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Token Status List (TSL)
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Abstract

This specification defines a status mechanism called Token Status List (TSL), data structures and processing rules for representing the status of tokens secured by JSON Object Signing and Encryption (JOSE) or CBOR Object Signing and Encryption (COSE), such as JWT, SD-JWT, CBOR Web Token, and ISO mdoc. It also defines an extension point and a registry for future status mechanisms.

About This Document

This note is to be removed before publishing as an RFC.

The latest revision of this draft can be found at <https://oauth-wg.github.io/draft-ietf-oauth-status-list/draft-ietf-oauth-status-list.html>. Status information for this document may be found at <https://datatracker.ietf.org/doc/draft-ietf-oauth-status-list/>.

Discussion of this document takes place on the Web Authorization Protocol Working Group mailing list (<mailto:oauth@ietf.org>), which is archived at <https://mailarchive.ietf.org/arch/browse/oauth/>. Subscribe at <https://www.ietf.org/mailman/listinfo/oauth/>.

Source for this draft and an issue tracker can be found at <https://github.com/oauth-wg/draft-ietf-oauth-status-list>.

Status of This Memo

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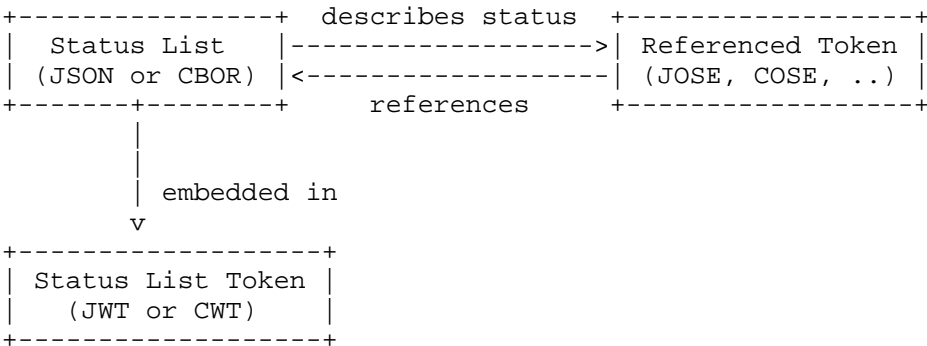
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1. Introduction

Token formats secured by JOSE [RFC7515] or COSE [RFC9052], such as JWTs [RFC7519], SD-JWTs [RFC9901], SD-JWT VCs [SD-JWT.VC], CWTs [RFC8392], SD-CWTs [SD-CWT] and ISO mdoc [ISO.mdoc], have vast possible applications. Some of these applications can involve issuing a token whereby certain semantics about the token or its validity may change over time. Communicating these changes to relying parties in an interoperable manner, such as whether the token is considered invalidated or suspended by its issuer is important for many of these applications.

This document defines a Status List data structure that describes the individual statuses of multiple Referenced Tokens. A Referenced Token may be of any format, but is most commonly a data structure secured by JOSE or COSE. The Referenced Token is referenced by the Status List, which describes the status of the Referenced Token. The statuses of all Referenced Tokens are conveyed via a bit array in the Status List. Each Referenced Token is allocated an index during issuance that represents its position within this bit array. The value of the bit(s) at this index corresponds to the Referenced Token's status. A Status List is provided within a Status List Token protected by cryptographic signature or MAC and this document defines its representations in JWT and CWT format.

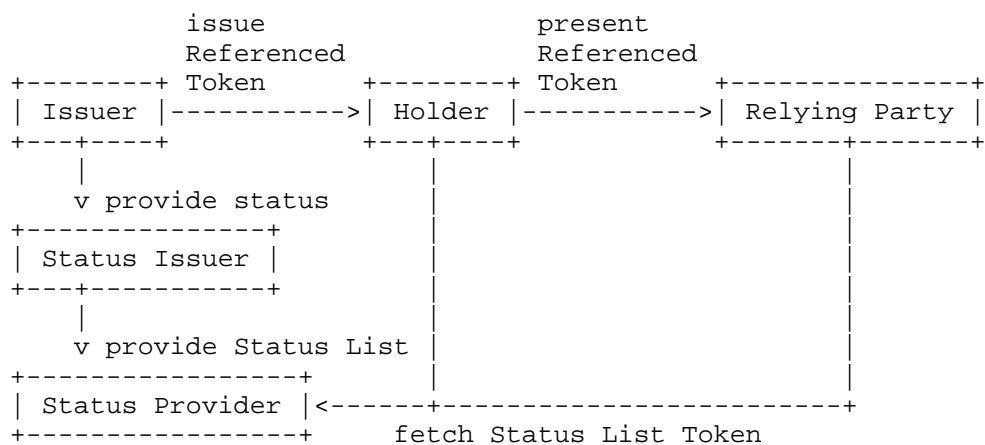
The following diagram depicts the relationship between the artifacts:



An Issuer issues Referenced Tokens to a Holder, the Holder uses and presents those Referenced Tokens to a Relying Party. The Issuer gives updated status information to the Status Issuer, who issues a Status List Token. The Status Issuer can be either the Issuer or an entity that has been authorized by the Issuer to issue Status List Tokens. The Status Issuer provides the Status List Token to the Status Provider, who serves the Status List Token on an accessible endpoint. The Relying Party or the Holder may fetch the Status List Token to retrieve the status of the Referenced Token.

The roles of the Issuer (of the Referenced Token), the Status Issuer and the Status Provider may be fulfilled by the same entity. If not further specified, the term Issuer may refer to an entity acting for all three roles. This document describes how an Issuer references a Status List Token and how a Relying Party fetches and validates Status Lists.

The following diagram depicts the relationship between the involved roles (Relying Party is equivalent to Verifier of [RFC9901]):



Status Lists can be used to express a variety of Status Types. This document defines basic Status Types for the most common use cases as well as an extensibility mechanism for custom Status Types.

Furthermore, the document creates an extension point and an IANA registry that enables other specifications to describe additional status mechanisms.

1.1. Example Use Cases

An example of the usage of a Status List is to manage the statuses of issued access tokens as defined in Section 1.4 of [RFC6749]. Token Introspection [RFC7662] provides a method to determine the status of an issued access token, but it necessitates the party attempting to validate the state of access tokens to directly contact the Issuer of each token for validation. In contrast, the mechanism defined in this specification allows a party to retrieve the statuses for many tokens, reducing interactions with the Issuer substantially. This not only improves scalability but also enhances privacy by preventing the Issuer from gaining knowledge of access tokens being verified (herd anonymity).

Another possible use case for the Status List is to express the status of verifiable credentials (Referenced Tokens) issued by an Issuer in the Issuer-Holder-Verifier model [RFC9901].

1.2. Rationale

Revocation mechanisms are an essential part of most identity ecosystems. In the past, revocation of X.509 TLS certificates has been proven difficult. Traditional certificate revocation lists (CRLs) have limited scalability; Online Certificate Status Protocol (OCSP) has additional privacy risks, since the client is leaking the requested website to a third party. OCSP stapling addresses some of these problems at the cost of less up-to-date data. Approaches based on cryptographic accumulators and Zero-Knowledge-Proofs try to accommodate for this privacy gap, but are currently (in 2026) facing scalability issues and are not yet standardized. Another alternative is short-lived Referenced Tokens with regular re-issuance, but this puts additional burden on the Issuer's infrastructure.

This specification seeks to find a balance between scalability, security and privacy by representing statuses as individual bits, packing them into an array, and compressing the resulting binary data. Thereby, a Status List may contain statuses of many thousands or millions Referenced Tokens while remaining as small as possible. Placing a large number of Referenced Tokens into the same list also offers Holders and Relying Parties herd privacy from the Status Provider.

1.3. Design Considerations

The decisions taken in this specification aim to achieve the following design goals:

- * the specification shall be easy, fast and secure to implement in all major programming languages
- * the specification shall be optimized to support the most common use cases, such as revocation, and avoid unnecessary complexity of corner cases, such as providing multiple statuses for a single token
- * the Status List shall scale up to millions of tokens to support large-scale government or enterprise use cases
- * the Status List shall enable caching policies and offline support
- * the specification shall support JSON and CBOR based tokens
- * the specification shall not specify key resolution or trust frameworks

- * the specification shall define an extension point that enables other mechanisms to convey information about the status of a Referenced Token

1.4. Prior Work

Representing statuses with bits in an array is a rather old and well-known concept in computer science. There has been prior work to use this for revocation and status management. For example, a paper by Smith et al. [smith2020let] proposed a mechanism called Certificate Revocation Vectors based on xz compressed bit vectors for each expiration day. The W3C bit Status List [W3C.SL] similarly uses a compressed bit representation.

1.5. Status Mechanisms Registry

This specification establishes IANA "Status Mechanisms" registries for status mechanisms for JOSE-based tokens and for status mechanisms for COSE-based tokens and registers the members defined by this specification. Other specifications can register other members used for status retrieval.

Other status mechanisms may have different tradeoffs regarding security, privacy, scalability and complexity. The privacy and security considerations in this document only represent the properties of the Status List mechanism.

2. Conventions and Definitions

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.

3. Terminology

Issuer: An entity that issues the Referenced Token. Also known as a Provider.

Status Issuer: An entity that issues the Status List Token about the status information of the Referenced Token. This role may be fulfilled by the Issuer.

Status Provider: An entity that provides the Status List Token on an accessible endpoint. This role may be fulfilled by the Status Issuer.

Holder: An entity that receives Referenced Tokens from the Issuer and presents them to Relying Parties.

Relying Party: An entity that relies on the Referenced Token and fetches the corresponding Status List Token to validate the status of that Referenced Token. Also known as a Verifier.

Status: A Status describes the current state, mode, condition or stage of an entity that is represented by the Referenced Token as determined by the Status Issuer.

Status List: An object in JSON or CBOR representation containing a compressed byte array that represents the statuses of many Referenced Tokens.

Status List Token: A token in JWT (as defined in [RFC7519]) or CWT (as defined in [RFC8392]) representation that contains a cryptographically secured Status List.

Referenced Token: A cryptographically secured data structure that contains a "status" claim that references a mechanism to retrieve status information about this Referenced Token. This document defines the Status List mechanism in which case the Referenced Token contains a reference to an entry in a Status List Token. It is RECOMMENDED to use JSON [RFC8259] with JOSE as defined in [RFC7515] or CBOR [RFC8949] with COSE as defined in [RFC9052]. Examples for Referenced Tokens are SD-JWT and ISO mdoc.

Client: An application that fetches information, such as a Status List Token, from the Status List Provider on behalf of the Holder or Relying Party.

base64url: Denotes the URL-safe base64 encoding with all trailing '=' characters omitted as defined in Section 2 of [RFC7515] as "Base64url Encoding".

4. Status List

A Status List is a data structure that contains the statuses of many Referenced Tokens represented by one or multiple bits. Section 4.1 describes how to construct a compressed byte array that is the base component for the Status List data structure. Section 4.2 and Section 4.3 describe how to encode such a Status List in JSON and CBOR representations.

4.1. Compressed Byte Array

A compressed byte array containing the status information of the Referenced Token is composed by the following algorithm:

1. The Status Issuer MUST define a number of bits (bits) of either 1,2,4 or 8, that represents the number of bits used to describe the status of each Referenced Token within this Status List. Therefore, up to 2,4,16 or 256 statuses for a Referenced Token are possible, depending on the bit size. This limitation is intended to limit bit manipulation necessary to a single byte for every operation, thus keeping implementations simpler and less error-prone.
2. The Status Issuer creates a byte array of size = number of Referenced Tokens * bits / 8 or greater. Depending on the bits, each byte in the array corresponds to 8/(bits) statuses (8,4,2 or 1).
3. The Status Issuer sets the status values for all Referenced Tokens within the byte array. Each Referenced Token is assigned a distinct index from 0 to one less than the number of Referenced Tokens assigned to the Status List. Each index identifies a contiguous block of bits in the byte array, with the blocks being packed into bytes from the least significant bit ("0") to the most significant bit ("7"). These bits contain the encoded status value of the Referenced Token (see Section 7 for more details on the values).
4. The Status Issuer compresses the byte array using DEFLATE [RFC1951] with the ZLIB [RFC1950] data format. Implementations are RECOMMENDED to use the highest compression level available.

The following example illustrates the byte array of a Status List that represents the statuses of 16 Referenced Tokens with a bits of 1, requiring 2 bytes (16 bits) for the uncompressed byte array:

```

status[0] = 0b1
status[1] = 0b0
status[2] = 0b0
status[3] = 0b1
status[4] = 0b1
status[5] = 0b1
status[6] = 0b0
status[7] = 0b1
status[8] = 0b1
status[9] = 0b1
status[10] = 0b0
status[11] = 0b0
status[12] = 0b0
status[13] = 0b1
status[14] = 0b0
status[15] = 0b1

```

These bits are concatenated:

Byte Index	0								1							
Bit Position	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Bit Values	1 0 1 1 1 0 0 1								1 0 1 0 0 0 1 1							
List Index	7	6	5	4	3	2	1	0	15	...	10	9	8			
Hex Value	\ 0xB9 /								\ 0xA3 /							

compressed array (hex): 78dadbb918000217015d

In the following example, the Status List additionally includes the Status Type "SUSPENDED". As the Status Type value for "SUSPENDED" is 0x02 and does not fit into 1 bit, the bits is required to be 2. This example illustrates the byte array of a Status List that represents the statuses of 12 Referenced Tokens with a bits of 2, requiring 3 bytes (24 bits) for the uncompressed byte array:

```

status[0] = 0b01
status[1] = 0b10
status[2] = 0b00
status[3] = 0b11
status[4] = 0b00
status[5] = 0b01
status[6] = 0b00
status[7] = 0b01
status[8] = 0b01
status[9] = 0b10
status[10] = 0b11
status[11] = 0b11

```

These bits are concatenated:

Byte Index	0								1								2							
Bit Position	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Bit Values	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
		1		1		0		0		1		0		0		1		0		0		1		1
	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	\	/	\	/	\	/	\	/	\	/	\	/	\	/	\	/	\	/	\	/	\	/	\	/
Status Value	11		00		10		01		01		00		01		00		11		11		10		01	
List Index	3		2		1		0		7		6		5		4		11		10		9		8	
	\ \ \ \ \ \ \ \ /								\ \ \ \ \ \ \ \ /								\ \ \ \ \ \ \ \ /							
Hex Value	0xC9								0x44								0xF9							

compressed array (hex): 78da3be9f2130003df0207

4.2. Status List in JSON Format

This section defines the data structure for a JSON-encoded Status List:

- * The StatusList structure is a JSON Object that contains the following members:
 - bits: REQUIRED. JSON Integer specifying the number of bits per Referenced Token in the compressed byte array (lst). The allowed values for bits are 1, 2, 4, and 8.
 - lst: REQUIRED. JSON String that contains the status values for all the Referenced Tokens it conveys statuses for. The value MUST be the base64url-encoded compressed byte array as specified in Section 4.1.
 - aggregation_uri: OPTIONAL. JSON String that contains a URI to retrieve the Status List Aggregation for this type of Referenced Token or Issuer. See Section 9 for further details.

