JSON Web Key (JWK)
draft-jones-json-web-key-03

Abstract

A JSON Web Key (JWK) is a JSON data structure that represents a set of public keys.

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].

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1. Introduction

A JSON Web Key (JWK) is a JSON data structure that represents a set of public keys as a JSON object [RFC4627]. The JWK format is used to represent bare keys; representing certificate chains is an explicit non-goal of this specification. JSON Web Keys are referenced in JSON Web Signature (JWS) [JWS] using the jku (JSON Key URL) header parameter and in JSON Web Encryption (JWE) [JWE] using the jku (JSON Key URL) and epk (Ephemeral Public Key) header parameters.

2. Terminology

JSON Web Key (JWK)
A JSON data structure that represents a set of public keys. A JWK consists of a single JWK Container Object that contains an array of JWK Key Objects.

JWK Container Object
A JSON object that contains an array of JWK Key Objects as a member.

JWK Key Object
A JSON object that represents a single public key.

Base64url Encoding
For the purposes of this specification, this term always refers to the URL- and filename-safe Base64 encoding described in RFC 4648 [RFC4648], Section 5, with the (non URL-safe) '=' padding characters omitted, as permitted by Section 3.2. (See Appendix C of [JWS] for notes on implementing base64url encoding without padding.)

3. JSON Web Key (JWK) Overview

It is sometimes useful to be able to reference public key representations, for instance, in order to verify the signature on content signed with the corresponding private key. The JSON Web Key (JWK) data structure provides a convenient JSON representation for sets of public keys utilizing either the Elliptic Curve or RSA families of algorithms.

3.1. Example JWK

The following example JWK contains two public keys: one using an Elliptic Curve algorithm and a second one using an RSA algorithm. The first specifies that the key is to be used for encryption. Both provide a Key ID for matching purposes. In both cases, integers are represented using the base64url encoding of their big endian representations. (Long lines are broken are for display purposes only.)

```json
{"jwk": [
  {
    "alg":"EC",
    "crv":"P-256",
    "x":"MKBCTNTcKUSDii11ySs35261DZBAiT07Tu6KPAqv7D4",
    "y":"4Et16SRW2YiLURN5vfVHuhp7x8Px1tmWW1bbM4IFyM",
  }
]}
```
4. JWK Format

A JWK consists of a JWK Container Object, which is a JSON object that contains an array of JWK Key Objects as a member. This section specifies the format of these objects.

4.1. JWK Container Object Format

A JWK Container Object is a JSON object containing a specific member. This member is:

<table>
<thead>
<tr>
<th>Member Name</th>
<th>JSON Value Type</th>
<th>Container Object Member Semantics</th>
</tr>
</thead>
<tbody>
<tr>
<td>jwk</td>
<td>array</td>
<td>The jwk member value contains an array of JWK Key Objects. This member is REQUIRED.</td>
</tr>
</tbody>
</table>

**JWK Container Object Member**

Additional members MAY be present in the JWK Container Object. If present, they MUST be understood by implementations using that JWK.

4.2. JWK Key Object Format

A JWK Key Object is a JSON object containing specific members. Those members that are common to all key types are as follows:

<table>
<thead>
<tr>
<th>Member Name</th>
<th>JSON Value Type</th>
<th>Key Object Member Semantics</th>
</tr>
</thead>
<tbody>
<tr>
<td>alg</td>
<td>string</td>
<td>The alg member identifies the cryptographic algorithm family used with the key. Values defined by this specification are EC and RSA. Specific additional members are required to represent the key, depending upon the alg value. The alg value is case sensitive. This member is REQUIRED.</td>
</tr>
<tr>
<td>use</td>
<td>string</td>
<td>The use member identifies the intended use of the key. Values defined by this specification are sig (signature) and enc (encryption). Other values MAY be used. The use value is case sensitive. This member is OPTIONAL.</td>
</tr>
<tr>
<td>kid</td>
<td>string</td>
<td>The kid (Key ID) member can be used to match a specific key. This can be used, for instance, to choose among a set of keys within the JWK during key rollover. The kid value MAY correspond to a JWS kid value. The interpretation of the kid value is unspecified. This member is OPTIONAL.</td>
</tr>
</tbody>
</table>
JWK Key Object Members

Additional members MAY be present in the JWK Key Object. If present, they MUST be understood by implementations using that key.

