Abstract

JSON Web Encryption (JWE) is a means of representing encrypted content using JSON data structures. Related signature capabilities are described in the separate JSON Web Signature (JWS) specification.

Requirements Language

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

Status of this Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79. Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at http://datatracker.ietf.org/drafts/current/. Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as “work in progress.”

This Internet-Draft will expire on May 2, 2012.

Copyright Notice

Copyright (c) 2011 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to BCP 78 and the IETF Trust's Legal Provisions Relating to IETF Documents (http://trustee.ietf.org/license-info) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.

Table of Contents

1. Introduction
2. Terminology
3. JSON Web Encryption (JWE) Overview
   3.1. Example JWE
4. JWE Header
   4.1. Reserved Header Parameter Names
1. Introduction

JSON Web Encryption (JWE) is a compact encryption format intended for space constrained environments such as HTTP Authorization headers and URI query parameters. It provides a wrapper for encrypted content using JSON [RFC4627] data structures. The JWE encryption mechanisms are independent of the type of content being encrypted. A related signature capability is described in a separate JSON Web Signature (JWS) [JWS] specification.

2. Terminology

JSON Web Encryption (JWE)
A data structure representing an encrypted version of a Plaintext. The structure consists of three parts: the JWE Header, the JWE Encrypted Key, and the JWE Ciphertext.

Plaintext
The bytes to be encrypted - a.k.a., the message.

Ciphertext
The encrypted version of the Plaintext.

Content Encryption Key (CEK)
A symmetric key generated to encrypt the Plaintext for the recipient to produce the Ciphertext, which is encrypted to the recipient as the JWE Encrypted Key.

JWE Header
A string containing a JSON object that describes the encryption operations applied to create the JWE Encrypted Key and the JWE Ciphertext.

JWE Encrypted Key
The Content Encryption Key (CEK) is encrypted with the intended recipient's key and the resulting encrypted content is recorded as a byte array, which is referred to as the JWE Encrypted Key.

JWE Ciphertext
A byte array containing the Ciphertext.

Encoded JWE Header
Base64url encoding of the bytes of the UTF-8 RFC 3629 [RFC3629] representation of the JWE Header.

Encoded JWE Encrypted Key
3. JSON Web Encryption (JWE) Overview

JWE represents encrypted content using JSON data structures and base64url encoding. The representation consists of three parts: the JWE Header, the JWE Encrypted Key, and the JWE Ciphertext. The three parts are base64url-encoded for transmission, and typically represented as the concatenation of the encoded strings in that order, with the three strings being separated by period (‘.’) characters, as is done when used in JSON Web Tokens (JWTs) [JWT].

JWE utilizes encryption to ensure the confidentiality of the contents of the Plaintext. JWE does not add a content integrity check if not provided by the underlying encryption algorithm. If such a check is needed, an algorithm providing it such as AES-GCM [NIST-800-38D] can be used, or alternatively, it can be provided through composition by encrypting a representation of the signed content.

3.1. Example JWE

The following example JWE Header declares that:

- the Content Encryption Key is encrypted to the recipient using the RSA-PKCS1_1.5 algorithm to produce the JWE Encrypted Key,
- the Plaintext is encrypted using the AES-256-GCM algorithm to produce the JWE Ciphertext,
- the specified 64-bit Initialization Vector with the base64url encoding __79_Pv6-fg was used, and
- the thumbprint of the X.509 certificate that corresponds to the key used to encrypt the JWE has the base64url encoding 7no0Pq-hJ1_hCnvWh6IeYI2w9Q0.

```
{"alg":"RSA1_5",
"enc":"A256GCM",
"iv":"__79_Pv6-fg",
"x5t":"7no0Pq-hJ1_hCnvWh6IeYI2w9Q0"}
```

Base64url encoding the bytes of the UTF-8 representation of the JWE Header yields this Encoded JWE Header value:

TBD

TBD: Finish this example by showing generation of a Content Encryption Key (CEK), using the CEK to encrypt the Plaintext to produce the Ciphertext (and base64url encoding it), and using the recipient's key to encrypt the CEK to produce the JWE Encrypted Key (and base64url encoding it).
4. JWE Header

The members of the JWE Header describe the encryption applied to the Plaintext. Implementations MUST understand the entire contents of the header; otherwise, the JWE MUST be rejected for processing.