The following example illustrates the JSON representation of the Status List with bits=1 from the examples above:

```
byte_array = [0xb9, 0xa3]
encoded:
{
  "bits": 1,
  "lst": "eNrBuRgAAhcBXQ"
}
```

The following example illustrates the JSON representation of the Status List with bits=2 from the examples above:

```
byte_array = [0xc9, 0x44, 0xf9]
encoded:
{
  "bits": 2,
  "lst": "eNo76fITAAPfAgc"
}
```

See Appendix C for more test vectors.

4.3. Status List in CBOR Format

This section defines the data structure for a CBOR-encoded Status List:

- * The StatusList structure is a CBOR map (major type 5) and defines the following entries:
 - bits: REQUIRED. CBOR Unsigned integer (major type 0) that contains the number of bits per Referenced Token in the compressed byte array (lst). The allowed values for bits are 1, 2, 4, and 8.
 - lst: REQUIRED. CBOR Byte string (major type 2) that contains the status values for all the Referenced Tokens it conveys statuses for. The value MUST be the compressed byte array as specified in Section 4.1.
 - aggregation_uri: OPTIONAL. CBOR Text string (major type 3) that contains a URI to retrieve the Status List Aggregation for this type of Referenced Token. See Section 9 for further detail.

The following is the CDDL [RFC8610] definition of the StatusList structure:

```

StatusList = {
  bits: 1 / 2 / 4 / 8, ; The number of bits used per Referenced Token
  lst: bstr, ; Byte string that contains the Status List
  ? aggregation_uri: tstr ; link to the Status List Aggregation
}

```

The following example illustrates the CBOR representation of the Status List in Hex:

```

byte_array = [0xb9, 0xa3]
encoded:
a2646269747301636c73744a78dadbb918000217015d

```

The following is the CBOR Annotated Hex output of the example above:

```

a2          # map(2)
 64         #  string(4)
  62697473  #    "bits"
 01         #  uint(1)
 63         #  string(3)
  6c7374    #    "lst"
 4a         #  bytes(10)
 78dadbb918000217015d  #    "xテ堙崢ケ\x18\x00\x02\x17\x01]"

```

See Appendix C for more test vectors.

5. Status List Token

A Status List Token embeds a Status List into a token that is cryptographically signed and protects the integrity of the Status List. This allows for the Status List Token to be hosted by third parties or be transferred for offline use cases.

This section specifies Status List Tokens in JSON Web Token (JWT) and CBOR Web Token (CWT) format.

5.1. Status List Token in JWT Format

The Status List Token MUST be encoded as a "JSON Web Token (JWT)" according to [RFC7519].

The following content applies to the JWT Header:

* typ: REQUIRED. The JWT type MUST be statuslist+jwt.

The following content applies to the JWT Claims Set:

- * **sub:** REQUIRED. As generally defined in [RFC7519]. The sub (subject) claim MUST specify the URI of the Status List Token. The value MUST be equal to that of the uri claim contained in the status_list claim of the Referenced Token.
- * **iat:** REQUIRED. As generally defined in [RFC7519]. The iat (issued at) claim MUST specify the time at which the Status List Token was issued.
- * **exp:** RECOMMENDED. As generally defined in [RFC7519]. The exp (expiration time) claim, if present, MUST specify the time at which the Status List Token is considered expired by the Status Issuer. Consider the guidance provided in Section 13.7.
- * **ttl:** RECOMMENDED. The ttl (time to live) claim, if present, MUST specify the maximum amount of time, in seconds, that the Status List Token can be cached by a consumer before a fresh copy SHOULD be retrieved. The value of the claim MUST be a positive number encoded in JSON as a number. Consider the guidance provided in Section 13.7.
- * **status_list:** REQUIRED. The status_list (status list) claim MUST specify the Status List conforming to the structure defined in Section 4.2.

The following additional rules apply:

1. The JWT MAY contain other claims.
2. The JWT MUST be secured using a cryptographic signature or MAC algorithm. Relying Parties MUST reject JWTs with an invalid signature.
3. Relying Parties MUST reject JWTs that are not valid in all other respects per "JSON Web Token (JWT)" [RFC7519].
4. Application of additional restrictions and policies are at the discretion of the Relying Party.

The following is a non-normative example of a Status List Token in JWT format:

```
{
  "alg": "ES256",
  "kid": "12",
  "typ": "statuslist+jwt"
}
.
{
  "exp": 2291720170,
  "iat": 1686920170,
  "status_list": {
    "bits": 1,
    "lst": "eNrBuRgAAhcBXQ"
  },
  "sub": "https://example.com/statuslists/1",
  "ttl": 43200
}
```

5.2. Status List Token in CWT Format

The Status List Token MUST be encoded as a "CBOR Web Token (CWT)" according to [RFC8392]. The Status List Token MUST NOT be tagged with the CWT tag defined in Section 6 of [RFC8392]. The COSE message MUST either be the tagged COSE_Sign1_Tagged (18) or COSE_Mac0_Tagged (17) as defined in Section 2 of [RFC9052].

The following content applies to the protected header of the CWT:

- * 16 (type): REQUIRED. The type of the CWT MUST be application/statuslist+cwt or the registered CoAP Content-Format ID (see Section 14.8) as defined in [RFC9596].

The following content applies to the CWT Claims Set:

- * 2 (subject): REQUIRED. As generally defined in [RFC8392]. The subject claim MUST specify the URI of the Status List Token. The value MUST be equal to that of the uri claim contained in the status_list claim of the Referenced Token.
- * 6 (issued at): REQUIRED. As generally defined in [RFC8392]. The issued at claim MUST specify the time at which the Status List Token was issued.
- * 4 (expiration time): RECOMMENDED. As generally defined in [RFC8392]. The expiration time claim, if present, MUST specify the time at which the Status List Token is considered expired by its issuer. Consider the guidance provided in Section 13.7.

- * 65534 (time to live): RECOMMENDED. Unsigned integer (major type 0). The time to live claim, if present, MUST specify the maximum amount of time, in seconds, that the Status List Token can be cached by a consumer before a fresh copy SHOULD be retrieved. The value of the claim MUST be a positive number. Consider the guidance provided in Section 13.7.
- * 65533 (status list): REQUIRED. The status list claim MUST specify the Status List conforming to the structure defined in Section 4.3.

The following additional rules apply:

1. The CWT MAY contain other claims.
2. The CWT MUST be secured using a cryptographic signature or MAC algorithm. Relying Parties MUST reject CWTs with an invalid signature.
3. Relying Parties MUST reject CWTs that are not valid in all other respects per "CBOR Web Token (CWT)" [RFC8392].
4. Application of additional restrictions and policies are at the discretion of the Relying Party.

The following is a non-normative example of a Status List Token in CWT format in Hex:

```
d2845820a2012610781a6170706c69636174696f6e2f7374617475736c6973742b63
7774a1044231325850a502782168747470733a2f2f6578616d706c652e636f6d2f73
74617475736c697374732f31061a648c5bea041a8898dfea19fffe19a8c019fffa2
646269747301636c73744a78dadbb918000217015d584093fa4d01032b18c35e2fe1
101b77fd6cc9440022caa4694450c4e4e9feab4e99d1fa6d9772ce2bf3a12e0323de
d7c982c5e101a5e67f0cbc1e2b6f57ce99c279
```

The following is the CBOR Annotated Hex output of the example above:

```
d2                                     # tag(18)
84                                     # array(4)
58 20                                # bytes(32)
a2012610781a6170706c6963           # "ヾ「\x01&\x10\x1aapplic"
6174696f6e2f737461747573           # "ation/status"
6c6973742b637774                     # "list+cwt"
a1                                     # map(1)
04                                     # uint(4)
42                                     # bytes(2)
3132                                  # "12"
58 50                                # bytes(80)
a502782168747470733a2f2f           # "ヾ・\x02x!https://"
6578616d706c652e636f6d2f           # "example.com/"
7374617475736c697374732f           # "statuslists/"
31061a648c5bea041a8898df           # "1\x06\x1ad\x8c[テエ\x04\x1a\x88\x98テ
ea19fffe19a8c019fffd264           # "\x19\x19"\x19 d"
6269747301636c73744a78da           # "bits\x01clstJx"
dbb918000217015d                     # "\x18\x00\x02\x17\x01]"
58 40                                # bytes(64)
93fa4d01032b18c35e2fe110           # "\x93M\x01\x03+\x18^\x10"
1b77fd6cc9440022caa46944           # "\x1bw1D\x00"iD"
50c4e4e9feab4e99d1fa6d97           # "PN\x99m\x97"
72ce2bf3a12e0323ded7c982           # "r+.\x03#×\x82"
c5e101a5e67f0cbc1e2b6f57           # "\x01¥\x7f\x0c\x1e+oW"
ce99c279                              # "\x99y"
```

6. Referenced Token

6.1. Status Claim

By including a "status" claim in a Referenced Token, the Issuer is referencing a mechanism to retrieve status information about this Referenced Token. This specification defines one possible member of the "status" object, called "status_list". Other members of the "status" object may be defined by other specifications. This is analogous to "cnf" claim in Section 3.1 of [RFC7800] in which different authenticity confirmation methods can be included.

6.2. Referenced Token in JOSE

The Referenced Token MAY be encoded as a "JSON Web Token (JWT)" according to [RFC7519], as an SD-JWT [RFC9901], as an SD-JWT VC [SD-JWT.VC] or other formats based on JOSE.

The following content applies to the JWT Claims Set:

- * status: REQUIRED. The status (status) claim MUST specify a JSON Object that contains at least one reference to a status mechanism.

- status_list: REQUIRED when the status mechanism defined in this specification is used. It MUST specify a JSON Object that contains a reference to a Status List Token. It MUST at least contain the following claims:
 - o idx: REQUIRED. The idx (index) claim MUST specify a non-negative Integer that represents the index to check for status information in the Status List for the current Referenced Token.
 - o uri: REQUIRED. The uri (URI) claim MUST specify a String value that identifies the Status List Token containing the status information for the Referenced Token. The value of uri MUST be a URI conforming to [RFC3986].

Application of additional restrictions and policies are at the discretion of the Relying Party.

The following is a non-normative example of a decoded header and payload of a Referenced Token:

```
{
  "alg": "ES256",
  "kid": "11"
}
:
{
  "status": {
    "status_list": {
      "idx": 0,
      "uri": "https://example.com/statuslists/1"
    }
  }
}
```

The following is a non-normative example of a Referenced Token in SD-JWT serialized form as received from an Issuer:

```

eyJhbGciOiAiRVMyNTYiLCAidHlwIjogImV4YW1wbGUrc2Qtand0In0.eyJfc2QiOiBb
Ikh2cktYNmZQVjB2OUtfeUNWRkJPtEzIc0lheGNEXzExNEVtNlZUOHgxbGciXSgwImlz
cyI6ICJodHRwczovL2V4YW1wbGUuY29tL2lzc3VlciIsICJpYXQiOiAxNjgzMDAwMDAw
LCAiZXhwIjogMTg4MzAwMDAwMCwgInN1YiI6ICI2YzVjMGE0OSliNTg5LTQzMWQtYmFl
Ny0yMTkxMjJhOWVjMmMiLCAic3RhZHVzIjogeyJzdGF0dXNfbGlzdCI6IHsiaWR4Ijog
MCwgInVyaSI6ICJodHRwczovL2V4YW1wbGUuY29tL3N0YXRlc2xpc3RzLzEifX0sICJf
c2RfYWxnIjogInNoYS0yNTYifQ.-kgS-R-Z4DEDlqb8kb6381_gHHNatsoF1fcVKZk3M
06CrnV8F8k9d2w2V_YAOvgcb0f11FqDFezXBXH30d4vcw~WyIyR0xDNDJzS1F2ZUNmR2
ZyeU5STj13IiwgInN0cmVldF9hZGRyZXNzIiwgIlNjaHVsc3RyLiAxMiJd~WyJlbHVWN
U9nM2dTtTklJOEVZbnN4QV9BIiwgImxvY2FsaXR5IiwgIlNjaHVscGZvcnRhIl0~WyI2S
Wo3dE0tYTVpVlBHYm9TNXRtdlZBIiwgInJlZ2lubiIsICJTYWNoc2VuLUFuaGFsdCJd~
WyJlSThaV205UW5LUHBOUGVOZW5IZGhRIiwgImNvdW50cnkiLCAiREUiXQ~WyJRZ19PN
jR6cUF4ZTQxMmExMDhpcm9BIiwgImFkZHZJlc3MiLCB7Il9zZCI6IFsiNnZoOWJxLXpTN
EdLTV83R3BnZ1ZiWXP6dTzvt0dYcm1OVkdQSFA3NVVkcMCiSiICI5Z2pWdVh0ZEZST0NnU
nJ0TmNHVhtRjY1cmRlemlfNkVyX2o3NmmttWXLNIiwgIktVUkRQaDRaQzE5LTN0aXotR
GYzOVY4ZWlkeTFvVjNhM0gxRGEyTjBnODgiLCAiV045cjlkQ0JKOEhUQ3NTMmpLQVN4V
GpFeVclbTV4NjVfWl8ycm8yamZyTSJdfV0~

```

The resulting payload of the example above:

```

{
  "_sd": [
    "HvrKX6fPV0v9K_yCVFBiLFHsMaxcD_114Em6VT8x1lg"
  ],
  "iss": "https://example.com/issuer",
  "iat": 1683000000,
  "exp": 1883000000,
  "sub": "6c5c0a49-b589-431d-bae7-219122a9ec2c",
  "status": {
    "status_list": {
      "idx": 0,
      "uri": "https://example.com/statuslists/1"
    }
  },
  "_sd_alg": "sha-256"
}

```

6.3. Referenced Token in COSE

The Referenced Token MAY be encoded as a "CBOR Web Token (CWT)" object according to [RFC8392], as an SD-CWTs [SD-CWT] or as an ISO mdoc according to [ISO.mdoc] or other formats based on COSE. Referenced Tokens in CBOR SHOULD share the same core data structure for a status list reference:

- * The Status CBOR structure is a Map that MUST include at least one data item that refers to a status mechanism. Each data item in the Status CBOR structure comprises a key-value pair, where the

key MUST be a CBOR text string (major type 3) specifying the identifier of the status mechanism and the corresponding value defines its contents.

