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Abstract

This document describes OpenToken (OTK), a format for the lightweight, secure, cross-application exchange of key-value pairs. The format is designed primarily for use as an HTTP cookie or query parameter, but may also be used in other scenarios that require a compact, application-neutral token.

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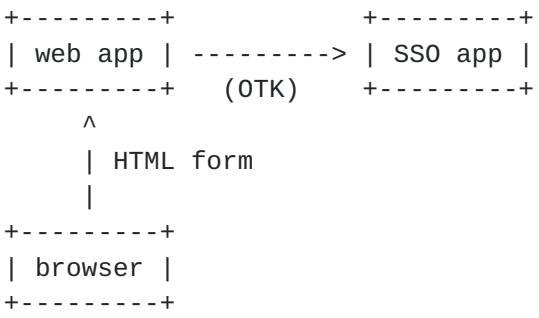
1. Introduction

1.1. Motivation

This document describes OpenToken (OTK), a format for the lightweight, secure, cross-application exchange of key-value pairs between applications that use HTTP (see [RFC2616]) as the transport protocol. The format is designed primarily for use as an HTTP cookie (see [RFC2965]) or query parameter, but may also be used in other scenarios that require a compact, application-neutral token.

The OpenToken technology is not designed to encapsulate formal identity assertions (for which see [SAML]) or authentication credentials (for which see [SASL]). Instead, OpenToken is designed to encapsulate basic name-value pairs for exchange between applications that use HTTP as the transport protocol.

Consider the example of a web application that receives information from an end user via a web browser and shares that information with a backend system such as a single-sign-on (SSO) application.



Naturally the web application or the single-sign-on application could exchange the same information with other applications (e.g., billing, customer service, enterprise resource planning) or push the information back to the end user via an HTTP cookie. The end user could also share that same information with other web applications (e.g., the web application could store the information on the end user's browser via an HTTP cookie, which could be shared with other applications).

The use of a consistent data format enables a more seamless exchange of information between applications (e.g., by removing the need to translate between different application-specific data formats).

1.2. Terminology

The following keywords are to be interpreted as described in [RFC2119]: "MUST", "SHALL", "REQUIRED"; "MUST NOT", "SHALL NOT";

"SHOULD", "RECOMMENDED"; "SHOULD NOT", "NOT RECOMMENDED"; "MAY", "OPTIONAL".

2. Token Layout

The OpenToken format is specified in the following table.

Byte Range	Length	Description
0..2	3	'O','T','K' literal
3	1	Version identifier
4	1	Cipher suite identifier
5..24	20	SHA-1 HMAC
25	1	IV length
26..x	x-26	IV
x+1	1	Key Info length
x+2..y	y-(x+2)	Key info
y+1..y+3	2	Payload length
y+4..z	z-(y+4)	Payload
TOTAL	29+x+y+z	N/A

The following notes apply to the foregoing token parameters:

- The datatype for the version identifier, cipher suite identifier, IV length, and Key Info length is unsigned byte.
- The initialization vector (IV) has a maximum length of 255 bytes. This field is optional and may have a length of 0 (IV length) to indicate that no IV is available for this token. For details about initialization vectors, see [RFC2898].
- The payload is a series of key-value pairs, as described under Section 5.
- The payload has a maximum (compressed) length of 64k bytes. While this format supports a payload of 64k bytes, deployment scenarios that pass the token using HTTP (either as a query parameter or cookie) should limit the token length to less than 4k for optimal compatibility.
- The [HMAC] used in this version of OpenToken is based on the SHA-1 hashing algorithm specified in [SHA]. See Section 7 for further information about the security characteristics of this algorithm.
- The Key Info field provides a place to store meta-data describing the key used to encrypt the payload. For example, it may contain a cryptographic hash of the key, or some other identifier, so that the token recipient can select the appropriate key for decryption. This field is optional and may have a length of 0 (Key Info length) to indicate that no meta-data is available for this token.

Given the limited scope of applicability and the desire for a lightweight exchange format, OpenToken uses a binary format rather than a more generic data-description language such as [ASN.1] or [XML].

3. Processing Rules

3.1. Encoding

Generating an OTK involves the following steps:

1. Generate the payload
2. Select a cipher suite and generate a corresponding IV
3. Initialize an [HMAC] using the SHA-1 algorithm specified in [SHA] and the following data (order is important):
    1. OTK version
    2. Cipher suite value
    3. IV value (if present)
    4. Key Info value (if present)
    5. Payload length (2-bytes, network order)
4. Update the SHA-1 HMAC (from the previous step) using the clear-text payload
5. Compress the payload using the DEFLATE specification in accordance with [RFC1950] and [RFC1951].
6. Encrypt the compressed payload using the selected cipher suite.
7. Construct the binary structure representing the OTK; place the MAC, IV, key info and cipher-text within the structure
8. Base 64 encode the entire binary structure, following the rules in Section 4 of [RFC4648] and ensuring that the padding bits are set to zero.
9. Replace all Base 64 padding characters "=" with "*". RFC 4648 does not account for the problems that Base64 padding causes when used as a cookie. This step corrects that issue.

