COSE and JOSE Registrations for WebAuthn Algorithms
draft-ietf-cose-webauthn-algorithms-06

Abstract

   The W3C Web Authentication (WebAuthn) specification and the FIDO
   Alliance Client to Authenticator Protocol (CTAP) specification use
   CBOR Object Signing and Encryption (COSE) algorithm identifiers.
   This specification registers the following algorithms in the IANA
   "COSE Algorithms" registry, which are used by WebAuthn and CTAP
   implementations: RSASSA-PKCS1-v1_5 using SHA-256, SHA-384, SHA-512,
   and SHA-1, and ECDSA using the secp256k1 curve and SHA-256. It
   registers the secp256k1 elliptic curve in the IANA "COSE Elliptic
   Curves" registry. Also, for use with JSON Object Signing and
   Encryption (JOSE), it registers the algorithm ECDSA using the
   secp256k1 curve and SHA-256 in the IANA "JSON Web Signature and
   Encryption Algorithms" registry and the secp256k1 elliptic curve in
   the IANA "JSON Web Key Elliptic Curve" registry.

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   This Internet-Draft is submitted in full conformance with the
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[1](#). Introduction

   This specification defines how to use several algorithms with CBOR
   Object Signing and Encryption (COSE) [[RFC8152](#)] that are used by
   implementations of the W3C Web Authentication (WebAuthn) [[WebAuthn](#)]
   and FIDO Alliance FIDO2 Client to Authenticator Protocol (CTAP)
   [[CTAP](#)] specifications. This specification registers these algorithms
   in the IANA "COSE Algorithms" registry [[IANA.COSE.Algorithms](#)] and
   registers an elliptic curve in the IANA "COSE Elliptic Curves"
   registry [[IANA.COSE.Curves](#)]. This specification also registers a
   corresponding algorithm for use with JSON Object Signing and
   Encryption (JOSE) [[RFC7515](#)] in the IANA "JSON Web Signature and

Encryption Algorithms" registry [IANA.JOSE.Algorithms] and registers
an elliptic curve in the IANA "JSON Web Key Elliptic Curve" registry
[IANA.JOSE.Curves].

1.1. Requirements Notation and Conventions

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

2. RSASSA-PKCS1-v1_5 Signature Algorithm

The RSASSA-PKCS1-v1_5 signature algorithm is defined in [RFC8017].
The RSASSA-PKCS1-v1_5 signature algorithm is parameterized with a
hash function (h).

A key of size 2048 bits or larger MUST be used with these algorithms.
Implementations need to check that the key type is 'RSA' when
creating or verifying a signature.

The RSASSA-PKCS1-v1_5 algorithms specified in this document are in
the following table.

Name	Value	Hash	Description	Recommended
RS256	TBD (temporary assignment -257 already in place)	SHA-256	RSASSA-PKCS1-v1_5 using SHA-256	No
RS384	TBD (temporary assignment -258 already in place)	SHA-384	RSASSA-PKCS1-v1_5 using SHA-384	No
RS512	TBD (temporary assignment -259 already in place)	SHA-512	RSASSA-PKCS1-v1_5 using SHA-512	No
RS1	TBD (temporary assignment -65535 already in place)	SHA-1	RSASSA-PKCS1-v1_5 using SHA-1	Deprecated

Table 1: RSASSA-PKCS1-v1_5 Algorithm Values

Security considerations for use of the first three algorithms are in Section 5.2. Security considerations for use of the last algorithm are in Section 5.3.

Note that these algorithms are already present in the IANA "JSON Web Signature and Encryption Algorithms" registry [IANA.JOSE.Algorithms], and so these registrations are only for the IANA "COSE Algorithms" registry [IANA.COSE.Algorithms].

3. Using secp256k1 with JOSE and COSE

This section defines algorithm encodings and representations enabling the Standards for Efficient Cryptography Group (SECG) elliptic curve secp256k1 [SEC2] to be used for JOSE [RFC7515] and COSE [RFC8152] messages.