- status_list (status list): REQUIRED when the status mechanism defined in this specification is used. It has the same definition as the status_list claim in Section 6.2 but MUST be encoded as a StatusListInfo CBOR structure with the following fields:
 - o idx: REQUIRED. Unsigned integer (major type 0). The idx (index) claim MUST specify a non-negative Integer that represents the index to check for status information in the Status List for the current Referenced Token.
 - o uri: REQUIRED. Text string (major type 3). The uri (URI) claim MUST specify a String value that identifies the Status List Token containing the status information for the Referenced Token. The value of uri MUST be a URI conforming to [RFC3986].

If the Referenced Token is a CWT, the following content applies to the CWT Claims Set:

- * 65535 (status): REQUIRED. The status claim contains the Status CBOR structure as described in this section.

Application of additional restrictions and policies are at the discretion of the Relying Party.

The following is a non-normative example of a Referenced Token in CWT format in Hex:

```
d28443a10126a1044231325866a502653132333435017368747470733a2f2f657861
6d706c652e636f6d061a648c5bea041a8898dfea19ffffa16b7374617475735f6c69
7374a2636964780063757269782168747470733a2f2f6578616d706c652e636f6d2f
7374617475736c697374732f315840340f7efea10f1a36dc4797636a17b4dd4848b6
8997d1d10e8cce3a38ff33b3dda72964a83989f6cf98560c2fc97a08bc8977cc6b0
f84cfedab93d3e4481e938
```

The following is the CBOR Annotated Hex output of the example above:

```

d2      # tag(18)
84      #   array(4)
43      #     bytes(3)
    a10126 #       "\x01&"
a1      #     map(1)
    04      #       uint(4)
    42      #       bytes(2)
    3132    #       "12"
58 66    #     bytes(102)
    a50265313233343501736874 #       "¥ \x02e12345\x01sht"
    7470733a2f2f6578616d706c #       "tps://exampl"
    652e636f6d061a648c5bea04 #       "e.com\x06\xlad\x8c[\x04"
    1a8898dfea19ffffa16b7374 #       "\x1a\x88\x98\x19kst"
    617475735f6c697374a26369 #       "atus_list ¢ ci"
    647800637572697821687474 #       "dx\x00curix!htt"
    70733a2f2f6578616d706c65 #       "ps://example"
    2e636f6d2f7374617475736c #       ".com/status1"
    697374732f31              #       "ists/1"
58 40    #     bytes(64)
    340f7efea10f1a36dc479763 #       "4\x0f~\x0f\xla6G\x97c"
    6a17b4dd4848b68997d1d10e #       "j\x17`HH¶ \x89\x97\x0e"
    8cceb3a38ff33b3dda72964a #       "\x8c£ \x8f;=r\x96J"
    83989f6cf98560c2fc97a08b #       "\x83\x98\x9f1\x85'\x97\xa0\x8b"
    c8977cc6b0f84cfedab93d3e #       "\x97|°L=>"
    4481e938                  #       "D\x818"

```

7. Status Types

This document defines the statuses of Referenced Tokens as Status Type values. A Status List represents exactly one status per Referenced Token. If the Status List contains more than one bit per token (as defined by bits in the Status List), then the whole value of bits MUST describe one value. Status Types MUST have a numeric value between 0 and 255 for their representation in the Status List. The issuer of the Status List MUST choose an adequate bits value (bit size) to be able to describe the required Status Types for its application.

7.1. Status Types Values

The processing rules for Referenced Tokens (such as JWT or CWT) supersede the Referenced Token's status in a TSL. In particular, a Referenced Token that is evaluated as being expired (e.g. through the exp claim) but in a TSL has a status of 0x00 ("VALID"), is considered expired.

This document creates a registry in Section 14.5 that includes the most common Status Type values. To improve interoperability, applications **MUST** use registered values for statuses if they have the same or compatible semantics of the use-case. Additional values may be defined for particular use cases. Status Types described by this document comprise:

- * 0x00 - "VALID" - The status of the Referenced Token is valid, correct or legal.
- * 0x01 - "INVALID" - The status of the Referenced Token is revoked, annulled, taken back, recalled or cancelled.
- * 0x02 - "SUSPENDED" - The status of the Referenced Token is temporarily invalid, hanging, debarred from privilege. This status is usually temporary.

The Status Type value 0x03 and Status Type values in the range 0x0C until 0x0F are permanently reserved as application specific. The processing of Status Types using these values is application specific. All other Status Type values are reserved for future registration.

See Section 12.8 for privacy considerations on status types.

8. Verification and Processing

The fetching, processing and verifying of a Status List Token may be done by either the Holder or the Relying Party. The following section is described from the role of the Relying Party, however the same rules apply to the Holder.

8.1. Status List Request

The default Status List request and response mechanism uses HTTP semantics and Content negotiation as defined in [RFC9110].

The Status Provider **MUST** return the Status List Token in response to an HTTP GET request to the URI provided in the Referenced Token, unless the Relying Party and the Status Provider have alternative methods of distribution for the Status List Token.

The HTTP endpoint **SHOULD** support the use of Cross-Origin Resource Sharing (CORS) [CORS] and/or other methods as appropriate to enable Browser-based clients to access it, unless ecosystems using this specification choose not to support Browser-based clients.

The following media types are defined by this specification for HTTP based Content negotiation:

- * "application/statuslist+jwt" for Status List Token in JWT format
- * "application/statuslist+cwt" for Status List Token in CWT format

The following is a non-normative example of a request for a Status List Token with type application/statuslist+jwt:

```
GET /statuslists/1 HTTP/1.1
Host: example.com
Accept: application/statuslist+jwt
```

8.2. Status List Response

A successful response that contains a Status List Token MUST use an HTTP status code in the 2xx range.

A response MAY also choose to redirect the client to another URI using an HTTP status code in the 3xx range, which clients SHOULD follow. See Section 11.4 for security considerations on redirects.

In the successful response, the Status Provider MUST use the following content-type:

- * "application/statuslist+jwt" for Status List Token in JWT format
- * "application/statuslist+cwt" for Status List Token in CWT format

In the case of "application/statuslist+jwt", the response MUST be of type JWT and follow the rules of Section 5.1. In the case of "application/statuslist+cwt", the response MUST be of type CWT and follow the rules of Section 5.2.

The body of such an HTTP response contains the raw Status List Token, that means the binary encoding as defined in Section 9.2.1 of [RFC8392] for a Status List Token in CWT format and the JWS Compact Serialization form for a Status List Token in JWT format. Note that while the examples for Status List Tokens in CWT format in this document are provided in hex encoding, this is done purely for readability; CWT format response bodies are "in binary".

The HTTP response SHOULD use Content-Encoding (such as gzip) using the content negotiation and encoding mechanisms as defined in [RFC9110] for Status List Tokens in JWT format.

If caching-related HTTP headers are present in the HTTP response, Relying Parties MUST prioritize the exp and ttl claims within the Status List Token over the HTTP headers for determining caching behavior.

The following is a non-normative example of a response with a Status List Token with type application/statuslist+jwt:

HTTP/1.1 200 OK

Content-Type: application/statuslist+jwt

```
eyJhbGciOiJFUzI1NiIsImtpZCI6IjEyIiwidHlwIjoic3RhZHVzbGlzdCtqd3QifQ.e
yJleHAiOiJyOTE3MjAxNzAsImhhdCI6MTY4NjkyMDE3MCwiaXNzIjoiaHR0cHM6Ly9le
GFtcGxlLnVbSIsInN0YXRlc19saXN0Ijp7ImJpdHMiOjEsImxzZCI6ImV0cmJlUmdBQ
WhjQlhrIn0sInN1YiI6Imh0dHBzOi8vZXhhbXBsZS5jb20vc3RhZHVzbGlzdHMvMSIsI
nR0bCI6NDMyMDB9.2lKUUNG503R9htu4aHAYi7vjmr3sgApbfoDvPr165N3URU01EYqq
Ql45Jfzd-Av4QzlKa3oVALpLwOEuOq-U_g
```

8.3. Validation Rules

Upon receiving a Referenced Token, a Relying Party MUST first perform the validation of the Referenced Token - e.g., checking for expected attributes, valid signature and expiration time. The processing rules for Referenced Tokens (such as JWT or CWT) MUST precede any evaluation of a Referenced Token's status. For example, if a token is evaluated as being expired through the "exp" (Expiration Time) but also has a status of 0x00 ("VALID"), the token is considered expired. If the validation procedures for the Referenced Token determine it is invalid, further procedures regarding Status List MUST NOT be performed, e.g. fetching a Status List Token, unless the Referenced Token procedures or the use case require further evaluation.

If this validation is not successful, the Referenced Token MUST be rejected. If the validation was successful, the Relying Party MUST perform the following validation steps to evaluate the status of the Referenced Token:

1. Check for the existence of a status claim, check for the existence of a status_list claim within the status claim and validate that the content of status_list adheres to the rules defined in Section 6.2 for JOSE-based Referenced Tokens and Section 6.3 for COSE-based Referenced Tokens. Other formats of Referenced Tokens may define other encoding of the URI and index.
2. Resolve the Status List Token from the provided URI
3. Validate the Status List Token:

- a. Validate the Status List Token by following the rules defined in Section 7.2 of [RFC7519] for JWTs and Section 7.2 of [RFC8392] for CWTs. This step might require the resolution of a public key as described in Section 11.3.
 - b. Check for the existence of the required claims as defined in Section 5.1 and Section 5.2 depending on the token type
4. All existing claims in the Status List Token MUST be checked according to the rules in Section 5.1 and Section 5.2
 - a. The subject claim (sub or 2) of the Status List Token MUST be equal to the uri claim in the status_list object of the Referenced Token
 - b. If the Relying Party has local policies regarding the freshness of the Status List Token, it SHOULD check the issued at claim (iat or 6)
 - c. If the expiration time is defined (exp or 4), it MUST be checked if the Status List Token is expired
 - d. If the Relying Party is using a system for caching the Status List Token, it SHOULD check the ttl claim of the Status List Token and retrieve a fresh copy if (time status was resolved + ttl < current time)
5. Decompress the Status List with a decompressor that is compatible with DEFLATE [RFC1951] and ZLIB [RFC1950]
6. Retrieve the status value of the index specified in the Referenced Token as described in Section 4. If the provided index is out of bounds of the Status List, no statement about the status of the Referenced Token can be made and the Referenced Token MUST be rejected.
7. Check the status value as described in Section 7

If any of these checks fails, no statement about the status of the Referenced Token can be made and the Referenced Token SHOULD be rejected.

8.4. Historical Resolution

By default, the status mechanism defined in this specification only conveys information about the state of Referenced Tokens at the time the Status List Token was issued. The validity period for this information, as defined by the issuer, is explicitly stated by the `iat` (issued at) and `exp` (expiration time) claims for JWT and their corresponding ones for the CWT representation. If support for historical status information is desired, this can be achieved by extending with a timestamp the request for the Status List Token as defined in Section 8.1. This feature has additional privacy implications as described in Section 12.7.

To obtain the Status List Token, the Relying Party MUST send an HTTP GET request to the URI provided in the Referenced Token with the additional query parameter `time` and its value being a unix timestamp, forming the query component `time=<timestamp>` (see below for a non-normative example of a request using such a query). The response for a valid request SHOULD contain a Status List Token that was valid for that specified time or an error.

If the Server does not support the additional query parameter, it SHOULD return a status code of 501 (Not Implemented) or if the requested time is not supported it SHOULD return a status code of 404 (Not Found). A Status List Token might be served via static file hosting (e.g., leveraging a Content Delivery Network) that ignores query parameters, which would result in the client requesting a historical status list but receiving the current status list. Thus, the client MUST reject a response unless the requested timestamp is within the valid time of the returned token signaled via `iat` (6 for CWT) and `exp` (4 for CWT).