The member names within the JWE Header are referred to as Header Parameter Names. These names MUST be unique. The corresponding values are referred to as Header Parameter Values.

4.1. Reserved Header Parameter Names

The following header parameter names are reserved. All the names are short because a core goal of JWE is for the representations to be compact.

TBD: Describe the relationship between the JWS and JWE header parameters - especially the alg parameter, which can contain either signature algorithms (from JWS) or encryption algorithms (from JWE), and the key reference parameters jku, kid, x5u, and x5t.

<table>
<thead>
<tr>
<th>Header Parameter Name</th>
<th>JSON Value Type</th>
<th>Header Parameter Syntax</th>
<th>Header Parameter Semantics</th>
</tr>
</thead>
<tbody>
<tr>
<td>alg</td>
<td>string</td>
<td>StringOrURI</td>
<td>The alg (algorithm) header parameter identifies the cryptographic algorithm used to secure the JWE Encrypted Key. A list of reserved alg values is presented in Table 3. The processing of the alg (algorithm) header parameter requires that the value of the alg header parameter MUST be one that is both supported and for which there exists a key for use with that algorithm associated with the intended recipient. The alg value is case sensitive. This header parameter is REQUIRED.</td>
</tr>
<tr>
<td>enc</td>
<td>string</td>
<td>StringOrURI</td>
<td>The enc (encryption method) header parameter identifies the symmetric encryption algorithm used to secure the Ciphertext. A list of reserved enc values is presented in Table 4. The processing of the enc (encryption method) header parameter requires that the value of the enc header parameter MUST be one that is supported. The enc value is case sensitive. This header parameter is REQUIRED.</td>
</tr>
<tr>
<td>iv</td>
<td>string</td>
<td>String</td>
<td>Initialization Vector (iv) value for algorithms requiring it, represented as a base64url encoded string. This header parameter is OPTIONAL.</td>
</tr>
<tr>
<td>epk</td>
<td>object</td>
<td>JWK Key Object</td>
<td>Ephemeral Public Key (epk) value created by the originator for the use in ECDH-ES RFC 6090 [RFC6090] encryption. This key is represented in the same manner as a JSON Web Key [JWK] JWK Key Object value, containing curve, x, and y members. The inclusion of the JWK Key Object algorithm member is OPTIONAL. This header parameter is OPTIONAL.</td>
</tr>
<tr>
<td>zip</td>
<td>string</td>
<td>String</td>
<td>Compression algorithm (zip) applied to the Plaintext before encryption, if any. This specification defines the value GZIP to refer to the encoding format produced by the file compression program &quot;gzip&quot; (GNU zip) as described in [RFC1952]; this format is a Lempel-Ziv coding (LZ77) with a 32 bit CRC. If no zip parameter is present, or its value is none, no compression is applied to the Plaintext before encryption. The zip value is case sensitive. This header parameter is OPTIONAL.</td>
</tr>
</tbody>
</table>
| jku                   | string          | URL                     | The jku (JSON Web Key URL) header parameter is an absolute URL that refers to a resource for a set of JSON-encoded public keys, one of which corresponds to the key that was used to encrypt the JWE. The keys MUST be encoded as described in the JSON Web Key (JWK) [JWK] specification. The protocol used to
acquire the resource MUST provide integrity protection. An HTTP GET request to retrieve the certificate MUST use TLS RFC 2818 [RFC2818] RFC 5246 [RFC5246] with server authentication RFC 6125 [RFC6125]. This header parameter is OPTIONAL.

The kid (key ID) header parameter is a hint indicating which key was used to encrypt the JWE. This allows originators to explicitly signal a change of key to recipients. The interpretation of the contents of the kid parameter is unspecified. This header parameter is OPTIONAL.

The x5u (X.509 URL) header parameter is an absolute URL that refers to a resource for the X.509 public key certificate or certificate chain corresponding to the key used to encrypt the JWE. The identified resource MUST provide a representation of the certificate or certificate chain that conforms to RFC 5280 [RFC5280] in PEM encoded form RFC 1421 [RFC1421]. The protocol used to acquire the resource MUST provide integrity protection. An HTTP GET request to retrieve the certificate MUST use TLS RFC 2818 [RFC2818] RFC 5246 [RFC5246] with server authentication RFC 6125 [RFC6125]. This header parameter is OPTIONAL.