3.1. JOSE and COSE secp256k1 Curve Key Representations

The Standards for Efficient Cryptography Group (SECG) elliptic curve secp256k1 [SEC2] is represented in a JSON Web Key (JWK) [RFC7517] using these values:

o "kty": "EC"
o "crv": "secp256k1"

plus the values needed to represent the curve point, as defined in Section 6.2.1 of [RFC7518]. As a compressed point encoding representation is not defined for JWK elliptic curve points, the uncompressed point encoding defined there MUST be used. The "x" and "y" values represented MUST both be exactly 256 bits, with any leading zeros preserved. Other optional values such as "alg" MAY also be present.

It is represented in a COSE_Key [RFC8152] using these values:

o "kty" (1): "EC2" (2)
o "crv" (-1): "secp256k1" (TBD - requested assignment 8)

plus the values needed to represent the curve point, as defined in Section 13.1.1 of [RFC8152]. Either the uncompressed or compressed point encoding representations defined there can be used. The "x" value represented MUST be exactly 256 bits, with any leading zeros preserved. If the uncompressed representation is used, the "y" value represented MUST likewise be exactly 256 bits, with any leading zeros preserved; if the compressed representation is used, the "y" value MUST be a boolean value, as specified in Section 13.1.1 of [RFC8152]. Other optional values such as "alg" (3) MAY also be present.

3.2. ECDSA Signature with secp256k1 Curve

The ECDSA signature algorithm is defined in [DSS]. This specification defines the "ES256K" algorithm identifier, which is used to specify the use of ECDSA with the secp256k1 curve and the SHA-256 [DSS] cryptographic hash function. Implementations need to check that the key type is "EC" for JOSE or "EC2" (2) for COSE and that the curve of the key is secp256k1 when creating or verifying a signature.

The ECDSA secp256k1 SHA-256 digital signature is generated as follows:

1. Generate a digital signature of the JWS Signing Input or the COSE Sig_structure using ECDSA secp256k1 SHA-256 with the desired

   private key. The output will be the pair (R, S), where R and S
   are 256-bit unsigned integers.

2. Turn R and S into octet sequences in big-endian order, with each
   array being be 32 octets long. The octet sequence
   representations MUST NOT be shortened to omit any leading zero
   octets contained in the values.

3. Concatenate the two octet sequences in the order R and then S.
   (Note that many ECDSA implementations will directly produce this
   concatenation as their output.)

4. The resulting 64-octet sequence is the JWS Signature or COSE
   signature value.

Implementations SHOULD use a deterministic algorithm to generate the
ECDSA nonce, k, such as [RFC6979]. However, in situations where
devices are vulnerable to physical attacks, deterministic ECDSA has
been shown to be susceptible to fault injection attacks [Kudelski17]
[EuroSP18]. Where this is a possibility, implementations SHOULD
implement appropriate countermeasures. Where there are specific
certification requirements (such as FIPS approval), implementors
should check whether deterministic ECDSA is an approved nonce
generation method.

The ECDSA secp256k1 SHA-256 algorithm specified in this document uses
these identifiers:

JOSE Alg Name	COSE Alg Value	Description	Recommended
ES256K	TBD (requested assignment -47)	ECDSA using secp256k1 curve and SHA-256	Yes

                 Table 2: ECDSA Algorithm Values

Implementation of this algorithm is recommended because of its
widespread use in decentralized systems and those that chose it over
the NIST curves.

When using a JWK or COSE_Key for this algorithm, the following checks
are made:

o The "kty" field MUST be present and it MUST be "EC" for JOSE or
   "EC2" for COSE.

o The "crv" field MUST be present and it MUST represent the
   "secp256k1" elliptic curve.

o If the "alg" field is present, it MUST represent the "ES256K"
   algorithm.

o If the "key_ops" field is present, it MUST include "sign" when
   creating an ECDSA signature.

o If the "key_ops" field is present, it MUST include "verify" when
   verifying an ECDSA signature.

o If the JWK _use_ field is present, its value MUST be "sig".