The following is a non-normative example of a GET request using the `time` query parameter:

```
GET /statuslists/1?time=1686925000 HTTP/1.1
Host: example.com
Accept: application/statuslist+jwt
```

The following is a non-normative example of a response for the above Request:

HTTP/1.1 200 OK
Content-Type: application/statuslist+jwt

eyJhbGciOiJFUzI1NiIsImtpZCI6IjEyIiwidHlwIjoic3RhZHVzbGlzdCtqd3QifQ.e
yJleHAiOiJyOTE3MjAxNzAsImhhdCI6MTY4NjkyMDE3MCwiaXNzIjoiaHR0cHM6Ly9le
GFtcGxlLmNvbSIsInN0YXRlc19saXN0Ijp7ImJpdHMiOjEsImxzZCI6ImV0cmJlUmdBQ
WhjQlhRIn0sInN1YiI6Imh0dHBzOi8vZXhhbXBsZS5jb20vc3RhZHVzbGlzdHMvMSIsI
nR0bCI6NDMyMDB9.2lKUUNG503R9htu4aHAYi7vjmr3sgApbfoDvPr165N3URUO1EYqq
Ql45Jfzd-Av4QzlKa3oVALpLwOEUOq-U_g

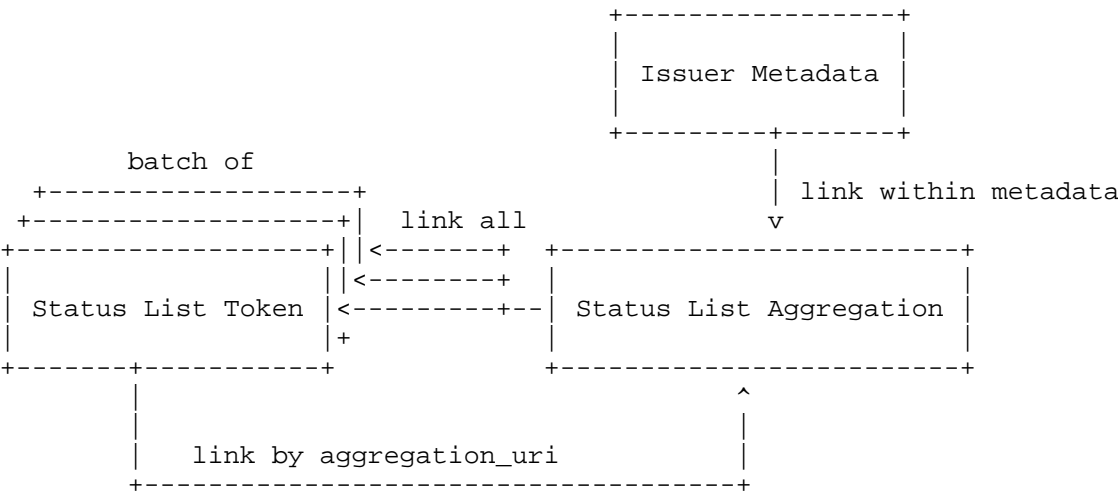
9. Status List Aggregation

Status List Aggregation is an optional mechanism offered by the Issuer to publish a list of one or more Status List Tokens URIs, allowing a Relying Party to fetch Status List Tokens provided by this Issuer. This mechanism is intended to support fetching and caching mechanisms and allow offline validation of the status of a Referenced Token for a period of time.

If a Relying Party encounters an error while validating one of the Status List Tokens returned from the Status List Aggregation endpoint, it SHOULD continue processing the other Status List Tokens.

There are two options for a Relying Party to retrieve the Status List Aggregation. An Issuer MAY support any of these mechanisms:

- * Issuer metadata: The Issuer of the Referenced Token publishes a URI which links to Status List Aggregation, e.g. in publicly available metadata of an issuance protocol
- * Status List Parameter: The Status Issuer includes an additional claim in the Status List Token that contains the Status List Aggregation URI.



9.1. Issuer Metadata

The Issuer MAY link to the Status List Aggregation URI in metadata that can be provided by different means like .well-known metadata as is used commonly in OAuth as defined in [RFC8414], or within Issuer certificates or trust lists (such as VICAL as defined in Annex C of [ISO.mdoc]). If the Issuer is an OAuth Authorization Server according to [RFC6749], it is RECOMMENDED to use the status_list_aggregation_endpoint parameter within its metadata defined by [RFC8414]. The Issuer MAY limit the Status List Tokens listed by a Status List Aggregation to a particular type of Referenced Token.

The concrete implementation details depend on the specific ecosystem and are out of scope of this specification.

9.2. Status List Parameter

The URI to the Status List Aggregation MAY be provided as the optional parameter aggregation_uri in the Status List itself as explained in Section 4.3 and Section 4.2 respectively. A Relying Party may use this URI to retrieve an up-to-date list of relevant Status Lists.

9.3. Status List Aggregation Data Structure

This section defines the structure for a JSON-encoded Status List Aggregation:

- * `status_lists`: REQUIRED. JSON array of strings that contains URIs linking to Status List Tokens.

The Status List Aggregation URI provides a list of Status List Token URIs. This aggregation is in JSON and the returned media type MUST be `application/json`. A Relying Party can iterate through this list and fetch all Status List Tokens before encountering the specific URI in a Referenced Token.

The following is a non-normative example for media type `application/json`:

```
{
  "status_lists" : [
    "https://example.com/statuslists/1",
    "https://example.com/statuslists/2",
    "https://example.com/statuslists/3"
  ]
}
```

10. X.509 Certificate Extended Key Usage Extension

[RFC5280] specifies the Extended Key Usage (EKU) X.509 certificate extension for use on end entity certificates. The extension indicates one or more purposes for which the certified public key is valid. The EKU extension can be used in conjunction with the Key Usage (KU) extension, which indicates the set of basic cryptographic operations for which the certified key may be used. A certificate's issuer explicitly delegates Status List Token signing authority by issuing an X.509 certificate containing the `KeyPurposeId` defined below in the extended key usage extension. Other specifications MAY choose to re-use this OID for other status mechanisms under the condition that they are registered in the "JWT Status Mechanisms" or "CWT Status Mechanisms" registries.

The following OID is defined for usage in the EKU extension:

```
id-kp OBJECT IDENTIFIER ::=
  { iso(1) identified-organization(3) dod(6) internet(1)
    security(5) mechanisms(5) pkix(7) kp(3) }

id-kp-oauthStatusSigning OBJECT IDENTIFIER ::= { id-kp TBD }
```

11. Security Considerations

Status List Tokens as defined in Section 5 only exist in cryptographically secured containers which allow checking the integrity and origin without relying on other factors such as transport security or web PKI.

11.1. Correct decoding and parsing of the encoded Status List

Implementers should be particularly careful with the correct parsing and decoding of the Status List. Incorrect implementations might check the index on the wrong data or miscalculate the bit and byte index leading to an erroneous status of the Referenced Token. Beware, that bits are indexed (bit order) from least significant bit to most significant bit (also called "right to left") while bytes are indexed (byte order) in their natural incrementing byte order (usually written for display purpose from left to right). Endianness does not apply here because each status value fits within a single byte.

Implementations SHOULD verify correctness using the test vectors given by this specification.

11.2. Security Guidance for JWT and CWT

A Status List Token in the JWT format MUST follow the security considerations of [RFC7519] and the best current practices of [RFC8725].

A Status List Token in the CWT format MUST follow the security considerations of [RFC8392].

11.3. Key Resolution and Trust Management

This specification does not mandate specific methods for key resolution and trust management, however the following recommendations are made for specifications, profiles, or ecosystems that are planning to make use of the Status List mechanism:

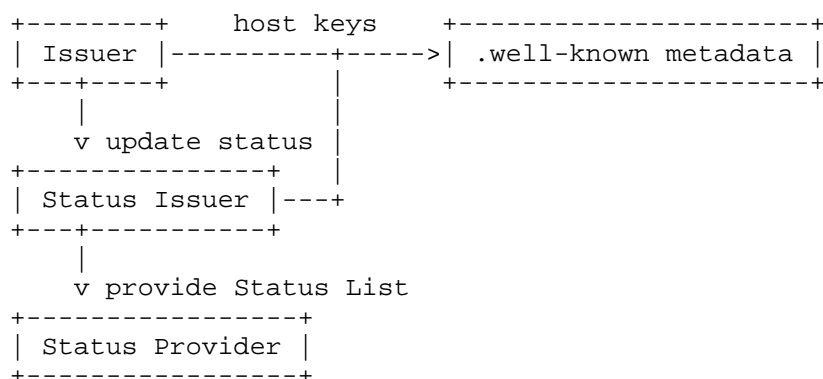
If the Issuer of the Referenced Token is the same entity as the Status Issuer, then the same key that is embedded into the Referenced Token may be used for the Status List Token. In this case the Status List Token may use:

- * the same x5c value or an x5t, x5t#S256 or kid parameter referencing to the same key as used in the Referenced Token for JOSE.

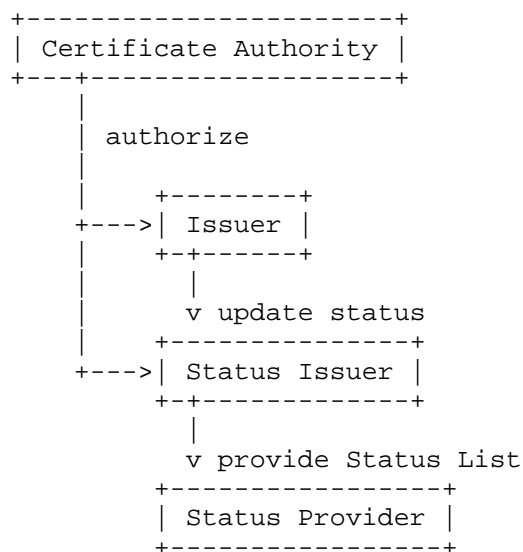
- * the same x5chain value or an x5t or kid parameter referencing to the same key as used in the Referenced Token for COSE.

Alternatively, the Status Issuer may use the same web-based key resolution that is used for the Referenced Token. In this case the Status List Token may use:

- * an x5u, jwks, jwks_uri or kid parameter referencing to a key using the same web-based resolution as used in the Referenced Token for JOSE.
- * an x5u or kid parameter referencing to a key using the same web-based resolution as used in the Referenced Token for COSE.



If the Issuer of the Referenced Token is a different entity than the Status Issuer, then the keys used for the Status List Token may be cryptographically linked, e.g. by a Certificate Authority through an x.509 PKI. The certificate of the Issuer for the Referenced Token and the Status Issuer should be issued by the same Certificate Authority and the Status Issuer's certificate should utilize extended key usage (Section 10).



11.4. Redirection 3xx

HTTP clients that follow 3xx (Redirection) status codes MUST be aware of the possible dangers of redirects, such as infinite redirection loops, since they can be used for denial-of-service attacks on clients. HTTP clients MUST follow the guidance provided in Section 15.4 of [RFC9110] for handling redirects.

11.5. Expiration and Caching

Expiration and caching information is conveyed via the `exp` and `t1` claims as explained in Section 13.7. Clients SHOULD check that both values are within reasonable ranges before requesting new Status List Tokens based on these values to prevent accidentally creating unreasonable amounts of requests for a specific URL. Status Issuers could accidentally or maliciously use this mechanism to effectively DDoS the contained URL of the Status Provider.

Reasonable values for both claims highly depend on the use-case requirements and clients should be configured with lower/upper bounds for these values that fit their respective use-cases.

11.6. Status List Token Protection

This specification allows both, digital signatures using asymmetric cryptography, and Message Authentication Codes (MAC) to be used to protect Status List Tokens. Implementers should only use MACs to secure the integrity of Status List Tokens if they fully understand the risks of MACs when compared to digital signatures and especially the requirements of their use-case scenarios. These use-cases typically represent deployments where Status Issuer and Relying Party have a trust relationship and the possibility to securely exchange keys out of band or are the same entity and no other entity needs to verify the Status List Token. We expect most deployments to use digital signatures for the protection of Status List Tokens and implementers SHOULD default to digital signatures if they are unsure.

12. Privacy Considerations

12.1. Observability of Issuers

The main privacy consideration for a Status List, especially in the context of the Issuer-Holder-Verifier model [RFC9901], is to prevent the Issuer from tracking the usage of the Referenced Token when the status is being checked. If an Issuer offers status information by referencing a specific token, this would enable the Issuer to create a profile for the issued token by correlating the date and identity of Relying Parties, that are requesting the status.

The Status List approaches these privacy implications by integrating the status information of many Referenced Tokens into the same list. Therefore, the Issuer does not learn for which Referenced Token the Relying Party is requesting the Status List. The privacy of the Holder is protected by the anonymity within the set of Referenced Tokens in the Status List, also called herd privacy. This limits the possibilities of tracking by the Issuer.

The herd privacy is depending on the number of entities within the Status List called its size. A larger size results in better privacy but also impacts the performance as more data has to be transferred to read the Status List.

Additionally, the Issuer may analyse data from the HTTP request to identify the Relying Party, e.g. through the sender's IP address.

This behaviour may be mitigated by:

- * private relay protocols or other mechanisms hiding the original sender like [RFC9458].

- * using trusted Third Party Hosting, see Section 12.6.

12.2. Issuer Tracking of Referenced Tokens

An Issuer could maliciously or accidentally bypass the privacy benefits of the herd privacy by either:

- * Generating a unique Status List for every Referenced Token. By these means, the Issuer could maintain a mapping between Referenced Tokens and Status Lists and thus track the usage of Referenced Tokens by utilizing this mapping for the incoming requests.
- * Encoding a unique URI in each Referenced Token which points to the underlying Status List. This may involve using URI components such as query parameters, unique path segments, or fragments to make the URI unique.

This malicious behavior can be detected by Relying Parties that request large amounts of Referenced Tokens by comparing the number of different Status Lists and their sizes with the volume of Referenced Tokens being verified.

12.3. Observability of Relying Parties

Once the Relying Party receives the Referenced Token, the Relying Party can request the Status List through the provided uri parameter and can validate the Referenced Token's status by looking up the corresponding index. However, the Relying Party may persistently store the uri and index of the Referenced Token to request the Status List again at a later time. By doing so regularly, the Relying Party may create a profile of the Referenced Token's validity status. This behaviour may be intended as a feature, e.g. for an identity proofing (e.g. Know-Your-Customer process in finance industry) that requires regular validity checks, but might also be abused in cases where this is not intended and unknown to the Holder, e.g. profiling the suspension of an employee credential.

This behaviour could be mitigated by:

- * regular re-issuance of the Referenced Token, see Section 13.2.

12.4. Observability of Outsiders

Outside actors may analyse the publicly available Status Lists to get information on the internal processes of the Issuer and its related business, e.g. number of customers or clients. This data may allow inferences on the total number of issued Referenced Tokens and the revocation rate. Additionally, actors may regularly fetch this data or use the historic data functionality to learn how these numbers change over time.

This behaviour could be mitigated by:

- * disabling the historical data feature Section 8.4
- * disabling the Status List Aggregation Section 9
- * choosing non-sequential, pseudo-random or random indices
- * using decoy entries to obfuscate the real number of Referenced Tokens within a Status List
- * choosing to deploy and utilize multiple Status Lists simultaneously

12.5. Unlinkability

The tuple of uri and index inside the Referenced Token are unique and therefore is traceable data.