3.2. Decoding

Processing an OTK involves the following steps:

1. Replace the "*" padding characters (see Encoding section, step 9) with standard Base 64 "=" characters.
2. Base 64 decode the OTK, following the rules in Section 4 of [RFC4648] and ensuring that the padding bits are set to zero.
3. Validate the OTK header literal and version
4. Extract the Key Info (if present) and select a key for decryption

5. Decrypt the payload cipher-text using the selected cipher suite.
6. Decompress the decrypted payload, in accordance with [RFC1950] and [RFC1951].
7. Initialize an [HMAC] using the SHA-1 algorithm specified in [SHA] and the following data (order is important):
   1. OTK version
   2. Cipher suite value
   3. IV value (if present)
   4. Key Info value (if present)
   5. Payload length (2-bytes, network order)
8. Update the HMAC from the previous step with the clear-text payload (after decompressing).
9. Compare the HMAC from step 8 with the HMAC received in the OTK. If they do not match, halt processing.
10. Process the payload.

3.3. Standard Key-Value Pairs

The token payload contains key-value pairs, as described under Section 5. These data pairs are used to describe the token presenter and may vary from application to application. In the interest of basic interoperability when exchanging an OTK, there is a small set of standardized data pairs.

Key Name	Value Format	Description
subject	string	Primary identifier for the token holder.
not-before	ISO 8601 datetime; yyyy-MM-ddTHH:mm:ssZ	Datetime when token was created; a token received before this datetime MUST be rejected as invalid.
not-on-or-after	ISO 8601 datetime; yyyy-MM-ddTHH:mm:ssZ	Datetime at which token will expire; a token received on or after this datetime MUST be rejected as invalid.
renew-until	ISO 8601 datetime; yyyy-MM-ddTHH:mm:ssZ	Datetime at which token must not automatically re-issued without further authentication; this may be viewed as a "session" lifetime.

The following rules apply:

- All datetimes MUST be calculated relative to UTC (i.e., no timezone offsets).
- The predefined key-value pairs MUST NOT be used for any purpose other than what is defined above and SHOULD be included with all issued OTKs.

4. Cipher Suites

A cipher suite groups a cryptographic cipher with a specific key size, cipher mode, and padding scheme. This grouping provides a convenient way of representing these inter-dependent options and also helps the implementor understand the exact cryptographic requirements for a given OTK.

ID	Cipher	Key Size	Mode	Padding	IV Length
0	Null	N/A	N/A	N/A	0
1	AES	256 bits	CBC	PKCS 5	16
2	AES	128 bits	CBC	PKCS 5	16
3	3DES	168 bits	CBC	PKCS 5	8

Note:

- The Null cipher is meant only for testing purposes. It MUST NOT be used in production environments as the payload would be passed in the clear. When using the Null cipher, the SHA-1 MAC value MUST be replaced with a standard SHA-1 hash of the uncompressed payload.
- For cipher suites that do not require an IV, the IV length MAY be zero.
- For information regarding PKCS #5 padding, see [RFC2898].

5. Payload Format

OTK uses a simple, line-based format for encoding the key-value pairs in the payload. The format is encoded with UTF-8 and thus is guaranteed to support the transport of multi-byte strings. The syntax for an OpenToken is defined as follows using the Augmented Backus-Naur Form as specified in [ABNF].

```
line        = key "=" value CRLF
key         = [whitespace] identifier [whitespace]
whitespace  = HTAB / SP
identifier  = anychar
value       = [whitespace] data [whitespace] /
              [whitespace] quoted-data [whitespace]
data        = anychar / "="
              ; all characters
quoted-data = "\"" anychar "\"" /
              "\'" anychar "\'"
              ; double and single quotes must be
              ; escaped via preceding backslash
anychar     = %x20-%x3C / %x3E-%x7E / %xA0-D7FF / %xF900-FDCF
              / %xFDF0-FFEF / %x10000-1FFFD / %x20000-2FFFD
              / %x30000-3FFFD / %x40000-4FFFD / %x50000-5FFFD
              / %x60000-6FFFD / %x70000-7FFFD / %x80000-8FFFD
              / %x90000-9FFFD / %xA0000-AFFFD / %xB0000-BFFFD
              / %xC0000-CFFFD / %xD0000-DFFFD / %xE1000-EFFFD
              ; any Unicode character except "="
```

The following rules apply:

- Key names are case-sensitive. It is RECOMMENDED that all key names be lowercase and use hyphens to separate "words".
- If the value for a key is or includes a Uniform Resource Identifier (URI), the characters "&" and "=" SHOULD be percent-encoded according to the rules specified in [URI].

6. Canonical Test Data

It is important to ensure interoperability across tokens generated by different implementations/languages. The following test cases can be used to test an implementation and ensure it generates properly encoded tokens. These tests are not exhaustive, but do cover the basic cipher suites.