3.3. Other Uses of the secp256k1 Elliptic Curve

This specification defines how to use the secp256k1 curve for ECDSA
signatures for both JOSE and COSE implementations. While in theory,
the curve could also be used for ECDH-ES key agreement, it is beyond
the scope of this specification to state whether this is or is not
advisable. Thus, whether to recommend its use with ECDH-ES is left
for experts to decide in future specifications.

When used for ECDSA, the secp256k1 curve MUST be used only with the
"ES256K" algorithm identifier and not any others, including not with
the COSE "ES256" identifier. Note that the "ES256K" algorithm
identifier needed to be introduced for JOSE to sign with the
secp256k1 curve because the JOSE "ES256" algorithm is defined to be
used only with the P-256 curve. The COSE treatment of how to sign
with secp256k1 is intentionally parallel to that for JOSE, where the
secp256k1 curve MUST be used with the "ES256K" algorithm identifier.

4. IANA Considerations

4.1. COSE Algorithms Registrations

This section registers the following values in the IANA "COSE
Algorithms" registry [IANA.COSE.Algorithms].

o Name: RS256
o Value: TBD (temporary assignment -257 already in place)
o Description: RSASSA-PKCS1-v1_5 using SHA-256
o Reference: Section 2 of this document
o Recommended: No

o Name: RS384
o Value: TBD (temporary assignment -258 already in place)
o Description: RSASSA-PKCS1-v1_5 using SHA-384

o Reference: [Section 2](#) of this document
o Recommended: No

o Name: RS512
o Value: TBD (temporary assignment -259 already in place)
o Description: RSASSA-PKCS1-v1_5 using SHA-512
o Reference: [Section 2](#) of this document
o Recommended: No

o Name: RS1
o Value: TBD (temporary assignment -65535 already in place)
o Description: RSASSA-PKCS1-v1_5 using SHA-1
o Reference: [Section 2](#) of this document
o Recommended: Deprecated

o Name: ES256K
o Value: TBD (requested assignment -47)
o Description: ECDSA using secp256k1 curve and SHA-256
o Reference: [Section 3.2](#) of this document
o Recommended: Yes

[4.2](#). COSE Elliptic Curves Registrations

This section registers the following value in the IANA "COSE Elliptic Curves" registry [[IANA.COSE.Curves](#)].

o Name: secp256k1
o Value: TBD (requested assignment 8)
o Key Type: EC2
o Description: SECG secp256k1 curve
o Change Controller: IESG
o Reference: [Section 3.1](#) of [[this specification]]
o Recommended: Yes

[4.3](#). JOSE Algorithms Registrations

This section registers the following value in the IANA "JSON Web Signature and Encryption Algorithms" registry [[IANA.JOSE.Algorithms](#)].

o Algorithm Name: ES256K
o Algorithm Description: ECDSA using secp256k1 curve and SHA-256
o Algorithm Usage Locations: alg
o JOSE Implementation Requirements: Optional
o Change Controller: IESG
o Reference: [Section 3.2](#) of [[this specification]]
o Algorithm Analysis Document(s): [[SEC2](#)]

4.4. JSON Web Key Elliptic Curves Registrations

   This section registers the following value in the IANA "JSON Web Key
   Elliptic Curve" registry [IANA.JOSE.Curves].

   o Curve Name: secp256k1
   o Curve Description: SECG secp256k1 curve
   o JOSE Implementation Requirements: Optional
   o Change Controller: IESG
   o Specification Document(s): Section 3.1 of [[this specification]]

5. Security Considerations

5.1. RSA Key Size Security Considerations

   The security considerations on key sizes for RSA algorithms from
   Section 6.1 of [RFC8230] also apply to the RSA algorithms in this
   specification.