12.5.1. Cross-party Collusion

Two or more colluding parties (e.g Relying Parties and or the Status Issuer) may link two transactions involving the same Referenced Token by comparing the status claims of received Referenced Tokens and therefore determine that they have interacted with the same Holder.

To avoid privacy risks of this possible collusion, it is RECOMMENDED that Issuers provide the ability to issue batches of one-time-use Referenced Tokens, enabling Holders to use them in a single interaction with a Relying Party before discarding. See Section 13.2 to avoid further correlatable information by the values of uri and idx, Status Issuers are RECOMMENDED to:

- * choose non-sequential, pseudo-random or random indices
- * use decoy entries to obfuscate the real number of Referenced Tokens within a Status List

- * choose to deploy and utilize multiple Status Lists simultaneously

12.6. External Status Provider for Privacy

If the roles of the Status Issuer and the Status Provider are performed by different entities, this may give additional privacy assurances as the Issuer has no means to identify the Relying Party or its request.

Third-Party hosting may also allow for greater scalability, as the Status List Tokens may be served by operators with greater resources, like CDNs, while still ensuring authenticity and integrity of Token Status List, as it is signed by the Status Issuer.

12.7. Historical Resolution

By default, this specification only supports providing Status List information for the most recent status information and does not allow the lookup of historical information like a validity state at a specific point in time. There exists optional support for a query parameter that allows this kind of historic lookup as described in Section 8.4. There are scenarios where such a functionality is necessary, but this feature should only be implemented when the scenario and the consequences of enabling historical resolution are fully understood.

There are strong privacy concerns that have to be carefully taken into consideration when providing a mechanism that allows historic requests for status information - see Section 12.3 for more details. Support for this functionality is optional and Implementers are RECOMMENDED to not support historic requests unless there are strong reasons to do so and after carefully considering the privacy implications.

12.8. Status Types

As previously explained, there is the potential risk of observability by Relying Parties (see Section 12.3) and Outsiders (see Section 12.4). That means that any Status Type that transports information beyond the routine statuses VALID and INVALID about a Referenced Token can leak information to other parties. This document defines one additional Status Type with "SUSPENDED" that conveys such additional information, but in practice all statuses other than VALID and INVALID are likely to contain information with privacy implications.

Ecosystems that want to use other Status Types than "VALID" and "INVALID" should consider the possible leakage of data and profiling possibilities before doing so and evaluate if revocation and re-issuance might be a better fit for their use-case.

13. Operational Considerations

13.1. Token Lifecycle

The lifetime of a Status List Token depends on the lifetime of its Referenced Tokens. Once all Referenced Tokens are expired, the Issuer may stop serving the Status List Token.

13.2. Linkability Mitigation

Referenced Tokens may be regularly re-issued to mitigate the linkability of presentations to Relying Parties. In this case, every re-issued Referenced Token **MUST** have a fresh Status List entry in order to prevent the index value from becoming a possible source of correlation.

Referenced Tokens may also be issued in batches and be presented by Holders in a one-time-use policy to avoid linkability. In this case, every Referenced Token **MUST** have a dedicated Status List entry and **MAY** be spread across multiple Status List Tokens. Batch revocation of a batch of Referenced Tokens might reveal that they are all members of the same batch.

Beware that this mechanism solves linkability issues between Relying Parties but does not prevent traceability by Issuers.

13.3. Default Values and Double Allocation

The Status Issuer is **RECOMMENDED** to initialize the Status List byte array with a default value provided as an initialization parameter by the Issuer of the Referenced Token. The Issuer is **RECOMMENDED** to use a default value that represents the most common value for its Referenced Tokens to avoid an update during issuance (usually 0x00, VALID). This preserves the benefits from compression and effectively hides the number of managed Referenced Tokens since an unused index value can not be distinguished from a valid Referenced Token.

The Status Issuer is **RECOMMENDED** to prevent double allocation, i.e. re-using the same uri and idx for multiple Referenced Tokens (since uri and idx form a unique identifier that might be used for tracking, see Section 12 for more details). The Status Issuer **MUST** prevent any unintended double allocation.

13.4. Status List Size

The storage and transmission size of the Status Issuer's Status List Tokens depend on:

- * the size of the Status List, i.e. the number of Referenced Tokens
- * the revocation rate and distribution of the Status List data (due to compression, revocation rates close to 0% or 100% lead to the lowest sizes while revocation rates closer to 50% and random distribution lead to the highest sizes)
- * the lifetime of Referenced Tokens (shorter lifetimes allows for earlier retirement of Status List Tokens)

The Status List Issuer may increase the size of a Status List if it requires indices for additional Referenced Tokens. It is RECOMMENDED that the size of a Status List in bits is divisible in bytes (8 bits) without a remainder, i.e. $\text{size-in-bits} \% 8 = 0$.

The Status List Issuer may divide its Referenced Tokens up into multiple Status Lists to reduce the transmission size of an individual Status List Token. This may be useful for ecosystems where some entities operate in constrained environments, e.g. for mobile internet or embedded devices. The Status List Issuer may organize the Status List Tokens depending on the Referenced Token's expiry date to align their lifecycles and allow for easier retiring of Status List Tokens, however the Status Issuer must be aware of possible privacy risks due to correlations.

13.5. External Status Issuer

If the roles of the Issuer of the Referenced Token and the Status Issuer are performed by different entities, this may allow for use cases that require revocation of Referenced Tokens to be managed by different entities, e.g. for regulatory or privacy reasons. In this scenario both parties must align on:

- * the key and trust management as described in Section 11.3
- * parameters for the Status List
 - number of bits for the Status Type as described in Section 4
 - update cycle of the Issuer used for ttl in the Status List Token as described in Section 5

13.6. External Status Provider for Scalability

If the roles of the Status Issuer and the Status Provider are performed by different entities, this may allow for greater scalability, as the Status List Tokens may be served by operators with greater resources, like CDNs. At the same time the authenticity and integrity of Token Status List is still guaranteed, as it is signed by the Status Issuer.

13.7. Status List Update Interval and Caching

Status Issuers have two options to communicate their update interval policy for the status of their Referenced Tokens:

- * the exp claim specifies an absolute timestamp, marking the point in time when the Status List expires and MUST NOT be relied upon any longer
- * the ttl claim represents a duration to be interpreted relative to the time the Status List is fetched, indicating when a new version of the Status List may be available

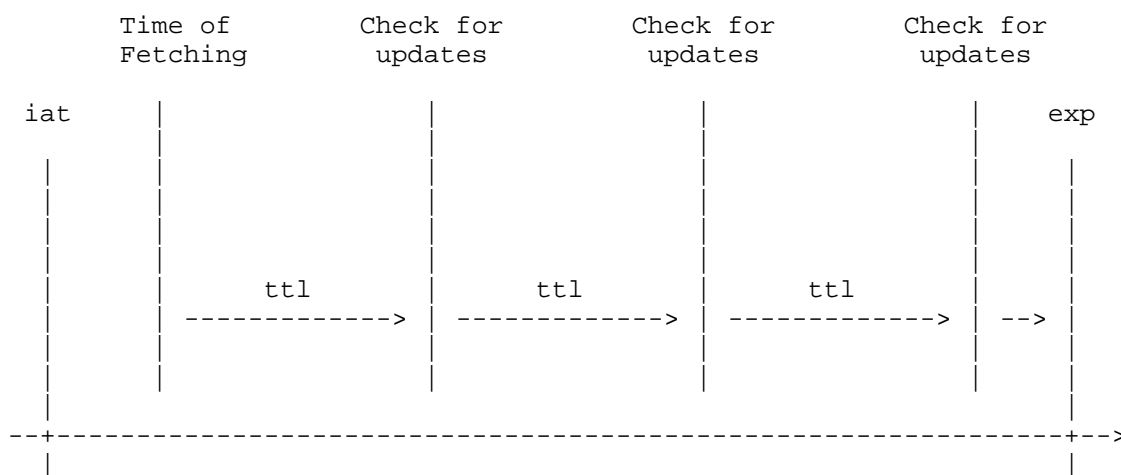
Both ttl and exp are RECOMMENDED to be used by the Status Issuer.

When fetching a Status List Token, Relying Parties must carefully evaluate how long a Status List is cached for. Collectively the iat, exp and ttl claims when present in a Status List Token communicate how long a Status List should be cached and should be considered valid for. Relying Parties have different options for caching the Status List:

- * After time of fetching, the Relying Party caches the Status List for time duration of ttl before making checks for updates. This method is RECOMMENDED to distribute the load for the Status Provider.
- * After initial fetching, the Relying Party checks for updates at time of iat + ttl. This method ensures the most up-to-date information for critical use cases. The Relying Party should account a minimal offset due to the signing and distribution process of the Status Issuer.
- * If no ttl is given, then Relying Party SHOULD check for updates latest after the time of exp.

Ultimately, it's the Relying Parties decision how often to check for updates, ecosystems may define their own guidelines and policies for updating the Status List information. Clients should ensure that exp and ttl are within reasonable bounds before creating requests to get a fresh Status List Token (see Section 11.5 for more details).

The following diagram illustrates the relationship between these claims and how they are designed to influence caching:



13.8. Relying Parties avoiding correlatable Information

If the Relying Party does not require the Referenced Token or the Status List Token for further processing, it is RECOMMENDED to delete correlatable information, in particular:

- * the status claim in the Referenced Token (after the validation)
- * the Status List Token itself (after expiration or update)

The Relying Party should instead only keep the needed fields from the Referenced Token.

13.9. Status List Formats

This specification defines 2 different token formats of the Status List:

- * JWT
- * CWT

This specification states no requirements to not mix different formats like a CBOR based Referenced Token using a JWT for the Status List, but the expectation is that within an ecosystem, a choice for specific formats is made. Within such an ecosystem, only support for those selected variants is required and implementations should know what to expect via a profile.

14. IANA Considerations

14.1. JSON Web Token Claims Registration

This specification requests registration of the following Claims in the IANA "JSON Web Token Claims" registry [IANA.JWT] established by [RFC7519].

14.1.1. Registry Contents

- * Claim Name: status
- * Claim Description: A JSON object containing a reference to a status mechanism from the JWT Status Mechanisms Registry.
- * Change Controller: IETF
- * Specification Document(s): Section 6.1 of this specification

- * Claim Name: status_list
- * Claim Description: A JSON object containing up-to-date status information on multiple tokens using the Token Status List mechanism.
- * Change Controller: IETF
- * Specification Document(s): Section 5.1 of this specification

- * Claim Name: ttl
- * Claim Description: Time to Live
- * Change Controller: IETF
- * Specification Document(s): Section 5.1 of this specification

14.2. JWT Status Mechanisms Registry

This specification establishes the IANA "JWT Status Mechanisms" registry for JWT "status" member values and adds it to the "JSON Web Token (JWT)" registry group at <https://www.iana.org/assignments/jwt>. The registry records the status mechanism member and a reference to the specification that defines it.

JWT Status Mechanisms are registered by Specification Required [RFC8126] after a three-week review period on the `jwt-reg-review@ietf.org` mailing list, on the advice of one or more Designated Experts. To allow for the allocation of values prior to publication of the final version of a specification, the designated experts may approve registration once they are satisfied that the specification will be completed and published. However, if the specification is not completed and published in a timely manner, as determined by the designated experts, the designated experts may request that IANA withdraw the registration.

Registration requests sent to the mailing list for review should use an appropriate subject (e.g., "Request to register JWT Status Mechanism: example").

Within the review period, the designated experts will either approve or deny the registration request, communicating this decision to the review list and IANA. Denials should include an explanation and, if applicable, suggestions as to how to make the request successful. If the designated experts are not responsive, the registration requesters should contact IANA to escalate the process.

Designated experts should apply at least the following criteria when reviewing proposed registrations:

- * they should not duplicate existing functionality
- * they are likely generally applicable, as opposed to being used for a single application
- * they are clear and fit the purpose of the registry
- * they use and extend the terminology of this document to describe the mechanism

IANA must only accept registry updates from the designated experts and should direct all requests for registration to the review mailing list.

In order to enable broadly informed review of registration decisions, there should be multiple designated experts to represent the perspectives of different applications using this specification. In cases where registration may be perceived as a conflict of interest for a particular expert, that expert should defer to the judgment of the other experts.

The mailing list is used to enable public review of registration requests, which enables both designated experts and other interested parties to provide feedback on proposed registrations. Designated experts may allocate values prior to publication of the final specification. This allows authors to receive guidance from the designated experts early, so any identified issues can be fixed before the final specification is published.

14.2.1. Registration Template

Status Mechanism Value:

The name requested (e.g., "status_list"). The name is case-sensitive. Names may not match other registered names in a case-insensitive manner unless the Designated Experts state that there is a compelling reason to allow an exception.

Status Mechanism Description:

Brief description of the status mechanism.

Change Controller:

For IETF Stream RFCs, list the IETF. For others, give the name of the responsible party. Other details (e.g., postal address, email address, home page URI) may also be included.

Specification Document(s):

Reference to the document or documents that specify the parameter, preferably including URIs that can be used to retrieve copies of the documents. An indication of the relevant sections may also be included but is not required.

14.2.2. Initial Registry Contents

- * Status Mechanism Value: status_list
- * Status Mechanism Description: A Token Status List containing up-to-date status information on multiple tokens.

- * Change Controller: IETF
- * Specification Document(s): Section 6.2 of this specification

14.3. CBOR Web Token Claims Registration

This specification requests registration of the following Claims in the IANA "CBOR Web Token (CWT) Claims" registry [IANA.CWT] established by [RFC8392].

14.3.1. Registry Contents

- * Claim Name: status
 - * Claim Description: A CBOR structure containing a reference to a status mechanism from the CWT Status Mechanisms Registry.
 - * JWT Claim Name: status
 - * Claim Key: TBD (requested assignment 65535)
 - * Claim Value Type: map
 - * Change Controller: IETF
 - * Reference: Section 6.1 of this specification
-
- * Claim Name: status_list
 - * Claim Description: A CBOR structure containing up-to-date status information on multiple tokens using the Token Status List mechanism.
 - * JWT Claim Name: status_list
 - * Claim Key: TBD (requested assignment 65533)
 - * Claim Value Type: map
 - * Change Controller: IETF
 - * Specification Document(s): Section 5.2 of this specification

- * Claim Name: ttl
- * Claim Description: Time to Live
- * JWT Claim Name: ttl
- * Claim Key: TBD (requested assignment 65534)
- * Claim Value Type: unsigned integer
- * Change Controller: IETF
- * Specification Document(s): Section 5.2 of this specification

14.4. CWT Status Mechanisms Registry

This specification establishes the IANA "CWT Status Mechanisms" registry for CWT "status" member values and adds it to the "CBOR Web Token (CWT) Claims" registry group at <https://www.iana.org/assignments/cwt>. The registry records the status mechanism member and a reference to the specification that defines it.