For each test case, the key that was used to generate the output is included in base64 encoding. The generated token is also base64 encoded, as specified above.

Each token should have two name-value pairs present:

```
foo = bar
bar = baz
```

Note: In the following test data, the tokens are wrapped across two lines to fit and the "\" character is used to denote the point of

line wrapping.

6.1. Test Case 1: AES-128

key:

a66C9MvM8eY4qJKyCXKW+w==

token:

UFRLAQK9THj0okLTUB663QrJFg5qA58IDhAb93ondvcx7sY6s44eszNqAAAga5W8Dc\
4XZwtsZ4qV3_lDI-Zn2_yadHHIhkGqNV5J9kw*

6.2. Test Case 2: AES-256

key:

a66C9MvM8eY4qJKyCXKW+19PWDeuc3thDyuiumak+Dc=

token:

UFRLAQEujlLGEvmVKDKyvL1vaZ27qMYhTxDSAZwtaufqUff7GQXTjvWBAAAgJJGPta\
7VOITap4uDZ_OkW_Kt4yYZ4BBQzw_NR2CNE-g*

6.3. Test Case 3: 3DES-168

key:

a66C9MvM8eY4qJKyCXKW+19PWDeuc3th

token:

UFRLAQNoCsuAwybXOSBpIc9ZvxQVx_3fhghqSjy-pNJpfgAAGGlGgJ79NhX43lLRXA\
b9Mp5unR7XFWopzw**

7. Security Considerations

Recent research has shown that in select cases it is possible to compromise the hashes produced by the SHA-1 hashing algorith. However, the use to which SHA-1 is put in version 1 of OpenToken, coupled with employment of a symmetric cipher key, should minimize the applicability of the attacks described in the literature. Furthermore, current estimates suggest that even with the new attack, it would still take one year of computing by a government-sized entity to produce a collision. Future versions of OpenToken may specify stronger crypotgraphic features. Naturally, tokens should be exchanged over a secure transport (e.g., HTTP Over TLS as described

in [RFC2818]) in order to minimize the possibility that a token can be intercepted by a man in the middle.

It may be desirable to digitally sign OpenTokens. Digital signatures are not included in version 1 of the OpenToken technology as currently deployed, but will probably be added in a future version of OpenToken.

8. References

8.1. Normative References

[ABNF] Crocker, D. and P. Overell, "Augmented BNF for Syntax Specifications: ABNF", RFC 4234, October 2005.

[HMAC] National Institute of Standards and Technology, "The Keyed-Hash Message Authentication Code (HMAC)", FIPS PUB 198, March 2002, <http://csrc.nist.gov/publications/fips/fips198/fips-198a.pdf>.

[RFC1950] Deutsch, L. and J-L. Gailly, "ZLIB Compressed Data Format Specification version 3.3", RFC 1950, May 1996.

[RFC1951] Deutsch, P., "DEFLATE Compressed Data Format Specification version 1.3", RFC 1951, May 1996.

[RFC4648] Josefsson, S., "The Base16, Base32, and Base64 Data Encodings", RFC 4648, October 2006.

[SHA] National Institute of Standards and Technology, "Secure Hash Standard", FIPS PUB 180-2, August 2002, <http://csrc.nist.gov/publications/fips/fips180-2/fips180-2withchangenotice.pdf>.

[URI] Berners-Lee, T., Fielding, R., and L. Masinter, "Uniform Resource Identifier (URI): Generic Syntax", STD 66, RFC 3986, January 2005.

8.2. Informative References

[ASN.1] CCITT, "Recommendation X.208: Specification of Abstract Syntax Notation One (ASN.1)", 1988.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC2616] Fielding, R., Gettys, J., Mogul, J., Frystyk, H.,

Masinter, L., Leach, P., and T. Berners-Lee, "Hypertext Transfer Protocol -- HTTP/1.1", RFC 2616, June 1999.

[RFC2818] Rescorla, E., "HTTP Over TLS", RFC 2818, May 2000.

[RFC2898] Kaliski, B., "PKCS #5: Password-Based Cryptography Specification Version 2.0", RFC 2898, September 2000.

[RFC2965] Kristol, D. and L. Montulli, "HTTP State Management Mechanism", RFC 2965, October 2000.

[SAML] Cantor, S., Kemp, J., Philpott, R., and E. Maler, "Assertions and Protocol for the OASIS Security Assertion Markup Language (SAML) V2.0", OASIS Standard saml-core-2.0-os, March 2005.

[SASL] Melnikov, A. and K. Zeilenga, "Simple Authentication and Security Layer (SASL)", RFC 4422, June 2006.

[XML] Paoli, J., Maler, E., Sperberg-McQueen, C., Yergeau, F., and T. Bray, "Extensible Markup Language (XML) 1.0 (Fourth Edition)", World Wide Web Consortium Recommendation REC-xml-20060816, August 2006, <http://www.w3.org/TR/2006/REC-xml-20060816>.

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