5.2. RSASSA-PKCS1-v1_5 with SHA-2 Security Considerations

   The security considerations on the use of RSASSA-PKCS1-v1_5 with
   SHA-2 hash functions from Section 8.3 of [RFC7518] also apply to
   their use in this specification. For that reason, these algorithms
   are registered as being "Not Recommended".

5.3. RSASSA-PKCS1-v1_5 with SHA-1 Security Considerations

   The security considerations on the use of the SHA-1 hash function
   from [RFC6194] apply in this specification. For that reason, the
   "RS1" algorithm is registered as "Deprecated". Likewise, the
   exponent restrictions described in Section 8.3 of [RFC7518] also
   apply.

   A COSE algorithm identifier for this algorithm is nonetheless being
   registered because deployed TPMs continue to use it, and therefore
   WebAuthn implementations need a COSE algorithm identifier for "RS1"
   when TPM attestations using this algorithm are being represented.
   New COSE applications MUST NOT use this algorithm.

5.4. secp256k1 Security Considerations

   Care should be taken that a secp256k1 key is not mistaken for a P-256
   [RFC7518] key, given that their representations are the same except
   for the "crv" value.

The procedures and security considerations described in the [SEC1], [SEC2], and [DSS] specifications apply to implementations of this specification.

6. References

6.1. Normative References

[DSS]   National Institute of Standards and Technology (NIST),
            "Digital Signature Standard (DSS)", FIPS PUB 186-4, July
            2013, <http://nvlpubs.nist.gov/nistpubs/FIPS/
            NIST.FIPS.186-4.pdf>.

[RFC2119]   Bradner, S., "Key words for use in RFCs to Indicate
            Requirement Levels", BCP 14, RFC 2119,
            DOI 10.17487/RFC2119, March 1997,
            <https://www.rfc-editor.org/info/rfc2119>.

[RFC6194]   Polk, T., Chen, L., Turner, S., and P. Hoffman, "Security
            Considerations for the SHA-0 and SHA-1 Message-Digest
            Algorithms", RFC 6194, DOI 10.17487/RFC6194, March 2011,
            <https://www.rfc-editor.org/info/rfc6194>.

[RFC7515]   Jones, M., Bradley, J., and N. Sakimura, "JSON Web
            Signature (JWS)", RFC 7515, DOI 10.17487/RFC7515, May
            2015, <https://www.rfc-editor.org/info/rfc7515>.

[RFC7517]   Jones, M., "JSON Web Key (JWK)", RFC 7517,
            DOI 10.17487/RFC7517, May 2015,
            <https://www.rfc-editor.org/info/rfc7517>.

[RFC7518]   Jones, M., "JSON Web Algorithms (JWA)", RFC 7518,
            DOI 10.17487/RFC7518, May 2015,
            <https://www.rfc-editor.org/info/rfc7518>.

[RFC8017]   Moriarty, K., Ed., Kaliski, B., Jonsson, J., and A. Rusch,
            "PKCS #1: RSA Cryptography Specifications Version 2.2",
            RFC 8017, DOI 10.17487/RFC8017, November 2016,
            <https://www.rfc-editor.org/info/rfc8017>.

[RFC8152]   Schaad, J., "CBOR Object Signing and Encryption (COSE)",
            RFC 8152, DOI 10.17487/RFC8152, July 2017,
            <https://www.rfc-editor.org/info/rfc8152>.

[RFC8174]   Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC
            2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174,
            May 2017, <https://www.rfc-editor.org/info/rfc8174>.

[RFC8230]   Jones, M., "Using RSA Algorithms with CBOR Object Signing
            and Encryption (COSE) Messages", RFC 8230,
            DOI 10.17487/RFC8230, September 2017,
            <https://www.rfc-editor.org/info/rfc8230>.

[SEC1]   Standards for Efficient Cryptography Group, "SEC 1:
            Elliptic Curve Cryptography", Version 2.0, May 2009,
            <http://www.secg.org/sec1-v2.pdf>.