CWT Status Mechanisms are registered by Specification Required [RFC8126] after a three-week review period on the cwt-reg-review@ietf.org mailing list, on the advice of one or more Designated Experts. To allow for the allocation of values prior to publication of the final version of a specification, the designated experts may approve registration once they are satisfied that the specification will be completed and published. However, if the specification is not completed and published in a timely manner, as determined by the designated experts, the designated experts may request that IANA withdraw the registration.

Registration requests sent to the mailing list for review should use an appropriate subject (e.g., "Request to register CWT Status Mechanism: example").

Within the review period, the designated experts will either approve or deny the registration request, communicating this decision to the review list and IANA. Denials should include an explanation and, if applicable, suggestions as to how to make the request successful. If the designated experts are not responsive, the registration requesters should contact IANA to escalate the process.

Designated experts should at least apply the following criteria when reviewing proposed registrations:

- * they should not duplicate existing functionality
- * they are likely generally applicable, as opposed to being used for a single application
- * they are clear and fit the purpose of the registry
- * they use and extend the terminology of this document to describe the mechanism

IANA must only accept registry updates from the designated experts and should direct all requests for registration to the review mailing list.

In order to enable broadly informed review of registration decisions, there should be multiple designated experts to represent the perspectives of different applications using this specification. In cases where registration may be perceived as a conflict of interest for a particular expert, that expert should defer to the judgment of the other experts.

The mailing list is used to enable public review of registration requests, which enables both designated experts and other interested parties to provide feedback on proposed registrations. Designated experts may allocate values prior to publication of the final specification. This allows authors to receive guidance from the designated experts early, so any identified issues can be fixed before the final specification is published.

14.4.1. Registration Template

Status Mechanism Value:

The name requested (e.g., "status_list"). The name is case-sensitive. Names may not match other registered names in a case-insensitive manner unless the Designated Experts state that there is a compelling reason to allow an exception.

Status Mechanism Description:

Brief description of the status mechanism.

Change Controller:

For IETF Stream RFCs, list the IETF. For others, give the name of the responsible party. Other details (e.g., postal address, email address, home page URI) may also be included.

Specification Document(s):

Reference to the document or documents that specify the parameter, preferably including URIs that can be used to retrieve copies of the documents. An indication of the relevant sections may also be included but is not required.

14.4.2. Initial Registry Contents

- * Status Mechanism Value: status_list
- * Status Mechanism Description: A Token Status List containing up-to-date status information on multiple tokens.
- * Change Controller: IETF
- * Specification Document(s): Section 6.3 of this specification

14.5. OAuth Status Types Registry

This specification establishes the IANA "OAuth Status Types" registry for Status List values and adds it to the "OAuth Parameters" registry group at <https://www.iana.org/assignments/oauth-parameters>. The registry records a human-readable label, the bit representation and a common description for it.

Status Types are registered by Specification Required [RFC8126] after a two-week review period on the oauth-ext-review@ietf.org mailing list, on the advice of one or more Designated Experts. To allow for the allocation of values prior to publication of the final version of a specification, the designated experts may approve registration once they are satisfied that the specification will be completed and published. However, if the specification is not completed and published in a timely manner, as determined by the designated experts, the designated experts may request that IANA withdraw the registration.

Registration requests sent to the mailing list for review should use an appropriate subject (e.g., "Request to register Status Type name: example").

Within the review period, the designated experts will either approve or deny the registration request, communicating this decision to the review list and IANA. Denials should include an explanation and, if applicable, suggestions as to how to make the request successful. If the designated experts are not responsive, the registration requesters should contact IANA to escalate the process.

Designated experts should apply at least the following criteria when reviewing proposed registrations:

- * they should not duplicate existing functionality
- * they are likely generally applicable, as opposed to being used for a single application
- * the Status Type Name is short, clear and using well-known terms
- * the Status Type Description gives a good explanation for the intended use
- * the Status Type value does not collide with existing values

IANA must only accept registry updates from the designated experts and should direct all requests for registration to the review mailing list.

In order to enable broadly informed review of registration decisions, there should be multiple designated experts to represent the perspectives of different applications using this specification. In cases where registration may be perceived as a conflict of interest for a particular expert, that expert should defer to the judgment of the other experts.

The mailing list is used to enable public review of registration requests, which enables both designated experts and other interested parties to provide feedback on proposed registrations. Designated experts may allocate values prior to publication of the final specification. This allows authors to receive guidance from the designated experts early, so any identified issues can be fixed before the final specification is published.

14.5.1. Registration Template

Status Type Name:

The name is a human-readable case-insensitive label for the Status Type that helps to talk about the status of Referenced Token in common language.

Status Type Description:

Brief description of the Status Type and optional examples.

Status Type value:

The bit representation of the Status Type in a byte hex representation. Valid Status Type values range from 0x00-0xFF. Values are filled up with zeros if they have less than 8 bits.

Change Controller:

For IETF Stream RFCs, list the IETF. For others, give the name of the responsible party. Other details (e.g., postal address, email address, home page URI) may also be included.

Specification Document(s):

Reference to the document or documents that specify the parameter, preferably including URIs that can be used to retrieve copies of the documents. An indication of the relevant sections may also be included but is not required.

14.5.2. Initial Registry Contents

- * Status Type Name: VALID
- * Status Type Description: The status of the Referenced Token is valid, correct or legal.
- * Status Type value: 0x00
- * Change Controller: IETF
- * Specification Document(s): Section 7 of this specification

- * Status Type Name: INVALID
- * Status Type Description: The status of the Referenced Token is revoked, annulled, taken back, recalled or cancelled.
- * Status Type value: 0x01
- * Change Controller: IETF
- * Specification Document(s): Section 7 of this specification

- * Status Type Name: SUSPENDED

- * Status Type Description: The status of the Referenced Token is temporarily invalid, hanging or debarred from privilege. This state is usually temporary.
 - * Status Type value: 0x02
 - * Change Controller: IETF
 - * Specification Document(s): Section 7 of this specification
-
- * Status Type Name: APPLICATION_SPECIFIC
 - * Status Type Description: The status of the Referenced Token is application specific.
 - * Status Type value: 0x03
 - * Change Controller: IETF
 - * Specification Document(s): Section 7 of this specification
-
- * Status Type Name: APPLICATION_SPECIFIC
 - * Status Type Description: The status of the Referenced Token is application specific.
 - * Status Type value: 0x0C-0x0F
 - * Change Controller: IETF
 - * Specification Document(s): Section 7 of this specification

14.6. OAuth Parameters Registration

This specification requests registration of the following values in the IANA "OAuth Authorization Server Metadata" registry [IANA.OAuth.Params] established by [RFC8414].

- * Metadata Name: status_list_aggregation_endpoint
- * Metadata Description: URL of the Authorization Server aggregating OAuth Token Status List URLs for token status management.

- * Change Controller: IESG
- * Reference: Section 9 of this specification

14.7. Media Type Registration

This section requests registration of the following media types [RFC2046] in the "Media Types" registry [IANA.MediaType] in the manner described in [RFC6838].

To indicate that the content is a JWT-based Status List:

- * Type name: application
- * Subtype name: statuslist+jwt
- * Required parameters: n/a
- * Optional parameters: n/a
- * Encoding considerations: See Section 5.1 of this specification
- * Security considerations: See Section 11 of this specification
- * Interoperability considerations: n/a
- * Published specification: this specification
- * Applications that use this media type: Applications using this specification for updated status information of tokens
- * Fragment identifier considerations: n/a
- * Additional information: n/a
- * Person & email address to contact for further information: OAuth WG mailing list, oauth@ietf.org
- * Intended usage: COMMON
- * Restrictions on usage: none
- * Author: OAuth WG mailing list, oauth@ietf.org
- * Change controller: IETF
- * Provisional registration? No

To indicate that the content is a CWT-based Status List:

- * Type name: application
- * Subtype name: statuslist+cwt
- * Required parameters: n/a
- * Optional parameters: n/a
- * Encoding considerations: See Section 5.2 of this specification
- * Security considerations: See Section 11 of this specification
- * Interoperability considerations: n/a
- * Published specification: this specification
- * Applications that use this media type: Applications using this specification for updated status information of tokens
- * Fragment identifier considerations: n/a
- * Additional information: n/a
- * Person & email address to contact for further information: OAuth WG mailing list, oauth@ietf.org
- * Intended usage: COMMON
- * Restrictions on usage: none
- * Author: OAuth WG mailing list, oauth@ietf.org
- * Change controller: IETF
- * Provisional registration? No

14.8. CoAP Content-Format Registrations

IANA is requested to register the following Content-Format numbers in the "CoAP Content-Formats" sub-registry, within the "Constrained RESTful Environments (CoRE) Parameters" Registry [IANA.Core.Params]:

- * Content Type: application/statuslist+cwt
- * Content Coding: -

- * ID: TBD
- * Reference: this specification

14.9. X.509 Certificate Extended Key Purpose OID Registration

IANA is requested to register the following OID "1.3.6.1.5.5.7.3.TBD" with a description of "id-kp-oauthStatusSigning" in the "SMI Security for PKIX Extended Key Purpose" registry (1.3.6.1.5.5.7.3). This OID is defined in Section 10.

IANA is requested to register the following OID "1.3.6.1.5.5.7.0.TBD" with a description of "id-mod-oauth-status-signing-eku" in the "SMI Security for PKIX Module Identifier" registry (1.3.6.1.5.5.7.0). This OID is defined in Appendix A.

15. Acknowledgments

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Appendix A. ASN.1 Module

The following module adheres to ASN.1 specifications [X.680] and [X.690]. It defines the OID used for OAuth Status Mechanism Key Extended Key Usage.

```

<CODE BEGINS>
  OAuthStatusSigning-EKU
    { iso(1) identified-organization(3) dod(6) internet(1)
      security(5) mechanisms(5) pkix(7) id-mod(0)
      id-mod-oauth-status-signing-eku (TBD) }

  DEFINITIONS IMPLICIT TAGS ::=
  BEGIN

  -- OID Arc

  id-kp OBJECT IDENTIFIER ::=
    { iso(1) identified-organization(3) dod(6) internet(1)
      security(5) mechanisms(5) pkix(7) kp(3) }

  -- OAuth Extended Key Usage

  id-kp-oauthStatusSigning OBJECT IDENTIFIER ::= { id-kp TBD }

  END
<CODE ENDS>

```

Appendix B. Size Comparison

The following tables show a size comparison for a Status List (compressed byte array as defined in Section 4.1) and a compressed Byte Array of UUIDs [RFC9562] (as an approximation to the list of IDs of Referenced Tokens in a Certificate Revocation List). Readers must be aware that these are not sizes for complete Status List Tokens in JSON/CBOR nor Certificate Revocation Lists (CRLs), as they don't contain metadata, certificates, and signatures.

If no further metadata is provided in Status List Tokens or CRLs, then the size of Status Lists or arrays of Certificate ids (represented as UUIDs) will be the main factors deciding on the overall size of a Status List Token or CRL, respectively.

Size of Status Lists for varying amount of entries and revocation rates

Size	0.01%	0.1%	1%	2%	5%	10%	25%	50%	75%	100%
100k	81 B	252 B	1.4 KB	2.3 KB	4.5 KB	6.9 KB	10.2 KB	12.2 KB	10.2 KB	35 B
1M	442 B	2.2 KB	13.7 KB	23.0 KB	43.9 KB	67.6 KB	102.2 KB	122.1 KB	102.4 KB	144 B

10M	3.8	21.1	135.4	230.0	437.0	672.9	1023.4	1.2	1023.5	1.2	
	KB	KB	KB	KB	KB	KB	KB	MB	KB	KB	
+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+
100M	38.3	213.0	1.3 MB	2.2	4.3	6.6	10.0	11.9	10.0	11.9	
	KB	KB		MB	MB	MB	MB	MB	MB	KB	
+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+

Table 1: Status List Size examples for varying amount of entries and revocation rates

Size of compressed array of UUIDv4 (128-bit UUIDs) for varying amount of entries and revocation rates

This is a simple approximation of a CRL using an array of UUIDs without any additional metadata (128-bit UUID per revoked entry).

+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+
Size	0.01%	0.1%	1%	2%	5%	10%	25%	50%	75%	100%	
+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+
100k	219 B	1.6 KB	15.4	29.7	78.1	154.9	392.9	783.1	1.1	1.5	
		KB	KB	KB	KB	KB	KB	KB	MB	MB	
+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+
1M	1.6	16.4	157.7	310.4	781	1.5	3.8	7.6	11.4	15.3	
	KB	KB	KB	KB	KB	MB	MB	MB	MB	MB	
+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+
10M	15.3	155.9	1.5	3.1	7.6	15.2	38.2	76.3	114.4	152.6	
	KB	KB	MB	MB	MB	MB	MB	MB	MB	MB	
+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+
100M	157.6	1.5 MB	15.3	30.5	76.3	152.6	381.4	762.9	1.1	1.5	
	KB		MB	MB	MB	MB	MB	MB	GB	GB	
+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+

Table 2: Size examples for 128-bit UUIDs for varying amount of entries and revocation rates

Appendix C. Test vectors for Status List encoding

All examples here are given in the form of JSON or CBOR payloads. The examples are encoded according to Section 4.2 for JSON and Section 4.3 for CBOR. The CBOR examples are displayed as hex values.

All values that are not mentioned for the examples below can be assumed to be 0 (VALID). All examples are initialized with a size of 2^{20} entries.

