acknowledgements section.

-13 to -14

Numerous additional algorithms almost all as requested by Pim van der Eijk who is added to the acknowledgements section. Update and add references.

-14 to -15

Add URLs for ECDSA with SHA3, SipHash-2-4, X25519, XMSS and XMSSMT. Add RFC reference 5869 for HKDF but not yet added elsewhere in the document.

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