[SEC2]   Standards for Efficient Cryptography Group, "SEC 2:
            Recommended Elliptic Curve Domain Parameters",
            Version 2.0, January 2010,
            <http://www.secg.org/sec2-v2.pdf>.

6.2. Informative References

[CTAP]   Brand, C., Czeskis, A., Ehrensvaerd, J., Jones, M., Kumar,
            A., Lindemann, R., Powers, A., and J. Verrept, "Client to
            Authenticator Protocol (CTAP)", FIDO Alliance Proposed
            Standard, January 2019, <https://fidoalliance.org/specs/
            fido-v2.0-ps-20190130/fido-client-to-authenticator-
            protocol-v2.0-ps-20190130.html>.

[EuroSP18]
            Poddebniak, D., Somorovsky, J., Schinzel, S., Lochter, M.,
            and P. Roesler, "Attacking Deterministic Signature Schemes
            using Fault Attacks", IEEE European Symposium on Security
            and Privacy (EuroS&P) 2018, April 2018,
            <https://eprint.iacr.org/2017/1014.pdf>.

[IANA.COSE.Algorithms]
            IANA, "COSE Algorithms",
            <https://www.iana.org/assignments/cose/
            cose.xhtml#algorithms>.

[IANA.COSE.Curves]
            IANA, "COSE Elliptic Curves",
            <https://www.iana.org/assignments/cose/
            cose.xhtml#elliptic-curves>.

[IANA.JOSE.Algorithms]
            IANA, "JSON Web Signature and Encryption Algorithms",
            <https://www.iana.org/assignments/jose/jose.xhtml#web-
            signature-encryption-algorithms>.

   [IANA.JOSE.Curves]
              IANA, "JSON Web Key Elliptic Curve",
              <https://www.iana.org/assignments/jose/jose.xhtml#web-key-
              elliptic-curve>.

   [Kudelski17]
              Romailler, Y., "How to defeat Ed25519 and EdDSA using
              faults", October 2017,
              <https://research.kudelskisecurity.com/2017/10/04/
              defeating-eddsa-with-faults/>.

   [RFC6979] Pornin, T., "Deterministic Usage of the Digital Signature
              Algorithm (DSA) and Elliptic Curve Digital Signature
              Algorithm (ECDSA)", RFC 6979, DOI 10.17487/RFC6979, August
              2013, <https://www.rfc-editor.org/info/rfc6979>.

   [WebAuthn]
              Balfanz, D., Czeskis, A., Hodges, J., Jones, J., Jones,
              M., Kumar, A., Liao, A., Lindemann, R., and E. Lundberg,
              "Web Authentication: An API for accessing Public Key
              Credentials - Level 1", World Wide Web Consortium
              (W3C) Recommendation, March 2019,
              <https://www.w3.org/TR/2019/REC-webauthn-1-20190304/>.

Acknowledgements

Document History

   [[to be removed by the RFC Editor before publication as an RFC]]

   -06

   o Addressed Area Directory review comment by Murray Kucherawy (which
      requested an editorial correction).

   o Changed requested assignment for ES256K from -46 to -47, due to an
      assignment conflict.

   -05

   o Removed unused reference to RFC 7049.

-04

o Added explanatory comments on design decisions made that were
   discussed on the mailing list that Jim Schaad requested be added
   to the draft.

-03

o Addressed review of -02 by Jim Schaad.

-02

o Addressed working group last call comments. Thanks to J.C.
   Jones, Kevin Jacobs, Jim Schaad, Neil Madden, and Benjamin Kaduk
   for their useful feedback.

-01

o Changed the JOSE curve identifier from "P-256K" to "secp256k1".

o Specified that secp256k1 signing is done using the SHA-256 hash
   function.

-00

o Created the initial working group draft from draft-jones-cose-
   additional-algorithms-00, changing only the title, date, and
   history entry.

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