C.1. 1-bit Status List

The following example uses a 1-bit Status List (2 possible values):

```
status[0] = 0b1
status[1993] = 0b1
status[25460] = 0b1
status[159495] = 0b1
status[495669] = 0b1
status[554353] = 0b1
status[645645] = 0b1
status[723232] = 0b1
status[854545] = 0b1
status[934534] = 0b1
status[1000345] = 0b1
```

JSON encoding:

```
{
  "bits": 1,
  "lst": "eNrt3AENwCAMAEGogklACtKQPg9LugC9k_ACvreiogE
AAKkeCQAAAAAAAAAAAAAAAAAIBylgQAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAXG9IAAAAAAAAAAPwsJAAAAAAAAAAAAAAAAAvhsSAAAAAAAA
A7KpLAAAAAAAAAAAAAAAAAAJSLCQAAAAAAAAAADjelAAAAAAAAAAAKjDMAQAAA
ACAZC8L2AEb"
}
```

CBOR encoding:

[illegible]

C.2. 2-bit Status List

The following example uses a 2-bit Status List (4 possible values):

[Page 62]

```
status[0] = 0b0001
status[1993] = 0b0010
status[35460] = 0b0011
status[459495] = 0b0100
status[595669] = 0b0101
status[754353] = 0b0110
status[845645] = 0b0111
status[923232] = 0b1000
status[924445] = 0b1001
status[934534] = 0b1010
status[1004534] = 0b1011
status[1000345] = 0b1100
status[1030203] = 0b1101
status[1030204] = 0b1110
status[1030205] = 0b1111
```

JSON encoding:

```
{
  "bits": 4,
  "lst": "eNrt0EENgDAQADAIHwImkIIEJEWcUpCEBBQRHOy35Li
1EjoOQGAbAgAAAAAAAAAAAAAAAAAACCSQEAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAABADrsCAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAADoxaEAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAIIoCgAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAACarpwKAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAGhqVklwIAAAAAiGVRAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAABx3AoAgLpVAQAAAAAAAAAAAAAwM89rwMAAAAAAAAAAA
AjsA9xMBMA"
```

CBOR encoding:

C.4. 8-bit Status List

```
status[233478] = 0b000000000
status[52451] = 0b000000001
status[576778] = 0b000000010
status[513575] = 0b000000011
status[468106] = 0b000000100
status[292632] = 0b000000101
status[214947] = 0b000000110
status[182323] = 0b000000111
status[884834] = 0b000001000
status[66653] = 0b000001001
status[62489] = 0b000001010
status[196493] = 0b000001011
status[458517] = 0b000001100
status[487925] = 0b000001101
status[55649] = 0b000001110
status[416992] = 0b000001111
status[879796] = 0b000010000
status[462297] = 0b000010001
status[942059] = 0b000010010
status[583408] = 0b000010011
status[13628] = 0b000010100
status[334829] = 0b000010101
status[886286] = 0b000010110
status[713557] = 0b000010111
```



```
status[582738] = 0b00011000
status[326064] = 0b00011001
status[451545] = 0b00011010
status[705889] = 0b00011011
status[214350] = 0b00011100
status[194502] = 0b00011101
status[796765] = 0b00011110
status[202828] = 0b00011111
status[752834] = 0b00100000
status[721327] = 0b00100001
status[554740] = 0b00100010
status[91122] = 0b00100011
status[963483] = 0b00100100
status[261779] = 0b00100101
status[793844] = 0b00100110
status[165255] = 0b00100111
status[614839] = 0b00101000
status[758403] = 0b00101001
status[403258] = 0b00101010
status[145867] = 0b00101011
status[96100] = 0b00101100
status[477937] = 0b00101101
status[606890] = 0b00101110
status[167335] = 0b00101111
status[488197] = 0b00110000
status[211815] = 0b00110001
status[797182] = 0b00110010
status[582952] = 0b00110011
status[950870] = 0b00110100
status[765108] = 0b00110101
status[341110] = 0b00110110
status[776325] = 0b00110111
status[745056] = 0b00111000
status[439368] = 0b00111001
status[559893] = 0b00111010
status[149741] = 0b00111011
status[358903] = 0b00111100
status[513405] = 0b00111101
status[342679] = 0b00111110
status[969429] = 0b00111111
status[795775] = 0b01000000
status[566121] = 0b01000001
status[460566] = 0b01000010
status[680070] = 0b01000011
status[117310] = 0b01000100
status[480348] = 0b01000101
status[67319] = 0b01000110
status[661552] = 0b01000111
```

```
status[841303] = 0b01001000
status[561493] = 0b01001001
status[138807] = 0b01001010
status[442463] = 0b01001011
status[659927] = 0b01001100
status[445910] = 0b01001101
status[1046963] = 0b01001110
status[829700] = 0b01001111
status[962282] = 0b01010000
status[299623] = 0b01010001
status[555493] = 0b01010010
status[292826] = 0b01010011
status[517215] = 0b01010100
status[551009] = 0b01010101
status[898490] = 0b01010110
status[837603] = 0b01010111
status[759161] = 0b01011000
status[459948] = 0b01011001
status[290102] = 0b01011010
status[1034977] = 0b01011011
status[190650] = 0b01011100
status[98810] = 0b01011101
status[229950] = 0b01011110
status[320531] = 0b01011111
status[335506] = 0b01100000
status[885333] = 0b01100001
status[133227] = 0b01100010
status[806915] = 0b01100011
status[800313] = 0b01100100
status[981571] = 0b01100101
status[527253] = 0b01100110
status[24077] = 0b01100111
status[240232] = 0b01101000
status[559572] = 0b01101001
status[713399] = 0b01101010
status[233941] = 0b01101011
status[615514] = 0b01101100
status[911768] = 0b01101101
status[331680] = 0b01101110
status[951527] = 0b01101111
status[6805] = 0b01110000
status[552366] = 0b01110001
status[374660] = 0b01110010
status[223159] = 0b01110011
status[625884] = 0b01110100
status[417146] = 0b01110101
status[320527] = 0b01110110
status[784154] = 0b01110111
```

```
status[338792] = 0b01111000
status[1199] = 0b01111001
status[679804] = 0b01111010
status[1024680] = 0b01111011
status[40845] = 0b01111100
status[234603] = 0b01111101
status[761225] = 0b01111110
status[644903] = 0b01111111
status[502167] = 0b10000000
status[121477] = 0b10000001
status[505144] = 0b10000010
status[165165] = 0b10000011
status[179628] = 0b10000100
status[1019195] = 0b10000101
status[145149] = 0b10000110
status[263738] = 0b10000111
status[269256] = 0b10001000
status[996739] = 0b10001001
status[346296] = 0b10001010
status[555864] = 0b10001011
status[887384] = 0b10001100
status[444173] = 0b10001101
status[421844] = 0b10001110
status[653716] = 0b10001111
status[836747] = 0b10010000
status[783119] = 0b10010001
status[918762] = 0b10010010
status[946835] = 0b10010011
status[253764] = 0b10010100
status[519895] = 0b10010101
status[471224] = 0b10010110
status[134272] = 0b10010111
status[709016] = 0b10011000
status[44112] = 0b10011001
status[482585] = 0b10011010
status[461829] = 0b10011011
status[15080] = 0b10011100
status[148883] = 0b10011101
status[123467] = 0b10011110
status[480125] = 0b10011111
status[141348] = 0b10100000
status[65877] = 0b10100001
status[692958] = 0b10100010
status[148598] = 0b10100011
status[499131] = 0b10100100
status[584009] = 0b10100101
status[1017987] = 0b10100110
status[449287] = 0b10100111
```

```
status[277478] = 0b10101000
status[991262] = 0b10101001
status[509602] = 0b10101010
status[991896] = 0b10101011
status[853666] = 0b10101100
status[399318] = 0b10101101
status[197815] = 0b10101110
status[203278] = 0b10101111
status[903979] = 0b10110000
status[743015] = 0b10110001
status[888308] = 0b10110010
status[862143] = 0b10110011
status[979421] = 0b10110100
status[113605] = 0b10110101
status[206397] = 0b10110110
status[127113] = 0b10110111
status[844358] = 0b10111000
status[711569] = 0b10111001
status[229153] = 0b10111010
status[521470] = 0b10111011
status[401793] = 0b10111100
status[398896] = 0b10111101
status[940810] = 0b10111110
status[293983] = 0b10111111
status[884749] = 0b11000000
status[384802] = 0b11000001
status[584151] = 0b11000010
status[970201] = 0b11000011
status[523882] = 0b11000100
status[158093] = 0b11000101
status[929312] = 0b11000110
status[205329] = 0b11000111
status[106091] = 0b11001000
status[30949] = 0b11001001
status[195586] = 0b11001010
status[495723] = 0b11001011
status[348779] = 0b11001100
status[852312] = 0b11001101
status[1018463] = 0b11001110
status[1009481] = 0b11001111
status[448260] = 0b11010000
status[841042] = 0b11010001
status[122967] = 0b11010010
status[345269] = 0b11010011
status[794764] = 0b11010100
status[4520] = 0b11010101
status[818773] = 0b11010110
status[556171] = 0b11010111
```

```
status[954221] = 0b11011000
status[598210] = 0b11011001
status[887110] = 0b11011010
status[1020623] = 0b11011011
status[324632] = 0b11011100
status[398244] = 0b11011101
status[622241] = 0b11011110
status[456551] = 0b11011111
status[122648] = 0b11100000
status[127837] = 0b11100001
status[657676] = 0b11100010
status[119884] = 0b11100011
status[105156] = 0b11100100
status[999897] = 0b11100101
status[330160] = 0b11100110
status[119285] = 0b11100111
status[168005] = 0b11101000
status[389703] = 0b11101001
status[143699] = 0b11101010
status[142524] = 0b11101011
status[493258] = 0b11101100
status[846778] = 0b11101101
status[251420] = 0b11101110
status[516351] = 0b11101111
status[83344] = 0b11110000
status[171931] = 0b11110001
status[879178] = 0b11110010
status[663475] = 0b11110011
status[546865] = 0b11110100
status[428362] = 0b11110101
status[658891] = 0b11110110
status[500560] = 0b11110111
status[557034] = 0b11111000
status[830023] = 0b11111001
status[274471] = 0b11111010
status[629139] = 0b11111011
status[958869] = 0b11111100
status[663071] = 0b11111101
status[152133] = 0b11111110
status[19535] = 0b11111111
```

JSON encoding:

```
{
  "bits": 8,
  "lst": "eNrt0WOQM2kYhtGsbdU2bdu2bdu2bdu2bdu2jVnU1my
-SWYm6U5enFPVf7ue97orFYAo7CQBAACQuuckAABStqUEAAAAAAAAAtN6wEgAE71QJA
AAAAIrwhwQAAAAAdtAAGAAAAAAACLwKAQAAAAAAAAAACUaFcJAACAEJwKAQAAAAA
AAABQvL4kAAAAWmJwCQAAAAAAAJAwBIAAAB06ywJoDKQBARpfGkAAAAAAAAAAAAA
AAAAACo50sJAAAAAAAAAOiRcSQAAAAAGAJNKG EAAG23mgQAAAAAAECw3pUAQvegBAA
AAAAAADduE4CAAAAYjSvBAAQiw8koHjvSABAb-wlARCONyVoxTMSZod0CQAAAOjWD
RKQmLckAAAAAACysLYEQGcnSAAAAAQooULaABI15kSAIH5RAIgLB9LABC4_SUGGZN
IAABAmM6RoLbTJIASzCIBAEAhfpcAAAAAAABquk8CAAAAAAAAJl9SvvzBOICAFWmk
IBgfSgBAAAAANogrCQAAAAAADStK8EAAC03gASAAAAAAADDFWfUCAAAAMjOaBEA
DHpYAQjCIBADduFwCAAAAAGitMSSI3BUSAECoHPAA6IHRJQAAAAAAsjeVBAAAKRpVA
orWvwQAAAAAAAKKrtJAAAAAAAGCbCLAF0bXUJAAAAoF02kYDg7CYBAAAAAEB6NpQ
AAAAAAAAAAAAAAAErLUQQAf06VgIAAAAAAAAGDaeBAAQqgMkAAAAAABogQM1AAAAA
AAa87MEAAQIwslAAAAAAAAAAAAAAAAAMrOyBAAAIekv-hcsY0Sgne6QAAAAAAGaUt
JAAAAAAAAAAAAAAAAAAAAAAAAAADwt-07vjVKAAGDy8KgFAUEaSAAAAAJL3vgQAW
dhcAGAAoBHDSUDolpQAAACI2o4SAABZm14CALoyuwQAAPznGQkgZwdLAAAQukclAAA
AAAAAAAAAGKbMKgEAAAAAAAAAAAAAAAAAECftPYAAAAAAAAAAAAACnaXBAAAAADk7
iMJAAAAAAAAAABqe00CAnGbBBG4TAIAGFDdKgFAXCaWAAAAAAAAAAAAAAAAAKAJQwR
72XbGAQAAAKahh0sAAAAAABQgO8kAAAAAAAAAAAAAACaAM0kAAAC5W0QCAIJ3mAQAx
GwxCQA6nhSAsjZBRIAANebWQIAAAAAAJE3JACAwA0qAUBIVpKAlphbAiAPp0iQnKE
kAAAAAAGBP1KAAAAd0L4CQAAAAAAPjLZBIAAG10RtrPm8_CAEBMTpYAAAAAAAIjQY
BL8z5QSAAAAAEDYPpUAACAsj0gAADQkHMLAAjHDxIA0Lg9JQAAGHDsLQEAAAABQs6
WAAAAGLjNFs2l_RgLAIAefCEBlGZZCQAAAIHjJACgtlskAAAOzb0SAAAVftfAgAAA
AAAAAAAAAAAAAAAAAAAKDDtxIAAAAVZaTAKB5W0kAANCAsSUGJ0tL0GqHSNBbL0g
AZf1lRAGCARG0kQXNmLgCABiWKAQAAAEb25pIAAAAAAAAAAAAAAoFh9SwAAAAAADWNm
OSrpjFsEoaRgDKcF9Q1dxsEAAAAAAAAAAAAAAAAAGPZ6SQIAAAAAAAGChMLgEAAAA
AAAAAQZlQAsK2qQAAAAAAD06XUJAAAAAG9bCQAAGLD9IgEAAAAAAAAAAAAAAAAAAA
EBNe0gAAAAAAAAAAEBPHSEBAAAA1OztCYA4fS8B0GFRCQAo0gISAOTgNwmC840EAAA
AAAAAAAAAAAAAAAAAUJydJfjXPBIAAAAAAAAAAAAAABk6WwJAAAAAAAAAAAAAAQ
G8UCQAAGPp0IAAIA83SQAANWwc9HUjGAGAAAAAACausaAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAQHKVBACQjxklAAAAAAAAAKBhxpQAAAAAACBME0lAdlaUAACyt7sEAAAA0
Nl0EgAAAAAAAAAAAAABA-8wgAQAAAAAAKU4SgKgUtlBAGAAAAAAAAAAAGMCLwEE51k
JICdzSgCJG12CsE0tAQAA0L11JQAAAAAAAJUOhIAAAAAAAAAAAAAAGTqeQkAAAAAA
AAAAAAAKM8SEjTrJwKAAAAAACocqQEULgVJAAACjDUxJUKgtKAAAAqbpRAGCA0n0
mAQAAAAABAGzwmAUCTLpUAAAAAAAAAAEjZNRIAAAAAAAAAAAAAAA8I-vJaAlh
pQAAAAAAHrvzjJ-OqCuuVlLAojP8BJAr70sQZVDJYAgXS0BAAAAAAAAAAAAAtMnyEgA
AAAAAFONKCQAAAAAADorc0kAAAAAAGDqOlGAAAAAAAAAAAAADiWv0SAAAAAAAAA
AAAAADBuV0CIFVDSwAAAAABAI6RAAAAGIwrQSEZAsJAABouRclAAAAAKDDrxIAAAA
0bkkJgFiMKwEAAAAAHQYhwRk7h4JAAAAAAAAAAGatdKAACUYj0JAAAAAAAAAAAAQ
nORBLTFJRIAAAAAkIaDJAAAAJryngQAAAAAAAAAAAA98oQEAAAAAAAAAAEC2zpcgWY9
LQKL2kwAgGK9IAAAAAPHARQIAAAAAAAAAAADIXyoSAAAAAAAAAAAAADQFotLAECz_
gQ1PX-B"
```