The x5t (x.509 certificate thumbprint) header parameter provides a base64url encoded SHA-1 thumbprint (a.k.a. digest) of the DER encoding of the X.509 certificate that corresponds to the key that was used to encrypt the JWE. This header parameter is OPTIONAL.

The typ (type) header parameter is used to declare the type of the encrypted content. The typ value is case sensitive. This header parameter is OPTIONAL.

Table 1: Reserved Header Parameter Definitions

Additional reserved header parameter names MAY be defined via the IANA JSON Web Encryption Header Parameters registry, as per Section 10. The syntax values used above are defined as follows:

<table>
<thead>
<tr>
<th>Syntax Name</th>
<th>Syntax Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>String</td>
<td>Any string value MAY be used.</td>
</tr>
<tr>
<td>StringOrURI</td>
<td>Any string value MAY be used but a value containing a &quot;::&quot; character MUST be a URI as defined in RFC 3986 [RFC3986].</td>
</tr>
<tr>
<td>URL</td>
<td>A URL as defined in RFC 1738 [RFC1738].</td>
</tr>
</tbody>
</table>

Table 2: Header Parameter Syntax Definitions

4.2. Public Header Parameter Names

Additional header parameter names can be defined by those using JWE. However, in order to prevent collisions, any new header parameter name or algorithm value SHOULD either be defined in the IANA JSON Web Encryption Header Parameters registry or be defined as a URI that contains a collision resistant namespace. In each case, the definer of the name or value MUST take reasonable precautions to make sure they are in control of the part of the namespace they use to define the header parameter name.

New header parameters should be introduced sparingly, as they can result in non-interoperable JWEs.

4.3. Private Header Parameter Names
A producer and consumer of a JWE may agree to any header parameter name that is not a Reserved Name Section 4.1 or a Public Name Section 4.2. Unlike Public Names, these private names are subject to collision and should be used with caution.

New header parameters should be introduced sparingly, as they can result in non-interoperable JWEs.

5. Message Encryption

The message encryption process is as follows:

1. Generate a random Content Encryption Key (CEK). The CEK MUST have a length at least equal to that of the required encryption keys and MUST be generated randomly. See RFC 4086 [RFC4086] for considerations on generating random values.
2. Encrypt the CEK for the recipient (see Section 7).
3. Generate a random IV (if required for the algorithm).
4. Compress the Plaintext if a zip parameter was included.
5. Serialize the (compressed) Plaintext into a bitstring M.
6. Encrypt M using the CEK and IV to form the bitstring C.
7. Set the Encoded JWE Ciphertext equal to the base64url encoded representation of C.
8. Create the JWE Header containing the encryption parameters used.
9. Base64url encoded the UTF-8 representation of the JWE Header to create the Encoded JWE Header.
10. The three encoded parts, taken together, are the result of the encryption.

6. Message Decryption

The message decryption process is the reverse of the encryption process. If any of these steps fails, the JWE MUST be rejected.

1. The Encoded JWE Header, the Encoded JWE Encrypted Key, and the Encoded JWE Ciphertext MUST be successfully base64url decoded following the restriction that no padding characters have been used.
2. The resulting JWE Header MUST be completely valid JSON syntax conforming to RFC 4627 [RFC4627].
3. The resulting JWE Header MUST be validated to only include parameters and values whose syntax and semantics are both understood and supported.
4. Verify that the JWE Header appears to reference a key known to the recipient.
5. Decrypt the JWE Encrypted Key to produce the CEK.
6. Decrypt the binary representation of the JWE Ciphertext using the CEK.
7. Uncompress the result of the previous step, if a zip parameter was included.
8. Output the result.

7. CEK Encryption

JWE supports two forms of CEK encryption:

- Asymmetric encryption under the recipient's public key.
- Symmetric encryption under a shared key.

7.1. Asymmetric Encryption

In the asymmetric encryption mode, the CEK is encrypted under the recipient's public key. The asymmetric encryption modes defined for use with this in this specification are listed in in Table 3.
7.2. Symmetric Encryption

In the symmetric encryption mode, the CEK is encrypted under a symmetric key shared between the sender and receiver. The symmetric encryption modes defined for use with this in this specification are listed in in Table 3. For GCM, the random 64-bit IV is prepended to the ciphertext.