4.2.1. JWK Key Object Members for Elliptic Curve Keys

JWKs can represent Elliptic Curve [FIPS.186-3] keys. In this case, the \texttt{alg} member value MUST be \texttt{EC}. Furthermore, these additional members MUST be present:

<table>
<thead>
<tr>
<th>Member Name</th>
<th>JSON Value Type</th>
<th>Key Object Member Semantics</th>
</tr>
</thead>
<tbody>
<tr>
<td>\texttt{crv}</td>
<td>string</td>
<td>The \texttt{crv} member identifies the cryptographic curve used with the key. Values defined by this specification are \texttt{P-256}, \texttt{P-384} and \texttt{P-521}. Additional \texttt{crv} values MAY be used, provided they are understood by implementations using that Elliptic Curve key. The \texttt{crv} value is case sensitive.</td>
</tr>
<tr>
<td>\texttt{x}</td>
<td>string</td>
<td>The \texttt{x} member contains the \texttt{x} coordinate for the elliptic curve point. It is represented as the base64url encoding of the coordinate's big endian representation.</td>
</tr>
<tr>
<td>\texttt{y}</td>
<td>string</td>
<td>The \texttt{y} member contains the \texttt{y} coordinate for the elliptic curve point. It is represented as the base64url encoding of the coordinate's big endian representation.</td>
</tr>
</tbody>
</table>

Members for Elliptic Curve Keys

4.2.2. JWK Key Object Members for RSA Keys

JWKs can represent RSA [RFC3447] keys. In this case, the \texttt{alg} member value MUST be \texttt{RSA}. Furthermore, these additional members MUST be present:

<table>
<thead>
<tr>
<th>Member Name</th>
<th>JSON Value Type</th>
<th>Key Object Member Semantics</th>
</tr>
</thead>
<tbody>
<tr>
<td>\texttt{mod}</td>
<td>string</td>
<td>The \texttt{mod} member contains the modulus value for the RSA public key. It is represented as the base64url encoding of the value's big endian representation.</td>
</tr>
<tr>
<td>\texttt{exp}</td>
<td>string</td>
<td>The \texttt{exp} member contains the exponent value for the RSA public key. It is represented as the base64url encoding of the value's big endian representation.</td>
</tr>
</tbody>
</table>

Members for RSA Keys

5. Base64url encoding as used by JWKs

JWKs make use of the base64url encoding as defined in RFC 4648 [RFC4648]. As allowed by Section 3.2 of the RFC, this specification mandates that base64url encoding when used with JWKs MUST NOT use padding. Notes on implementing base64url encoding can be found in the JWS [JWS] specification.
6. IANA Considerations

No IANA actions are required by this specification.

7. Security Considerations

TBD

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

The following items remain to be done in this draft:

- Write the Security Considerations section.

9. References

9.1. Normative References


9.2. Informative References


Appendix A. Acknowledgements

A JSON representation for RSA public keys was previously introduced in Magic Signatures [MagicSignatures].

Appendix B. Document History

-03

- Use short names since JWK Key Object values are used as JWE Ephemeral Public Keys, and so compactness matters.
- Respect line length restrictions in examples.

-02
- Editorial changes to have this spec better match the JWT, JWS, and JWE specs. No normative changes.

- Changed **algorithm** member value for Elliptic Curve keys from **ECDSA** to **EC**, since Elliptic Curve keys can be used with more algorithms than just the Elliptic Curve Digital Signature Algorithm (ECDSA).

- Added OPTIONAL **use** member to identify intended key usage, especially since the same Elliptic Curve key should not be used for both signing and encryption operations.

- Created first version based upon decisions made at the Internet Identity Workshop (IIW), as documented at http://self-issued.info/?p=390.

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