CBOR encoding:

a2646269747308636c73745907b078daedd1639033691886d1ac6ddbb66ddbb66ddb
b66ddbb66ddbb68d59d4d66cbe496626e94e5e9c53d57fbb9ef7ba2b158028ec2401
000090bae724000052b6a504000000000000b4deb0120004ef5409000000008af087
040000000001db400200000000000022f0900400000000000000000946857090000
80789c2401000000000000050bcb240000005a62700900000000000008c0c01200
000074eb2c09a032900404697e0900000000000000000000000000000a8e74b0900
000000000000e89171240000000080024d2a0100006db79a0400000000040b0de95
0042f7a00400000000000000ddb84e02000000ca34af0400108b0f24a078ef480040
6fec2501108e372568c6d31264e77409000000e8d60d129098b724000000000b2b0
b604406727480000000010a28525000048d799120081f94402202c1f4b0010b8fd25
2019934800004098ce91a0b6d3248012cc22010040217e970000000000006aba4f02
00000000000068997d4afbf304e2020055a69080607d280100000034e82b09000000
00000000d2b4af040000b4de0012000000000000000c558550200000032339a0440
031e96004230880400ddb85c020000000068ad312488dc151200408e1e9000e881eb
250000000000b23795040000291a55028ad6bf04000000000000090a46d24000000
00008026dc2c01746d7509000000a05d369180e0ec260100000000407a3694000000
00000000000000004af5b90400005d3a560200000000000000a8369e040010aa0324
00000000006881032500000000001af3b3040000108b0b250000000000000000000
000032b3b204000089e92ffa172c6344a09dee90000000000020694b490000000000
00000000000000000000000000000f0b7ed3bbe3564000000803cbc2a0140504692
00000000092f7be040059d85c020000a011c34940e8d69400000088da8e120000599b
5e0200ba32bb040000fce719092067074b000010ba47250000000000000000080a6
cc2a01000000000000000000000000000409fb69600000000000000000000a7697
0400000000e4ee230900000000000000006a7b4d0202719b0411b84c02008050dd2a
01405c26960000000000000000000000000a00943047bd976c601000000a021874b
0000000000005080ef24000000000000000000000201a3349000000b95b4402008277
980400c46c31090000ea785202c8d905120000d11b59020000000689137240080c0
0d2a01404856928096985b02200fa748909ca12400000000002004fd4a00000074e9
7809000000000000f8cb641200006d7446dacf9bcfc200404c4e9600000000088d0
6012fccf94120000000040d83e950000202c8f48000000d09073250008c70f1200d0
b83d2500008070ec2d0100000040412e9600000080b8cd16cda5fd180b0080047c21
019466590900006881e32400a0b65b24000028cddb12000000545b5f020000000000
0000000000000000000000000000a0c3b7120000000055969300a0795b490000d080b1
2520274b4bd06a8748d05b2f480065f951020080446d24417366960080062c240100
00004076e69200000000000000000000a0587d4b000000000000358d98e4aba6316c
12869180329c17d435771b04000000000000000000000000080f67a4902000000000
000080284c2e0100000000000000a9995002c2b6a90400000000000f4e975090000
00a86f5b09000080b0fd22010000000000000000000000000404d7b4800000000
00000000404f1d210100000094e66d0980387d2f01d06151090028d2021200e4e037
0982f38d0400000000000000000000000000000509c9d25f8d73c12000000000000
00000000000064e96c09000000000000000000000000a86f1409000080fa4e940000
200f37490000356c1cf4752318080000000000080bac69200000000000000000000
0000000000000000000000a872950400908f19250000000000000a047c694000000
0000204c1349407656940000b2b7bb04000000d0d97412000000000000000000040
fbcc2001000000000000a5384a02a052d941020000000000000080c08c2f0104e7
59092027734a00891a5d82b04d2d010000d0bd752500000000000008d43a1200000
000000000000000064ea79090000000000000000000028cf121234eb270900000000
0000a872a40450b8152400000028c35312542a0b4a000000a9ba51020080d27d2601

```
00000000401b3c260140932e95000000000000000048d9351200000000000000000
000000000000000f08faf25a025869400000000007aefce327e3aa0aeb9594b0288cf
f01240afbd2c4195432580205d2d010000000000000000b4c9f212000000000014
e34a09000000000000000e8adcd24000000000000803a8e96000000000000000000
c8c2fd12000000000000000000000000c1b95d022055434b0000000040008e91000000
006230ad0484640b09000068b9172500000000a0c3af12000000346e490980588c2b
0100000000007432870464ee1e09000000000000000206ad74a000094623d090000
000000000000042739104b4c5251200000000908683240000009af29e0400000000
000000000003df284040000000000000040b6ce9720598f4b40a2f693002018af4800
000000f1da4502000000000000000000c8c72a12000000000000000000000d0168b
4b0040b3fe04353d7f81
```

Document History

[[To be removed from the final specification]]

-20

- * extend requirements for IANA registries

-19

- * revert grapahics to ASCII
- * grammar, spelling, nits
- * add official link to ISO 18013-5 specification

-18

- * add references to SD-JWT VC and SD-CWT

-17

- * change SD-JWT VC reference to SD-JWT
- * clarify that Status List validation MUST not be performed if Referenced Token validation is deemed invalid already

-16

- * change http status codes & query parameter wording for the historical resolution
- * grammatical/style fixes
- * making several SHOULDs non-normative

- * small corrections in the introduction
- * change guidance around HTTP content negotiation to refer to RFC 9110
- * strengthen normative guidance around handling cases or redirection
- * changing media type contact to oauth WG mailing list
- * update discussion around collusion risk in unlinkability section
- * strength guidance to MUST about rejecting reference tokens with an index which is out of bounds of the resolved list
- * remove non-normative ISO mdoc examples

-15

- * limit Status List Token CWT COSE message to Sign1/Mac0
- * be explicit about tagging and re-add cose_sign1 tag to example
- * add description field to EKU iana registration request
- * fix typos in referenced token
- * fix typos
- * make IANA references informative
- * remove unused iana.jose reference

-14

- * use binary value encoding for all test vectors (display purposes only)
- * removed bytes from graphic that were interpreted as padding bytes
- * removed 0x0B from application-specific Status Type
- * reemphasized that expired tokens with status "VALID" are still expired
- * renamed section "Status List Aggregation in JSON Format" to "Status List Aggregation Data Structure"
- * slightly restructure/clarify referenced token cose section

- * Add ASN.1 module
- * many nits and improvements from genart review
- * remove cose_sign1 tag from statuslist in cwt form examples
- * slightly restructure/clarify referenced token cose section
- * Add ASN.1 module
- * removed DL suspension example

-13

- * add definition of client to terminology
- * Make exp and ttl recommended in claim description (fixes inconsistency, was recommended in other text)
- * Add short security consideration on redirects and ttl
- * fix CORS spec to specific version
- * explain KYC
- * link implementation guidance to exp and ttl in Status List Token definition
- * reference RFC7515 instead of IANA:JOSE
- * add a note that cwt is encoded in raw/binary.
- * added further privacy consideration around issuer tracking using unique URIs

-12

- * Allow for extended key usage OID to be used for other status mechanisms
- * add Paul's affiliation
- * add feedback from Dan Moore
- * change JSON Status List structure to only contain JSON object
- * further nitpicks

- * clarifying status and status_list IANA descriptions for JWT/CWT
- * clarifying description texts for status and status_list in CBOR
- * splitting Linkability Mitigation from Token Lifecycle section in Implementation Consideration
- * relax the accept header from must to should

-11

- * incorporate feedback from shepherd review
- * some nitpicks
- * even more nitpicks

-10

- * improve caching guidelines and move them to implementation considerations
- * Add CoAP Content-Format ID and IANA registration
- * Add size comparison for status list and compressed uuids
- * Change Controller IESG for OAuths Parameters Registration

-09

- * update acknowledgments
- * introduce dedicated section for compressed byte array of the Status List
- * fix Status List definitions
- * Add CDDL for CBOR StatusList encoding
- * add diagram for Status List Aggregation for further explanation
- * rename "chunking" of Status List Tokens (for scalability reasons) into "divide .. up"

-08

- * Fix cwt typ value to full media type

- * Holders may also fetch and verify Status List Tokens
- * Update terminology for referenced token and Status List Token

-07

- * add considerations about External Status Issuer or Status Provider
- * add recommendations for Key Resolution and Trust Management
- * add extended key usage extensions for x509
- * Relying Parties avoiding correlatable Information
- * editorial changes on terminology and Referenced Tokens
- * clarify privacy consideration around one time use referenced tokens
- * explain the Status List Token size dependencies
- * explain possibility to chunk Status List Tokens depending on Referenced Token's expiry date
- * add short-lived tokens in the Rationale
- * rename Status Mechanism Methods registry to Status Mechanisms registry
- * changes as requested by IANA review
- * emphasize that security and privacy considerations only apply to Status List and no other status mechanisms
- * differentiate unlinkability between Issuer-RP and RP-RP
- * add more test vectors for the status list encoding
- * add prior art
- * updated language around application specific status type values and assigned ranges for application specific usage
- * add short security considerations section for mac based deployments
- * privacy considerations for other status types like suspended

- * fix aggregation_uri text in referenced token

- * mention key resolution in validation rules

-06

- * iana registration text updated with update procedures

- * explicitly mention that status list is expected to be contained in cryptographically secured containers

- * reworked and simplified introduction and abstract

- * specify http status codes and allow redirects

- * add status_list_aggregation_endpoint OAuth metadata

- * remove unsigned options (json/cbor) of status list

- * add section about mixing status list formats and media type

- * fixes from IETF review

- * update guidance around ttl

- * add guidance around aggregation endpoint

-05

- * add optional support for historical requests

- * update CBOR claim definitions

- * improve section on Status Types and introduce IANA registry for it

- * add Status Issuer and Status Provider role description to the introduction/terminology

- * add information on third party hosting to security consideration

- * remove constraint that Status List Token must not use a MAC

-04

- * add mDL example as Referenced Token and consolidate CWT and CBOR sections

- * add implementation consideration for Default Values, Double Allocation and Status List Size
- * add privacy consideration on using private relay protocols
- * add privacy consideration on observability of outsiders
- * add security considerations on correct parsing and decoding
- * remove requirement for matching iss claim in Referenced Token and Status List Token
- * add sd-jwt-vc example
- * fix CWT status_list map encoding
- * editorial fixes
- * add CORS considerations to the http endpoint
- * fix reference of Status List in CBOR format
- * added status_list CWT claim key assigned
- * move base64url definition to terminology

-03

- * remove unused reference to RFC9111
- * add validation rules for status list token
- * introduce the status list aggregation mechanism
- * relax requirements for status_list claims to contain other parameters
- * change cwt referenced token example to hex and annotated hex
- * require TLS only for fetching Status List, not for Status List Token
- * remove the undefined phrase Status List endpoint
- * remove http caching in favor of the new ttl claim
- * clarify the sub claim of Status List Token

- * relax status_list iss requirements for CWT
 - * Fixes missing parts & iana ttl registration in CWT examples
- 02
- * add ttl claim to Status List Token to convey caching
 - * relax requirements on referenced token
 - * clarify Deflate / zlib compression
 - * make a reference to the Issuer-Holder-Verifier model of SD-JWT VC
 - * add COSE/CWT/CBOR encoding
- 01
- * Rename title of the draft
 - * add design consideration to the introduction
 - * Change status claim to in referenced token to allow re-use for other mechanisms
 - * Add IANA Registry for status mechanisms
 - * restructure the sections of this document
 - * add option to return an unsigned Status List
 - * Changing compression from gzip to zlib
 - * Change typo in Status List Token sub claim description
 - * Add access token as an example use-case
- 00
- * Initial draft after working group adoption
 - * update acknowledgments
 - * renamed Verifier to Relying Party
 - * added IANA consideration
- [draft-ietf-oauth-status-list]

-01

* Applied editorial improvements suggested by Michael Jones.

-00

* Initial draft

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