8. Composition

This document does not specify a combination signed and encrypted mode. However, because the contents of a message can be arbitrary, encryption and data origin authentication can be provided by recursively encapsulating multiple JWE and JWS messages. In general, senders SHOULD sign the message and then encrypt the result (thus encrypting the signature). This prevents attacks in which the signature is stripped, leaving just an encrypted message, as well as providing privacy for the signer.

9. Encrypting JWEs with Cryptographic Algorithms

JWE uses cryptographic algorithms to encrypt the Content Encryption Key (CEK) and the Plaintext. This section specifies a set of specific algorithms for these purposes.

The table below Table 3 is the set of alg header parameter values that are reserved by this specification. These algorithms are used to encrypt the CEK, which produces the JWE Encrypted Key.

<table>
<thead>
<tr>
<th>alg Parameter Value</th>
<th>Encryption Algorithm</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSA1_5</td>
<td>RSA using RSA-PKCS1-1.5 padding, as defined in RFC 3447 [RFC3447]</td>
</tr>
<tr>
<td>RSA-OAEP</td>
<td>RSA using Optimal Asymmetric Encryption Padding (OAEP), as defined in RFC 3447 [RFC3447]</td>
</tr>
<tr>
<td>ECDH-ES</td>
<td>Elliptic Curve Diffie-Hellman Ephemeral Static, as defined in RFC 6090 [RFC6090], and using the Concat KDF, as defined in [NIST-800-56A], where the Digest Method is SHA-256</td>
</tr>
<tr>
<td>A128KW</td>
<td>Advanced Encryption Standard (AES) Key Wrap Algorithm using 128 bit keys, as defined in RFC 3394 [RFC3394]</td>
</tr>
<tr>
<td>A256KW</td>
<td>Advanced Encryption Standard (AES) Key Wrap Algorithm using 256 bit keys, as defined in RFC 3394 [RFC3394]</td>
</tr>
<tr>
<td>A128GCM</td>
<td>Advanced Encryption Standard (AES) using 128 bit keys in Galois/Counter Mode, as defined in [FIPS-197] and [NIST-800-38D]</td>
</tr>
<tr>
<td>A256GCM</td>
<td>Advanced Encryption Standard (AES) using 256 bit keys in Galois/Counter Mode, as defined in [FIPS-197] and [NIST-800-38D]</td>
</tr>
</tbody>
</table>

Table 3: JWE Reserved alg Parameter Values

The table below Table 4 is the set of enc header parameter values that are reserved by this specification. These algorithms are used to encrypt the Plaintext, which produces the Ciphertext.

<table>
<thead>
<tr>
<th>enc Parameter Value</th>
<th>Symmetric Encryption Algorithm</th>
</tr>
</thead>
</table>

Table 4
Of these algorithms, only RSA-PKCS1-1.5 with 2048 bit keys, AES-128-CBC, and AES-256-CBC MUST be implemented by conforming implementations. It is RECOMMENDED that implementations also support ECDH-ES with 256 bit keys, AES-128-GCM, and AES-256-GCM. Support for other algorithms and key sizes is OPTIONAL.

### 9.1. Encrypting a JWE with TBD

TBD: Descriptions of the particulars of each specified algorithm go here.

### 9.2. Additional Algorithms

Additional algorithms MAY be used to protect JWEs with corresponding `alg` and `enc` header parameter values being defined to refer to them. New `alg` and `enc` header parameter values SHOULD either be defined in the IANA JSON Web Encryption Algorithms registry or be a URI that contains a collision resistant namespace. In particular, the use of algorithm identifiers defined in [W3C.REC-xmllenc-core-20021210], [W3C.CR-xmllenc-core1-20110303], and related specifications is permitted.

### 10. IANA Considerations

This specification calls for:

- A new IANA registry entitled "JSON Web Encryption Header Parameters" for reserved header parameter names is defined in Section 4.1. Inclusion in the registry is RFC Required in the RFC 5226 [RFC5226] sense for reserved JWE header parameter names that are intended to be interoperable between implementations. The registry will just record the reserved header parameter name and a pointer to the RFC that defines it. This specification defines inclusion of the header parameter names defined in Table 1.
- A new IANA registry entitled "JSON Web Encryption Algorithms" for reserved values used with the `alg` and `enc` header parameter values, as defined in Section 9.2. Inclusion in the registry is RFC Required in the RFC 5226 [RFC5226] sense. The registry will record the `alg` or `enc` value and a pointer to the RFC that defines it. This specification defines inclusion of the algorithm values defined in Table 3 and Table 4.

### 11. Security Considerations

TBD: Lots of work to do here. We need to remember to look into any issues relating to security and JSON parsing. One wonders just how secure most JSON parsing libraries are. Were they ever hardened for security scenarios? If not, what kind of holes does that open up? Also, we need to walk through the JSON standard and see what kind of issues we have especially around comparison of names. For instance, comparisons of header parameter names and other parameters must occur after they are unescaped. Need to also put in text
about: Importance of keeping secrets secret. Rotating keys. Strengths and weaknesses of the different algorithms.

TBD: Need to put in text about why strict JSON validation is necessary. Basically, that if malformed JSON is received then the intent of the sender is impossible to reliably discern. One example of malformed JSON that MUST be rejected is an object in which the same member name occurs multiple times.

TBD: We need a section on generating randomness in browsers - it's easy to screw up.

When utilizing TLS to retrieve information, the authority providing the resource MUST be authenticated and the information retrieved MUST be free from modification.

11.1. Unicode Comparison Security Issues

Header parameter names in JWEs are Unicode strings. For security reasons, the representations of these names must be compared verbatim after performing any escape processing (as per RFC 4627 [RFC4627], Section 2.5).

This means, for instance, that these JSON strings must compare as being equal ("enc", "\u0065nc"), whereas these must all compare as being not equal to the first set or to each other ("ENC", "Enc", "en\u0043").

JSON strings MAY contain characters outside the Unicode Basic Multilingual Plane. For instance, the G clef character (U+1D11E) may be represented in a JSON string as "\uD834\uDD1E". Ideally, JWE implementations SHOULD ensure that characters outside the Basic Multilingual Plane are preserved and compared correctly; alternatively, if this is not possible due to these characters exercising limitations present in the underlying JSON implementation, then input containing them MUST be rejected.

12. Open Issues and Things To Be Done (TBD)

The following items remain to be done in this draft:

- Describe the relationship between the JWE, JWS, and JWT header parameters. In particular, point out that the set of "alg" values defined by each must be compatible and non-overlapping.
- Consider whether we want to define composite signing/encryption operations (as was the consensus to do at IIW, as documented at http://self-issued.info/?p=378).
- Consider whether reusing the JWS jku, kid, x5u, and x5t parameters is the right thing to do, particularly as it effectively precludes specifying composite operations.
- Consider whether to add parameters for directly including keys in the header, either as JWK Key Objects, or X.509 cert values, or both.
- Consider whether to add version numbers.
- Consider which of the open issues from the JWS and JWT specs also apply here.
- Think about how to best describe the concept currently described as "the bytes of the UTF-8 representation of". Possible terms to use instead of "bytes of" include "byte sequence", "octet series", and "octet sequence". Also consider whether we want to add an overall clarifying statement somewhere in each spec something like "every place we say 'the UTF-8 representation of X', we mean 'the bytes of the UTF-8 representation of X'". That would potentially allow us to omit the "the bytes of" part everywhere else.
- Finish the Security Considerations section.
- Write a note in the Security Considerations section about how x5t (x.509 certificate thumbprint) should be deprecated because of known problems with SHA-1.
- Should StringOrURI use IRIs rather than RFC 3986 URIs?
- Provide a more robust description of the use of the IV. The current statement "For GCM, the random 64-bit IV is prepended to the ciphertext" in the Symmetric Encryption section is almost certainly out of place.
- It would be good to say somewhere, in normative language, that eventually the
algorithms and/or key sizes currently specified will no longer be considered sufficiently secure and will be removed. Therefore, implementers MUST be prepared for this eventuality.

- Consider whether a media type should be proposed, such as "application/jwe".
- Should we define the use of RFC 5649 key wrapping functions, which allow arbitrary key sizes, in addition to the current use of RFC 3394 key wrapping functions, which require that keys be multiples of 64 bits? Is this needed in practice?

### 13. References

#### 13.1. Normative References


[JWK] Jones, M., "JSON Web Key (JWK)," October 2011.


#### 13.2. Informative References

Appendix A. JWE Examples

This section provides several examples of JWEs.

A.1. JWE Example using TBD Algorithm

A.1.1. Encrypting

TBD: Demonstrate encryption steps with this algorithm

A.1.2. Decrypting

TBD: Demonstrate decryption steps with this algorithm

Appendix B. Algorithm Identifier Cross-Reference

This appendix contains a table cross-referencing the alg and enc values used in this specification with the equivalent identifiers used by other standards and software packages. See XML DSIG [RFC3275] and Java Cryptography Architecture [JCA] for more information about the names defined by those documents.

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>JWE</th>
<th>XML ENC</th>
<th>JCA</th>
<th>OID</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSA using RSA-PKCS1-1.5 padding</td>
<td>RSA_1_5</td>
<td><a href="http://www.w3.org/2001/04/xmlenc#rsa-1_5">http://www.w3.org/2001/04/xmlenc#rsa-1_5</a></td>
<td>RSA/ECB/PKCS1Padding</td>
<td>TBD</td>
</tr>
<tr>
<td>RSA using Optimal Asymmetric Encryption Padding (OAEP)</td>
<td>RSA-OAEP</td>
<td><a href="http://www.w3.org/2001/04/xmlenc#rsa-oaep-mgf1p">http://www.w3.org/2001/04/xmlenc#rsa-oaep-mgf1p</a></td>
<td>RSA/ECB/OAEPWithSHA-1AndMGF1Padding</td>
<td>TBD</td>
</tr>
<tr>
<td>RFC A128KW</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
</tbody>
</table>
Table 5: Algorithm Identifier Cross-Reference

<table>
<thead>
<tr>
<th>Algorithm Identifier</th>
<th>Algorithm</th>
<th>Key Usage</th>
<th>Key Size</th>
<th>Key Wrap Algorithm</th>
<th>URI</th>
<th>Key Wrap Key Size</th>
<th>Key Wrap Mode</th>
<th>Key Wrap Padding</th>
</tr>
</thead>
<tbody>
<tr>
<td>AES/CBC/PKCS5Padding</td>
<td>AES128CBC</td>
<td>using 128 bit keys</td>
<td>Cipher Block Chaining mode</td>
<td>A128CBC</td>
<td><a href="http://www.w3.org/2001/04/xmlenc#aes128-cbc">http://www.w3.org/2001/04/xmlenc#aes128-cbc</a></td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AES/CBC/PKCS5Padding</td>
<td>AES256CBC</td>
<td>using 256 bit keys</td>
<td>Cipher Block Chaining mode</td>
<td>A256CBC</td>
<td><a href="http://www.w3.org/2001/04/xmlenc#aes256-cbc">http://www.w3.org/2001/04/xmlenc#aes256-cbc</a></td>
<td>TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AES/GCM/NoPadding</td>
<td>AES256GCM</td>
<td>using 256 bit keys in Galois/Counter Mode</td>
<td>A256GCM</td>
<td><a href="http://www.w3.org/2009/xmlenc11#aes256-gcm">http://www.w3.org/2009/xmlenc11#aes256-gcm</a></td>
<td>TBD</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Appendix C. Acknowledgements

Solutions for encrypting JSON content were also explored by [JSS] and [I-D.rescorla-jsms], both of which significantly influenced this draft. This draft attempts to explicitly reuse as much from [W3C.CR-xmlenc-core1-20110303] and RFC 5652 [RFC5652] as possible, while utilizing simple compact JSON-based data structures.

Special thanks are due to John Bradley and Nat Sakimura for the discussions that helped inform the content of this specification and to Eric Rescorla and Joe Hildebrand for allowing the reuse of some of the text from [I-D.rescorla-jsms] in this document.

Appendix D. Document History

-01

- Changed type of Ephemeral Public Key (epk) from string to JSON object, so that a JWKey Object value can be used directly.
Specified that the Digest Method for ECDH-ES is SHA-256. (The specification was previously silent about the choice of digest method.)

- The jku and x5u URLs are now required to be absolute URLs.
- Removed this unnecessary language from the kid description: "Omitting this parameter is equivalent to setting it to an empty string".
- Use the same language as RFC 2616 does when describing GZIP message compression.

First encryption draft based upon consensus decisions at IIW documented at http://self-issued.info/?p=378. The ability to provide encryption for JSON Web Tokens (JWTs) [JWT] is a primary use case.

Authors' Addresses

Michael B. Jones
Microsoft
Email: mb@microsoft.com
URL: http://self-issued.info/

Eric Rescorla
RTFM, Inc.
Email: ekr@rtfm.com

Joe Hildebrand
Cisco Systems, Inc.
Email: jhildebr@cisco.com